Attachment A. 2024-2026 Statewide EM&V Expenses

The 2024-2026 EE Plan includes EM&V Expenses as shown in Table 1. The following narrative provides an explanation of how these costs were derived, including consulting and contractor costs.

Table 1. Proposed 2024-2026 EM&V Expenses

EM&V Tasks	2024	2025	2026
1. Activities to support regulatory and other mandated reporting requirements	**$1,530,000**	**$1,4800,000**	**$1,515,000**
a. ISO NE certification of utility demand resources[1]	*$70,000*	*$70,000*	*$70,000*
b. Utility modeling and tracking system software	*$520,000*	*$520,000*	*$520,000*
c. AESC Study	*$50,000*	*$0*	*$35,000*
d. TRM Hosting	*$40,000*	*$40,000*	*$40,000*
e. Others (internal staff time, other supporting efforts)	*$850,000*	*$850,000*	*$850,000*
2. Third-party EM&V Studies	**$1,510,000**	**$1,235,000**	**$305,000**
3. Department of Energy Consultants Support	**$100,000**	**$100,000**	**$100,000**
Total EM&V Budget	**$3,140,000**	**$2,815,000**	**$1,920,000**

Note: Numbers may not add up due to rounding.

1. **Activities to support regulatory and other mandated reporting requirements**: As described in the Strategic Evaluation Plan, these efforts are necessary to meet NH Utilities' reporting requirements. Costs are approximately $1.5 million per year based on prior costs and budgeting. The proposed budget in 2024-2026 includes funds for ISO NE certification (5%), utility modeling and tracking system software fees (34%), hosting the TRM (3%), NH cost share for the regional AESC study (2%) and internal staff time and other supporting efforts (56%). Narrative descriptions of each tasks are included in Attachment P.
2. **Third party EM&V studies:** Attachment P describes the 10 priority EM&V studies to be initiated in the 2024-2026 term. The NH Utilities with input from the EM&V Working Group estimate that the total amount needed to complete the studies is about $3 million, (with an average cost per study of $245,000, a low of $100,000/study and a high of $500,000/study). Based on tentative timing of studies, the budget assumes that 90% of study budgets would be expended by the end of 2025 and the remaining 10% would be used by the end of the 2024-2026 term. In addition, the EM&V Working Group

included a cost of $200,000 per year in the EM&V budget to fund studies addressing policy, program design or market issues that may arise during the 2024-2026 Plan Term.

3. **Department of Energy Consultants Support:** The budget for the Department of Energy Consultants represents the costs for the EM&V Consultants hired by the Department of Energy to support the EM&V Working Group and to provide technical advice and support to EM&V studies. Similar to prior budgeting, the consultant cost is assumed to be $100,000 per year.

NHSAVES PROGRAMS
2024 Statewide Goals
Statewide & Company-Specific Programs

Description	Program Budget[1]	kWh Savings		kW Savings		MMBtu Savings		Customers
		Annual	Lifetime	Winter kW	Summer kW	Annual	Lifetime	Count
Electric Utilities								
Statewide Programs	$ 61,885,954	95,820,458	858,988,159	14,350	13,717	57,950	1,631,681	44,973
Company Specific Programs[2]	$ 7,301,424	5,201,031	5,201,031	1,124	20,312	-	-	38,556
Total Electric	**$ 69,187,378**	**101,021,489**	**864,189,190**	**15,474**	**34,029**	**57,950**	**1,631,681**	**83,529**
Gas Utilities								
Statewide Programs	$ 11,359,969	83,475	1,466,770	21	10	130,321	2,080,621	6,906
Company Specific Programs[2]	$ 1,095,171	-	-			31,844	31,844	33,243
Total Gas	**$ 12,455,140**	**83,475**	**1,466,770**	**21**	**10**	**162,166**	**2,112,465**	**40,149**
Grand Total	**$ 81,642,517**	**101,104,963**	**865,655,961**	**15,495**	**34,039**	**220,116**	**3,744,146**	**123,678**

Notes:
(1) Program budgets shown in this report exclude the performance incentive (PI).
(2) Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2024 Statewide Goals
Statewide Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
Home Energy Assistance	$ 12,093,240	3,195,736	43,632,568	567	506	13,092	310,194	934
Sub-total	$ 12,093,240	3,195,736	43,632,568	567	506	13,092	310,194	934
Residential								
EnergyStar® Homes	$ 3,598,136	2,330,862	54,745,806	676	127	24,267	558,875	1,290
Home Performance	$ 9,822,086	805,624	14,688,464	115	214	41,003	793,093	2,333
EnergyStar® Products	$ 7,676,235	8,818,050	108,556,962	2,430	1,544	9,593	146,182	28,919
Sub-total	$ 21,096,456	11,954,536	177,991,232	3,221	1,884	74,863	1,498,150	32,542
Commercial & Industrial								
Large Business Energy Solutions	$ 13,668,932	35,796,333	316,140,192	4,511	4,131	(11,468)	(62,435)	2,252
Small Business Energy Solutions	$ 12,938,048	41,233,345	288,504,993	5,652	6,699	(17,231)	(107,100)	8,705
Municipal Program	$ 2,089,277	3,640,507	32,719,175	398	496	(1,305)	(7,128)	540
Sub-total	$ 28,696,258	80,670,185	637,364,359	10,561	11,326	(30,005)	(176,663)	11,497
Total Electric	**$ 61,885,954**	**95,820,458**	**858,988,159**	**14,350**	**13,717**	**57,950**	**1,631,681**	**44,973**
Gas Utilities								
Income Eligible								
Home Energy Assistance	$ 2,318,890	20,138	415,059	4	5	12,772	272,290	235
Sub-total	$ 2,318,890	20,138	415,059	4	5	12,772	272,290	235
Residential								
EnergyStar® Homes	$ 1,006,146	-	-	-	-	7,425	175,074	301
Home Performance	$ 1,759,593	17,366	287,633	3	4	10,932	224,832	213
EnergyStar® Products	$ 1,518,141	38,075	621,951	12	1	29,210	477,217	4,090
Sub-total	$ 4,283,880	55,441	909,584	15	5	47,567	877,122	4,604
Commercial & Industrial								
Large Business Energy Solutions	$ 2,201,156	-	-	-	-	43,158	539,668	321
Small Business Energy Solutions	$ 2,078,803	7,392	133,056	2	-	20,570	299,305	1,485
Municipal Program	$ 477,240	504	9,072	0	-	6,254	92,236	261
Sub-total	$ 4,757,199	7,896	142,128	2	-	69,982	931,209	2,066
Total Gas	**$ 11,359,969**	**83,475**	**1,466,770**	**21**	**10**	**130,321**	**2,080,621**	**6,906**
Grand Total	**$ 73,245,922**	**95,903,932**	**860,454,930**	**14,371**	**13,726**	**188,271**	**3,712,302**	**51,878**

Notes:
(1) Amounts shown above pertain only to the Statewide programs. The amounts pertaining to the Company-Specific programs are shown on Attachment B, page 3.

NHSAVES PROGRAMS
2024 Statewide Goals
Company-Specific Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
IE Education	$ 1,049,941	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 630,919	-	-	-	-	-	-	-
Sub-total	$ 1,680,860	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 341,831	5,204,511	5,204,511	1,124	725	-	-	34,800
Res Active Demand Response	$ 485,704	(3,480)	(3,480)	-	2,561	-	-	3,650
Res Education	$ 411,306	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 1,201,062	-	-	-	-	-	-	-
Sub-total	$ 2,439,904	5,201,031	5,201,031	1,124	3,286	-	-	38,450
Commercial & Industrial								
C&I Active Demand Response	$ 1,088,624	-	-	-	17,027	-	-	107
C&I Education	$ 455,740	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 1,591,079	-	-	-	-	-	-	-
C&I Customer Partnerships	$ 15,217	-	-	-	-	-	-	-
Smart Start	$ 30,000	-	-	-	-	-	-	-
Sub-total	$ 3,180,660	-	-	-	17,027	-	-	107
Total IE, Residential, and C&I	**$ 7,301,424**	**5,201,031**	**5,201,031**	**1,124**	**20,312**	**-**	**-**	**38,556**
Gas Utilities								
Income Eligible								
IE Education	$ 48,500	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 123,639	-	-	-	-	-	-	-
Sub-total	$ 172,138	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 268,597	-	-	-	-	31,844	31,844	33,243
Res Education	$ 87,482	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 237,680	-	-	-	-	-	-	-
Sub-total	$ 593,759	-	-	-	-	31,844	31,844	33,243
Commercial & Industrial								
C&I Education	$ 84,803	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 244,471	-	-	-	-	-	-	-
Sub-total	$ 329,274	-	-	-	-	-	-	-
Total IE, Residential, and C&I	**$ 1,095,171**	**-**	**-**	**-**	**-**	**31,844**	**31,844**	**33,243**
Grand Total	**$ 8,396,595**	**5,201,031**	**5,201,031**	**1,124**	**20,312**	**31,844**	**31,844**	**71,799**

Notes:
(1) Amounts shown above pertain only to the Company-Specific programs. The amounts pertaining to the Statewide programs are shown on Attachment B, page 2.
Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2025 Statewide Goals
Statewide & Company-Specific Programs

Description	Program Budget[1]	kWh Savings		kW Savings		MMBtu Savings		Customers
		Annual	Lifetime	Winter kW	Summer kW	Annual	Lifetime	Count
Electric Utilities								
Statewide Programs	$ 64,373,478	95,188,030	863,307,132	14,468	13,365	63,310	1,733,573	46,880
Company Specific Programs[2]	$ 7,342,659	5,200,161	5,200,161	1,124	25,415	-	-	39,522
Total Electric	**$ 71,716,137**	**100,388,192**	**868,507,293**	**15,592**	**38,781**	**63,310**	**1,733,573**	**86,402**
Gas Utilities								
Statewide Programs	$ 11,834,886	79,821	1,413,521	20	9	133,466	2,119,348	6,741
Company Specific Programs[2]	$ 1,137,364	-	-			31,844	31,844	33,243
Total Gas	**$ 12,972,250**	**79,821**	**1,413,521**	**20**	**9**	**165,311**	**2,151,192**	**39,984**
Grand Total	**$ 84,688,387**	**100,468,013**	**869,920,814**	**15,612**	**38,790**	**228,621**	**3,884,765**	**126,386**

Notes:
(1) Program budgets shown in this report exclude the performance incentive (PI).
(2) Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2025 Statewide Goals
Statewide Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
Home Energy Assistance	$ 13,335,690	3,501,400	47,110,140	617	561	14,272	339,625	997
Sub-total	$ 13,335,690	3,501,400	47,110,140	617	561	14,272	339,625	997
Residential								
EnergyStar® Homes	$ 3,783,971	2,493,042	58,574,779	723	134	25,792	593,998	1,368
Home Performance	$ 10,340,107	855,173	15,479,371	123	225	42,299	818,199	2,370
EnergyStar® Products	$ 8,555,004	10,156,638	127,798,110	2,936	1,806	10,053	152,958	31,066
Sub-total	$ 22,679,083	13,504,853	201,852,260	3,783	2,166	78,144	1,565,154	34,803
Commercial & Industrial								
Large Business Energy Solutions	$ 13,547,182	34,870,567	305,748,115	4,351	3,919	(11,117)	(60,544)	2,191
Small Business Energy Solutions	$ 12,790,908	39,814,401	277,169,570	5,347	6,305	(16,749)	(104,068)	8,379
Municipal Program	$ 2,020,615	3,496,809	31,427,047	370	415	(1,239)	(6,594)	511
Sub-total	$ 28,358,705	78,181,777	614,344,732	10,068	10,639	(29,106)	(171,206)	11,080
Total Electric	**$ 64,373,478**	**95,188,030**	**863,307,132**	**14,468**	**13,365**	**63,310**	**1,733,573**	**46,880**
Gas Utilities								
Income Eligible								
Home Energy Assistance	$ 2,418,308	20,577	427,121	4	5	13,344	285,075	248
Sub-total	$ 2,418,308	20,577	427,121	4	5	13,344	285,075	248
Residential								
EnergyStar® Homes	$ 982,651	-	-	-	-	7,032	165,825	285
Home Performance	$ 1,709,553	16,244	271,846	3	4	10,402	216,106	207
EnergyStar® Products	$ 1,457,572	34,937	569,403	11	1	27,620	450,436	3,877
Sub-total	$ 4,149,776	51,180	841,249	14	5	45,053	832,367	4,369
Commercial & Industrial								
Large Business Energy Solutions	$ 2,462,512	-	-	-	-	47,430	595,072	341
Small Business Energy Solutions	$ 2,299,267	7,560	136,080	2	-	21,588	317,509	1,523
Municipal Program	$ 505,024	504	9,072	0	-	6,051	89,325	261
Sub-total	$ 5,266,803	8,064	145,152	2	-	75,069	1,001,906	2,125
Total Gas	**$ 11,834,886**	**79,821**	**1,413,521**	**20**	**9**	**133,466**	**2,119,348**	**6,741**
Grand Total	**$ 76,208,364**	**95,267,851**	**864,720,653**	**14,488**	**13,375**	**196,777**	**3,852,921**	**53,621**

Notes:
(1) Amounts shown above pertain only to the Statewide programs. The amounts pertaining to the Company-Specific programs are shown on Attachment B, page 3.

NHSAVES PROGRAMS
2025 Statewide Goals
Company-Specific Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
IE Education	$ 666,387	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 649,430	-	-	-	-	-	-	-
Sub-total	$ 1,315,817	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 345,829	5,204,511	5,204,511	1,124	725	-	-	34,800
Res Active Demand Response	$ 537,938	(4,350)	(4,350)	-	3,209	-	-	4,584
Res Education	$ 441,539	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 1,195,114	-	-	-	-	-	-	-
Sub-total	$ 2,520,420	5,200,161	5,200,161	1,124	3,934	-	-	39,384
Commercial & Industrial								
C&I Active Demand Response	$ 1,383,715	-	-	-	21,482	-	-	138
C&I Education	$ 488,182	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 1,589,308	-	-	-	-	-	-	-
C&I Customer Partnerships	$ 15,217	-	-	-	-	-	-	-
Smart Start	$ 30,000	-	-	-	-	-	-	-
Sub-total	$ 3,506,422	-	-	-	21,482	-	-	138
Total IE, Residential, and C&I	**$ 7,342,659**	**5,200,161**	**5,200,161**	**1,124**	**25,415**	**-**	**-**	**39,522**
Gas Utilities								
Income Eligible								
IE Education	$ 50,379	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 125,763	-	-	-	-	-	-	-
Sub-total	$ 176,142	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 266,301	-	-	-	-	31,844	31,844	33,243
Res Education	$ 85,816	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 224,165	-	-	-	-	-	-	-
Sub-total	$ 576,282	-	-	-	-	31,844	31,844	33,243
Commercial & Industrial								
C&I Education	$ 102,353	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 282,587	-	-	-	-	-	-	-
Sub-total	$ 384,940	-	-	-	-	-	-	-
Total IE, Residential, and C&I	**$ 1,137,364**	**-**	**-**	**-**	**-**	**31,844**	**31,844**	**33,243**
Grand Total	**$ 8,480,023**	**5,200,161**	**5,200,161**	**1,124**	**25,415**	**31,844**	**31,844**	**72,765**

Notes:
(1) Amounts shown above pertain only to the Company-Specific programs. The amounts pertaining to the Statewide programs are shown on Attachment B, page 2.
Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2026 Statewide Goals
Statewide & Company-Specific Programs

Description	Program Budget[1]	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Statewide Programs	$ 66,441,446	94,338,956	858,667,624	14,532	13,279	66,466	1,790,416	49,068
Company Specific Programs[2]	$ 7,585,956	5,199,509	5,199,509	1,124	30,562	-	-	40,287
Total Electric	**$ 74,027,403**	**99,538,465**	**863,867,132**	**15,656**	**43,842**	**66,466**	**1,790,416**	**89,355**
Gas Utilities								
Statewide Programs	$ 12,236,308	81,835	1,449,209	20	10	135,647	2,159,500	6,894
Company Specific Programs[2]	$ 1,174,709	-	-			31,844	31,844	33,243
Total Gas	**$ 13,411,016**	**81,835**	**1,449,209**	**20**	**10**	**167,491**	**2,191,344**	**40,137**
Grand Total	**$ 87,438,419**	**99,620,300**	**865,316,341**	**15,676**	**43,851**	**233,957**	**3,981,761**	**129,493**

Notes:
(1) Program budgets shown in this report exclude the performance incentive (PI).
(2) Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2026 Statewide Goals
Statewide Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
Home Energy Assistance	$ 14,273,268	3,763,541	50,102,188	658	607	15,051	358,577	1,044
Sub-total	$ 14,273,268	3,763,541	50,102,188	658	607	15,051	358,577	1,044
Residential								
EnergyStar® Homes	$ 3,874,881	2,595,205	60,989,744	753	139	26,053	600,110	1,403
Home Performance	$ 10,850,684	911,058	16,410,496	131	240	43,283	836,338	2,406
EnergyStar® Products	$ 9,147,200	10,998,480	138,645,027	3,192	1,952	10,593	160,868	33,559
Sub-total	$ 23,872,765	14,504,743	216,045,267	4,076	2,331	79,930	1,597,315	37,368
Commercial & Industrial								
Large Business Energy Solutions	$ 13,397,106	33,457,888	288,895,940	4,182	3,749	(10,779)	(56,423)	2,038
Small Business Energy Solutions	$ 12,698,994	38,717,939	268,891,463	5,202	6,127	(16,322)	(101,268)	8,115
Municipal Program	$ 2,199,313	3,894,845	34,732,765	414	465	(1,415)	(7,785)	504
Sub-total	$ 28,295,413	76,070,672	592,520,168	9,798	10,341	(28,516)	(165,476)	10,656
Total Electric	**$ 66,441,446**	**94,338,956**	**858,667,624**	**14,532**	**13,279**	**66,466**	**1,790,416**	**49,068**
Gas Utilities								
Income Eligible								
Home Energy Assistance	$ 2,504,003	21,139	438,746	4	5	13,683	292,298	254
Sub-total	$ 2,504,003	21,139	438,746	4	5	13,683	292,298	254
Residential								
EnergyStar® Homes	$ 1,024,334	-	-	-	-	7,183	169,395	291
Home Performance	$ 1,780,640	16,244	271,846	3	4	10,618	220,722	212
EnergyStar® Products	$ 1,505,849	36,388	593,464	12	1	28,671	467,738	4,032
Sub-total	$ 4,310,823	52,632	865,310	14	5	46,472	857,855	4,534
Commercial & Industrial								
Large Business Energy Solutions	$ 2,513,457	-	-	-	-	46,900	588,228	329
Small Business Energy Solutions	$ 2,379,433	7,392	133,056	2	-	22,402	329,693	1,515
Municipal Program	$ 528,592	672	12,096	0	-	6,190	91,426	263
Sub-total	$ 5,421,482	8,064	145,152	2	-	75,492	1,009,347	2,107
Total Gas	**$ 12,236,308**	**81,835**	**1,449,209**	**20**	**10**	**135,647**	**2,159,500**	**6,894**
Grand Total	**$ 78,677,754**	**94,420,791**	**860,116,832**	**14,553**	**13,289**	**202,113**	**3,949,916**	**55,963**

Notes:
(1) Amounts shown above pertain only to the Statewide programs. The amounts pertaining to the Company-Specific programs are shown on Attachment B, page 3.

NHSAVES PROGRAMS
2026 Statewide Goals
Company-Specific Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
IE Education	$ 266,955	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 680,801	-	-	-	-	-	-	-
Sub-total	$ 947,756	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 353,856	5,204,511	5,204,511	1,124	725	-	-	34,800
Res Active Demand Response	$ 639,262	(5,002)	(5,002)	-	3,714	-	-	5,312
Res Education	$ 489,644	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 1,276,115	-	-	-	-	-	-	-
Sub-total	$ 2,758,876	5,199,509	5,199,509	1,124	4,438	-	-	40,112
Commercial & Industrial								
C&I Active Demand Response	$ 1,751,913	-	-	-	26,124	-	-	174
C&I Education	$ 498,155	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 1,503,835	-	-	-	-	-	-	-
C&I Customer Partnerships	$ 15,217	-	-	-	-	-	-	-
Smart Start	$ 110,205	-	-	-	-	-	-	-
Sub-total	$ 3,879,324	-	-	-	26,124	-	-	174
Total IE, Residential, and C&I	**$ 7,585,956**	**5,199,509**	**5,199,509**	**1,124**	**30,562**	**-**	**-**	**40,287**
Gas Utilities								
Income Eligible								
IE Education	$ 54,102	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 124,098	-	-	-	-	-	-	-
Sub-total	$ 178,200	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 276,270	-	-	-	-	31,844	31,844	33,243
Res Education	$ 90,478	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 222,459	-	-	-	-	-	-	-
Sub-total	$ 589,208	-	-	-	-	31,844	31,844	33,243
Commercial & Industrial								
C&I Education	$ 115,862	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 291,439	-	-	-	-	-	-	-
Sub-total	$ 407,301	-	-	-	-	-	-	-
Total IE, Residential, and C&I	**$ 1,174,709**	**-**	**-**	**-**	**-**	**31,844**	**31,844**	**33,243**
Grand Total	**$ 8,760,665**	**5,199,509**	**5,199,509**	**1,124**	**30,562**	**31,844**	**31,844**	**73,530**

Notes:
(1) Amounts shown above pertain only to the Company-Specific programs. The amounts pertaining to the Statewide programs are shown on Attachment B, page 2.
Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.

NHSAVES PROGRAMS
2024-2026 Statewide Goals
Statewide & Company-Specific Programs

Description	Program Budget[1]	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW[3]	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Statewide Programs	$ 192,700,877	285,347,444	2,580,962,914	43,351	40,361	187,726	5,155,670	140,921
Company Specific Programs[2]	$ 22,230,039	15,600,701	15,600,701	3,371	76,290	-	-	118,365
Total Electric	**$ 214,930,917**	**300,948,145**	**2,596,563,615**	**46,721**	**116,651**	**187,726**	**5,155,670**	**259,286**
Gas Utilities								
Statewide Programs	$ 35,431,163	245,130	4,329,501	61	29	399,435	6,359,469	20,541
Company Specific Programs[2]	$ 3,407,244	-	-	-	-	95,533	95,533	99,729
Total Gas	**$ 38,838,406**	**245,130**	**4,329,501**	**61**	**29**	**494,968**	**6,455,002**	**120,270**
Grand Total	**$ 253,769,323**	**301,193,276**	**2,600,893,116**	**46,783**	**116,680**	**682,694**	**11,610,672**	**379,556**

Notes:
(1) Program budgets shown in this report exclude the performance incentive (PI).
(2) Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.
(3) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not cumulative.

NHSAVES PROGRAMS
2024-2026 Statewide Goals
Statewide Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
Home Energy Assistance	$ 39,702,198	10,460,677	140,844,895	1,843	1,674	42,415	1,008,396	2,974
Sub-total	$ 39,702,198	10,460,677	140,844,895	1,843	1,674	42,415	1,008,396	2,974
Residential								
EnergyStar® Homes	$ 11,256,987	7,419,110	174,310,328	2,153	400	76,112	1,752,982	4,061
Home Performance	$ 31,012,876	2,571,855	46,578,331	370	679	126,585	2,447,630	7,108
EnergyStar® Products	$ 25,378,440	29,973,168	375,000,100	8,558	5,302	30,239	460,008	93,543
Sub-total	$ 67,648,303	39,964,132	595,888,759	11,080	6,381	232,936	4,660,620	104,713
Commercial & Industrial								
Large Business Energy Solutions	$ 40,613,221	104,124,788	910,784,247	13,044	11,799	(33,365)	(179,402)	6,481
Small Business Energy Solutions	$ 38,427,950	119,765,685	834,566,026	16,201	19,131	(50,302)	(312,437)	25,198
Municipal Program	$ 6,309,206	11,032,162	98,878,987	1,182	1,376	(3,959)	(21,507)	1,555
Sub-total	$ 85,350,376	234,922,635	1,844,229,260	30,428	32,306	(87,626)	(513,345)	33,234
Total Electric	**$ 192,700,877**	**285,347,444**	**2,580,962,914**	**43,351**	**40,361**	**187,726**	**5,155,670**	**140,921**
Gas Utilities								
Income Eligible								
Home Energy Assistance	$ 7,241,200	61,853	1,280,926	11	14	39,800	849,663	736
Sub-total	$ 7,241,200	61,853	1,280,926	11	14	39,800	849,663	736
Residential								
EnergyStar® Homes	$ 3,013,131	-	-	-	-	21,639	510,294	877
Home Performance	$ 5,249,785	49,853	831,325	9	12	31,951	661,659	631
EnergyStar® Products	$ 4,481,562	109,400	1,784,818	35	3	85,501	1,395,391	11,999
Sub-total	$ 12,744,479	159,253	2,616,143	43	15	139,092	2,567,345	13,507
Commercial & Industrial								
Large Business Energy Solutions	$ 7,177,124	-	-	-	-	137,487	1,722,967	991
Small Business Energy Solutions	$ 6,757,503	22,344	402,192	7	-	64,560	946,506	4,522
Municipal Program	$ 1,510,856	1,680	30,240	0	-	18,496	272,988	785
Sub-total	$ 15,445,484	24,024	432,432	7	-	220,543	2,942,461	6,298
Total Gas	**$ 35,431,163**	**245,130**	**4,329,501**	**61**	**29**	**399,435**	**6,359,469**	**20,541**
Grand Total	**$ 228,132,040**	**285,592,574**	**2,585,292,415**	**43,412**	**40,389**	**587,161**	**11,515,139**	**161,462**

Notes:
(1) Amounts shown above pertain only to the Statewide programs. The amounts pertaining to the Company-Specific programs are shown on Attachment B, page 3.

NHSAVES PROGRAMS
2024-2026 Statewide Goals
Company-Specific Programs[1]

Description	Program Budget	kWh Savings Annual	kWh Savings Lifetime	kW Savings Winter kW	kW Savings Summer kW[2]	MMBtu Savings Annual	MMBtu Savings Lifetime	Customers Count
Electric Utilities								
Income Eligible								
IE Education	$ 1,983,283	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 1,961,150	-	-	-	-	-	-	-
Sub-total	$ 3,944,433	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 1,041,516	15,613,533	15,613,533	3,371	2,174	-	-	104,400
Res Active Demand Response	$ 1,662,904	(12,832)	(12,832)	-	9,484	-	-	13,546
Res Education	$ 1,342,489	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 3,672,291	-	-	-	-	-	-	-
Sub-total	$ 7,719,200	15,600,701	15,600,701	3,371	11,658	-	-	117,946
Commercial & Industrial								
C&I Active Demand Response	$ 4,224,252	-	-	-	64,633	-	-	419
C&I Education	$ 1,442,077	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 4,684,222	-	-	-	-	-	-	-
C&I Customer Partnerships	$ 45,650	-	-	-	-	-	-	-
Smart Start	$ 170,205	-	-	-	-	-	-	-
Sub-total	$ 10,566,406	-	-	-	64,633	-	-	419
Total IE, Residential, and C&I	**$ 22,230,039**	**15,600,701**	**15,600,701**	**3,371**	**76,290**	**-**	**-**	**118,365**
Gas Utilities								
Income Eligible								
IE Education	$ 152,981	-	-	-	-	-	-	-
IE Evaluation, Measurement and Verification	$ 373,500	-	-	-	-	-	-	-
Sub-total	$ 526,481	-	-	-	-	-	-	-
Residential								
Res Behavior	$ 811,168	-	-	-	-	95,533	95,533	99,729
Res Education	$ 263,776	-	-	-	-	-	-	-
Res Evaluation, Measurement and Verification	$ 684,304	-	-	-	-	-	-	-
Sub-total	$ 1,759,248	-	-	-	-	95,533	95,533	99,729
Commercial & Industrial								
C&I Education	$ 303,018	-	-	-	-	-	-	-
C&I Evaluation, Measurement and Verification	$ 818,497	-	-	-	-	-	-	-
Sub-total	$ 1,121,515	-	-	-	-	-	-	-
Total IE, Residential, and C&I	**$ 3,407,244**	**-**	**-**	**-**	**-**	**95,533**	**95,533**	**99,729**
Grand Total	**$ 25,637,283**	**15,600,701**	**15,600,701**	**3,371**	**76,290**	**95,533**	**95,533**	**218,094**

Notes:
(1) Amounts shown above pertain only to the Company-Specific programs. The amounts pertaining to the Statewide programs are shown on Attachment B, page 2.
Company-specific includes behavior programs, active demand response, education, EM&V, and loan program administration.
(2) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not cumulative.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024 UTILITY BUDGETS BY ACTIVITY
Income Eligible Programs

Description		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Home Energy Assistance	Program Planning & Administration	$ 50,757	$ 66,637	$ 151,996	$ 43,499	$ 312,888	$ 77,547	$ 17,700	$ 95,246	$ 408,135
	Customer Incentives	$ 1,035,210	$ 767,598	$ 7,247,415	$ 1,064,000	$ 10,114,223	$ 1,621,091	$ 353,857	$ 1,974,948	$ 12,089,172
	Implementation Services	$ 47,216	$ 103,016	$ 1,112,340	$ 150,257	$ 1,412,829	$ 73,854	$ 87,111	$ 160,964	$ 1,573,793
	Education and Marketing	$ 47,216	$ 5,000	$ 173,709	$ 27,374	$ 253,299	$ 73,854	$ 13,877	$ 87,731	$ 341,030
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,180,399	$ 942,251	$ 8,685,460	$ 1,285,130	$ 12,093,240	$ 1,846,345	$ 472,544	$ 2,318,890	$ 14,412,129
Other[1]	Program Planning & Administration	$ 1,121	$ -	$ 17,045	$ -	$ 18,166	$ 1,668	$ -	$ 1,668	$ 19,833
	Customer Incentives	$ 13,528	$ -	$ -	$ -	$ 13,528	$ 20,131	$ -	$ 20,131	$ 33,659
	Implementation Services	$ 3,469	$ -	$ 50,000	$ -	$ 53,469	$ 5,162	$ -	$ 5,162	$ 58,631
	Education and Marketing	$ 8,565	$ 25,563	$ 906,955	$ 23,695	$ 964,778	$ 12,746	$ 8,793	$ 21,539	$ 986,317
	EM&V	$ 63,531	$ 47,144	$ 460,329	$ 59,915	$ 630,919	$ 99,266	$ 24,373	$ 123,639	$ 754,558
	Total	$ 90,213	$ 72,706	$ 1,434,329	$ 83,610	$ 1,680,860	$ 138,972	$ 33,166	$ 172,138	$ 1,852,998
Total Income Eligible	Program Planning & Administration	$ 51,878	$ 66,637	$ 169,041	$ 43,499	$ 331,054	$ 79,214	$ 17,700	$ 96,914	$ 427,968
	Customer Incentives	$ 1,048,738	$ 767,598	$ 7,247,415	$ 1,064,000	$ 10,127,751	$ 1,641,222	$ 353,857	$ 1,995,079	$ 12,122,831
	Implementation Services	$ 50,685	$ 103,016	$ 1,162,340	$ 150,257	$ 1,466,298	$ 79,016	$ 87,111	$ 166,126	$ 1,632,424
	Education and Marketing	$ 55,781	$ 30,563	$ 1,080,664	$ 51,069	$ 1,218,077	$ 86,600	$ 22,670	$ 109,269	$ 1,327,347
	EM&V	$ 63,531	$ 47,144	$ 460,329	$ 59,915	$ 630,919	$ 99,266	$ 24,373	$ 123,639	$ 754,558
	Total	$ 1,270,613	$ 1,014,957	$ 10,119,789	$ 1,368,740	$ 13,774,100	$ 1,985,318	$ 505,710	$ 2,491,028	$ 16,265,128
Total Income Eligible %	Program Planning & Administration	4.1%	6.6%	1.7%	3.2%	2.4%	4.0%	3.5%	3.9%	2.6%
	Customer Incentives	82.5%	75.6%	71.6%	77.7%	73.5%	82.7%	70.0%	80.1%	74.5%
	Implementation Services	4.0%	10.1%	11.5%	11.0%	10.6%	4.0%	17.2%	6.7%	10.0%
	Education and Marketing	4.4%	3.0%	10.7%	3.7%	8.8%	4.4%	4.5%	4.4%	8.2%
	EM&V	5.0%	4.6%	4.5%	4.4%	4.6%	5.0%	4.8%	5.0%	4.6%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes education and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024 UTILITY BUDGETS BY ACTIVITY
Residential Programs

Description		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
EnergyStar® Homes	Program Planning & Administration	$ 9,675	$ 33,882	$ 41,198	$ 15,306	$ 100,061	$ 33,146	$ 4,071	$ 37,217	$ 137,278
	Customer Incentives	$ 185,625	$ 390,287	$ 2,049,308	$ 221,000	$ 2,846,221	$ 677,911	$ 165,250	$ 843,161	$ 3,689,381
	Implementation Services	$ 20,700	$ 52,379	$ 176,563	$ 291,797	$ 541,439	$ 46,562	$ 44,591	$ 91,153	$ 632,592
	Education and Marketing	$ 9,000	$ 5,000	$ 87,104	$ 9,311	$ 110,415	$ 31,567	$ 3,049	$ 34,616	$ 145,032
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 225,000	$ 481,548	$ 2,354,174	$ 537,414	$ 3,598,136	$ 789,186	$ 216,961	$ 1,006,146	$ 4,604,282
Home Performance	Program Planning & Administration	$ 23,447	$ 42,352	$ 139,071	$ 27,551	$ 232,421	$ 60,900	$ 7,124	$ 68,024	$ 300,445
	Customer Incentives	$ 428,590	$ 487,859	$ 6,896,934	$ 484,491	$ 8,297,874	$ 1,173,050	$ 264,675	$ 1,437,725	$ 9,735,600
	Implementation Services	$ 71,432	$ 65,473	$ 596,216	$ 200,418	$ 933,540	$ 129,050	$ 32,458	$ 161,508	$ 1,095,048
	Education and Marketing	$ 21,811	$ 5,000	$ 314,679	$ 16,760	$ 358,250	$ 87,000	$ 5,336	$ 92,336	$ 450,586
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 545,280	$ 600,685	$ 7,946,901	$ 729,220	$ 9,822,086	$ 1,450,000	$ 309,593	$ 1,759,593	$ 11,581,678
Energy Star® Products	Program Planning & Administration	$ 19,019	$ 92,720	$ 91,972	$ 22,959	$ 226,670	$ 56,316	$ 6,106	$ 62,422	$ 289,092
	Customer Incentives	$ 288,160	$ 993,802	$ 4,266,843	$ 463,662	$ 6,012,467	$ 1,054,578	$ 129,732	$ 1,184,310	$ 7,196,777
	Implementation Services	$ 117,431	$ 218,439	$ 686,499	$ 152,848	$ 1,175,218	$ 149,505	$ 36,881	$ 186,385	$ 1,361,603
	Education and Marketing	$ 17,692	$ 20,000	$ 210,221	$ 13,966	$ 261,880	$ 80,451	$ 4,573	$ 85,024	$ 346,904
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 442,302	$ 1,324,961	$ 5,255,536	$ 653,436	$ 7,676,235	$ 1,340,849	$ 177,292	$ 1,518,141	$ 9,194,376
Other[1]	Program Planning & Administration	$ 13,274	$ -	$ 10,187	$ 9,184	$ 32,644	$ 10,836	$ 2,646	$ 13,482	$ 46,126
	Customer Incentives	$ 187,770	$ -	$ 114,975	$ 215,508	$ 518,253	$ 196,148	$ 54,880	$ 251,028	$ 769,281
	Implementation Services	$ 86,666	$ -	$ 210,809	$ 53,487	$ 350,962	$ 19,015	$ 24,089	$ 43,104	$ 394,066
	Education and Marketing	$ 20,988	$ 47,519	$ 266,576	$ 46,374	$ 381,457	$ 32,001	$ 16,464	$ 48,465	$ 429,921
	EM&V	$ 80,067	$ 125,577	$ 838,655	$ 112,289	$ 1,156,588	$ 202,002	$ 35,678	$ 237,680	$ 1,394,268
	Total	$ 388,765	$ 173,096	$ 1,441,201	$ 436,841	$ 2,439,904	$ 460,002	$ 133,757	$ 593,759	$ 3,033,663
Total Residential	Program Planning & Administration	$ 65,415	$ 168,953	$ 282,427	$ 75,001	$ 591,797	$ 161,197	$ 19,947	$ 181,144	$ 772,941
	Customer Incentives	$ 1,090,145	$ 1,871,949	$ 13,328,061	$ 1,384,661	$ 17,674,815	$ 3,101,686	$ 614,537	$ 3,716,223	$ 21,391,038
	Implementation Services	$ 296,229	$ 336,291	$ 1,670,087	$ 698,551	$ 3,001,158	$ 344,132	$ 138,019	$ 482,151	$ 3,483,309
	Education and Marketing	$ 69,491	$ 77,519	$ 878,581	$ 86,410	$ 1,112,002	$ 231,019	$ 29,421	$ 260,441	$ 1,372,443
	EM&V	$ 80,067	$ 125,577	$ 838,655	$ 112,289	$ 1,156,588	$ 202,002	$ 35,678	$ 237,680	$ 1,394,268
	Total	$ 1,601,347	$ 2,580,289	$ 16,997,811	$ 2,356,912	$ 23,536,360	$ 4,040,037	$ 837,602	$ 4,877,639	$ 28,413,999
Total Residential %	Program Planning & Administration	4.1%	6.5%	1.7%	3.2%	2.5%	4.0%	2.4%	3.7%	2.7%
	Customer Incentives	68.1%	72.5%	78.4%	58.7%	75.1%	76.8%	73.4%	76.2%	75.3%
	Implementation Services	18.5%	13.0%	9.8%	29.6%	12.8%	8.5%	16.5%	9.9%	12.3%
	Education and Marketing	4.3%	3.0%	5.2%	3.7%	4.7%	5.7%	3.5%	5.3%	4.8%
	EM&V	5.0%	4.9%	4.9%	4.8%	4.9%	5.0%	4.3%	4.9%	4.9%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes behavior programs, active demand response, education, and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Programs

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Large Business Energy Solutions	Program Planning & Administration	$ 60,774	$ 50,222	$ 179,891	$ 52,427	$ 343,314	$ 72,842	$ 15,576	$ 88,418	$ 431,732
	Customer Incentives	$ 1,059,166	$ 578,511	$ 8,845,414	$ 978,550	$ 11,461,642	$ 1,214,598	$ 385,300	$ 1,599,898	$ 13,061,540
	Implementation Services	$ 236,878	$ 77,639	$ 941,898	$ 199,602	$ 1,456,017	$ 321,860	$ 93,960	$ 415,820	$ 1,871,837
	Education and Marketing	$ 56,534	$ 5,000	$ 312,291	$ 34,134	$ 407,959	$ 84,700	$ 12,320	$ 97,020	$ 504,979
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,413,353	$ 711,372	$ 10,279,495	$ 1,264,713	$ 13,668,932	$ 1,694,000	$ 507,156	$ 2,201,156	$ 15,870,089
Small Business Energy Solutions	Program Planning & Administration	$ 53,110	$ 39,494	$ 171,738	$ 53,543	$ 317,885	$ 68,420	$ 15,576	$ 83,996	$ 401,881
	Customer Incentives	$ 936,713	$ 520,992	$ 8,933,356	$ 977,755	$ 11,368,817	$ 1,148,031	$ 365,771	$ 1,513,801	$ 12,882,619
	Implementation Services	$ 195,890	$ 64,182	$ 392,544	$ 190,994	$ 843,610	$ 295,162	$ 93,964	$ 389,127	$ 1,232,737
	Education and Marketing	$ 49,405	$ 7,500	$ 315,971	$ 34,860	$ 407,736	$ 79,559	$ 12,320	$ 91,879	$ 499,615
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,235,118	$ 632,168	$ 9,813,610	$ 1,257,152	$ 12,938,048	$ 1,591,172	$ 487,631	$ 2,078,803	$ 15,016,851
Municipal Energy Solutions	Program Planning & Administration	$ 7,639	$ 16,196	$ 25,387	$ 12,394	$ 61,616	$ 15,540	$ 3,540	$ 19,080	$ 80,696
	Customer Incentives	$ 134,747	$ 198,019	$ 1,323,495	$ 152,500	$ 1,808,761	$ 271,210	$ 77,500	$ 348,710	$ 2,157,471
	Implementation Services	$ 28,157	$ 25,039	$ 58,269	$ 41,312	$ 152,777	$ 68,450	$ 23,400	$ 91,850	$ 244,627
	Education and Marketing	$ 7,106	$ 7,428	$ 43,520	$ 8,069	$ 66,124	$ 14,800	$ 2,800	$ 17,600	$ 83,724
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 177,649	$ 246,681	$ 1,450,671	$ 214,276	$ 2,089,277	$ 370,000	$ 107,240	$ 477,240	$ 2,566,517
Other[1]	Program Planning & Administration	$ 12,900	$ 4,015	$ 33,112	$ 3,346	$ 53,374	$ 2,142	$ -	$ 2,142	$ 55,516
	Customer Incentives	$ 230,550	$ 46,253	$ 541,350	$ 100,000	$ 918,153	$ 22,287	$ -	$ 22,287	$ 940,440
	Implementation Services	$ 26,100	$ 6,207	$ 109,204	$ 105,758	$ 247,270	$ 2,805	$ -	$ 2,805	$ 250,075
	Education and Marketing	$ 30,450	$ 33,117	$ 268,418	$ 40,327	$ 372,311	$ 23,766	$ 33,803	$ 57,569	$ 429,879
	EM&V	$ 164,533	$ 95,824	$ 1,174,804	$ 154,392	$ 1,589,552	$ 195,062	$ 49,410	$ 244,471	$ 1,834,024
	Total	$ 464,533	$ 185,416	$ 2,126,888	$ 403,823	$ 3,180,660	$ 246,062	$ 83,212	$ 329,274	$ 3,509,934

(1) Other includes active demand response, education, EM&V, and loan program administration.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024 UTILITY BUDGETS BY ACTIVITY

Commercial & Industrial Program Total and Grand Total (Income Eligible, Residential, and Commercial & Industrial)

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Total Commercial & Industrial	Program Planning & Administration	$ 134,423	$ 109,926	$ 410,128	$ 121,711	$ 776,188	$ 158,944	$ 34,692	$ 193,637	$ 969,825
	Customer Incentives	$ 2,361,177	$ 1,343,776	$ 19,643,616	$ 2,208,805	$ 25,557,373	$ 2,656,126	$ 828,571	$ 3,484,696	$ 29,042,069
	Implementation Services	$ 487,025	$ 173,067	$ 1,501,916	$ 537,666	$ 2,699,674	$ 688,277	$ 211,324	$ 899,602	$ 3,599,276
	Education and Marketing	$ 143,495	$ 53,045	$ 940,201	$ 117,390	$ 1,254,130	$ 202,825	$ 61,243	$ 264,067	$ 1,518,197
	EM&V	$ 164,533	$ 95,824	$ 1,174,804	$ 154,392	$ 1,589,552	$ 195,062	$ 49,410	$ 244,471	$ 1,834,024
	Total	$ 3,290,652	$ 1,775,637	$ 23,670,665	$ 3,139,964	$ 31,876,918	$ 3,901,234	$ 1,185,239	$ 5,086,473	$ 36,963,391
Total Commercial & Industrial %	Program Planning & Administration	4.1%	6.2%	1.7%	3.9%	2.4%	4.1%	2.9%	3.8%	2.6%
	Customer Incentives	71.8%	75.7%	83.0%	70.3%	80.2%	68.1%	69.9%	68.5%	78.6%
	Implementation Services	14.8%	9.7%	6.3%	17.1%	8.5%	17.6%	17.8%	17.7%	9.7%
	Education and Marketing	4.4%	3.0%	4.0%	3.7%	3.9%	5.2%	5.2%	5.2%	4.1%
	EM&V	5.0%	5.4%	5.0%	4.9%	5.0%	5.0%	4.2%	4.8%	5.0%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Grand Total (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	$ 251,716	$ 345,516	$ 861,596	$ 240,211	$ 1,699,039	$ 399,356	$ 72,339	$ 471,695	$ 2,170,734
	Customer Incentives	$ 4,500,060	$ 3,983,323	$ 40,219,091	$ 4,657,466	$ 53,359,940	$ 7,399,035	$ 1,796,964	$ 9,195,999	$ 62,555,939
	Implementation Services	$ 833,939	$ 612,375	$ 4,334,343	$ 1,386,474	$ 7,167,131	$ 1,111,425	$ 436,454	$ 1,547,879	$ 8,715,009
	Education and Marketing	$ 268,767	$ 161,126	$ 2,899,446	$ 254,870	$ 3,584,209	$ 520,444	$ 113,334	$ 633,777	$ 4,217,986
	EM&V	$ 308,131	$ 268,544	$ 2,473,789	$ 326,596	$ 3,377,059	$ 496,329	$ 109,461	$ 605,790	$ 3,982,849
	Total	$ 6,162,612	$ 5,370,884	$ 50,788,265	$ 6,865,616	$ 69,187,378	$ 9,926,588	$ 2,528,551	$ 12,455,140	$ 81,642,517
Grand Total % (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	4.1%	6.4%	1.7%	3.5%	2.5%	4.0%	2.9%	3.8%	2.7%
	Customer Incentives	73.0%	74.2%	79.2%	67.8%	77.1%	74.5%	71.1%	73.8%	76.6%
	Implementation Services	13.5%	11.4%	8.5%	20.2%	10.4%	11.2%	17.3%	12.4%	10.7%
	Education and Marketing	4.4%	3.0%	5.7%	3.7%	5.2%	5.2%	4.5%	5.1%	5.2%
	EM&V	5.0%	5.0%	4.9%	4.8%	4.9%	5.0%	4.3%	4.9%	4.9%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NHSAVES ENERGY EFFICIENCY PROGRAM - 2025 UTILITY BUDGETS BY ACTIVITY
Income Eligible Programs

Description		Electric Utilities: Liberty	Electric Utilities: NHEC	Electric Utilities: Eversource	Electric Utilities: Unitil	Electric Utilities: Sub-total Electric	Gas Utilities: Liberty	Gas Utilities: Unitil	Gas Utilities: Sub-total Gas	Grand Total
Home Energy Assistance	Program Planning & Administration	$ 54,962	$ 69,593	$ 171,917	$ 44,756	$ 341,228	$ 82,989	$ 19,823	$ 102,812	$ 444,040
	Customer Incentives	$ 988,121	$ 806,670	$ 8,229,023	$ 1,064,000	$ 11,087,814	$ 1,652,239	$ 393,907	$ 2,046,146	$ 13,133,960
	Implementation Services	$ 103,950	$ 109,374	$ 1,226,422	$ 189,437	$ 1,629,182	$ 75,445	$ 102,919	$ 178,364	$ 1,807,546
	Education and Marketing	$ 47,793	$ 5,000	$ 196,477	$ 28,195	$ 277,465	$ 75,445	$ 15,541	$ 90,986	$ 368,451
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,194,825	$ 990,637	$ 9,823,838	$ 1,326,389	$ 13,335,690	$ 1,886,118	$ 532,190	$ 2,418,308	$ 15,753,997
Other[1]	Program Planning & Administration	$ 1,190	$ -	$ 10,273	$ -	$ 11,462	$ 1,704	$ -	$ 1,704	$ 13,166
	Customer Incentives	$ 15,154	$ -	$ -	$ -	$ 15,154	$ 20,646	$ -	$ 20,646	$ 35,800
	Implementation Services	$ 3,767	$ -	$ 50,000	$ -	$ 53,767	$ 5,192	$ -	$ 5,192	$ 58,959
	Education and Marketing	$ 8,214	$ 26,797	$ 526,728	$ 24,265	$ 586,004	$ 13,020	$ 9,818	$ 22,838	$ 608,842
	EM&V	$ 64,376	$ 38,599	$ 491,192	$ 55,262	$ 649,430	$ 101,404	$ 24,359	$ 125,763	$ 775,193
	Total	$ 92,702	$ 65,396	$ 1,078,192	$ 79,527	$ 1,315,817	$ 141,966	$ 34,176	$ 176,142	$ 1,491,959
Total Income Eligible	Program Planning & Administration	$ 56,152	$ 69,593	$ 182,190	$ 44,756	$ 352,691	$ 84,693	$ 19,823	$ 104,516	$ 457,206
	Customer Incentives	$ 1,003,275	$ 806,670	$ 8,229,023	$ 1,064,000	$ 11,102,968	$ 1,672,885	$ 393,907	$ 2,066,792	$ 13,169,760
	Implementation Services	$ 107,717	$ 109,374	$ 1,276,422	$ 189,437	$ 1,682,950	$ 80,637	$ 102,919	$ 183,556	$ 1,866,506
	Education and Marketing	$ 56,007	$ 31,797	$ 723,204	$ 52,460	$ 863,469	$ 88,465	$ 25,359	$ 113,824	$ 977,292
	EM&V	$ 64,376	$ 38,599	$ 491,192	$ 55,262	$ 649,430	$ 101,404	$ 24,359	$ 125,763	$ 775,193
	Total	$ 1,287,527	$ 1,056,034	$ 10,902,030	$ 1,405,915	$ 14,651,507	$ 2,028,083	$ 566,366	$ 2,594,450	$ 17,245,957
Total Income Eligible %	Program Planning & Administration	4.4%	6.6%	1.7%	3.2%	2.4%	4.2%	3.5%	4.0%	2.7%
	Customer Incentives	77.9%	76.4%	75.5%	75.7%	75.8%	82.5%	69.5%	79.7%	76.4%
	Implementation Services	8.4%	10.4%	11.7%	13.5%	11.5%	4.0%	18.2%	7.1%	10.8%
	Education and Marketing	4.4%	3.0%	6.6%	3.7%	5.9%	4.4%	4.5%	4.4%	5.7%
	EM&V	5.0%	3.7%	4.5%	3.9%	4.4%	5.0%	4.3%	4.8%	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes education and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2025 UTILITY BUDGETS BY ACTIVITY
Residential Programs

Description		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
EnergyStar® Homes	Program Planning & Administration	$ 10,367	$ 36,182	$ 42,768	$ 15,765	$ 105,083	$ 32,035	$ 4,232	$ 36,267	$ 141,349
	Customer Incentives	$ 183,231	$ 419,432	$ 2,113,807	$ 221,000	$ 2,937,470	$ 636,603	$ 165,250	$ 801,853	$ 3,739,323
	Implementation Services	$ 22,763	$ 56,864	$ 196,885	$ 350,877	$ 627,389	$ 46,563	$ 65,029	$ 111,591	$ 738,981
	Education and Marketing	$ 9,015	$ 5,000	$ 90,424	$ 9,590	$ 114,029	$ 29,800	$ 3,140	$ 32,940	$ 146,969
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 225,376	$ 517,478	$ 2,443,884	$ 597,232	$ 3,783,971	$ 745,000	$ 237,651	$ 982,651	$ 4,766,622
Home Performance	Program Planning & Administration	$ 25,320	$ 45,182	$ 147,908	$ 28,378	$ 246,788	$ 58,154	$ 7,405	$ 65,560	$ 312,348
	Customer Incentives	$ 429,066	$ 523,766	$ 7,333,859	$ 484,491	$ 8,771,183	$ 1,104,932	$ 297,925	$ 1,402,857	$ 10,174,040
	Implementation Services	$ 74,034	$ 71,009	$ 635,253	$ 162,681	$ 942,976	$ 128,480	$ 46,300	$ 174,781	$ 1,117,757
	Education and Marketing	$ 22,018	$ 5,000	$ 334,879	$ 17,262	$ 379,159	$ 60,859	$ 5,496	$ 66,355	$ 445,514
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 550,438	$ 644,958	$ 8,451,900	$ 692,812	$ 10,340,107	$ 1,352,426	$ 357,126	$ 1,709,553	$ 12,049,660
Energy Star® Products	Program Planning & Administration	$ 20,779	$ 99,238	$ 104,388	$ 23,648	$ 248,053	$ 54,182	$ 6,348	$ 60,529	$ 308,582
	Customer Incentives	$ 280,736	$ 1,045,687	$ 4,903,635	$ 463,662	$ 6,693,719	$ 978,419	$ 129,732	$ 1,108,151	$ 7,801,870
	Implementation Services	$ 132,124	$ 256,891	$ 718,427	$ 214,734	$ 1,322,177	$ 150,574	$ 56,745	$ 207,320	$ 1,529,496
	Education and Marketing	$ 18,068	$ 20,000	$ 238,602	$ 14,385	$ 291,056	$ 76,862	$ 4,711	$ 81,573	$ 372,628
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 451,707	$ 1,421,816	$ 5,965,052	$ 716,429	$ 8,555,004	$ 1,260,037	$ 197,535	$ 1,457,572	$ 10,012,577
Other[1]	Program Planning & Administration	$ 13,505	$ -	$ 11,744	$ 9,459	$ 34,708	$ 11,440	$ 2,751	$ 14,191	$ 48,899
	Customer Incentives	$ 190,191	$ -	$ 143,719	$ 220,508	$ 554,418	$ 197,900	$ 54,880	$ 252,780	$ 807,198
	Implementation Services	$ 69,234	$ -	$ 246,770	$ 54,389	$ 370,392	$ 20,520	$ 16,629	$ 37,149	$ 407,541
	Education and Marketing	$ 20,653	$ 52,385	$ 289,315	$ 47,908	$ 410,262	$ 30,140	$ 17,858	$ 47,998	$ 458,259
	EM&V	$ 80,058	$ 106,010	$ 859,695	$ 104,876	$ 1,150,640	$ 190,393	$ 33,772	$ 224,165	$ 1,374,805
	Total	$ 373,641	$ 158,396	$ 1,551,243	$ 437,140	$ 2,520,420	$ 450,393	$ 125,889	$ 576,282	$ 3,096,702
Total Residential	Program Planning & Administration	$ 69,971	$ 180,602	$ 306,809	$ 77,250	$ 634,632	$ 155,811	$ 20,735	$ 176,546	$ 811,178
	Customer Incentives	$ 1,083,224	$ 1,988,885	$ 14,495,020	$ 1,389,661	$ 18,956,790	$ 2,917,854	$ 647,787	$ 3,565,641	$ 22,522,430
	Implementation Services	$ 298,155	$ 384,765	$ 1,797,335	$ 782,680	$ 3,262,935	$ 346,137	$ 184,703	$ 530,840	$ 3,793,775
	Education and Marketing	$ 69,754	$ 82,385	$ 953,221	$ 89,146	$ 1,194,506	$ 197,661	$ 31,204	$ 228,865	$ 1,423,371
	EM&V	$ 80,058	$ 106,010	$ 859,695	$ 104,876	$ 1,150,640	$ 190,393	$ 33,772	$ 224,165	$ 1,374,805
	Total	$ 1,601,162	$ 2,742,648	$ 18,412,079	$ 2,443,613	$ 25,199,503	$ 3,807,856	$ 918,201	$ 4,726,057	$ 29,925,560
Total Residential %	Program Planning & Administration	4.4%	6.6%	1.7%	3.2%	2.5%	4.1%	2.3%	3.7%	2.7%
	Customer Incentives	67.7%	72.5%	78.7%	56.9%	75.2%	76.6%	70.5%	75.4%	75.3%
	Implementation Services	18.6%	14.0%	9.8%	32.0%	12.9%	9.1%	20.1%	11.2%	12.7%
	Education and Marketing	4.4%	3.0%	5.2%	3.6%	4.7%	5.2%	3.4%	4.8%	4.8%
	EM&V	5.0%	3.9%	4.7%	4.3%	4.6%	5.0%	3.7%	4.7%	4.6%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes behavior programs, active demand response, education, and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2025 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Programs

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Large Business Energy Solutions	Program Planning & Administration	$ 63,026	$ 50,250	$ 177,629	$ 54,006	$ 344,911	$ 83,520	$ 14,653	$ 98,173	$ 443,084
	Customer Incentives	$ 1,000,882	$ 636,062	$ 8,734,249	$ 978,550	$ 11,349,743	$ 1,363,851	$ 385,300	$ 1,749,151	$ 13,098,894
	Implementation Services	$ 251,419	$ 66,076	$ 933,854	$ 201,709	$ 1,453,059	$ 355,911	$ 148,017	$ 503,928	$ 1,956,987
	Education and Marketing	$ 54,805	$ 5,000	$ 304,507	$ 35,158	$ 399,470	$ 94,910	$ 16,349	$ 111,259	$ 510,729
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,370,132	$ 757,388	$ 10,150,240	$ 1,269,423	$ 13,547,182	$ 1,898,192	$ 564,319	$ 2,462,512	$ 16,009,694
Small Business Energy Solutions	Program Planning & Administration	$ 54,336	$ 44,873	$ 168,913	$ 55,155	$ 323,276	$ 77,223	$ 14,653	$ 91,875	$ 415,152
	Customer Incentives	$ 871,732	$ 556,016	$ 8,807,622	$ 977,755	$ 11,213,125	$ 1,275,929	$ 365,771	$ 1,641,700	$ 12,854,825
	Implementation Services	$ 207,893	$ 75,375	$ 386,088	$ 204,932	$ 874,287	$ 314,156	$ 147,433	$ 461,589	$ 1,335,876
	Education and Marketing	$ 47,248	$ 7,500	$ 289,566	$ 35,906	$ 380,220	$ 87,753	$ 16,349	$ 104,102	$ 484,322
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,181,208	$ 683,763	$ 9,652,189	$ 1,273,747	$ 12,790,908	$ 1,755,061	$ 544,206	$ 2,299,267	$ 15,090,175
Municipal Energy Solutions	Program Planning & Administration	$ 7,574	$ 11,132	$ 25,387	$ 13,141	$ 57,234	$ 16,720	$ -	$ 16,720	$ 73,954
	Customer Incentives	$ 120,695	$ 135,217	$ 1,323,477	$ 152,500	$ 1,731,889	$ 274,740	$ 92,500	$ 367,240	$ 2,099,129
	Implementation Services	$ 29,803	$ 17,495	$ 58,287	$ 62,402	$ 167,987	$ 73,340	$ 25,000	$ 98,340	$ 266,327
	Education and Marketing	$ 6,586	$ 5,086	$ 43,520	$ 8,312	$ 63,504	$ 15,200	$ 7,524	$ 22,724	$ 86,229
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 164,660	$ 168,930	$ 1,450,671	$ 236,355	$ 2,020,615	$ 380,000	$ 125,024	$ 505,024	$ 2,525,639
Other[1]	Program Planning & Administration	$ 19,596	$ 4,259	$ 35,817	$ 3,447	$ 63,120	$ 2,408	$ -	$ 2,408	$ 65,528
	Customer Incentives	$ 334,224	$ 49,375	$ 669,319	$ 105,000	$ 1,157,918	$ 24,360	$ -	$ 24,360	$ 1,182,278
	Implementation Services	$ 35,820	$ 6,694	$ 228,330	$ 115,098	$ 385,943	$ 3,640	$ -	$ 3,640	$ 389,583
	Education and Marketing	$ 36,360	$ 35,729	$ 272,203	$ 66,368	$ 410,660	$ 25,592	$ 46,353	$ 71,945	$ 482,605
	EM&V	$ 165,368	$ 78,721	$ 1,101,551	$ 143,140	$ 1,488,781	$ 215,224	$ 67,363	$ 282,587	$ 1,771,368
	Total	$ 591,368	$ 174,779	$ 2,307,221	$ 433,054	$ 3,506,422	$ 271,224	$ 113,716	$ 384,940	$ 3,891,362

(1) Other includes active demand response, education, EM&V, and loan program administration.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2025 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Program Total and Grand Total (Income Eligible, Residential, and Commercial & Industrial)

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Total Commercial & Industrial	Program Planning & Administration	$ 144,532	$ 110,514	$ 407,747	$ 125,749	$ 788,541	$ 179,871	$ 29,305	$ 209,177	$ 997,718
	Customer Incentives	$ 2,327,533	$ 1,376,670	$ 19,534,667	$ 2,213,805	$ 25,452,675	$ 2,938,881	$ 843,571	$ 3,782,451	$ 29,235,126
	Implementation Services	$ 524,935	$ 165,640	$ 1,606,559	$ 584,141	$ 2,881,276	$ 747,047	$ 320,450	$ 1,067,497	$ 3,948,773
	Education and Marketing	$ 145,000	$ 53,315	$ 909,796	$ 145,743	$ 1,253,854	$ 223,455	$ 86,577	$ 310,031	$ 1,563,885
	EM&V	$ 165,368	$ 78,721	$ 1,101,551	$ 143,140	$ 1,488,781	$ 215,224	$ 67,363	$ 282,587	$ 1,771,368
	Total	$ 3,307,369	$ 1,784,860	$ 23,560,320	$ 3,212,579	$ 31,865,127	$ 4,304,477	$ 1,347,266	$ 5,651,743	$ 37,516,870
Total Commercial & Industrial %	Program Planning & Administration	4.4%	6.2%	1.7%	3.9%	2.5%	4.2%	2.2%	3.7%	2.7%
	Customer Incentives	70.4%	77.1%	82.9%	68.9%	79.9%	68.3%	62.6%	66.9%	77.9%
	Implementation Services	15.9%	9.3%	6.8%	18.2%	9.0%	17.4%	23.8%	18.9%	10.5%
	Education and Marketing	4.4%	3.0%	3.9%	4.5%	3.9%	5.2%	6.4%	5.5%	4.2%
	EM&V	5.0%	4.4%	4.7%	4.5%	4.7%	5.0%	5.0%	5.0%	4.7%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Grand Total (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	$ 270,654	$ 360,710	$ 896,745	$ 247,755	$ 1,775,864	$ 420,375	$ 69,864	$ 490,238	$ 2,266,102
	Customer Incentives	$ 4,414,032	$ 4,172,226	$ 42,258,709	$ 4,667,466	$ 55,512,433	$ 7,529,619	$ 1,885,264	$ 9,414,884	$ 64,927,317
	Implementation Services	$ 930,808	$ 659,778	$ 4,680,316	$ 1,556,259	$ 7,827,160	$ 1,173,821	$ 608,072	$ 1,781,893	$ 9,609,054
	Education and Marketing	$ 270,762	$ 167,497	$ 2,586,221	$ 287,349	$ 3,311,829	$ 509,581	$ 143,139	$ 652,720	$ 3,964,549
	EM&V	$ 309,803	$ 223,331	$ 2,452,439	$ 303,278	$ 3,288,851	$ 507,021	$ 125,494	$ 632,515	$ 3,921,365
	Total	$ 6,196,058	$ 5,583,542	$ 52,874,430	$ 7,062,107	$ 71,716,137	$ 10,140,417	$ 2,831,833	$ 12,972,250	$ 84,688,387
Grand Total % (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	4.4%	6.5%	1.7%	3.5%	2.5%	4.1%	2.5%	3.8%	2.7%
	Customer Incentives	71.2%	74.7%	79.9%	66.1%	77.4%	74.3%	66.6%	72.6%	76.7%
	Implementation Services	15.0%	11.8%	8.9%	22.0%	10.9%	11.6%	21.5%	13.7%	11.3%
	Education and Marketing	4.4%	3.0%	4.9%	4.1%	4.6%	5.0%	5.1%	5.0%	4.7%
	EM&V	5.0%	4.0%	4.6%	4.3%	4.6%	5.0%	4.4%	4.9%	4.6%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NHSAVES ENERGY EFFICIENCY PROGRAM - 2026 UTILITY BUDGETS BY ACTIVITY
Income Eligible Programs

Description		Electric Utilities: Liberty	Electric Utilities: NHEC	Electric Utilities: Eversource	Electric Utilities: Unitil	Electric Utilities: Sub-total Electric	Gas Utilities: Liberty	Gas Utilities: Unitil	Gas Utilities: Sub-total Gas	Grand Total
Home Energy Assistance	Program Planning & Administration	$ 54,227	$ 70,064	$ 187,616	$ 46,151	$ 358,057	$ 89,459	$ 20,608	$ 110,067	$ 468,125
	Customer Incentives	$ 953,004	$ 837,309	$ 9,027,839	$ 1,064,000	$ 11,882,152	$ 1,695,832	$ 420,607	$ 2,116,439	$ 13,998,591
	Implementation Services	$ 100,377	$ 110,113	$ 1,291,051	$ 236,908	$ 1,738,449	$ 81,680	$ 101,869	$ 183,549	$ 1,921,998
	Education and Marketing	$ 46,150	$ 5,000	$ 214,419	$ 29,041	$ 294,610	$ 77,790	$ 16,157	$ 93,947	$ 388,557
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,153,757	$ 1,022,487	$ 10,720,925	$ 1,376,099	$ 14,273,268	$ 1,944,762	$ 559,241	$ 2,504,003	$ 16,777,271
Other[1]	Program Planning & Administration	$ 1,149	$ -	$ 3,273	$ -	$ 4,421	$ 1,846	$ -	$ 1,846	$ 6,268
	Customer Incentives	$ 14,442	$ -	$ -	$ -	$ 14,442	$ 23,168	$ -	$ 23,168	$ 37,609
	Implementation Services	$ 3,747	$ -	$ 50,000	$ -	$ 53,747	$ 5,979	$ -	$ 5,979	$ 59,726
	Education and Marketing	$ 8,014	$ 27,850	$ 133,728	$ 24,753	$ 194,344	$ 12,969	$ 10,141	$ 23,110	$ 217,454
	EM&V	$ 62,164	$ 39,978	$ 536,046	$ 42,613	$ 680,801	$ 104,670	$ 19,428	$ 124,098	$ 804,899
	Total	$ 89,516	$ 67,828	$ 723,046	$ 67,366	$ 947,756	$ 148,631	$ 29,569	$ 178,200	$ 1,125,956
Total Income Eligible	Program Planning & Administration	$ 55,375	$ 70,064	$ 190,889	$ 46,151	$ 362,479	$ 91,305	$ 20,608	$ 111,914	$ 474,393
	Customer Incentives	$ 967,445	$ 837,309	$ 9,027,839	$ 1,064,000	$ 11,896,594	$ 1,719,000	$ 420,607	$ 2,139,607	$ 14,036,201
	Implementation Services	$ 104,124	$ 110,113	$ 1,341,051	$ 236,908	$ 1,792,196	$ 87,659	$ 101,869	$ 189,527	$ 1,981,724
	Education and Marketing	$ 54,164	$ 32,850	$ 348,146	$ 53,794	$ 488,954	$ 90,759	$ 26,298	$ 117,057	$ 606,011
	EM&V	$ 62,164	$ 39,978	$ 536,046	$ 42,613	$ 680,801	$ 104,670	$ 19,428	$ 124,098	$ 804,899
	Total	$ 1,243,273	$ 1,090,315	$ 11,443,971	$ 1,443,465	$ 15,221,024	$ 2,093,393	$ 588,810	$ 2,682,203	$ 17,903,227
Total Income Eligible %	Program Planning & Administration	4.5%	6.4%	1.7%	3.2%	2.4%	4.4%	3.5%	4.2%	2.6%
	Customer Incentives	77.8%	76.8%	78.9%	73.7%	78.2%	82.1%	71.4%	79.8%	78.4%
	Implementation Services	8.4%	10.1%	11.7%	16.4%	11.8%	4.2%	17.3%	7.1%	11.1%
	Education and Marketing	4.4%	3.0%	3.0%	3.7%	3.2%	4.3%	4.5%	4.4%	3.4%
	EM&V	5.0%	3.7%	4.7%	3.0%	4.5%	5.0%	3.3%	4.6%	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes education and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2026 UTILITY BUDGETS BY ACTIVITY
Residential Programs

Description		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
EnergyStar® Homes	Program Planning & Administration	$ 10,396	$ 36,217	$ 43,888	$ 16,237	$ 106,738	$ 34,695	$ 4,371	$ 39,066	$ 145,803
	Customer Incentives	$ 178,508	$ 433,275	$ 2,186,602	$ 221,000	$ 3,019,385	$ 655,350	$ 165,250	$ 820,600	$ 3,839,985
	Implementation Services	$ 23,447	$ 56,919	$ 189,598	$ 367,293	$ 637,256	$ 50,115	$ 80,479	$ 130,594	$ 767,850
	Education and Marketing	$ 8,848	$ 5,000	$ 87,775	$ 9,878	$ 111,501	$ 30,840	$ 3,235	$ 34,075	$ 145,576
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 221,200	$ 531,411	$ 2,507,862	$ 614,407	$ 3,874,881	$ 771,000	$ 253,334	$ 1,024,334	$ 4,899,214
Home Performance	Program Planning & Administration	$ 26,135	$ 45,226	$ 155,851	$ 29,226	$ 256,438	$ 62,868	$ 7,649	$ 70,516	$ 326,954
	Customer Incentives	$ 431,282	$ 541,053	$ 7,863,806	$ 484,491	$ 9,320,631	$ 1,140,699	$ 293,425	$ 1,434,124	$ 10,754,755
	Implementation Services	$ 76,403	$ 71,077	$ 577,196	$ 195,011	$ 919,687	$ 134,816	$ 76,846	$ 211,663	$ 1,131,350
	Education and Marketing	$ 22,242	$ 5,000	$ 308,904	$ 17,780	$ 353,927	$ 58,676	$ 5,660	$ 64,337	$ 418,264
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 556,062	$ 662,356	$ 8,905,757	$ 726,509	$ 10,850,684	$ 1,397,060	$ 383,581	$ 1,780,640	$ 12,631,324
Energy Star® Products	Program Planning & Administration	$ 21,257	$ 99,245	$ 114,659	$ 24,355	$ 259,516	$ 58,640	$ 6,556	$ 65,196	$ 324,712
	Customer Incentives	$ 278,375	$ 1,082,210	$ 5,451,374	$ 463,662	$ 7,275,622	$ 1,024,241	$ 129,732	$ 1,153,972	$ 8,429,594
	Implementation Services	$ 134,552	$ 258,635	$ 746,087	$ 180,061	$ 1,319,335	$ 155,070	$ 61,604	$ 216,674	$ 1,536,009
	Education and Marketing	$ 18,091	$ 20,000	$ 239,820	$ 14,817	$ 292,727	$ 65,155	$ 4,852	$ 70,007	$ 362,735
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 452,275	$ 1,460,090	$ 6,551,940	$ 682,895	$ 9,147,200	$ 1,303,105	$ 202,744	$ 1,505,849	$ 10,653,050
Other[1]	Program Planning & Administration	$ 14,840	$ -	$ 13,520	$ 9,742	$ 38,102	$ 12,105	$ 2,841	$ 14,946	$ 53,048
	Customer Incentives	$ 208,296	$ -	$ 179,648	$ 233,116	$ 621,060	$ 203,472	$ 54,880	$ 258,352	$ 879,412
	Implementation Services	$ 70,861	$ -	$ 290,746	$ 47,018	$ 408,625	$ 21,277	$ 21,447	$ 42,724	$ 451,349
	Education and Marketing	$ 21,742	$ 54,625	$ 309,135	$ 73,946	$ 459,448	$ 32,146	$ 18,580	$ 50,726	$ 510,174
	EM&V	$ 81,330	$ 108,987	$ 919,057	$ 122,267	$ 1,231,641	$ 196,851	$ 25,608	$ 222,459	$ 1,454,100
	Total	$ 397,069	$ 163,612	$ 1,712,107	$ 486,089	$ 2,758,876	$ 465,851	$ 123,357	$ 589,208	$ 3,348,084
Total Residential	Program Planning & Administration	$ 72,628	$ 180,687	$ 327,918	$ 79,561	$ 660,794	$ 168,307	$ 21,417	$ 189,724	$ 850,518
	Customer Incentives	$ 1,096,461	$ 2,056,539	$ 15,681,429	$ 1,402,269	$ 20,236,699	$ 3,023,762	$ 643,287	$ 3,667,048	$ 23,903,747
	Implementation Services	$ 305,263	$ 386,631	$ 1,803,627	$ 789,383	$ 3,284,904	$ 361,278	$ 240,376	$ 601,654	$ 3,886,558
	Education and Marketing	$ 70,923	$ 84,625	$ 945,635	$ 116,421	$ 1,217,603	$ 186,818	$ 32,327	$ 219,145	$ 1,436,748
	EM&V	$ 81,330	$ 108,987	$ 919,057	$ 122,267	$ 1,231,641	$ 196,851	$ 25,608	$ 222,459	$ 1,454,100
	Total	$ 1,626,606	$ 2,817,470	$ 19,677,665	$ 2,509,900	$ 26,631,641	$ 3,937,015	$ 963,015	$ 4,900,031	$ 31,531,672
Total Residential %	Program Planning & Administration	4.5%	6.4%	1.7%	3.2%	2.5%	4.3%	2.2%	3.9%	2.7%
	Customer Incentives	67.4%	73.0%	79.7%	55.9%	76.0%	76.8%	66.8%	74.8%	75.8%
	Implementation Services	18.8%	13.7%	9.2%	31.5%	12.3%	9.2%	25.0%	12.3%	12.3%
	Education and Marketing	4.4%	3.0%	4.8%	4.6%	4.6%	4.7%	3.4%	4.5%	4.6%
	EM&V	5.0%	3.9%	4.7%	4.9%	4.6%	5.0%	2.7%	4.5%	4.6%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes behavior programs, active demand response, education, and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2026 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Programs

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Large Business Energy Solutions	Program Planning & Administration	$ 60,361	$ 50,073	$ 175,714	$ 55,630	$ 341,778	$ 89,240	$ 15,098	$ 104,338	$ 446,116
	Customer Incentives	$ 908,824	$ 636,062	$ 8,626,170	$ 978,550	$ 11,149,607	$ 1,370,610	$ 385,300	$ 1,755,910	$ 12,905,517
	Implementation Services	$ 263,728	$ 83,559	$ 937,671	$ 226,956	$ 1,511,913	$ 383,150	$ 150,296	$ 533,446	$ 2,045,359
	Education and Marketing	$ 51,371	$ 5,000	$ 301,223	$ 36,212	$ 393,807	$ 97,000	$ 22,763	$ 119,763	$ 513,570
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,284,285	$ 774,694	$ 10,040,778	$ 1,297,349	$ 13,397,106	$ 1,940,000	$ 573,457	$ 2,513,457	$ 15,910,562
Small Business Energy Solutions	Program Planning & Administration	$ 53,592	$ 44,670	$ 167,283	$ 56,814	$ 322,358	$ 83,983	$ 15,098	$ 99,081	$ 421,439
	Customer Incentives	$ 821,892	$ 572,471	$ 8,722,603	$ 977,755	$ 11,094,722	$ 1,311,786	$ 365,771	$ 1,677,556	$ 12,772,278
	Implementation Services	$ 219,156	$ 75,068	$ 382,361	$ 228,466	$ 905,050	$ 338,673	$ 150,073	$ 488,746	$ 1,393,796
	Education and Marketing	$ 45,610	$ 7,500	$ 286,771	$ 36,983	$ 376,863	$ 91,286	$ 22,763	$ 114,050	$ 490,913
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,140,250	$ 699,709	$ 9,559,017	$ 1,300,018	$ 12,698,994	$ 1,825,728	$ 553,705	$ 2,379,433	$ 15,078,427
Municipal Energy Solutions	Program Planning & Administration	$ 7,739	$ 10,847	$ 28,665	$ 13,151	$ 60,402	$ 17,550	$ -	$ 17,550	$ 77,952
	Customer Incentives	$ 118,473	$ 135,951	$ 1,495,149	$ 152,500	$ 1,902,073	$ 277,290	$ 100,000	$ 377,290	$ 2,279,363
	Implementation Services	$ 31,862	$ 17,047	$ 65,034	$ 53,524	$ 167,466	$ 79,560	$ 27,500	$ 107,060	$ 274,526
	Education and Marketing	$ 6,586	$ 5,086	$ 49,140	$ 8,561	$ 69,373	$ 15,600	$ 11,092	$ 26,692	$ 96,065
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 164,660	$ 168,930	$ 1,637,988	$ 227,736	$ 2,199,313	$ 390,000	$ 138,592	$ 528,592	$ 2,727,905
Other[1]	Program Planning & Administration	$ 27,589	$ 4,246	$ 39,238	$ 3,551	$ 74,624	$ 2,655	$ -	$ 2,655	$ 77,279
	Customer Incentives	$ 465,169	$ 50,794	$ 829,280	$ 158,242	$ 1,503,484	$ 25,783	$ -	$ 25,783	$ 1,529,267
	Implementation Services	$ 51,069	$ 6,673	$ 253,713	$ 75,401	$ 386,856	$ 3,127	$ -	$ 3,127	$ 389,983
	Education and Marketing	$ 43,173	$ 36,815	$ 278,920	$ 71,940	$ 430,847	$ 27,435	$ 56,862	$ 84,297	$ 515,145
	EM&V	$ 167,168	$ 80,205	$ 1,110,510	$ 125,631	$ 1,483,513	$ 221,828	$ 69,611	$ 291,439	$ 1,774,951
	Total	$ 754,168	$ 178,731	$ 2,511,660	$ 434,765	$ 3,879,324	$ 280,828	$ 126,473	$ 407,301	$ 4,286,625

(1) Other includes active demand response, education, EM&V, and loan program administration.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2026 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Program Total and Grand Total (Income Eligible, Residential, and Commercial & Industrial)

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Total Commercial & Industrial	Program Planning & Administration	$ 149,281	$ 109,835	$ 410,900	$ 129,146	$ 799,162	$ 193,428	$ 30,195	$ 223,624	$ 1,022,786
	Customer Incentives	$ 2,314,358	$ 1,395,278	$ 19,673,202	$ 2,267,047	$ 25,649,886	$ 2,985,469	$ 851,071	$ 3,836,539	$ 29,486,425
	Implementation Services	$ 565,815	$ 182,345	$ 1,638,779	$ 584,348	$ 2,971,286	$ 804,510	$ 327,869	$ 1,132,379	$ 4,103,665
	Education and Marketing	$ 146,741	$ 54,400	$ 916,053	$ 153,696	$ 1,270,890	$ 231,321	$ 113,481	$ 344,802	$ 1,615,693
	EM&V	$ 167,168	$ 80,205	$ 1,110,510	$ 125,631	$ 1,483,513	$ 221,828	$ 69,611	$ 291,439	$ 1,774,951
	Total	$ 3,343,363	$ 1,822,064	$ 23,749,444	$ 3,259,867	$ 32,174,737	$ 4,436,556	$ 1,392,227	$ 5,828,783	$ 38,003,520
Total Commercial & Industrial %	Program Planning & Administration	4.5%	6.0%	1.7%	4.0%	2.5%	4.4%	2.2%	3.8%	2.7%
	Customer Incentives	69.2%	76.6%	82.8%	69.5%	79.7%	67.3%	61.1%	65.8%	77.6%
	Implementation Services	16.9%	10.0%	6.9%	17.9%	9.2%	18.1%	23.5%	19.4%	10.8%
	Education and Marketing	4.4%	3.0%	3.9%	4.7%	3.9%	5.2%	8.2%	5.9%	4.3%
	EM&V	5.0%	4.4%	4.7%	3.9%	4.6%	5.0%	5.0%	5.0%	4.7%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Grand Total (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	$ 277,284	$ 360,586	$ 929,706	$ 254,857	$ 1,822,434	$ 453,041	$ 72,220	$ 525,262	$ 2,347,696
	Customer Incentives	$ 4,378,265	$ 4,289,127	$ 44,382,471	$ 4,733,316	$ 57,783,179	$ 7,728,230	$ 1,914,964	$ 9,643,195	$ 67,426,373
	Implementation Services	$ 975,202	$ 679,090	$ 4,783,457	$ 1,610,638	$ 8,048,387	$ 1,253,446	$ 670,114	$ 1,923,560	$ 9,971,947
	Education and Marketing	$ 271,828	$ 171,875	$ 2,209,834	$ 323,911	$ 2,977,448	$ 508,898	$ 172,106	$ 681,004	$ 3,658,452
	EM&V	$ 310,662	$ 229,170	$ 2,565,612	$ 290,511	$ 3,395,955	$ 523,348	$ 114,648	$ 637,996	$ 4,033,950
	Total	$ 6,213,242	$ 5,729,848	$ 54,871,080	$ 7,213,233	$ 74,027,403	$ 10,466,964	$ 2,944,052	$ 13,411,016	$ 87,438,419
Grand Total % (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	4.5%	6.3%	1.7%	3.5%	2.5%	4.3%	2.5%	3.9%	2.7%
	Customer Incentives	70.5%	74.9%	80.9%	65.6%	78.1%	73.8%	65.0%	71.9%	77.1%
	Implementation Services	15.7%	11.9%	8.7%	22.3%	10.9%	12.0%	22.8%	14.3%	11.4%
	Education and Marketing	4.4%	3.0%	4.0%	4.5%	4.0%	4.9%	5.8%	5.1%	4.2%
	EM&V	5.0%	4.0%	4.7%	4.0%	4.6%	5.0%	3.9%	4.8%	4.6%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024-2026 UTILITY BUDGETS BY ACTIVITY
Income Eligible Programs

Description		Electric Utilities					Gas Utilities			Grand Total
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	
Home Energy Assistance	Program Planning & Administration	$ 159,946	$ 206,294	$ 511,529	$ 134,406	$ 1,012,174	$ 249,995	$ 58,131	$ 308,126	$ 1,320,300
	Customer Incentives	$ 2,976,334	$ 2,411,578	$ 24,504,277	$ 3,192,000	$ 33,084,189	$ 4,969,163	$ 1,168,371	$ 6,137,534	$ 39,221,723
	Implementation Services	$ 251,543	$ 322,503	$ 3,629,813	$ 576,602	$ 4,780,461	$ 230,979	$ 291,898	$ 522,877	$ 5,303,337
	Education and Marketing	$ 141,159	$ 15,000	$ 584,604	$ 84,610	$ 825,374	$ 227,089	$ 45,575	$ 272,664	$ 1,098,038
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 3,528,982	$ 2,955,375	$ 29,230,224	$ 3,987,618	$ 39,702,198	$ 5,677,225	$ 1,563,975	$ 7,241,200	$ 46,943,398
Other[1]	Program Planning & Administration	$ 3,459	$ -	$ 30,590	$ -	$ 34,049	$ 5,218	$ -	$ 5,218	$ 39,267
	Customer Incentives	$ 43,124	$ -	$ -	$ -	$ 43,124	$ 63,945	$ -	$ 63,945	$ 107,069
	Implementation Services	$ 10,983	$ -	$ 150,000	$ -	$ 160,983	$ 16,332	$ -	$ 16,332	$ 177,316
	Education and Marketing	$ 24,794	$ 80,210	$ 1,567,410	$ 72,713	$ 1,745,126	$ 38,735	$ 28,752	$ 67,486	$ 1,812,613
	EM&V	$ 190,071	$ 125,721	$ 1,487,568	$ 157,790	$ 1,961,150	$ 305,340	$ 68,160	$ 373,500	$ 2,334,649
	Total	$ 272,431	$ 205,931	$ 3,235,568	$ 230,503	$ 3,944,433	$ 429,569	$ 96,912	$ 526,481	$ 4,470,913
Total Income Eligible	Program Planning & Administration	$ 163,405	$ 206,294	$ 542,119	$ 134,406	$ 1,046,223	$ 255,212	$ 58,131	$ 313,343	$ 1,359,567
	Customer Incentives	$ 3,019,459	$ 2,411,578	$ 24,504,277	$ 3,192,000	$ 33,127,313	$ 5,033,107	$ 1,168,371	$ 6,201,478	$ 39,328,792
	Implementation Services	$ 262,526	$ 322,503	$ 3,779,813	$ 576,602	$ 4,941,444	$ 247,311	$ 291,898	$ 539,209	$ 5,480,653
	Education and Marketing	$ 165,953	$ 95,210	$ 2,152,014	$ 157,323	$ 2,570,500	$ 265,824	$ 74,327	$ 340,150	$ 2,910,650
	EM&V	$ 190,071	$ 125,721	$ 1,487,568	$ 157,790	$ 1,961,150	$ 305,340	$ 68,160	$ 373,500	$ 2,334,649
	Total	$ 3,801,413	$ 3,161,306	$ 32,465,791	$ 4,218,121	$ 43,646,631	$ 6,106,794	$ 1,660,887	$ 7,767,681	$ 51,414,311
Total Income Eligible %	Program Planning & Administration	4.3%	6.5%	1.7%	3.2%	2.4%	4.2%	3.5%	4.0%	2.6%
	Customer Incentives	79.4%	76.3%	75.5%	75.7%	75.9%	82.4%	70.3%	79.8%	76.5%
	Implementation Services	6.9%	10.2%	11.6%	13.7%	11.3%	4.0%	17.6%	6.9%	10.7%
	Education and Marketing	4.4%	3.0%	6.6%	3.7%	5.9%	4.4%	4.5%	4.4%	5.7%
	EM&V	5.0%	4.0%	4.6%	3.7%	4.5%	5.0%	4.1%	4.8%	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes education and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024-2026 UTILITY BUDGETS BY ACTIVITY
Residential Programs

Description		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
EnergyStar® Homes	Program Planning & Administration	$ 30,439	$ 106,281	$ 127,854	$ 47,309	$ 311,881	$ 99,876	$ 12,673	$ 112,549	$ 424,430
	Customer Incentives	$ 547,364	$ 1,242,995	$ 6,349,717	$ 663,000	$ 8,803,076	$ 1,969,863	$ 495,750	$ 2,465,613	$ 11,268,689
	Implementation Services	$ 66,910	$ 166,162	$ 563,046	$ 1,009,966	$ 1,806,084	$ 143,239	$ 190,098	$ 333,338	$ 2,139,422
	Education and Marketing	$ 26,863	$ 15,000	$ 265,303	$ 28,779	$ 335,945	$ 92,207	$ 9,424	$ 101,631	$ 437,577
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 671,576	$ 1,530,437	$ 7,305,920	$ 1,749,054	$ 11,256,987	$ 2,305,186	$ 707,945	$ 3,013,131	$ 14,270,118
Home Performance	Program Planning & Administration	$ 74,902	$ 132,760	$ 442,830	$ 85,155	$ 735,647	$ 181,922	$ 22,178	$ 204,100	$ 939,748
	Customer Incentives	$ 1,288,938	$ 1,552,679	$ 22,094,599	$ 1,453,473	$ 26,389,689	$ 3,418,681	$ 856,025	$ 4,274,706	$ 30,664,395
	Implementation Services	$ 221,868	$ 207,560	$ 1,808,665	$ 558,110	$ 2,796,203	$ 392,347	$ 155,605	$ 547,952	$ 3,344,155
	Education and Marketing	$ 66,071	$ 15,000	$ 958,463	$ 51,802	$ 1,091,337	$ 206,536	$ 16,492	$ 223,027	$ 1,314,364
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,651,780	$ 1,907,999	$ 25,304,557	$ 2,148,541	$ 31,012,876	$ 4,199,486	$ 1,050,300	$ 5,249,785	$ 36,262,662
Energy Star® Products	Program Planning & Administration	$ 61,054	$ 291,202	$ 311,019	$ 70,963	$ 734,239	$ 169,137	$ 19,010	$ 188,147	$ 922,385
	Customer Incentives	$ 847,271	$ 3,121,699	$ 14,621,852	$ 1,390,986	$ 19,981,808	$ 3,057,237	$ 389,195	$ 3,446,433	$ 23,428,241
	Implementation Services	$ 384,107	$ 733,966	$ 2,151,014	$ 547,643	$ 3,816,730	$ 455,149	$ 155,230	$ 610,379	$ 4,427,109
	Education and Marketing	$ 53,851	$ 60,000	$ 688,643	$ 43,169	$ 845,663	$ 222,468	$ 14,136	$ 236,604	$ 1,082,267
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 1,346,284	$ 4,206,867	$ 17,772,528	$ 2,052,761	$ 25,378,440	$ 3,903,991	$ 577,571	$ 4,481,562	$ 29,860,002
Other[1]	Program Planning & Administration	$ 41,619	$ -	$ 35,451	$ 28,385	$ 105,455	$ 34,381	$ 8,238	$ 42,619	$ 148,073
	Customer Incentives	$ 586,257	$ -	$ 438,342	$ 669,132	$ 1,693,731	$ 597,520	$ 164,640	$ 762,160	$ 2,455,891
	Implementation Services	$ 226,761	$ -	$ 748,324	$ 154,894	$ 1,129,980	$ 60,812	$ 62,165	$ 122,977	$ 1,252,956
	Education and Marketing	$ 63,383	$ 154,530	$ 865,026	$ 168,227	$ 1,251,166	$ 94,287	$ 52,902	$ 147,189	$ 1,398,355
	EM&V	$ 241,456	$ 340,574	$ 2,617,407	$ 339,431	$ 3,538,869	$ 589,245	$ 95,058	$ 684,304	$ 4,223,173
	Total	$ 1,159,475	$ 495,104	$ 4,704,552	$ 1,360,070	$ 7,719,200	$ 1,376,245	$ 383,003	$ 1,759,248	$ 9,478,448
Total Residential	Program Planning & Administration	$ 208,014	$ 530,243	$ 917,154	$ 231,812	$ 1,887,222	$ 485,316	$ 62,099	$ 547,414	$ 2,434,637
	Customer Incentives	$ 3,269,830	$ 5,917,373	$ 43,504,510	$ 4,176,591	$ 56,868,304	$ 9,043,302	$ 1,905,610	$ 10,948,912	$ 67,817,216
	Implementation Services	$ 899,647	$ 1,107,687	$ 5,271,049	$ 2,270,614	$ 9,548,998	$ 1,051,547	$ 563,098	$ 1,614,645	$ 11,163,643
	Education and Marketing	$ 210,168	$ 244,530	$ 2,777,436	$ 291,977	$ 3,524,111	$ 615,499	$ 92,953	$ 708,451	$ 4,232,562
	EM&V	$ 241,456	$ 340,574	$ 2,617,407	$ 339,431	$ 3,538,869	$ 589,245	$ 95,058	$ 684,304	$ 4,223,173
	Total	$ 4,829,115	$ 8,140,407	$ 55,087,556	$ 7,310,425	$ 75,367,504	$ 11,784,908	$ 2,718,818	$ 14,503,727	$ 89,871,230
Total Residential %	Program Planning & Administration	4.3%	6.5%	1.7%	3.2%	2.5%	4.1%	2.3%	3.8%	2.7%
	Customer Incentives	67.7%	72.7%	79.0%	57.1%	75.5%	76.7%	70.1%	75.5%	75.5%
	Implementation Services	18.6%	13.6%	9.6%	31.1%	12.7%	8.9%	20.7%	11.1%	12.4%
	Education and Marketing	4.4%	3.0%	5.0%	4.0%	4.7%	5.2%	3.4%	4.9%	4.7%
	EM&V	5.0%	4.2%	4.8%	4.6%	4.7%	5.0%	3.5%	4.7%	4.7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1) Other includes behavior programs, active demand response, education, and EM&V.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024-2026 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Programs

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Large Business Energy Solutions	Program Planning & Administration	$ 184,162	$ 150,545	$ 533,234	$ 162,063	$ 1,030,003	$ 245,602	$ 45,326	$ 290,929	$ 1,320,932
	Customer Incentives	$ 2,968,872	$ 1,850,636	$ 26,205,834	$ 2,935,650	$ 33,960,992	$ 3,949,059	$ 1,155,900	$ 5,104,959	$ 39,065,951
	Implementation Services	$ 752,025	$ 227,274	$ 2,813,423	$ 628,267	$ 4,420,989	$ 1,060,921	$ 392,273	$ 1,453,194	$ 5,874,183
	Education and Marketing	$ 162,711	$ 15,000	$ 918,022	$ 105,504	$ 1,201,237	$ 276,610	$ 51,433	$ 328,042	$ 1,529,279
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 4,067,770	$ 2,243,454	$ 30,470,513	$ 3,831,484	$ 40,613,221	$ 5,532,192	$ 1,644,932	$ 7,177,124	$ 47,790,345
Small Business Energy Solutions	Program Planning & Administration	$ 161,037	$ 129,036	$ 507,934	$ 165,511	$ 963,519	$ 229,627	$ 45,326	$ 274,953	$ 1,238,472
	Customer Incentives	$ 2,630,338	$ 1,649,480	$ 26,463,582	$ 2,933,265	$ 33,676,664	$ 3,735,746	$ 1,097,312	$ 4,833,058	$ 38,509,721
	Implementation Services	$ 622,938	$ 214,624	$ 1,160,993	$ 624,392	$ 2,622,947	$ 947,991	$ 391,471	$ 1,339,462	$ 3,962,409
	Education and Marketing	$ 142,263	$ 22,500	$ 892,308	$ 107,749	$ 1,164,819	$ 258,598	$ 51,433	$ 310,031	$ 1,474,850
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 3,556,576	$ 2,015,640	$ 29,024,816	$ 3,830,917	$ 38,427,950	$ 5,171,961	$ 1,585,542	$ 6,757,503	$ 45,185,453
Municipal Energy Solutions	Program Planning & Administration	$ 22,952	$ 38,174	$ 79,438	$ 38,687	$ 179,251	$ 49,810	$ 3,540	$ 53,350	$ 232,601
	Customer Incentives	$ 373,915	$ 469,187	$ 4,142,121	$ 457,500	$ 5,442,723	$ 823,240	$ 270,000	$ 1,093,240	$ 6,535,963
	Implementation Services	$ 89,822	$ 59,580	$ 181,590	$ 157,238	$ 488,231	$ 221,350	$ 75,900	$ 297,250	$ 785,481
	Education and Marketing	$ 20,279	$ 17,600	$ 136,180	$ 24,942	$ 199,000	$ 45,600	$ 21,416	$ 67,016	$ 266,017
	EM&V	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total	$ 506,968	$ 584,541	$ 4,539,330	$ 678,367	$ 6,309,206	$ 1,140,000	$ 370,856	$ 1,510,856	$ 7,820,062
Other[1]	Program Planning & Administration	$ 60,085	$ 12,520	$ 108,168	$ 10,344	$ 191,118	$ 7,205	$ -	$ 7,205	$ 198,323
	Customer Incentives	$ 1,029,943	$ 146,422	$ 2,039,948	$ 363,242	$ 3,579,556	$ 72,430	$ -	$ 72,430	$ 3,651,986
	Implementation Services	$ 112,989	$ 19,574	$ 591,247	$ 296,258	$ 1,020,069	$ 9,572	$ -	$ 9,572	$ 1,029,641
	Education and Marketing	$ 109,983	$ 105,660	$ 819,540	$ 178,635	$ 1,213,818	$ 76,793	$ 137,018	$ 213,811	$ 1,427,629
	EM&V	$ 497,069	$ 254,749	$ 3,386,865	$ 423,163	$ 4,561,846	$ 632,113	$ 186,384	$ 818,497	$ 5,380,343
	Total	$ 1,810,069	$ 538,926	$ 6,945,769	$ 1,271,642	$ 10,566,406	$ 798,113	$ 323,402	$ 1,121,515	$ 11,687,921

(1) Other includes active demand response, education, EM&V, and loan program administration.

NHSAVES ENERGY EFFICIENCY PROGRAM - 2024-2026 UTILITY BUDGETS BY ACTIVITY
Commercial & Industrial Program Total and Grand Total (Income Eligible, Residential, and Commercial & Industrial)

		Electric Utilities					Gas Utilities			
		Liberty	NHEC	Eversource	Unitil	Sub-total Electric	Liberty	Unitil	Sub-total Gas	Grand Total
Total Commercial & Industrial	Program Planning & Administration	$ 428,236	$ 330,276	$ 1,228,775	$ 376,605	$ 2,363,892	$ 532,244	$ 94,193	$ 626,437	$ 2,990,329
	Customer Incentives	$ 7,003,068	$ 4,115,724	$ 58,851,485	$ 6,689,657	$ 76,659,934	$ 8,580,475	$ 2,523,212	$ 11,103,687	$ 87,763,621
	Implementation Services	$ 1,577,775	$ 521,052	$ 4,747,254	$ 1,706,155	$ 8,552,237	$ 2,239,834	$ 859,644	$ 3,099,478	$ 11,651,714
	Education and Marketing	$ 435,236	$ 160,760	$ 2,766,050	$ 416,829	$ 3,778,874	$ 657,601	$ 261,300	$ 918,901	$ 4,697,775
	EM&V	$ 497,069	$ 254,749	$ 3,386,865	$ 423,163	$ 4,561,846	$ 632,113	$ 186,384	$ 818,497	$ 5,380,343
	Total	$ 9,941,384	$ 5,382,561	$ 70,980,428	$ 9,612,409	$ 95,916,782	$ 12,642,267	$ 3,924,732	$ 16,566,999	$ 112,483,781
Total Commercial & Industrial %	Program Planning & Administration	4.3%	6.1%	1.7%	3.9%	2.5%	4.2%	2.4%	3.8%	2.7%
	Customer Incentives	70.4%	76.5%	82.9%	69.6%	79.9%	67.9%	64.3%	67.0%	78.0%
	Implementation Services	15.9%	9.7%	6.7%	17.7%	8.9%	17.7%	21.9%	18.7%	10.4%
	Education and Marketing	4.4%	3.0%	3.9%	4.3%	3.9%	5.2%	6.7%	5.5%	4.2%
	EM&V	5.0%	4.7%	4.8%	4.4%	4.8%	5.0%	4.7%	4.9%	4.8%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Grand Total (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	$ 799,655	$ 1,066,813	$ 2,688,047	$ 742,822	$ 5,297,337	$ 1,272,772	$ 214,423	$ 1,487,195	$ 6,784,532
	Customer Incentives	$ 13,292,357	$ 12,444,675	$ 126,860,272	$ 14,058,248	$ 166,655,551	$ 22,656,884	$ 5,597,193	$ 28,254,077	$ 194,909,629
	Implementation Services	$ 2,739,948	$ 1,951,243	$ 13,798,116	$ 4,553,372	$ 23,042,678	$ 3,538,692	$ 1,714,640	$ 5,253,332	$ 28,296,010
	Education and Marketing	$ 811,357	$ 500,499	$ 7,695,500	$ 866,129	$ 9,873,486	$ 1,538,923	$ 428,579	$ 1,967,502	$ 11,840,988
	EM&V	$ 928,596	$ 721,044	$ 7,491,840	$ 920,384	$ 10,061,864	$ 1,526,698	$ 349,602	$ 1,876,300	$ 11,938,165
	Total	$ 18,571,912	$ 16,684,273	$ 158,533,775	$ 21,140,956	$ 214,930,917	$ 30,533,969	$ 8,304,437	$ 38,838,406	$ 253,769,323
Grand Total % (Income Eligible, Residential, and Commercial & Industrial)	Program Planning & Administration	4.3%	6.4%	1.7%	3.5%	2.5%	4.2%	2.6%	3.8%	2.7%
	Customer Incentives	71.6%	74.6%	80.0%	66.5%	77.5%	74.2%	67.4%	72.7%	76.8%
	Implementation Services	14.8%	11.7%	8.7%	21.5%	10.7%	11.6%	20.6%	13.5%	11.2%
	Education and Marketing	4.4%	3.0%	4.9%	4.1%	4.6%	5.0%	5.2%	5.1%	4.7%
	EM&V	5.0%	4.3%	4.7%	4.4%	4.7%	5.0%	4.2%	4.8%	4.7%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NHSAVES ELECTRIC PROGRAMS - 2024 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	82	1,209,524	114	4,793,736	672	36,091,883	65	1,537,424	934	43,632,568
B/C Ratio[1] / Planned Budget	1.98	$1,180,399	2.24	$942,251	1.64	$8,685,460	1.28	$1,285,130	1.68	$12,093,240
/ Lifetime MMBtu Savings		49,421		20,075		210,584		30,114		310,194
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	89	200,132	128	15,898,189	993	37,758,471	80	889,014	1,290	54,745,806
B/C Ratio[1] / Planned Budget	5.35	$225,000	6.26	$481,548	7.91	$2,354,174	1.47	$537,414	6.56	$3,598,136
/ Lifetime MMBtu Savings		32,952		57,583		444,585		23,755		558,875
Home Performance										
Number of Customers Served / Lifetime kWh Savings	56	421,612	71	456,264	2,140	12,756,861	65	1,053,727	2,333	14,688,464
B/C Ratio[1] / Planned Budget	2.29	$545,280	2.48	$600,685	2.34	$7,946,901	1.53	$729,220	2.28	$9,822,086
/ Lifetime MMBtu Savings		42,938		55,476		660,733		33,946		793,093
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,391	4,552,768	5,734	17,850,177	15,594	78,574,685	6,200	7,579,332	28,919	108,556,962
B/C Ratio[1] / Planned Budget	1.35	$442,302	2.49	$1,324,961	1.98	$5,255,536	1.38	$653,436	1.98	$7,676,235
/ Lifetime MMBtu Savings		5,839		70,374		64,229		5,740		146,182
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,344	30,977,724	19	22,943,337	840	232,865,827	49	29,353,304	2,252	316,140,192
B/C Ratio[1] / Planned Budget	1.97	$1,413,353	2.80	$711,372	2.01	$10,279,495	1.77	$1,264,713	2.03	$13,668,932
/ Lifetime MMBtu Savings		-2,969		-1,031		-52,350		-6,085		-62,435
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	868	25,531,535	158	14,165,638	7,548	226,806,643	130	22,001,177	8,705	288,504,993
B/C Ratio[1] / Planned Budget	1.84	$1,235,118	1.89	$632,168	2.31	$9,813,610	1.63	$1,257,152	2.18	$12,938,048
/ Lifetime MMBtu Savings		-3,702		-6,412		-90,048		-6,939		-107,100
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	426	1,069,851	15	1,864,069	93	27,069,923	6	2,715,331	540	32,719,175
B/C Ratio[1] / Planned Budget	1.09	$177,649	0.60	$246,681	1.79	$1,450,671	1.07	$214,276	1.52	$2,089,277
/ Lifetime MMBtu Savings		2,890		-1,149		-8,331		-538		-7,128
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.08	$125,000	-	$0	-	$3,065	1.50	$213,766	1.70	$341,831
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	834	0	0	0	2,152	-3,480	770	0	3,756	-3,480
/ Planned Budget	2.13	$406,698	-	$0	3.12	$886,347	3.17	$281,283	2.87	$1,574,328
/ Active kW Savings		3,943		0		11,817		3,828		19,588
Educational Programs										
Planned Budget		$103,683		$162,674		$1,548,000		$102,630		$1,916,987
Evaluation, Measurement and Verification										
Planned Budget		$308,131		$268,544		$2,519,790		$326,596		$3,423,060
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$30,000		$0		$30,000
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$338,944		$295,399		$2,791,705		$377,609		$3,803,656
TOTAL PLANNED BUDGET[2]		**$6,501,556**		**$5,666,283**		**$53,579,970**		**$7,243,225**		**$72,991,034**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS
SBC[1] and RGGI Funding Allocation
2024 Budget

Program Allocation Summary

Program	RGGI	SBC[1]	TOTAL
HEA[2]			
Liberty	2.91093%	97.08907%	100.00000%
NHEC	3.27067%	96.72933%	100.00000%
Eversource	3.19017%	96.80983%	100.00000%
Unitil	3.54311%	96.45689%	100.00000%
Municipal			
Liberty	100.00000%	0.00000%	100.00000%
NHEC	100.00000%	0.00000%	100.00000%
Eversource	100.00000%	0.00000%	100.00000%
Unitil	100.00000%	0.00000%	100.00000%

A	B	C	D
Utility	**HEA Budget**	**RGGI HEA[3]**	**SBC HEA[4]**
Liberty	$ 1,270,613	$36,987	$1,233,626
NHEC	$ 1,014,957	$33,196	$981,761
Eversource	$ 10,119,789	$322,838	$9,796,951
Unitil	$ 1,368,740	$48,496	$1,320,244
Total	$ 13,774,100	$441,517	$13,332,583

Notes:

[1] SBC = System Benefits Charge, Forward Capacity Market and Carryforward/Interest

[2] HEA Allocation
RGGI HEA = RGGI HEA (C) /Total HEA Funds (B)
SBC HEA = SBC HEA (D) /Total HEA Funds (B)

[3] 17.0% of Total RGGI Funds including SB 268 funding less RGGI HEA Performance Incentive

[4] SBC HEA = Utility's total HEA program budget (B) less RGGI HEA (C)

NHSAVES ELECTRIC PROGRAMS - 2024 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(System Benefits Charge, Forward Capacity Market and Interest Funds Only)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	80	1,174,316	111	4,636,949	651	34,940,492	63	1,482,952	904	42,234,708
B/C Ratio[1] / Planned Budget	1.98	$1,146,038	2.24	$911,433	1.64	$8,408,379	1.28	$1,239,596	1.68	$11,705,447
/ Lifetime MMBtu Savings		47,982		19,418		203,866		29,047		300,314
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	89	200,132	128	15,898,189	993	37,758,471	80	889,014	1,290	54,745,806
B/C Ratio[1] / Planned Budget	5.35	$225,000	6.26	$481,548	7.91	$2,354,174	1.47	$537,414	6.56	$3,598,136
/ Lifetime MMBtu Savings		32,952		57,583		444,585		23,755		558,875
Home Performance										
Number of Customers Served / Lifetime kWh Savings	56	421,612	71	456,264	2,140	12,756,861	65	1,053,727	2,333	14,688,464
B/C Ratio[1] / Planned Budget	2.29	$545,280	2.48	$600,685	2.34	$7,946,901	1.53	$729,220	2.28	$9,822,086
/ Lifetime MMBtu Savings		42,938		55,476		660,733		33,946		793,093
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,391	4,552,768	5,734	17,850,177	15,594	78,574,685	6,200	7,579,332	28,919	108,556,962
B/C Ratio[1] / Planned Budget	1.35	$442,302	2.49	$1,324,961	1.98	$5,255,536	1.38	$653,436	1.98	$7,676,235
/ Lifetime MMBtu Savings		5,839		70,374		64,229		5,740		146,182
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,344	30,977,724	19	22,943,337	840	232,865,827	49	29,353,304	2,252	316,140,192
B/C Ratio[1] / Planned Budget	1.97	$1,413,353	2.80	$711,372	2.01	$10,279,495	1.77	$1,264,713	2.03	$13,668,932
/ Lifetime MMBtu Savings		-2,969		-1,031		-52,350		-6,085		-62,435
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	868	25,531,535	158	14,165,638	7,548	226,806,643	130	22,001,177	8,705	288,504,993
B/C Ratio[1] / Planned Budget	1.84	$1,235,118	1.89	$632,168	2.31	$9,813,610	1.63	$1,257,152	2.18	$12,938,048
/ Lifetime MMBtu Savings		-3,702		-6,412		-90,048		-6,939		-107,100
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.08	$125,000	-	$0	-	$3,065	1.50	$213,766	1.70	$341,831
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	834	0	0	0	2,152	-3,480	770	0	3,756	-3,480
/ Planned Budget	2.13	$406,698	-	$0	3.12	$886,347	3.17	$281,283	2.87	$1,574,328
/ Active kW Savings		3,943		0		11,817		3,828		19,588
Educational Programs										
Planned Budget		$102,906		$161,838		$1,516,928		$101,791		$1,883,463
Evaluation, Measurement and Verification										
Planned Budget		$306,281		$267,002		$2,505,105		$324,473		$3,402,861
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$30,000		$0		$30,000
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$327,139		$280,005		$2,694,162		$363,156		$3,664,462
TOTAL PLANNED BUDGET[2]		**$6,275,115**		**$5,371,012**		**$51,708,918**		**$6,966,000**		**$64,677,674**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2024 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(Energy Efficiency Fund Only - Regional Greenhouse Gas Initiative)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	2	35,208	4	156,787	21	1,151,391	2	54,473	30	1,397,859
B/C Ratio[1] / Planned Budget	1.98	$34,361	2.24	$30,818	1.64	$277,081	1.28	$45,534	1.68	$387,793
/ Lifetime MMBtu Savings		1,439		657		6,718		1,067		9,880
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Home Performance										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	426	1,069,851	15	1,864,069	93	27,069,923	6	2,715,331	540	32,719,175
B/C Ratio[1] / Planned Budget	1.09	$177,649	0.60	$246,681	1.79	$1,450,671	1.07	$214,276	1.52	$2,089,277
/ Lifetime MMBtu Savings		2,890		-1,149		-8,331		-538		-7,128
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Active kW Savings		0		0		0		0		0
Educational Programs										
Planned Budget		$777		$836		$31,072		$840		$33,525
Evaluation, Measurement and Verification										
Planned Budget		$1,849		$1,542		$14,685		$2,123		$20,199
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$0		$0		$0
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$0		$0		$0
Utility Performance Incentive										
Planned Budget		$11,805		$15,393		$97,543		$14,452		$139,194
TOTAL PLANNED BUDGET[2]		**$226,441**		**$295,270**		**$1,871,052**		**$277,224**		**$2,616,264**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES GAS PROGRAMS - 2024 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets and Lifetime MMBtu Savings

	Liberty		Unitil		Total	
Home Energy Assistance						
Number of Customers Served / Lifetime MMBtu Savings	190	221,939	45	50,351	235	272,290
B/C Ratio[1] / Planned Budget	2.02	$1,846,345	1.82	$472,544	1.98	$2,318,890
ENERGY STAR Homes						
Number of Customers Served / Lifetime MMBtu Savings	236	137,974	65	37,100	301	175,074
B/C Ratio[1] / Planned Budget	1.43	$789,186	1.40	$216,961	1.42	$1,006,146
Home Performance						
Number of Customers Served / Lifetime MMBtu Savings	178	181,477	35	43,355	213	224,832
B/C Ratio[1] / Planned Budget	1.09	$1,450,000	1.23	$309,593	1.12	$1,759,593
ENERGY STAR Products						
Number of Customers Served / Lifetime MMBtu Savings	3,840	432,783	250	44,434	4,090	477,217
B/C Ratio[1] / Planned Budget	2.84	$1,340,849	2.21	$177,292	2.76	$1,518,141
Large Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	310	377,707	11	161,961	321	539,668
B/C Ratio[1] / Planned Budget	2.01	$1,694,000	2.44	$507,156	2.11	$2,201,156
Small Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	1,410	217,325	75	81,979	1,485	299,305
B/C Ratio[1] / Planned Budget	1.45	$1,591,172	1.88	$487,631	1.55	$2,078,803
Municipal Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	256	71,798	5	20,438	261	92,236
B/C Ratio[1] / Planned Budget	1.66	$370,000	1.68	$107,240	1.67	$477,240
Behavior Programs						
Number of Customers Served / Lifetime MMBtu Savings	22,043	20,044	11,200	11,800	33,243	31,844
B/C Ratio[1] / Planned Budget	1.15	$185,000	1.50	$83,597	1.26	$268,597
Education						
Planned Budget		$163,706		$57,078		$220,784
Evaluation, Measurement and Verification						
Planned Budget		$496,329		$109,461		$605,790
Utility Performance Incentive						
Planned Budget		$545,962		$139,070		$685,033
TOTAL PLANNED BUDGET[2]		**$10,472,551**		**$2,667,622**		**$13,140,172**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2025 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	81	948,820	121	5,054,748	730	39,569,148	65	1,537,424	997	47,110,140
B/C Ratio[1] / Planned Budget	2.12	$1,194,825	2.51	$990,637	1.83	$9,823,838	1.38	$1,326,389	1.86	$13,335,690
/ Lifetime MMBtu Savings		48,278		21,168		240,066		30,114		339,625
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	88	200,132	138	17,084,068	1,062	40,401,564	80	889,014	1,368	58,574,779
B/C Ratio[1] / Planned Budget	5.91	$225,376	6.99	$517,478	9.10	$2,443,884	1.48	$597,232	7.42	$3,783,971
/ Lifetime MMBtu Savings		32,654		61,883		475,706		23,755		593,998
Home Performance										
Number of Customers Served / Lifetime kWh Savings	56	420,895	78	494,654	2,172	13,510,094	65	1,053,727	2,370	15,479,371
B/C Ratio[1] / Planned Budget	2.52	$550,438	2.80	$644,958	2.55	$8,451,900	1.80	$692,812	2.51	$10,340,107
/ Lifetime MMBtu Savings		42,541		59,908		681,804		33,946		818,199
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,304	4,454,436	5,834	23,210,379	17,728	92,382,017	6,200	7,751,279	31,066	127,798,110
B/C Ratio[1] / Planned Budget	1.42	$451,707	3.00	$1,421,816	2.28	$5,965,052	1.43	$716,429	2.28	$8,555,004
/ Lifetime MMBtu Savings		5,509		71,986		69,722		5,740		152,958
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,314	27,435,277	20	24,356,431	808	224,790,915	49	29,165,492	2,191	305,748,115
B/C Ratio[1] / Planned Budget	1.91	$1,370,132	3.13	$757,388	2.18	$10,150,240	1.95	$1,269,423	2.18	$13,547,182
/ Lifetime MMBtu Savings		-2,880		-1,095		-50,484		-6,085		-60,544
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	805	21,968,048	162	14,467,108	7,282	218,733,257	130	22,001,157	8,379	277,169,570
B/C Ratio[1] / Planned Budget	1.80	$1,181,208	1.99	$683,763	2.48	$9,652,189	1.80	$1,273,747	2.32	$12,790,908
/ Lifetime MMBtu Savings		-3,478		-6,549		-87,103		-6,939		-104,068
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	408	910,314	10	1,272,877	86	26,528,525	6	2,715,331	511	31,427,047
B/C Ratio[1] / Planned Budget	1.24	$164,660	0.67	$168,930	1.82	$1,450,671	1.08	$236,355	1.59	$2,020,615
/ Lifetime MMBtu Savings		2,893		-784		-8,165		-538		-6,594
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.18	$130,000	-	$0	-	$3,065	1.65	$212,764	1.83	$345,829
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	1,251	0	0	0	2,662	-4,350	809	0	4,722	-4,350
/ Planned Budget	2.61	$510,583	-	$0	3.27	$1,107,934	3.24	$303,136	3.09	$1,921,653
/ Active kW Savings		5,915		0		14,757		4,019		24,691
Educational Programs										
Planned Budget		$107,326		$175,240		$1,183,000		$130,543		$1,596,108
Evaluation, Measurement and Verification										
Planned Budget		$309,803		$223,331		$2,597,440		$303,278		$3,433,852
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$30,000		$0		$30,000
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$340,783		$307,095		$2,906,444		$388,416		$3,942,738
TOTAL PLANNED BUDGET[2]		**$6,536,842**		**$5,890,636**		**$55,780,873**		**$7,450,523**		**$75,658,874**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS
SBC[1] and RGGI Funding Allocation
2025 Budget

Program Allocation Summary

Program	RGGI	SBC[1]	TOTAL
HEA[2]			
Liberty	2.71542%	97.28458%	100.00000%
NHEC	2.97136%	97.02864%	100.00000%
Eversource	2.79915%	97.20085%	100.00000%
Unitil	3.26058%	96.73942%	100.00000%
Municipal			
Liberty	100.00000%	0.00000%	100.00000%
NHEC	100.00000%	0.00000%	100.00000%
Eversource	100.00000%	0.00000%	100.00000%
Unitil	100.00000%	0.00000%	100.00000%

A	B	C	D
Utility	**HEA Budget**	**RGGI HEA[3]**	**SBC HEA[4]**
Liberty	$ 1,287,527	$34,962	$1,252,566
NHEC	$ 1,056,034	$31,379	$1,024,655
Eversource	$ 10,902,030	$305,165	$10,596,866
Unitil	$ 1,405,915	$45,841	$1,360,074
Total	$ 14,651,507	$417,346	$14,234,161

Notes:
[1] SBC = System Benefits Charge, Forward Capacity Market and Carryforward/Interest
[2] HEA Allocation
RGGI HEA = RGGI HEA (C) /Total HEA Funds (B)
SBC HEA = SBC HEA (D) /Total HEA Funds (B)
[3] 17.0% of Total RGGI Funds including SB 268 funding less RGGI HEA Performance Incentive
[4] SBC HEA = Utility's total HEA program budget (B) less RGGI HEA (C)

NHSAVES ELECTRIC PROGRAMS - 2025 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(System Benefits Charge, Forward Capacity Market and Interest Funds Only)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	79	923,055	117	4,904,553	710	38,461,547	63	1,487,295	968	45,776,450
B/C Ratio[1] / Planned Budget	2.12	$1,162,381	2.51	$961,202	1.83	$9,548,854	1.38	$1,283,141	1.86	$12,955,577
/ Lifetime MMBtu Savings		46,967		20,539		233,346		29,132		329,984
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	88	200,132	138	17,084,068	1,062	40,401,564	80	889,014	1,368	58,574,779
B/C Ratio[1] / Planned Budget	5.91	$225,376	6.99	$517,478	9.10	$2,443,884	1.48	$597,232	7.42	$3,783,971
/ Lifetime MMBtu Savings		32,654		61,883		475,706		23,755		593,998
Home Performance										
Number of Customers Served / Lifetime kWh Savings	56	420,895	78	494,654	2,172	13,510,094	65	1,053,727	2,370	15,479,371
B/C Ratio[1] / Planned Budget	2.52	$550,438	2.80	$644,958	2.55	$8,451,900	1.80	$692,812	2.51	$10,340,107
/ Lifetime MMBtu Savings		42,541		59,908		681,804		33,946		818,199
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,304	4,454,436	5,834	23,210,379	17,728	92,382,017	6,200	7,751,279	31,066	127,798,110
B/C Ratio[1] / Planned Budget	1.42	$451,707	3.00	$1,421,816	2.28	$5,965,052	1.43	$716,429	2.28	$8,555,004
/ Lifetime MMBtu Savings		5,509		71,986		69,722		5,740		152,958
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,314	27,435,277	20	24,356,431	808	224,790,915	49	29,165,492	2,191	305,748,115
B/C Ratio[1] / Planned Budget	1.91	$1,370,132	3.13	$757,388	2.18	$10,150,240	1.95	$1,269,423	2.18	$13,547,182
/ Lifetime MMBtu Savings		-2,880		-1,095		-50,484		-6,085		-60,544
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	805	21,968,048	162	14,467,108	7,282	218,733,257	130	22,001,157	8,379	277,169,570
B/C Ratio[1] / Planned Budget	1.80	$1,181,208	1.99	$683,763	2.48	$9,652,189	1.80	$1,273,747	2.32	$12,790,908
/ Lifetime MMBtu Savings		-3,478		-6,549		-87,103		-6,939		-104,068
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.18	$130,000	-	$0	-	$3,065	1.65	$212,764	1.83	$345,829
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	1,251	0	0	0	2,662	-4,350	809	0	4,722	-4,350
/ Planned Budget	2.61	$510,583	-	$0	3.27	$1,107,934	3.24	$303,136	3.09	$1,921,653
/ Active kW Savings		5,915		0		14,757		4,019		24,691
Educational Programs										
Planned Budget		$106,556		$174,444		$1,166,569		$129,751		$1,577,321
Evaluation, Measurement and Verification										
Planned Budget		$308,055		$222,184		$2,583,691		$301,476		$3,415,406
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$30,000		$0		$30,000
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$329,804		$296,078		$2,809,873		$372,895		$3,808,650
TOTAL PLANNED BUDGET[2]		**$6,326,241**		**$5,679,311**		**$53,928,467**		**$7,152,806**		**$67,733,053**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2025 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(Energy Efficiency Fund Only - Regional Greenhouse Gas Initiative)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	2	25,764	4	150,195	20	1,107,601	2	50,129	28	1,333,689
B/C Ratio[1] / Planned Budget	2.12	$32,445	2.51	$29,435	1.83	$274,984	1.38	$43,248	1.86	$380,112
/ Lifetime MMBtu Savings		1,311		629		6,720		982		9,642
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Home Performance										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	408	910,314	10	1,272,877	86	26,528,525	6	2,715,331	511	31,427,047
B/C Ratio[1] / Planned Budget	1.24	$164,660	0.67	$168,930	1.82	$1,450,671	1.08	$236,355	1.59	$2,020,615
/ Lifetime MMBtu Savings		2,893		-784		-8,165		-538		-6,594
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Active kW Savings		0		0		0		0		0
Educational Programs										
Planned Budget		$769		$796		$16,431		$791		$18,788
Evaluation, Measurement and Verification										
Planned Budget		$1,748		$1,147		$13,749		$1,802		$18,446
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$0		$0		$0
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$0		$0		$0
Utility Performance Incentive										
Planned Budget		$10,979		$11,017		$96,571		$15,521		$134,088
TOTAL PLANNED BUDGET[2]		**$210,601**		**$211,325**		**$1,852,406**		**$297,716**		**$2,534,815**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES GAS PROGRAMS - 2025 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets and Lifetime MMBtu Savings

	Liberty		Unitil		Total	
Home Energy Assistance						
Number of Customers Served / Lifetime MMBtu Savings	197	228,510	51	56,565	248	285,075
B/C Ratio[1] / Planned Budget	2.27	$1,886,118	2.03	$532,190	2.22	$2,418,308
ENERGY STAR Homes						
Number of Customers Served / Lifetime MMBtu Savings	220	128,725	65	37,100	285	165,825
B/C Ratio[1] / Planned Budget	1.58	$745,000	1.42	$237,651	1.54	$982,651
Home Performance						
Number of Customers Served / Lifetime MMBtu Savings	167	167,096	40	49,009	207	216,106
B/C Ratio[1] / Planned Budget	1.20	$1,352,426	1.34	$357,126	1.23	$1,709,553
ENERGY STAR Products						
Number of Customers Served / Lifetime MMBtu Savings	3,627	406,003	250	44,434	3,877	450,436
B/C Ratio[1] / Planned Budget	3.17	$1,260,037	2.22	$197,535	3.04	$1,457,572
Large Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	330	433,111	11	161,961	341	595,072
B/C Ratio[1] / Planned Budget	2.30	$1,898,192	2.46	$564,319	2.34	$2,462,512
Small Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	1,448	238,597	75	78,912	1,523	317,509
B/C Ratio[1] / Planned Budget	1.57	$1,755,061	1.84	$544,206	1.64	$2,299,267
Municipal Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	256	71,055	5	18,270	261	89,325
B/C Ratio[1] / Planned Budget	1.80	$380,000	1.44	$125,024	1.71	$505,024
Behavior Programs						
Number of Customers Served / Lifetime MMBtu Savings	22,043	20,044	11,200	11,800	33,243	31,844
B/C Ratio[1] / Planned Budget	1.25	$190,000	1.83	$76,301	1.42	$266,301
Education						
Planned Budget		$166,562		$71,987		$238,549
Evaluation, Measurement and Verification						
Planned Budget		$507,021		$125,494		$632,515
Utility Performance Incentive						
Planned Budget		$557,723		$155,751		$713,474
TOTAL PLANNED BUDGET[2]		**$10,698,140**		**$2,987,584**		**$13,685,724**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	82	1,196,603	125	5,259,423	772	42,108,739	65	1,537,424	1,044	50,102,188
B/C Ratio[1] / Planned Budget	2.38	$1,153,757	2.81	$1,022,487	2.03	$10,720,925	1.49	$1,376,099	2.06	$14,273,268
/ Lifetime MMBtu Savings		44,044		22,027		262,392		30,114		358,577
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	85	189,397	142	17,648,731	1,096	42,262,601	80	889,014	1,403	60,989,744
B/C Ratio[1] / Planned Budget	6.60	$221,200	7.84	$531,411	10.06	$2,507,862	1.61	$614,407	8.22	$3,874,881
/ Lifetime MMBtu Savings		32,065		63,826		480,463		23,755		600,110
Home Performance										
Number of Customers Served / Lifetime kWh Savings	55	420,476	81	513,137	2,205	14,423,156	65	1,053,727	2,406	16,410,496
B/C Ratio[1] / Planned Budget	2.78	$556,062	3.16	$662,356	2.79	$8,905,757	1.92	$726,509	2.75	$10,850,684
/ Lifetime MMBtu Savings		42,309		62,041		698,041		33,946		836,338
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,279	4,411,430	5,914	23,981,975	20,166	102,414,370	6,200	7,837,252	33,559	138,645,027
B/C Ratio[1] / Planned Budget	1.56	$452,275	3.34	$1,460,090	2.56	$6,551,940	1.69	$682,895	2.57	$9,147,200
/ Lifetime MMBtu Savings		5,450		72,953		76,724		5,740		160,868
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,192	23,838,869	18	22,266,940	778	217,850,410	49	24,939,722	2,038	288,895,940
B/C Ratio[1] / Planned Budget	1.95	$1,284,285	3.13	$774,694	2.39	$10,040,778	1.83	$1,297,349	2.33	$13,397,106
/ Lifetime MMBtu Savings		-2,547		-1,001		-48,934		-3,942		-56,423
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	753	19,740,709	164	14,661,256	7,068	212,488,360	130	22,001,138	8,115	268,891,463
B/C Ratio[1] / Planned Budget	1.87	$1,140,250	2.21	$699,709	2.73	$9,559,017	1.99	$1,300,018	2.55	$12,698,994
/ Lifetime MMBtu Savings		-3,100		-6,636		-84,593		-6,939		-101,268
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	398	872,183	10	1,279,787	90	29,865,465	6	2,715,331	504	34,732,765
B/C Ratio[1] / Planned Budget	1.37	$164,660	0.75	$168,930	2.03	$1,637,988	1.26	$227,736	1.80	$2,199,313
/ Lifetime MMBtu Savings		2,896		-789		-9,354		-538		-7,785
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.34	$135,000	-	$0	-	$3,065	1.82	$215,791	2.00	$353,856
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	1,577	0	0	0	3,061	-5,002	849	0	5,487	-5,002
/ Planned Budget	2.91	$686,738	-	$0	3.15	$1,384,918	3.38	$319,518	3.11	$2,391,174
/ Active kW Savings		8,647		0		16,970		4,220		29,838
Educational Programs										
Planned Budget		$108,352		$181,001		$803,000		$162,400		$1,254,754
Evaluation, Measurement and Verification										
Planned Budget		$310,662		$148,965		$2,710,614		$290,511		$3,460,751
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$80,205		$30,000		$0		$110,205
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$341,728		$310,730		$3,016,259		$396,728		$4,065,446
TOTAL PLANNED BUDGET[2]		**$6,554,970**		**$6,040,578**		**$57,887,340**		**$7,609,961**		**$73,008,271**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS
SBC[1] and RGGI Funding Allocation
2026 Budget

Program Allocation Summary

Program	RGGI	SBC[1]	TOTAL
HEA[2]			
Liberty	3.37382%	96.62618%	100.00000%
NHEC	3.45283%	96.54717%	100.00000%
Eversource	3.19927%	96.80073%	100.00000%
Unitil	3.81015%	96.18985%	100.00000%
Municipal			
Liberty	100.00000%	0.00000%	100.00000%
NHEC	100.00000%	0.00000%	100.00000%
Eversource	100.00000%	0.00000%	100.00000%
Unitil	100.00000%	0.00000%	100.00000%

A	B	C	D
Utility	**HEA Budget**	**RGGI HEA[3]**	**SBC HEA[4]**
Liberty	$ 1,243,273	$41,946	$1,201,327
NHEC	$ 1,090,315	$37,647	$1,052,668
Eversource	$ 11,443,971	$366,124	$11,077,848
Unitil	$ 1,443,465	$54,998	$1,388,467
Total	$ 15,221,024	$500,714	$14,720,310

Notes:
[1] SBC = System Benefits Charge, Forward Capacity Market and Carryforward/Interest
[2] HEA Allocation
RGGI HEA = RGGI HEA (C) /Total HEA Funds (B)
SBC HEA = SBC HEA (D) /Total HEA Funds (B)
[3] 17.0% of Total RGGI Funds including SB 268 funding less RGGI HEA Performance Incentive
[4] SBC HEA = Utility's total HEA program budget (B) less RGGI HEA (C)

NHSAVES ELECTRIC PROGRAMS - 2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(System Benefits Charge, Forward Capacity Market and Interest Funds Only)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	79	1,156,231	121	5,077,824	747	40,761,566	63	1,478,846	1,010	48,474,468
B/C Ratio[1] / Planned Budget	2.38	$1,114,832	2.81	$987,182	2.03	$10,377,934	1.49	$1,323,668	2.06	$13,803,615
/ Lifetime MMBtu Savings		42,558		21,266		253,997		28,967		346,788
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	85	189,397	142	17,648,731	1,096	42,262,601	80	889,014	1,403	60,989,744
B/C Ratio[1] / Planned Budget	6.60	$221,200	7.84	$531,411	10.06	$2,507,862	1.61	$614,407	8.22	$3,874,881
/ Lifetime MMBtu Savings		32,065		63,826		480,463		23,755		600,110
Home Performance										
Number of Customers Served / Lifetime kWh Savings	55	420,476	81	513,137	2,205	14,423,156	65	1,053,727	2,406	16,410,496
B/C Ratio[1] / Planned Budget	2.78	$556,062	3.16	$662,356	2.79	$8,905,757	1.92	$726,509	2.75	$10,850,684
/ Lifetime MMBtu Savings		42,309		62,041		698,041		33,946		836,338
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	1,279	4,411,430	5,914	23,981,975	20,166	102,414,370	6,200	7,837,252	33,559	138,645,027
B/C Ratio[1] / Planned Budget	1.56	$452,275	3.34	$1,460,090	2.56	$6,551,940	1.69	$682,895	2.57	$9,147,200
/ Lifetime MMBtu Savings		5,450		72,953		76,724		5,740		160,868
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,192	23,838,869	18	22,266,940	778	217,850,410	49	24,939,722	2,038	288,895,940
B/C Ratio[1] / Planned Budget	1.95	$1,284,285	3.13	$774,694	2.39	$10,040,778	1.83	$1,297,349	2.33	$13,397,106
/ Lifetime MMBtu Savings		-2,547		-1,001		-48,934		-3,942		-56,423
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	753	19,740,709	164	14,661,256	7,068	212,488,360	130	22,001,138	8,115	268,891,463
B/C Ratio[1] / Planned Budget	1.87	$1,140,250	2.21	$699,709	2.73	$9,559,017	1.99	$1,300,018	2.55	$12,698,994
/ Lifetime MMBtu Savings		-3,100		-6,636		-84,593		-6,939		-101,268
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	8,000	2,300,000	0	0	0	0	26,800	2,904,511	34,800	5,204,511
/ Planned Budget	2.34	$135,000	-	$0	-	$3,065	1.82	$215,791	2.00	$353,856
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	1,577	0	0	0	3,061	-5,002	849	0	5,487	-5,002
/ Planned Budget	2.91	$686,738	-	$0	3.15	$1,384,918	3.38	$319,518	3.11	$2,391,174
/ Active kW Savings		8,647		0		16,970		4,220		29,838
Educational Programs										
Planned Budget		$107,429		$180,040		$797,017		$161,457		$1,245,944
Evaluation, Measurement and Verification										
Planned Budget		$308,565		$147,585		$2,693,464		$288,887		$3,438,500
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$80,205		$30,000		$0		$110,205
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$15,217		$0		$15,217
Utility Performance Incentive										
Planned Budget		$330,365		$299,369		$2,906,033		$381,177		$3,916,944
TOTAL PLANNED BUDGET[2]		**$6,337,001**		**$5,822,640**		**$55,773,002**		**$7,311,676**		**$70,190,803**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(Energy Efficiency Fund Only - Regional Greenhouse Gas Initiative)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	3	40,371	4	181,599	25	1,347,172	2	58,578	34	1,627,720
B/C Ratio[1] / Planned Budget	2.38	$38,926	2.81	$35,305	2.03	$342,991	1.49	$52,431	2.06	$469,653
/ Lifetime MMBtu Savings		1,486		761		8,395		1,147		11,789
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Home Performance										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	398	872,183	10	1,279,787	90	29,865,465	6	2,715,331	504	34,732,765
B/C Ratio[1] / Planned Budget	1.37	$164,660	0.75	$168,930	2.03	$1,637,988	1.26	$227,736	1.80	$2,199,313
/ Lifetime MMBtu Savings		2,896		-789		-9,354		-538		-7,785
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Active kW Savings		0		0		0		0		0
Educational Programs										
Planned Budget		$923		$962		$5,983		$943		$8,810
Evaluation, Measurement and Verification										
Planned Budget		$2,097		$1,380		$17,150		$1,624		$22,251
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$0		$0		$0
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$0		$0		$0
Utility Performance Incentive										
Planned Budget		$11,363		$11,362		$110,226		$15,550		$148,502
TOTAL PLANNED BUDGET[2]		**$217,969**		**$217,938**		**$2,114,338**		**$298,285**		**$2,817,468**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES GAS PROGRAMS - 2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets and Lifetime MMBtu Savings

	Liberty		Unitil		Total	
Home Energy Assistance						
Number of Customers Served / Lifetime MMBtu Savings	199	231,591	55	60,707	254	292,298
B/C Ratio[1] / Planned Budget	2.48	$1,944,762	2.31	$559,241	2.44	$2,504,003
ENERGY STAR Homes						
Number of Customers Served / Lifetime MMBtu Savings	226	132,295	65	37,100	291	169,395
B/C Ratio[1] / Planned Budget	1.75	$771,000	1.49	$253,334	1.68	$1,024,334
Home Performance						
Number of Customers Served / Lifetime MMBtu Savings	172	171,712	40	49,009	212	220,722
B/C Ratio[1] / Planned Budget	1.34	$1,397,060	1.39	$383,581	1.35	$1,780,640
ENERGY STAR Products						
Number of Customers Served / Lifetime MMBtu Savings	3,782	423,304	250	44,434	4,032	467,738
B/C Ratio[1] / Planned Budget	3.57	$1,303,105	2.41	$202,744	3.41	$1,505,849
Large Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	318	426,267	11	161,961	329	588,228
B/C Ratio[1] / Planned Budget	2.48	$1,940,000	2.71	$573,457	2.53	$2,513,457
Small Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	1,440	247,714	75	81,979	1,515	329,693
B/C Ratio[1] / Planned Budget	1.74	$1,825,728	2.07	$553,705	1.82	$2,379,433
Municipal Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	258	70,111	5	21,315	263	91,426
B/C Ratio[1] / Planned Budget	1.94	$390,000	1.70	$138,592	1.88	$528,592
Behavior Programs						
Number of Customers Served / Lifetime MMBtu Savings	22,043	20,044	11,200	11,800	33,243	31,844
B/C Ratio[1] / Planned Budget	1.37	$195,000	1.93	$81,270	1.54	$276,270
Education						
Planned Budget		$176,961		$83,481		$260,443
Evaluation, Measurement and Verification						
Planned Budget		$523,348		$114,648		$637,996
Utility Performance Incentive						
Planned Budget		$575,683		$161,923		$737,606
TOTAL PLANNED BUDGET[2]		**$11,042,647**		**$3,105,975**		**$14,148,622**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2024-2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	245	3,354,947	360	15,107,906	2,174	117,769,770	195	4,612,272	2,974	140,844,895
B/C Ratio[1] / Planned Budget	2.15	$3,528,982	2.51	$2,955,375	1.83	$29,230,224	1.38	$3,987,618	1.87	$39,702,198
/ Lifetime MMBtu Savings		141,743		63,269		713,042		90,342		1,008,396
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	262	589,661	408	50,630,988	3,151	120,422,637	240	2,667,042	4,061	174,310,328
B/C Ratio[1] / Planned Budget	5.92	$671,576	7.01	$1,530,437	8.99	$7,305,920	1.52	$1,749,054	7.38	$11,256,987
/ Lifetime MMBtu Savings		97,671		183,292		1,400,755		71,265		1,752,982
Home Performance										
Number of Customers Served / Lifetime kWh Savings	167	1,262,982	230	1,464,055	6,517	40,690,112	195	3,161,182	7,108	46,578,331
B/C Ratio[1] / Planned Budget	2.52	$1,651,780	2.81	$1,907,999	2.55	$25,304,557	1.74	$2,148,541	2.51	$31,012,876
/ Lifetime MMBtu Savings		127,789		177,425		2,040,577		101,838		2,447,630
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	3,974	13,418,634	17,482	65,042,531	53,487	273,371,072	18,600	23,167,863	93,543	375,000,100
B/C Ratio[1] / Planned Budget	1.44	$1,346,284	2.94	$4,206,867	2.28	$17,772,528	1.49	$2,052,761	2.28	$25,378,440
/ Lifetime MMBtu Savings		16,799		215,313		210,675		17,221		460,008
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	3,851	82,251,869	57	69,566,708	2,426	675,507,151	147	83,458,518	6,481	910,784,247
B/C Ratio[1] / Planned Budget	1.94	$4,067,770	3.01	$2,243,454	2.18	$30,470,513	1.85	$3,831,484	2.17	$40,613,221
/ Lifetime MMBtu Savings		-8,396		-3,127		-151,767		-16,112		-179,402
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	2,426	67,240,291	484	43,294,002	21,898	658,028,260	390	66,003,472	25,198	834,566,026
B/C Ratio[1] / Planned Budget	1.84	$3,556,576	2.02	$2,015,640	2.49	$29,024,816	1.80	$3,830,917	2.34	$38,427,950
/ Lifetime MMBtu Savings		-10,280		-19,597		-261,744		-20,816		-312,437
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,232	2,852,347	36	4,416,733	269	83,463,913	18	8,145,993	1,555	98,878,987
B/C Ratio[1] / Planned Budget	1.23	$506,968	0.66	$584,541	1.88	$4,539,330	1.13	$678,367	1.63	$6,309,206
/ Lifetime MMBtu Savings		8,680		-2,722		-25,850		-1,615		-21,507
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	24,000	6,900,000	0	0	0	0	80,400	8,713,533	104,400	15,613,533
/ Planned Budget	2.19	$390,000	-	$0	-	$9,196	1.65	$642,321	1.84	$1,041,516
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	3,662	0	0	0	7,875	-12,832	2,428	0	13,965	-12,832
/ Planned Budget	2.62	$1,604,019	-	$0	3.18	$3,379,199	3.27	$903,937	3.04	$5,887,156
/ Active kW Savings		18,505		0		43,543		12,068		74,116
Educational Programs										
Planned Budget		$319,360		$518,916		$3,534,000		$395,573		$4,767,849
Evaluation, Measurement and Verification										
Planned Budget		$928,596		$640,840		$7,827,843		$920,384		$10,317,663
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$80,205		$90,000		$0		$170,205
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$45,650		$0		$45,650
Utility Performance Incentive										
Planned Budget		$1,021,455		$913,224		$8,714,408		$1,162,753		$11,811,839
TOTAL PLANNED BUDGET[2]		**$19,593,367**		**$17,597,497**		**$167,248,183**		**$22,303,708**		**$210,570,077**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS
SBC[1] and RGGI Funding Allocation
2024-2026 Budget

Program Allocation Summary

Program	RGGI	SBC[1]	TOTAL
HEA[2]			
Liberty	2.99610%	97.00390%	100.00000%
NHEC	3.23351%	96.76649%	100.00000%
Eversource	3.06207%	96.93793%	100.00000%
Unitil	3.54032%	96.45968%	100.00000%
Municipal			
Liberty	100.00000%	0.00000%	100.00000%
NHEC	100.00000%	0.00000%	100.00000%
Eversource	100.00000%	0.00000%	100.00000%
Unitil	100.00000%	0.00000%	100.00000%

A	B	C	D
Utility	**HEA Budget**	**RGGI HEA[3]**	**SBC HEA[4]**
Liberty	$ 3,801,413	$113,894	$3,687,519
NHEC	$ 3,161,306	$102,221	$3,059,085
Eversource	$ 32,465,791	$994,126	$31,471,665
Unitil	$ 4,218,121	$149,335	$4,068,786
Total	$ 43,646,631	$1,359,577	$42,287,054

Notes:
[1] SBC = System Benefits Charge, Forward Capacity Market and Carryforward/Interest
[2] HEA Allocation
RGGI HEA = RGGI HEA (C) /Total HEA Funds (B)
SBC HEA = SBC HEA (D) /Total HEA Funds (B)
[3] 17.0% of Total RGGI Funds including SB 268 funding less RGGI HEA Performance Incentive
[4] SBC HEA = Utility's total HEA program budget (B) less RGGI HEA (C)

NHSAVES ELECTRIC PROGRAMS - 2024-2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(System Benefits Charge, Forward Capacity Market and Interest Funds Only)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	238	3,254,429	349	14,619,391	2,107	114,163,574	188	4,448,983	2,882	136,486,376
B/C Ratio[1] / Planned Budget	2.15	$3,423,250	2.51	$2,859,813	1.83	$28,335,173	1.38	$3,846,443	1.87	$38,464,678
/ Lifetime MMBtu Savings		137,496		61,224		691,208		87,144		977,071
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	262	589,661	408	50,630,988	3,151	120,422,637	240	2,667,042	4,061	174,310,328
B/C Ratio[1] / Planned Budget	5.92	$671,576	7.01	$1,530,437	8.99	$7,305,920	1.52	$1,749,054	7.38	$11,256,987
/ Lifetime MMBtu Savings		97,671		183,292		1,400,755		71,265		1,752,982
Home Performance										
Number of Customers Served / Lifetime kWh Savings	167	1,262,982	230	1,464,055	6,517	40,690,112	195	3,161,182	7,108	46,578,331
B/C Ratio[1] / Planned Budget	2.52	$1,651,780	2.81	$1,907,999	2.55	$25,304,557	1.74	$2,148,541	2.51	$31,012,876
/ Lifetime MMBtu Savings		127,789		177,425		2,040,577		101,838		2,447,630
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	3,974	13,418,634	17,482	65,042,531	53,487	273,371,072	18,600	23,167,863	93,543	375,000,100
B/C Ratio[1] / Planned Budget	1.44	$1,346,284	2.94	$4,206,867	2.28	$17,772,528	1.49	$2,052,761	2.28	$25,378,440
/ Lifetime MMBtu Savings		16,799		215,313		210,675		17,221		460,008
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	3,851	82,251,869	57	69,566,708	2,426	675,507,151	147	83,458,518	6,481	910,784,247
B/C Ratio[1] / Planned Budget	1.94	$4,067,770	3.01	$2,243,454	2.18	$30,470,513	1.85	$3,831,484	2.17	$40,613,221
/ Lifetime MMBtu Savings		-8,396		-3,127		-151,767		-16,112		-179,402
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	2,426	67,240,291	484	43,294,002	21,898	658,028,260	390	66,003,472	25,198	834,566,026
B/C Ratio[1] / Planned Budget	1.84	$3,556,576	2.02	$2,015,640	2.49	$29,024,816	1.80	$3,830,917	2.34	$38,427,950
/ Lifetime MMBtu Savings		-10,280		-19,597		-261,744		-20,816		-312,437
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	24,000	6,900,000	0	0	0	0	80,400	8,713,533	104,400	15,613,533
/ Planned Budget	2.19	$390,000	-	$0	-	$9,196	1.65	$642,321	1.84	$1,041,516
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	3,662	0	0	0	7,875	-12,832	2,428	0	13,965	-12,832
/ Planned Budget	2.62	$1,604,019	-	$0	3.18	$3,379,199	3.27	$903,937	3.04	$5,887,156
/ Active kW Savings		18,505		0		43,543		12,068		74,116
Educational Programs										
Planned Budget		$316,893		$516,322		$3,480,475		$392,999		$4,706,689
Evaluation, Measurement and Verification										
Planned Budget		$922,901		$636,775		$7,782,293		$914,798		$10,256,766
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$80,205		$90,000		$0		$170,205
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$45,650		$0		$45,650
Utility Performance Incentive										
Planned Budget		$987,308		$875,452		$8,410,068		$1,117,229		$11,390,056
TOTAL PLANNED BUDGET[2]		**$18,938,358**		**$16,872,963**		**$161,410,387**		**$21,430,483**		**$202,601,569**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES ELECTRIC PROGRAMS - 2024-2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets, Lifetime kWh and MMBtu Savings

(Energy Efficiency Fund Only - Regional Greenhouse Gas Initiative)

	Liberty		NHEC		Eversource		Unitil		Total	
Home Energy Assistance										
Number of Customers Served / Lifetime kWh Savings	7	100,518	12	488,516	67	3,606,196	7	163,289	92	4,358,519
B/C Ratio[1] / Planned Budget	2.15	$105,732	2.51	$95,562	1.83	$895,051	1.38	$141,175	1.87	$1,237,520
/ Lifetime MMBtu Savings		4,247		2,046		21,834		3,198		31,325
ENERGY STAR Homes										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Home Performance										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
ENERGY STAR Products										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Large Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Small Business Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
B/C Ratio[1] / Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Municipal Energy Solutions										
Number of Customers Served / Lifetime kWh Savings	1,232	2,852,347	36	4,416,733	269	83,463,913	18	8,145,993	1,555	98,878,987
B/C Ratio[1] / Planned Budget	1.23	$506,968	0.66	$584,541	1.88	$4,539,330	1.13	$678,367	1.63	$6,309,206
/ Lifetime MMBtu Savings		8,680		-2,722		-25,850		-1,615		-21,507
Behavior Programs										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Lifetime MMBtu Savings		0		0		0		0		0
Demand Response										
Number of Customers Served / Lifetime kWh Savings	0	0	0	0	0	0	0	0	0	0
/ Planned Budget	0.00	$0	0.00	$0	0.00	$0	0.00	$0	0.00	$0
/ Active kW Savings		0		0		0		0		0
Educational Programs										
Planned Budget		$239,468		$441,300		$1,839,525		$325,435		$2,845,727
Evaluation, Measurement and Verification										
Planned Budget		$744,220		$519,184		$6,385,826		$768,180		$8,417,410
Smart Start (Eversource/NHEC)										
Planned Budget		$0		$0		$0		$0		$0
C&I Customer Partnerships (Eversource)										
Planned Budget		$0		$0		$0		$0		$0
Utility Performance Incentive										
Planned Budget		$87,801		$90,232		$751,285		$105,224		$1,034,542
TOTAL PLANNED BUDGET[2]		**$1,684,189**		**$1,730,819**		**$14,411,017**		**$2,018,380**		**$8,581,268**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

NHSAVES GAS PROGRAMS - 2024-2026 UTILITY GOALS BY PROGRAM
Total Customers Served, Program Budgets and Lifetime MMBtu Savings

	Liberty		Unitil		Total	
Home Energy Assistance						
Number of Customers Served / Lifetime MMBtu Savings	585	682,039	151	167,624	736	849,663
B/C Ratio[1] / Planned Budget	2.25	$5,677,225	2.06	$1,563,975	2.20	$7,241,200
ENERGY STAR Homes						
Number of Customers Served / Lifetime MMBtu Savings	682	398,994	195	111,300	877	510,294
B/C Ratio[1] / Planned Budget	1.57	$2,305,186	1.44	$707,945	1.54	$3,013,131
Home Performance						
Number of Customers Served / Lifetime MMBtu Savings	516	520,285	115	141,374	631	661,659
B/C Ratio[1] / Planned Budget	1.20	$4,199,486	1.32	$1,050,300	1.23	$5,249,785
ENERGY STAR Products						
Number of Customers Served / Lifetime MMBtu Savings	11,249	1,262,090	750	133,301	11,999	1,395,391
B/C Ratio[1] / Planned Budget	3.17	$3,903,991	2.28	$577,571	3.05	$4,481,562
Large Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	958	1,237,085	33	485,882	991	1,722,967
B/C Ratio[1] / Planned Budget	2.26	$5,532,192	2.53	$1,644,932	2.32	$7,177,124
Small Business Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	4,297	703,635	225	242,871	4,522	946,506
B/C Ratio[1] / Planned Budget	1.59	$5,171,961	1.93	$1,585,542	1.67	$6,757,503
Municipal Energy Solutions						
Number of Customers Served / Lifetime MMBtu Savings	770	212,964	15	60,023	785	272,988
B/C Ratio[1] / Planned Budget	1.80	$1,140,000	1.61	$370,856	1.75	$1,510,856
Behavior Programs						
Number of Customers Served / Lifetime MMBtu Savings	66,129	60,133	33,600	35,400	99,729	95,533
B/C Ratio[1] / Planned Budget	1.25	$570,000	1.74	$241,168	1.40	$811,168
Education						
Planned Budget		$507,229		$212,546		$719,775
Evaluation, Measurement and Verification						
Planned Budget		$1,526,698		$349,602		$1,876,300
Utility Performance Incentive						
Planned Budget		$1,679,368		$456,744		$2,136,112
TOTAL PLANNED BUDGET[2]		**$32,213,338**		**$8,761,181**		**$40,974,518**

Notes:
(1) B/C Ratios based on Utility Costs set to 2024 dollars.
(2) Includes performance incentive.

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	Granite State Test	*Total Resource Cost Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs													
B1 - Home Energy Assistance	1.64	*1.64*	14,210.4	*14,210.4*	8,685.5	-	2,730.0	36,091.9	495.2	410.4	672	8,509.8	210,584.0
B2a - IE Education	-	-	-	-	974.0	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	460.3	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.40**	**1.40**	**14,210.4**	***14,210.4***	**10,119.8**	**-**	**2,730.0**	**36,091.9**	**495.2**	**410.4**	**672**	**8,509.8**	**210,584.0**
Residential Programs													
A1 - Energy Star Homes	7.91	5.74	18,610.4	*23,192.1*	2,354.2	1,683.3	1,612.0	37,758.5	475.6	91.9	993	19,335.8	444,585.1
A2 - Home Performance	2.34	2.12	18,577.7	*23,106.5*	7,946.9	2,969.2	670.6	12,756.9	92.7	181.8	2,140	34,537.1	660,733.2
A3 - Energy Star Products	1.98	1.67	10,404.4	*12,914.6*	5,255.5	2,482.6	6,028.2	78,574.7	1,910.0	1,136.7	15,594	4,419.3	64,228.6
A4 - Residential Behavior	-	-	-	-	3.1	-	-	-	-	-		-	-
A5 - Residential Active Demand Response	1.14	1.14	301.8	*301.8*	264.0	-	(3.5)	(3.5)	-	1,322.8	2,100	-	-
A6a - Res Education	-	-	-	-	291.0	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	883.1	-	-	-	-	-		-	-
Sub-Total Residential	**2.82**	**2.47**	**47,894.2**	***59,514.9***	**16,997.8**	**7,135.1**	**8,307.3**	**129,086.5**	**2,478.3**	**2,733.2**	**20,827**	**58,292.1**	**1,169,546.9**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.01	1.16	20,705.2	*22,778.9*	10,279.5	9,338.6	26,842.0	232,865.8	3,477.0	3,387.5	840	(9,869.9)	(52,349.5)
C2 - Small Business Energy Solutions	2.31	1.54	22,705.0	*24,978.4*	9,813.6	6,360.8	34,089.7	226,806.6	4,899.8	5,841.2	7,548	(14,771.0)	(90,048.1)
C3 - Municipal Energy Solutions	1.79	1.04	2,597.9	*2,858.2*	1,450.7	1,284.5	3,029.1	27,069.9	339.5	447.5	93	(1,205.2)	(8,331.3)
C5 - C&I Active Demand Response	3.70	3.70	2,305.4	*2,305.4*	622.3	-	-	-	-	10,493.8	53	-	-
C6a - C&I Education	-	-	-	-	283.0	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	1,176.3	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	15.2	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.04**	**1.30**	**48,313.5**	***52,920.9***	**23,640.7**	**16,983.9**	**63,960.9**	**486,742.4**	**8,716.4**	**20,169.9**	**8,534**	**(25,846.1)**	**(150,728.8)**
C6d - Smart Start	-	-	-	-	30.0	-	-	-	-	-		-	-
Total	**2.17**	**1.69**	**110,418.1**	***126,646.2***	**50,788.3**	**24,119.0**	**74,998.2**	**651,920.8**	**11,689.9**	**23,313.5**	**30,032**	**40,955.8**	**1,229,402.1**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.

Annual kWh Savings	74,998,220	86.2%	**kWh > 65%**	**Lifetime** kWh Savings	651,920,814	64.4%
Annual MMBTU Savings (in kWh)	12,002,960	13.8%		**Lifetime** MMBTU Savings (in kWh)	360,302,198	35.6%
	87,001,180	100.0%			**1,012,223,013**	100.0%

Annual Net Savings as a % of 2022 Sales	0.97%

Spending per Customer	Low-Income	$ 425.81
	Residential	$ 40.64
	C&I	$ 303.72

Program Cost-Effectiveness - 2025 PLAN

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	1.83	*1.83*	16,578.9	*16,578.9*	9,075.1	-	3,042.5	39,569.1	545.5	464.8	730	9,701.2	240,065.7
B2a - IE Education	-	-	-	-	542.3	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	453.8	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.65**	***1.65***	**16,578.9**	***16,578.9***	**10,071.2**	**-**	**3,042.5**	**39,569.1**	**545.5**	**464.8**	**730**	**9,701.2**	**240,065.7**
Residential Programs													
A1 - Energy Star Homes	9.10	*6.48*	20,551.3	*25,609.7*	2,257.6	1,697.1	1,724.9	40,401.6	508.9	98.4	1,062	20,689.3	475,706.1
A2 - Home Performance	2.55	*2.31*	19,906.1	*24,757.1*	7,807.8	2,926.4	717.9	13,510.1	100.3	192.8	2,172	35,632.8	681,803.6
A3 - Energy Star Products	2.28	*1.95*	12,568.7	*15,610.6*	5,510.4	2,483.1	7,074.8	92,382.0	2,322.1	1,363.3	17,728	4,795.2	69,722.1
A4 - Residential Behavior	-	-	-	-	2.8	-	-	-	-	-		-	-
A5 - Residential Active Demand Response	1.26	*1.26*	384.2	*384.2*	304.9	-	(4.3)	(4.3)	-	1,639.3	2,596	-	-
A6a - Res Education	-	-	-	-	290.1	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	835.3	-	-	-	-	-		-	-
Sub-Total Residential	**3.14**	***2.75***	**53,410.4**	***66,361.6***	**17,008.8**	**7,106.6**	**9,513.2**	**146,289.3**	**2,931.3**	**3,293.8**	**23,558**	**61,117.2**	**1,227,231.7**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.18	*1.26*	20,422.2	*22,467.7*	9,376.7	8,523.7	25,930.0	224,790.9	3,303.3	3,212.9	808	(9,520.3)	(50,484.0)
C2 - Small Business Energy Solutions	2.48	*1.65*	22,106.0	*24,319.7*	8,916.6	5,800.5	32,845.9	218,733.3	4,609.1	5,483.3	7,282	(14,286.1)	(87,102.9)
C3 - Municipal Energy Solutions	1.82	*1.06*	2,439.2	*2,683.7*	1,340.1	1,186.2	2,968.5	26,528.5	319.5	373.0	86	(1,181.1)	(8,164.6)
C5 - C&I Active Demand Response	4.11	*4.11*	2,956.5	*2,956.5*	718.6	-	-	-	-	13,117.2	66	-	-
C6a - C&I Education	-	-	-	-	260.5	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	1,110.5	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	14.1	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.20**	***1.41***	**47,923.8**	***52,427.6***	**21,737.0**	**15,510.4**	**61,744.5**	**470,052.7**	**8,231.9**	**22,186.5**	**8,241**	**(24,987.5)**	**(145,751.6)**
C6d - Smart Start	-	-	-	-	27.7	-	-	-	-	-		-	-
Total	**2.41**	***1.89***	**117,913.1**	***135,368.1***	**48,844.7**	**22,617.0**	**74,300.2**	**655,911.2**	**11,708.7**	**25,945.0**	**32,529**	**45,830.8**	**1,321,545.9**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

Annual kWh Savings	74,300,234	84.7%	**kWh > 65%**	**Lifetime** kWh Savings	655,911,170	62.9%
Annual MMBTU Savings (in kWh)	13,431,696	15.3%		**Lifetime** MMBTU Savings (in kWh)	387,306,872	37.1%
	87,731,930	100.0%			**1,043,218,043**	100.0%

Annual Net Savings as a % of 2022 Sales	0.96%

Spending per Customer	Low-Income	$	458.72
	Residential	$	44.02
	C&I	$	302.30

Program Cost-Effectiveness - 2026 PLAN

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)²**	**Customer Costs ($000 - 2024$)²**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.03	*2.03*	18,587.8	*18,587.8*	9,149.1	-	3,275.0	42,108.7	582.5	505.7	772	10,603.4	262,391.8
B2a - IE Education	-	-	-	-	159.6	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	457.5	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.90**	***1.90***	**18,587.8**	***18,587.8***	**9,766.1**	**-**	**3,275.0**	**42,108.7**	**582.5**	**505.7**	**772**	**10,603.4**	**262,391.8**
Residential Programs													
A1 - Energy Star Homes	10.06	*7.08*	21,520.2	*26,816.1*	2,140.2	1,645.0	1,803.6	42,262.6	532.1	102.8	1,096	20,895.5	480,463.4
A2 - Home Performance	2.79	*2.51*	21,174.1	*26,332.2*	7,600.0	2,905.4	772.7	14,423.2	108.1	207.7	2,205	36,521.7	698,040.8
A3 - Energy Star Products	2.56	*2.19*	14,336.1	*17,806.6*	5,591.3	2,529.4	7,867.9	102,414.4	2,564.7	1,503.8	20,166	5,276.7	76,724.2
A4 - Residential Behavior	-	-	-	-	2.6	-	-	-	-	-		-	-
A5 - Residential Active Demand Response	1.29	*1.29*	452.8	*452.8*	352.0	-	(5.0)	(5.0)	-	1,885.2	2,985	-	-
A6a - Res Education	-	-	-	-	284.2	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	822.3	-	-	-	-	-		-	-
Sub-Total Residential	**3.42**	***2.99***	**57,483.1**	***71,407.8***	**16,792.6**	**7,079.8**	**10,439.2**	**159,095.1**	**3,204.9**	**3,699.5**	**26,451**	**62,693.8**	**1,255,228.4**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.39	*1.38*	20,466.2	*22,516.3*	8,568.6	7,788.5	25,116.6	217,850.4	3,198.5	3,110.1	778	(9,228.5)	(48,933.7)
C2 - Small Business Energy Solutions	2.73	*1.82*	22,269.4	*24,499.7*	8,157.5	5,317.4	31,885.8	212,488.4	4,472.5	5,321.8	7,068	(13,873.1)	(84,593.0)
C3 - Municipal Energy Solutions	2.03	*1.17*	2,838.0	*3,122.5*	1,397.8	1,279.8	3,369.1	29,865.5	363.1	423.0	90	(1,356.2)	(9,353.8)
C5 - C&I Active Demand Response	4.20	*4.20*	3,484.3	*3,484.3*	829.8	-	-	-	-	15,084.8	75	-	-
C6a - C&I Education	-	-	-	-	241.5	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	1,033.5	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	13.0	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.42**	***1.55***	**49,057.9**	***53,622.8***	**20,241.8**	**14,385.7**	**60,371.6**	**460,204.2**	**8,034.2**	**23,939.7**	**8,011**	**(24,457.8)**	**(142,880.5)**
C6d - Smart Start	-	-	-	-	25.6	-	-	-	-	-		-	-
Total	**2.67**	***2.10***	**125,128.8**	***143,618.4***	**46,826.1**	**21,465.5**	**74,085.8**	**661,408.1**	**11,821.6**	**28,144.9**	**35,235**	**48,839.3**	**1,374,739.7**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

Annual kWh Savings	74,085,784	83.8%	**kWh > 65%**
Annual MMBTU Savings (in kWh)	14,313,401	16.2%	
	88,399,185	100.0%	

Lifetime kWh Savings	661,408,098	62.1%
Lifetime MMBTU Savings (in kWh)	402,896,452	37.9%
	1,064,304,550	100.0%

Annual Net Savings as a % of 2022 Sales	0.95%

Spending per Customer	Low-Income	$ 481.53
	Residential	$ 47.04
	C&I	$ 304.73

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios Granite State Test	Benefit/Cost Ratios *Total Resource Cost Test*	Benefits ($000) Granite State Test	Benefits ($000) *Total Resource Cost Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings[4]	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs													
B1 - Home Energy Assistance	1.83	*1.83*	49,377.1	*49,377.1*	26,909.7	-	9,047.6	117,769.8	1,623.3	1,380.9	2,174	28,814.3	713,041.5
B2a - IE Education	-	-	-	-	1,675.8	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	1,371.5	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**1.65**	***1.65***	**49,377.1**	***49,377.1***	**29,957.0**	**-**	**9,047.6**	**117,769.8**	**1,623.3**	**1,380.9**	**2,174**	**28,814.3**	**713,041.5**
Residential Programs													
A1 - Energy Star Homes	8.99	*6.42*	60,681.9	*75,617.9*	6,752.0	5,025.4	5,140.5	120,422.6	1,516.6	293.1	3,151	60,920.5	1,400,754.7
A2 - Home Performance	2.55	*2.31*	59,657.9	*74,195.8*	23,354.7	8,801.0	2,161.2	40,690.1	301.1	582.2	6,517	106,691.5	2,040,577.5
A3 - Energy Star Products	2.28	*1.94*	37,309.2	*46,331.8*	16,357.3	7,495.1	20,970.9	273,371.1	6,796.8	4,003.8	53,487	14,491.1	210,674.9
A4 - Residential Behavior	-	-	-	-	8.5	-	-	-	-	-	-	-	-
A5 - Residential Active Demand Response	1.24	*1.24*	1,138.7	*1,138.7*	920.9	-	(12.8)	(12.8)	-	4,847.3	7,681	-	-
A6a - Res Education	-	-	-	-	865.2	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	2,540.7	-	-	-	-	-	-	-	-
Sub-Total Residential	**3.13**	***2.74***	**158,787.7**	***197,284.3***	**50,799.3**	**21,321.5**	**28,259.7**	**434,471.0**	**8,614.5**	**9,726.5**	**70,836**	**182,103.1**	**3,652,007.0**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.18	*1.26*	61,593.5	*67,762.9*	28,224.8	25,650.8	77,888.7	675,507.2	9,978.9	9,710.5	2,426	(28,618.7)	(151,767.2)
C2 - Small Business Energy Solutions	2.49	*1.66*	67,080.4	*73,797.8*	26,887.7	17,478.6	98,821.5	658,028.3	13,981.4	16,646.2	21,898	(42,930.2)	(261,744.0)
C3 - Municipal Energy Solutions	1.88	*1.09*	7,875.1	*8,664.4*	4,188.6	3,750.5	9,366.8	83,463.9	1,022.1	1,243.5	269	(3,742.5)	(25,849.7)
C5 - C&I Active Demand Response	4.03	*4.03*	8,746.2	*8,746.2*	2,170.8	-	-	-	-	38,695.8	194	-	-
C6a - C&I Education	-	-	-	-	785.0	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	3,320.3	-	-	-	-	-	-	-	-
C6c - C&I Customer Partnerships	-	-	-	-	42.3	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**2.21**	***1.41***	**145,295.3**	***158,971.3***	**65,619.5**	**46,880.0**	**186,077.0**	**1,416,999.3**	**24,982.4**	**66,296.1**	**24,786**	**(75,291.4)**	**(439,360.9)**
C6d - Smart Start	-	-	-	-	83.3	-	-	-	-	-	-	-	-
Total	**2.41**	***1.89***	**353,460.1**	***405,632.7***	**146,459.1**	**68,201.5**	**223,384.2**	**1,969,240.1**	**35,220.1**	**77,403.5**	**97,796**	**135,626.0**	**3,925,687.6**

Notes:

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(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

(4) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not in fact cumulative.

Annual kWh Savings	223,384,237	84.9%	**kWh > 65%**
Annual MMBTU Savings (in kWh)	39,748,057	15.1%	
	263,132,294	100.0%	

Lifetime kWh Savings	1,969,240,083	63.1%
Lifetime MMBTU Savings (in kWh)	1,150,505,522	36.9%
	3,119,745,605	100.0%

Annual Net Savings as a % of 2022 Sales	2.88%

Spending per Customer	Low-Income	$ 1,366.06
	Residential	$ 131.70
	C&I	$ 910.75

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 14,210**	*$ 14,210*	$ 275	$ -	$ 453	$ 531	$ -	$ 740	$ 807	$ 309	$ 276	$ 160	**$ 3,551**	$ 5,613	$ 38	**$ 9,202**	$ 145	$ 4,863	**$ 5,008**	**$ 1,344**
Sub-Total Income Eligible	**$ 14,210**	*$ 14,210*	**$ 275**	**$ -**	**$ 453**	**$ 531**	**$ -**	**$ 740**	**$ 807**	**$ 309**	**$ 276**	**$ 160**	**$ 3,551**	**$ 5,613**	**$ 38**	**$ 9,202**	**$ 145**	**$ 4,863**	**$ 5,008**	**$ 1,344**
Residential Programs																				
A1 - Energy Star Homes	**$ 18,610**	*$ 23,192*	$ 81	$ -	$ 129	$ 151	$ -	$ 931	$ 1,171	$ 70	$ 58	$ 118	**$ 2,708**	$ 15,619	$ 17	**$ 18,343**	$ 267	$ 4,582	**$ 4,849**	**$ 1,010**
A2 - Home Performance	**$ 18,578**	*$ 23,107*	$ 176	$ -	$ 277	$ 325	$ -	$ 176	$ 189	$ 170	$ 147	$ 39	**$ 1,499**	$ 16,616	$ 38	**$ 18,153**	$ 425	$ 4,529	**$ 4,953**	**$ 401**
A3 - Energy Star Products	**$ 10,404**	*$ 12,915*	$ 748	$ -	$ 1,259	$ 1,475	$ -	$ 1,918	$ 2,177	$ 410	$ 369	$ 370	**$ 8,727**	$ 1,314	$ 321	**$ 10,362**	$ 43	$ 2,510	**$ 2,553**	**$ 2,980**
A5 - Residential Active Demand Response	**$ 302**	*$ 302*	$ 16	$ -	$ 128	$ 150	$ -	$ -	$ -	$ -	$ -	$ 7	**$ 302**	$ -	$ -	**$ 302**	$ -	$ -	**$ -**	**$ (1)**
Sub-Total Residential	**$ 47,894**	*$ 59,515*	**$ 1,022**	**$ -**	**$ 1,793**	**$ 2,101**	**$ -**	**$ 3,024**	**$ 3,536**	**$ 650**	**$ 574**	**$ 535**	**$ 13,235**	**$ 33,550**	**$ 376**	**$ 47,160**	**$ 734**	**$ 11,621**	**$ 12,355**	**$ 4,390**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 20,705**	*$ 22,779*	$ 1,399	$ -	$ 2,503	$ 2,933	$ -	$ 4,201	$ 3,327	$ 3,386	$ 2,730	$ 1,233	**$ 21,713**	$ (975)	$ -	**$ 20,738**	$ (32)	$ 2,074	**$ 2,041**	**$ 10,675**
C2 - Small Business Energy Solutions	**$ 22,705**	*$ 24,978*	$ 1,824	$ -	$ 3,426	$ 4,014	$ -	$ 4,806	$ 2,907	$ 3,879	$ 2,099	$ 1,440	**$ 24,396**	$ (1,663)	$ 28	**$ 22,761**	$ (56)	$ 2,273	**$ 2,217**	**$ 11,559**
C3 - Municipal Energy Solutions	**$ 2,598**	*$ 2,858*	$ 203	$ -	$ 359	$ 420	$ -	$ 595	$ 353	$ 427	$ 236	$ 148	**$ 2,741**	$ (138)	$ -	**$ 2,603**	$ (5)	$ 260	**$ 255**	**$ 1,221**
C5 - C&I Active Demand Response	**$ 2,305**	*$ 2,305*	$ 69	$ -	$ 1,016	$ 1,190	$ -	$ -	$ -	$ -	$ -	$ 30	**$ 2,305**	$ -	$ -	**$ 2,305**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 48,314**	*$ 52,921*	**$ 3,496**	**$ -**	**$ 7,303**	**$ 8,558**	**$ -**	**$ 9,602**	**$ 6,588**	**$ 7,692**	**$ 5,065**	**$ 2,851**	**$ 51,155**	**$ (2,776)**	**$ 28**	**$ 48,408**	**$ (94)**	**$ 4,607**	**$ 4,513**	**$ 23,455**
Total	**$ 110,418**	*$ 126,646*	**$ 4,793**	**$ -**	**$ 9,549**	**$ 11,190**	**$ -**	**$ 13,365**	**$ 10,932**	**$ 8,651**	**$ 5,915**	**$ 3,546**	**$ 67,941**	**$ 36,387**	**$ 442**	**$ 104,770**	**$ 785**	**$ 21,091**	**$ 21,876**	**$ 29,188**

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(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 16,579**	*$ 16,579*	$ 329	$ -	$ 524	$ 614	$ -	$ 826	$ 899	$ 361	$ 322	$ 182	**$ 4,057**	$ 6,622	$ 45	**$ 10,724**	$ 173	$ 5,681	**$ 5,855**	**$ 1,436**
Sub-Total Income Eligible	**$ 16,579**	*$ 16,579*	**$ 329**	**$ -**	**$ 524**	**$ 614**	**$ -**	**$ 826**	**$ 899**	**$ 361**	**$ 322**	**$ 182**	**$ 4,057**	**$ 6,622**	**$ 45**	**$ 10,724**	**$ 173**	**$ 5,681**	**$ 5,855**	**$ 1,436**
Residential Programs																				
A1 - Energy Star Homes	**$ 20,551**	*$ 25,610*	$ 91	$ -	$ 141	$ 165	$ -	$ 1,025	$ 1,291	$ 77	$ 64	$ 129	**$ 2,984**	$ 17,249	$ 18	**$ 20,252**	$ 300	$ 5,058	**$ 5,358**	**$ 1,034**
A2 - Home Performance	**$ 19,906**	*$ 24,757*	$ 196	$ -	$ 300	$ 351	$ -	$ 193	$ 207	$ 186	$ 160	$ 43	**$ 1,636**	$ 17,768	$ 40	**$ 19,444**	$ 462	$ 4,851	**$ 5,313**	**$ 410**
A3 - Energy Star Products	**$ 12,569**	*$ 15,611*	$ 958	$ -	$ 1,560	$ 1,828	$ -	$ 2,326	$ 2,666	$ 477	$ 430	$ 445	**$ 10,690**	$ 1,478	$ 352	**$ 12,520**	$ 49	$ 3,042	**$ 3,091**	**$ 3,362**
A5 - Residential Active Demand Response	**$ 384**	*$ 384*	$ 22	$ -	$ 163	$ 191	$ -	$ -	$ -	$ -	$ -	$ 9	**$ 384**	$ -	$ -	**$ 384**	$ -	$ -	**$ -**	**$ (1)**
Sub-Total Residential	**$ 53,410**	*$ 66,362*	**$ 1,267**	**$ -**	**$ 2,164**	**$ 2,536**	**$ -**	**$ 3,543**	**$ 4,164**	**$ 740**	**$ 654**	**$ 627**	**$ 15,694**	**$ 36,495**	**$ 411**	**$ 52,600**	**$ 811**	**$ 12,951**	**$ 13,762**	**$ 4,806**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 20,422**	*$ 22,468*	$ 1,415	$ -	$ 2,423	$ 2,839	$ -	$ 4,150	$ 3,296	$ 3,369	$ 2,718	$ 1,220	**$ 21,429**	$ (973)	$ -	**$ 20,456**	$ (34)	$ 2,046	**$ 2,012**	**$ 10,020**
C2 - Small Business Energy Solutions	**$ 22,106**	*$ 24,320*	$ 1,805	$ -	$ 3,221	$ 3,774	$ -	$ 4,746	$ 2,879	$ 3,864	$ 2,091	$ 1,423	**$ 23,802**	$ (1,665)	$ 28	**$ 22,165**	$ (59)	$ 2,214	**$ 2,155**	**$ 10,915**
C3 - Municipal Energy Solutions	**$ 2,439**	*$ 2,684*	$ 173	$ -	$ 295	$ 346	$ -	$ 597	$ 355	$ 431	$ 238	$ 149	**$ 2,584**	$ (140)	$ -	**$ 2,445**	$ (6)	$ 244	**$ 239**	**$ 1,163**
C5 - C&I Active Demand Response	**$ 2,957**	*$ 2,957*	$ 91	$ -	$ 1,301	$ 1,525	$ -	$ -	$ -	$ -	$ -	$ 39	**$ 2,957**	$ -	$ -	**$ 2,957**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 47,924**	*$ 52,428*	**$ 3,485**	**$ -**	**$ 7,240**	**$ 8,484**	**$ -**	**$ 9,493**	**$ 6,530**	**$ 7,664**	**$ 5,046**	**$ 2,830**	**$ 50,772**	**$ (2,778)**	**$ 28**	**$ 48,022**	**$ (98)**	**$ 4,504**	**$ 4,406**	**$ 22,098**
Total	**$ 117,913**	*$ 135,368*	**$ 5,080**	**$ -**	**$ 9,928**	**$ 11,634**	**$ -**	**$ 13,862**	**$ 11,593**	**$ 8,765**	**$ 6,022**	**$ 3,638**	**$ 70,522**	**$ 40,340**	**$ 483**	**$ 111,345**	**$ 887**	**$ 23,136**	**$ 24,023**	**$ 28,340**

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(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 18,588**	*$ 18,588*	$ 379	$ -	$ 584	$ 684	$ -	$ 902	$ 977	$ 407	$ 363	$ 200	**$ 4,495**	$ 7,480	$ 50	**$ 12,025**	$ 199	$ 6,364	**$ 6,562**	**$ 1,466**
Sub-Total Income Eligible	**$ 18,588**	*$ 18,588*	**$ 379**	**$ -**	**$ 584**	**$ 684**	**$ -**	**$ 902**	**$ 977**	**$ 407**	**$ 363**	**$ 200**	**$ 4,495**	**$ 7,480**	**$ 50**	**$ 12,025**	**$ 199**	**$ 6,364**	**$ 6,562**	**$ 1,466**
Residential Programs																				
A1 - Energy Star Homes	**$ 21,520**	*$ 26,816*	$ 101	$ -	$ 151	$ 177	$ -	$ 1,105	$ 1,394	$ 84	$ 70	$ 138	**$ 3,221**	$ 17,963	$ 19	**$ 21,203**	$ 317	$ 5,296	**$ 5,613**	**$ 1,025**
A2 - Home Performance	**$ 21,174**	*$ 26,332*	$ 221	$ -	$ 329	$ 385	$ -	$ 212	$ 227	$ 206	$ 178	$ 48	**$ 1,807**	$ 18,826	$ 44	**$ 20,676**	$ 498	$ 5,158	**$ 5,656**	**$ 418**
A3 - Energy Star Products	**$ 14,336**	*$ 17,807*	$ 1,119	$ -	$ 1,761	$ 2,064	$ -	$ 2,653	$ 3,046	$ 552	$ 498	$ 506	**$ 12,199**	$ 1,683	$ 397	**$ 14,279**	$ 57	$ 3,471	**$ 3,528**	**$ 3,551**
A5 - Residential Active Demand Response	**$ 453**	*$ 453*	$ 26	$ -	$ 192	$ 225	$ -	$ -	$ -	$ -	$ -	$ 11	**$ 453**	$ -	$ -	**$ 453**	$ -	$ -	**$ -**	**$ (1)**
Sub-Total Residential	**$ 57,483**	*$ 71,408*	**$ 1,467**	**$ -**	**$ 2,433**	**$ 2,851**	**$ -**	**$ 3,971**	**$ 4,668**	**$ 842**	**$ 745**	**$ 703**	**$ 17,680**	**$ 38,472**	**$ 460**	**$ 56,611**	**$ 872**	**$ 13,925**	**$ 14,797**	**$ 4,994**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 20,466**	*$ 22,516*	$ 1,469	$ -	$ 2,405	$ 2,818	$ -	$ 4,145	$ 3,298	$ 3,396	$ 2,738	$ 1,211	**$ 21,479**	$ (978)	$ -	**$ 20,501**	$ (35)	$ 2,050	**$ 2,015**	**$ 9,300**
C2 - Small Business Energy Solutions	**$ 22,269**	*$ 24,500*	$ 1,905	$ -	$ 3,205	$ 3,755	$ -	$ 4,761	$ 2,897	$ 3,920	$ 2,122	$ 1,416	**$ 23,979**	$ (1,676)	$ 27	**$ 22,330**	$ (61)	$ 2,230	**$ 2,169**	**$ 10,199**
C3 - Municipal Energy Solutions	**$ 2,838**	*$ 3,123*	$ 209	$ -	$ 340	$ 399	$ -	$ 692	$ 415	$ 505	$ 279	$ 172	**$ 3,012**	$ (167)	$ -	**$ 2,845**	$ (7)	$ 284	**$ 278**	**$ 1,260**
C5 - C&I Active Demand Response	**$ 3,484**	*$ 3,484*	$ 107	$ -	$ 1,534	$ 1,797	$ -	$ -	$ -	$ -	$ -	$ 46	**$ 3,484**	$ -	$ -	**$ 3,484**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 49,058**	*$ 53,623*	**$ 3,690**	**$ -**	**$ 7,484**	**$ 8,769**	**$ -**	**$ 9,598**	**$ 6,609**	**$ 7,821**	**$ 5,138**	**$ 2,845**	**$ 51,954**	**$ (2,821)**	**$ 27**	**$ 49,161**	**$ (103)**	**$ 4,565**	**$ 4,462**	**$ 20,758**
Total	**$ 125,129**	*$ 143,618*	**$ 5,535**	**$ -**	**$ 10,501**	**$ 12,305**	**$ -**	**$ 14,471**	**$ 12,254**	**$ 9,071**	**$ 6,246**	**$ 3,747**	**$ 74,129**	**$ 43,131**	**$ 538**	**$ 117,797**	**$ 968**	**$ 24,853**	**$ 25,821**	**$ 27,218**

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(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 49,377**	*$ 49,377*	$ 982	$ -	$ 1,561	$ 1,829	$ -	$ 2,467	$ 2,683	$ 1,077	$ 961	$ 542	**$ 12,103**	$ 19,715	$ 134	**$ 31,952**	$ 517	$ 16,908	**$ 17,425**	**$ 4,245**
Sub-Total Income Eligible	**$ 49,377**	*$ 49,377*	**$ 982**	**$ -**	**$ 1,561**	**$ 1,829**	**$ -**	**$ 2,467**	**$ 2,683**	**$ 1,077**	**$ 961**	**$ 542**	**$ 12,103**	**$ 19,715**	**$ 134**	**$ 31,952**	**$ 517**	**$ 16,908**	**$ 17,425**	**$ 4,245**
Residential Programs																				
A1 - Energy Star Homes	**$ 60,682**	*$ 75,618*	$ 274	$ -	$ 421	$ 493	$ -	$ 3,060	$ 3,855	$ 231	$ 192	$ 385	**$ 8,912**	$ 50,832	$ 54	**$ 59,798**	$ 884	$ 14,936	**$ 15,820**	**$ 3,069**
A2 - Home Performance	**$ 59,658**	*$ 74,196*	$ 593	$ -	$ 906	$ 1,062	$ -	$ 581	$ 623	$ 562	$ 485	$ 130	**$ 4,941**	$ 53,210	$ 122	**$ 58,274**	$ 1,384	$ 14,538	**$ 15,922**	**$ 1,230**
A3 - Energy Star Products	**$ 37,309**	*$ 46,332*	$ 2,825	$ -	$ 4,580	$ 5,367	$ -	$ 6,897	$ 7,889	$ 1,439	$ 1,297	$ 1,321	**$ 31,616**	$ 4,475	$ 1,070	**$ 37,160**	$ 149	$ 9,023	**$ 9,171**	**$ 9,893**
A5 - Residential Active Demand Response	**$ 1,139**	*$ 1,139*	$ 64	$ -	$ 482	$ 565	$ -	$ -	$ -	$ -	$ -	$ 27	**$ 1,139**	$ -	$ -	**$ 1,139**	$ -	$ -	**$ -**	**$ (2)**
Sub-Total Residential	**$ 158,788**	*$ 197,284*	**$ 3,755**	**$ -**	**$ 6,390**	**$ 7,488**	**$ -**	**$ 10,538**	**$ 12,368**	**$ 2,232**	**$ 1,973**	**$ 1,864**	**$ 46,608**	**$ 108,517**	**$ 1,246**	**$ 156,371**	**$ 2,417**	**$ 38,497**	**$ 40,913**	**$ 14,190**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 61,594**	*$ 67,763*	$ 4,283	$ -	$ 7,331	$ 8,590	$ -	$ 12,496	$ 9,921	$ 10,151	$ 8,185	$ 3,663	**$ 64,621**	$ (2,926)	$ -	**$ 61,694**	$ (101)	$ 6,169	**$ 6,069**	**$ 29,995**
C2 - Small Business Energy Solutions	**$ 67,080**	*$ 73,798*	$ 5,535	$ -	$ 9,851	$ 11,543	$ -	$ 14,313	$ 8,683	$ 11,663	$ 6,312	$ 4,278	**$ 72,178**	$ (5,005)	$ 83	**$ 67,256**	$ (176)	$ 6,717	**$ 6,541**	**$ 32,672**
C3 - Municipal Energy Solutions	**$ 7,875**	*$ 8,664*	$ 585	$ -	$ 994	$ 1,165	$ -	$ 1,884	$ 1,123	$ 1,364	$ 752	$ 469	**$ 8,337**	$ (444)	$ -	**$ 7,893**	$ (18)	$ 789	**$ 772**	**$ 3,644**
C5 - C&I Active Demand Response	**$ 8,746**	*$ 8,746*	$ 267	$ -	$ 3,851	$ 4,513	$ -	$ -	$ -	$ -	$ -	$ 115	**$ 8,746**	$ -	$ -	**$ 8,746**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 145,295**	*$ 158,971*	**$ 10,670**	**$ -**	**$ 22,027**	**$ 25,811**	**$ -**	**$ 28,693**	**$ 19,728**	**$ 23,178**	**$ 15,249**	**$ 8,525**	**$ 153,882**	**$ (8,375)**	**$ 83**	**$ 145,590**	**$ (295)**	**$ 13,676**	**$ 13,382**	**$ 66,311**
Total	**$ 353,460**	*$ 405,633*	**$ 15,408**	**$ -**	**$ 29,978**	**$ 35,129**	**$ -**	**$ 41,698**	**$ 34,778**	**$ 26,487**	**$ 18,183**	**$ 10,931**	**$ 212,592**	**$ 119,857**	**$ 1,463**	**$ 333,912**	**$ 2,639**	**$ 69,081**	**$ 71,720**	**$ 84,746**

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(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI**[3]	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	651,920,814	*488,940,611*		-	1.925%	-	$ 977,097	*$ 1,221,371*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	74,998,220	*56,248,665*		-	0.550%	-	$ 279,170	*$ 348,963*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW[4]	11,497	*7,473*		-	0.660%	-	$ 335,005	*$ 418,756*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	11,690	*7,598*		-	0.440%	-	$ 223,336	*$ 279,170*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 104,769,957			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 50,758,265			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 54,011,692	*$ 40,508,769*		-	1.925%	-	$ 977,097	*$ 1,221,371*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 2,791,705	*$ 3,489,631*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
9	Total Benefits	$ 110,418,102		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 2,791,705	$ -	from row 8 above
11	Total Utility Costs	$ 50,758,265	$ -	from row 6 above
12	**Portfolio GST BCR**	**2.06**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Portfolio Planned Versus Actual Performance - 2025

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	655,911,170	*491,933,378*		-	1.925%	-	$ 1,017,255	*$ 1,271,569*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	74,300,234	*55,725,175*		-	0.550%	-	$ 290,644	*$ 363,305*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW[4]	11,188	*7,273*		-	0.660%	-	$ 348,773	*$ 435,967*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	11,709	*7,611*		-	0.440%	-	$ 232,515	*$ 290,644*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 111,345,129			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 52,844,430			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 58,500,699	*$ 43,875,525*		-	1.925%	-	$ 1,017,255	*$ 1,271,569*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 2,906,444	*$ 3,633,055*	**$ -**	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 117,913,105		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 2,906,444	$ -	from row 8 above
11	Total Utility Costs	$ 52,844,430	$ -	from row 6 above
12	**Portfolio GST BCR**	**2.12**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

	Portfolio Planned Versus Actual Performance - 2026										
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	661,408,098	*496,056,074*		-	1.925%	-	$ 1,055,691	*$ 1,319,613*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	74,085,784	*55,564,338*		-	0.550%	-	$ 301,626	*$ 377,032*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW[4]	11,175	*7,264*		-	0.660%	-	$ 361,951	*$ 452,439*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	11,822	*7,684*		-	0.440%	-	$ 241,301	*$ 301,626*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 117,797,323			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 54,841,080			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 62,956,242	*$ 47,217,182*		-	1.925%	-	$ 1,055,691	*$ 1,319,613*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 3,016,259	*$ 3,770,324*	**$ -**	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 125,128,850		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 3,016,259	$ -	from row 8 above
11	Total Utility Costs	$ 54,841,080	$ -	from row 6 above
12	**Portfolio GST BCR**	**2.16**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

	Portfolio Planned Versus Actual Performance - 2024-2026										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	1,969,240,083	*1,476,930,062*		-	1.925%	-	$ 3,050,043	*$ 3,812,553*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	223,384,237	*167,538,178*		-	0.550%	-	$ 871,441	*$ 1,089,301*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW[4]	33,860	*22,009*		-	0.660%	-	$ 1,045,729	*$ 1,307,161*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	35,220	*22,893*		-	0.440%	-	$ 697,153	*$ 871,441*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 333,912,409			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 158,443,775			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 175,468,634	*$ 131,601,475*		-	1.925%	-	$ 3,050,043	*$ 3,812,553*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 8,714,408	*$ 10,893,010*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
9	Total Benefits	$ 353,460,057		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 8,714,408	$ -	from row 8 above
11	Total Utility Costs	$ 158,443,775	$ -	from row 6 above
12	**Portfolio GST BCR**	**2.11**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization	Air Sealing, Cord Wood	EB1a001	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Electric	EB1a002	60	68	75	86.2	98.2	107.4	1,292.4	1,473.3	1,610.3	13.6	15.5	16.9	22.7	25.8	28.3	-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Gas	EB1a003	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Kerosene	EB1a004	75	86	93	6.7	7.7	8.4	100.8	115.0	125.7	-	-	-	3.7	4.2	4.6	298.1	339.8	371.4	4,471.3	5,097.3	5,571.3
B1a - HEA (Weatherization	Air Sealing, Oil	EB1a005	270	308	336	40.7	46.4	50.7	610.5	696.0	760.7	-	-	-	22.4	25.6	28.0	2,078.2	2,369.1	2,589.5	31,172.9	35,537.1	38,842.0
B1a - HEA (Weatherization	Air Sealing, Propane	EB1a006	103	117	128	5.4	6.2	6.7	81.0	92.3	100.9	-	-	-	3.0	3.4	3.7	834.2	950.9	1,039.4	12,512.3	14,264.0	15,590.6
B1a - HEA (Weatherization	Air Sealing, Wood Pellets	EB1a007	3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	34.7	39.5	43.2	520.1	592.9	648.1
B1a - HEA (Weatherization	Duct Sealing, Cord Wood	EB1a084	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Electric	EB1a085	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Gas	EB1a086	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Kerosene	EB1a087	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Oil	EB1a088	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Propane	EB1a089	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Wood Pellets	EB1a090	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Electric	EB1a009	12	14	15	0.5	0.6	0.6	3.6	4.1	4.5	0.1	0.1	0.1	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Gas	EB1a010	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Kerosene	EB1a011	28	32	35	-	-	-	-	-	-	-	-	-	-	-	-	4.0	4.5	5.0	27.8	31.7	34.7
B1a - HEA (Weatherization	Faucet Aerator, Oil	EB1a012	129	147	161	-	-	-	-	-	-	-	-	-	-	-	-	18.3	20.9	22.8	128.2	146.1	159.7
B1a - HEA (Weatherization	Faucet Aerator, Propane	EB1a013	16	18	20	-	-	-	-	-	-	-	-	-	-	-	-	2.3	2.6	2.8	15.9	18.1	19.8
B1a - HEA (Weatherization	Tank Wrap, Electric	EB1a091	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Gas	EB1a092	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Kerosene	EB1a093	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Oil	EB1a094	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Propane	EB1a095	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Electric	EB1a016	12	14	15	1.6	1.8	2.0	23.8	27.1	29.6	0.3	0.4	0.4	0.1	0.1	0.2	-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Gas	EB1a017	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Kerosene	EB1a018	28	32	35	-	-	-	-	-	-	-	-	-	-	-	-	16.1	18.4	20.1	241.9	275.8	301.5
B1a - HEA (Weatherization	Hand Held Showerhead, Oil	EB1a019	129	147	161	-	-	-	-	-	-	-	-	-	-	-	-	74.3	84.7	92.6	1,114.6	1,270.7	1,388.8
B1a - HEA (Weatherization	Hand Held Showerhead, Propane	EB1a020	16	18	20	-	-	-	-	-	-	-	-	-	-	-	-	9.2	10.5	11.5	138.2	157.6	172.3
B1a - HEA (Weatherization	Insulation, Cord Wood	EB1a022	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Electric	EB1a023	72	82	90	120.0	136.8	149.6	3,000.8	3,420.9	3,739.1	18.9	21.5	23.5	31.6	36.0	39.4	-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Gas	EB1a024	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Kerosene	EB1a025	80	91	100	11.2	12.8	14.0	280.7	319.9	349.7	-	-	-	6.2	7.1	7.7	1,325.8	1,511.4	1,652.0	33,145.2	37,785.5	41,299.6
B1a - HEA (Weatherization	Insulation, Oil	EB1a026	261	298	325	79.4	90.5	99.0	1,985.5	2,263.5	2,474.0	-	-	-	43.8	49.9	54.6	3,225.7	3,677.3	4,019.3	80,643.0	91,933.0	100,482.8
B1a - HEA (Weatherization	Insulation, Propane	EB1a027	106	121	132	14.8	16.9	18.5	370.8	422.7	462.1	-	-	-	8.2	9.3	10.2	1,341.6	1,529.5	1,671.7	33,540.8	38,236.5	41,792.5
B1a - HEA (Weatherization	Insulation, Wood Pellets	EB1a028	3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	13.3	15.1	16.6	332.2	378.7	413.9
B1a - HEA (Weatherization	Duct Insulation, Cord Wood	EB1a077	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Electric	EB1a078	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Gas	EB1a079	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Kerosene	EB1a080	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Oil	EB1a081	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Propane	EB1a082	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Wood Pellets	EB1a083	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Electric	EB1a030	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Gas	EB1a031	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Kerosene	EB1a032	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Oil	EB1a033	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Propane	EB1a034	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Electric	EB1a037	30	34	37	6.6	7.5	8.2	98.9	112.8	123.2	1.3	1.5	1.6	0.5	0.6	0.6	-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Gas	EB1a038	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Kerosene	EB1a039	14	16	17	3.5	4.0	4.3	52.0	59.3	64.8	0.5	0.6	0.6	0.3	0.3	0.3	4.3	4.9	5.3	64.2	73.1	79.9
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Oil	EB1a040	26	30	32	7.0	8.0	8.7	104.8	119.5	130.6	1.0	1.1	1.2	0.5	0.6	0.7	(3.3)	(3.8)	(4.2)	(50.0)	(57.0)	(62.3)
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Propane	EB1a041	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Electric	EB1a042	2	2	2	0.1	0.2	0.2	0.3	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Gas	EB1a060	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Kerosene	EB1a061	4	5	5	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.7	1.9	3.0	3.4	3.7
B1a - HEA (Weatherization	Hot Water Setback, Oil	EB1a062	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Propane	EB1a063	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.9	0.9	1.5	1.7	1.9
B1a - HEA (Weatherization	DHW Heat Pump Water Heater	EB1a043	30	34	37	26.2	29.9	32.7	393.5	448.6	490.3	4.3	4.9	5.4	2.4	2.7	3.0	58.7	66.9	73.1	880.0	1,003.2	1,096.5
B1a - HEA (Weatherization	Stand Alone Water Heater, Electric	EB1a096	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Stand Alone Water Heater, Gas	EB1a097	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Stand Alone Water Heater, Propane	EB1a099	8	9	10	1.8	2.1	2.3	23.7	27.0	29.5	0.3	0.3	0.3	0.1	0.2	0.2	0.7	0.8	0.9	9.7	11.0	12.1
B1a - HEA (Weatherization	Indirect Water Heater, Oil	EB1a098	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, General Service Lamps	EB1a044	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, Linear	EB1a045	2,737	3,120	3,410	820.8	935.7	1,022.7	5,745.6	6,550.0	7,159.1	177.2	202.0	220.8	114.3	130.3	142.4	(1,864.9)	(2,125.9)	(2,323.6)	(13,054.0)	(14,881.5)	(16,265.5)
B1a - HEA (Weatherization	LED Bulb, Other Specialty	EB1a046	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization	LED Bulb, Reflector	EB1a047	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Fixture	EB1a048	557	635	694	128.4	146.3	159.9	256.7	292.6	319.9	27.7	31.6	34.5	17.9	20.4	22.3	(291.6)	(332.4)	(363.4)	(583.2)	(664.9)	(726.7)
B1a - HEA (Weatherization	Refrigerator	EB1a049	702	800	875	581.8	663.3	725.0	6,982.1	7,959.6	8,699.8	66.5	75.8	82.8	81.5	92.9	101.6	-	-	-	-	-	-
B1a - HEA (Weatherization	Freezer	EB1a050	247	282	308	172.9	197.1	215.4	2,074.8	2,365.3	2,585.3	16.9	19.3	21.1	22.8	26.0	28.4	-	-	-	-	-	-
B1a - HEA (Weatherization	Clothes Washer	EB1a051	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Clothes Dryer	EB1a052	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Dehumidifier	EB1a053	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Room Air Conditioner	EB1a054	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Cord Wood	EB1a055	3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Electric	EB1a064	184	210	229	42.4	48.3	52.8	1,059.7	1,208.0	1,320.4	6.7	7.6	8.3	11.2	12.7	13.9	-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Gas	EB1a065	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Kerosene	EB1a066	103	117	128	-	-	-	-	-	-	-	-	-	-	-	-	46.4	52.9	57.8	1,159.5	1,321.9	1,444.8
B1a - HEA (Weatherization	Window Replacement, Oil	EB1a067	382	435	476	3.2	3.6	3.9	78.8	89.8	98.2	-	-	-	1.7	2.0	2.2	263.1	299.9	327.8	6,576.5	7,497.2	8,194.4
B1a - HEA (Weatherization	Window Replacement, Propane	EB1a068	138	157	172	-	-	-	-	-	-	-	-	-	-	-	-	26.3	30.0	32.8	657.7	749.8	819.5
B1a - HEA (Weatherization	Window Replacement, Wood Pellets	EB1a069	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Cord Wood	EB1a100	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Electric	EB1a101	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Gas	EB1a102	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Kerosene	EB1a103	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Oil	EB1a104	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Propane	EB1a105	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Wood Pellets	EB1a106	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Cord Wood	EB1a070	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Electric	EB1a071	5	6	6	1.9	2.1	2.3	47.1	53.7	58.7	0.3	0.3	0.4	0.5	0.6	0.6	-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Gas	EB1a072	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Kerosene	EB1a073	13	15	16	-	-	-	-	-	-	-	-	-	-	-	-	10.3	11.8	12.9	258.4	294.5	321.9
B1a - HEA (Weatherization	Insulated Door, Oil	EB1a074	43	49	54	-	-	-	-	-	-	-	-	-	-	-	-	40.4	46.0	50.3	1,008.9	1,150.1	1,257.1
B1a - HEA (Weatherization	Insulated Door, Propane	EB1a075	45	51	56	-	-	-	-	-	-	-	-	-	-	-	-	31.8	36.3	39.6	795.2	906.5	990.8
B1a - HEA (Weatherization	Insulated Door, Wood Pellets	EB1a076	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Cooling, Electric, SF New Construction	EB1a107	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Cooling, Electric, MF New Construction	EB1a116	150	135	122	14.1	12.7	11.4	353.4	318.1	286.2	-	-	-	7.8	7.0	6.3	-	-	-	-	-	-
B1a - HEA (Weatherization	Heating, Electric, SF New Construction	EB1a108	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Heating, Electric, MF New Construction	EB1a117	150	135	122	206.6	185.9	167.4	5,165.1	4,648.6	4,183.8	65.6	59.0	53.1	-	-	-	-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water, Electric, SF New Construction	EB1a112	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water, Electric, MF New Construction	EB1a121	150	135	122	69.8	62.8	56.5	1,046.5	941.8	847.6	13.7	12.3	11.1	5.3	4.8	4.3	-	-	-	-	-	-
B1a - HEA (Weatherization	Heating, Propane, SF New Construction	EB1a111	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water, Propane, SF New Construction	EB1a114	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Boiler Replacement, Gas	EB1b001	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Boiler Replacement, Kerosene	EB1b002	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Boiler Replacement, Oil	EB1b003	30	34	37	0.8	0.9	1.0	14.9	17.0	18.6	0.2	0.3	0.3	-	-	-	475.9	542.5	592.9	9,041.4	10,307.2	11,265.8
B1b - HEA (HVAC System	Boiler Replacement, Propane	EB1b004	7	8	9	3.2	3.6	3.9	60.1	68.5	74.9	0.9	1.1	1.2	-	-	-	73.6	83.9	91.7	1,398.1	1,593.8	1,742.1
B1b - HEA (HVAC System	Furnace Replacement, Gas	EB1b005	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Furnace Replacement, Kerosene	EB1b006	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Furnace Replacement, Oil	EB1b007	8	9	10	1.0	1.1	1.2	16.2	18.4	20.1	0.2	0.2	0.3	-	-	-	118.2	134.7	147.2	2,008.8	2,290.0	2,503.0
B1b - HEA (HVAC System	Furnace Replacement, Propane	EB1b008	4	5	5	0.5	0.5	0.6	8.1	9.2	10.1	0.1	0.1	0.1	-	-	-	38.8	44.3	48.4	660.2	752.6	822.6
B1b - HEA (HVAC System	Programmable Thermostat, Electric	EB1b009	9	10	11	2.1	2.3	2.6	30.8	35.2	38.4	1.6	1.8	1.9	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC System	Programmable Thermostat, Gas	EB1b010	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Programmable Thermostat, Kerosene	EB1b011	17	19	21	-	-	-	-	-	-	-	-	-	-	-	-	31.9	36.3	39.7	478.0	544.9	595.6
B1b - HEA (HVAC System	Programmable Thermostat, Oil	EB1b012	32	36	40	-	-	-	-	-	-	-	-	-	-	-	-	60.3	68.7	75.1	904.2	1,030.8	1,126.6
B1b - HEA (HVAC System	Programmable Thermostat, Propane	EB1b013	4	5	5	-	-	-	-	-	-	-	-	-	-	-	-	7.5	8.5	9.3	112.5	128.2	140.1
B1b - HEA (HVAC System	Programmable Thermostat, Wood Pellets	EB1b014	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1.9	2.1	2.3	28.1	32.1	35.0
B1b - HEA (HVAC System	Wifi Thermostat, Electric	EB1b015	56	64	70	21.4	24.3	26.6	320.3	365.1	399.1	-	-	-	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC System	Wifi Thermostat, Gas	EB1b016	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Wifi Thermostat, Kerosene	EB1b017	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Wifi Thermostat, Oil	EB1b018	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	5.4	6.1	6.7	80.5	91.8	100.3
B1b - HEA (HVAC System	Wifi Thermostat, Propane	EB1b019	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Wifi Thermostat, Wood Pellets	EB1b020	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Mini Split HP (cooling)	EB1b021	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC System	Mini Split HP (heating)	EB1b022	61	70	76	241.2	275.0	300.6	4,342.0	4,949.9	5,410.3	76.6	87.3	95.4	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC System	ES Central AC	EB1b023	1	1	1	3.5	4.0	4.4	63.1	71.9	78.6	-	-	-	1.9	2.2	2.4	-	-	-	-	-	-
B1b - HEA (HVAC System	Oil K1 HVAC Repair or Cleaning	EB1b024	22	25	27	2.3	2.6	2.9	2.3	2.6	2.9	0.7	0.8	0.8	-	-	-	52.1	59.4	65.0	52.1	59.4	65.0
B1b - HEA (HVAC System	Gas LP HVAC Repair or Cleaning	EB1b025	11	13	14	0.6	0.7	0.7	1.1	1.3	1.4	0.2	0.2	0.2	-	-	-	44.2	50.3	55.0	88.3	100.7	110.1
B1b - HEA (HVAC System	GSHP HVAC Repair or Cleaning	EB1b026	-	-	-													-	-	-	-	-	-
	Home Energy Assistance Subtotal					**2,730.0**	**3,042.5**	**3,275.0**	**36,091.9**	**39,569.1**	**42,108.7**	**495.2**	**545.5**	**582.5**	**410.4**	**464.8**	**505.7**	**8,509.8**	**9,701.2**	**10,603.4**	**210,584.0**	**240,065.7**	**262,391.8**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	EA1a001	405	433	455	40.9	43.8	45.9	1,022.3	1,093.8	1,148.5	-	-	-	22.5	24.1	25.3	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, SF	EA1a002	72	77	81	629.1	673.1	706.8	15,727.4	16,828.3	17,669.7	199.7	213.7	224.4	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, SF	EA1a003	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Oil, SF	EA1a004	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, SF	EA1a005	430	460	464	115.5	123.6	124.9	2,888.2	3,090.4	3,121.3	36.7	39.2	39.6	-	-	-	14,984.6	16,033.6	16,193.9	374,615.7	400,838.8	404,847.2
A1a - ES Homes	Heating, Wood Pellets, SF	EA1a006	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, SF	EA1a007	63	67	71	78.5	83.9	88.1	1,176.9	1,259.2	1,322.2	15.4	16.5	17.3	6.0	6.4	6.7	-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, SF	EA1a008	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Oil, SF	EA1a009	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, SF	EA1a010	363	388	392	39.1	41.8	42.2	586.0	627.0	633.2	5.6	6.0	6.0	3.0	3.2	3.2	1,904.7	2,038.1	2,058.5	28,571.1	30,571.1	30,876.8
A1a - ES Homes	Hot Water, Wood Pellets, SF	EA1a011	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Cooling, Electric, MF	EA1a012	468	500	525	46.9	50.1	52.6	1,171.3	1,253.3	1,315.9	-	-	-	25.8	27.6	29.0	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, MF	EA1a013	460	493	517	563.0	602.4	632.5	14,074.2	15,059.4	15,812.3	178.7	191.2	200.8	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, MF	EA1a014	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Oil, MF	EA1a015	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, MF	EA1a016	31	33	33	1.0	1.0	1.0	24.1	25.8	26.0	0.3	0.3	0.3	-	-	-	438.1	468.7	473.4	10,951.7	11,718.3	11,835.5
A1a - ES Homes	Heating, Wood Pellets, MF	EA1a017	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, MF	EA1a018	31	33	35	14.5	15.5	16.3	217.6	232.8	244.5	2.9	3.1	3.2	1.1	1.2	1.2	-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, MF	EA1a019	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Oil, MF	EA1a020	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, MF	EA1a021	278	298	301	-	-	-	-	-	-	-	-	-	-	-	-	2,029.2	2,171.3	2,193.0	30,438.5	32,569.2	32,894.9
A1a - ES Homes	Hot Water, Wood Pellets, MF	EA1a022	-	-	-													-	-	-	-	-	-
A1a - ES Homes	LED Bulb	EA1a023	-	-	-													-	-	-	-	-	-
A1a - ES Homes	LED Fixture	EA1a024	546	584	607	13.1	14.0	14.6	39.3	42.1	43.7	2.8	3.0	3.1	1.8	2.0	2.0	(29.8)	(31.9)	(33.1)	(89.3)	(95.6)	(99.4)
A1a - ES Homes	Refrigerator	EA1a025	613	656	682	27.1	29.0	30.1	325.1	347.8	361.7	3.1	3.3	3.4	3.8	4.1	4.2	-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	EA1a026	177	190	197	15.9	17.0	17.7	175.2	187.5	195.0	25.7	27.5	28.6	24.3	26.0	27.0	8.9	9.5	9.9	97.4	104.3	108.4
A1a - ES Homes	Clothes Dryer	EA1a027	172	184	191	27.6	29.5	30.7	331.1	354.3	368.4	4.7	5.0	5.2	3.6	3.9	4.0	-	-	-	-	-	-
A1a - ES Homes	HERS - Lighting and Appliances	EA1a028	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Residential New Construction Code Compliance	EA1a029	-	-	-													-	-	-	-	-	-
	ES Homes Subtotal					**1,612.0**	**1,724.9**	**1,803.6**	**37,758.5**	**40,401.6**	**42,262.6**	**475.6**	**508.9**	**532.1**	**91.9**	**98.4**	**102.8**	**19,335.8**	**20,689.3**	**20,895.5**	**444,585.1**	**475,706.1**	**480,463.4**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (	Air Sealing, Cord Wood	EA2a001	51	53	56	4.7	4.9	5.1	70.1	72.9	76.6	-	-	-	2.6	2.7	2.8	794.4	817.9	832.8	11,916.0	12,268.7	12,491.7
A2a - Home Performance (	Air Sealing, Electric	EA2a002	56	58	61	57.9	60.2	63.2	868.1	902.8	947.9	9.1	9.5	9.9	15.2	15.8	16.6	-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Gas	EA2a003	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Kerosene	EA2a004	8	8	9	-	-	-	-	-	-	-	-	-	-	-	-	28.8	29.7	30.2	432.7	445.5	453.6
A2a - Home Performance (	Air Sealing, Oil	EA2a005	687	714	750	6.9	7.2	7.5	103.7	107.8	113.2	-	-	-	3.8	4.0	4.2	9,439.5	9,718.9	9,895.6	141,592.8	145,783.9	148,434.5
A2a - Home Performance (	Air Sealing, Propane	EA2a006	154	160	168	15.6	16.2	17.0	233.7	243.1	255.2	-	-	-	8.6	8.9	9.4	1,680.5	1,730.2	1,761.7	25,207.4	25,953.6	26,425.5
A2a - Home Performance (	Air Sealing, Wood Pellets	EA2a007	21	22	23	1.9	2.0	2.1	28.9	30.0	31.5	-	-	-	1.1	1.1	1.2	327.1	336.8	342.9	4,906.6	5,051.8	5,143.7
A2a - Home Performance (	Duct Sealing, Cord Wood	EA2a070	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Electric	EA2a071	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Gas	EA2a072	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Kerosene	EA2a073	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Oil	EA2a074	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Propane	EA2a075	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Wood Pellets	EA2a076	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Electric	EA2a009	43	45	48	1.9	2.0	2.1	13.4	13.9	14.9	0.4	0.4	0.4	0.1	0.2	0.2	-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Gas	EA2a010	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Kerosene	EA2a011	6	6	7	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.2	7.4	7.7	8.1
A2a - Home Performance (	Faucet Aerator, Oil	EA2a012	99	103	108	-	-	-	-	-	-	-	-	-	-	-	-	17.4	18.1	19.0	122.0	126.9	133.2
A2a - Home Performance (	Faucet Aerator, Propane	EA2a013	35	36	38	-	-	-	-	-	-	-	-	-	-	-	-	6.2	6.4	6.7	43.1	44.9	47.1
A2a - Home Performance (	Tank Wrap, Electric	EA2a077	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Gas	EA2a078	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Kerosene	EA2a079	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Oil	EA2a080	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Propane	EA2a081	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Electric	EA2a016	19	20	21	2.6	2.7	2.9	39.2	40.8	43.8	0.5	0.5	0.6	0.2	0.2	0.2	-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Gas	EA2a017	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Kerosene	EA2a018	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	2.9	3.0	3.1	42.9	44.6	46.8
A2a - Home Performance (	Hand Held Showerhead, Oil	EA2a019	43	45	47	-	-	-	-	-	-	-	-	-	-	-	-	30.7	31.9	33.5	460.8	479.2	503.2
A2a - Home Performance (	Hand Held Showerhead, Propane	EA2a020	15	16	16	-	-	-	-	-	-	-	-	-	-	-	-	10.7	11.1	11.7	160.7	167.2	175.5
A2a - Home Performance (	Insulation, Cord Wood	EA2a022	51	53	56	8.4	8.7	9.2	209.9	218.2	229.2	-	-	-	4.6	4.8	5.1	1,041.4	1,072.3	1,091.8	26,036.2	26,806.9	27,294.3
A2a - Home Performance (	Insulation, Electric	EA2a023	118	123	129	190.5	198.1	208.0	4,762.3	4,952.8	5,200.4	30.0	31.2	32.7	50.1	52.1	54.7	-	-	-	-	-	-
A2a - Home Performance (	Insulation, Gas	EA2a024	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Kerosene	EA2a025	8	8	9	-	-	-	-	-	-	-	-	-	-	-	-	66.1	68.1	69.3	1,652.7	1,701.7	1,732.6
A2a - Home Performance (	Insulation, Oil	EA2a026	687	714	750	58.3	60.6	63.6	1,456.7	1,515.0	1,590.7	-	-	-	32.1	33.4	35.1	10,200.6	10,502.6	10,693.5	255,015.8	262,564.3	267,338.2
A2a - Home Performance (	Insulation, Propane	EA2a027	152	158	166	23.4	24.3	25.5	584.5	607.9	638.3	-	-	-	12.9	13.4	14.1	2,065.0	2,126.2	2,164.8	51,625.9	53,154.0	54,120.4
A2a - Home Performance (	Insulation, Wood Pellets	EA2a028	23	24	25	3.8	3.9	4.1	94.6	98.4	103.3	-	-	-	2.1	2.2	2.3	469.7	483.6	492.4	11,741.8	12,089.4	12,309.2
A2a - Home Performance (	Duct Insulation, Cord Wood	EA2a063	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Electric	EA2a064	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Gas	EA2a065	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Kerosene	EA2a066	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Oil	EA2a067	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Propane	EA2a068	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Wood Pellets	EA2a069	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Electric	EA2a030	15	16	17	2.1	2.1	2.3	30.9	32.2	34.6	0.4	0.4	0.5	0.2	0.2	0.2	-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Gas	EA2a031	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Kerosene	EA2a032	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Oil	EA2a033	37	38	40	-	-	-	-	-	-	-	-	-	-	-	-	26.4	27.5	28.9	396.5	412.4	433.0
A2a - Home Performance (	Low Flow Showerhead, Propane	EA2a034	11	11	12	-	-	-	-	-	-	-	-	-	-	-	-	7.9	8.2	8.6	117.9	122.6	128.7
A2a - Home Performance (	Pipe Insulation - Hot Water, Electric	EA2a037	84	87	94	4.6	4.8	5.2	69.4	72.2	77.6	0.9	0.9	1.0	0.4	0.4	0.4	-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Gas	EA2a038	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Kerosene	EA2a039	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Oil	EA2a040	230	239	251	4.4	4.5	4.8	65.3	67.9	71.3	0.6	0.6	0.7	0.3	0.3	0.4	85.2	87.7	89.3	1,277.9	1,315.8	1,339.7
A2a - Home Performance (	Pipe Insulation - Hot Water, Propane	EA2a041	107	111	117	1.0	1.0	1.1	14.9	15.5	16.3	0.1	0.1	0.2	0.1	0.1	0.1	6.4	6.6	6.8	96.6	99.5	101.3
A2a - Home Performance (	Hot Water Setback, Electric	EA2a042	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Gas	EA2a059	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Kerosene	EA2a060	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Oil	EA2a061	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Propane	EA2a062	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	DHW Heat Pump Water Heater	EA2a043	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Indirect Water Heater, Oil	EA2a082	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Indirect Water Heater, Propane	EA2a083	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, General Service Lamps	EA2a044	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Linear	EA2a045	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Other Specialty	EA2a046	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Reflector	EA2a047	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Fixture	EA2a048	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (	Refrigerator	EA2a049	37	38	40	19.1	19.9	20.9	229.6	238.8	250.7	2.2	2.3	2.4	2.7	2.8	2.9	-	-	-	-	-	-
A2a - Home Performance (	Freezer	EA2a053	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Clothes Washer	EA2a054	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Clothes Dryer	EA2a055	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Dehumidifier	EA2a056	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Room Air Conditioner	EA2a057	27	28	50	2.9	3.0	5.4	26.1	27.1	48.3	-	-	-	1.5	1.6	2.8	-	-	-	-	-	-
A2a - Home Performance (	Triple Pane Window	EA2a058	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Cord Wood	EA2a084	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Electric	EA2a085	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Gas	EA2a086	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Kerosene	EA2a087	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Oil	EA2a088	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Propane	EA2a089	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Wood Pellets	EA2a090	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Oil Savings	EA2a050	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Propane Savings	EA2a051	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Electric Savings	EA2a052	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Electric (Multifamily)	EA2a091	18	22	25	11.2	13.4	15.2	167.4	200.9	228.0	1.8	2.1	2.4	2.9	3.5	4.0	-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Gas (Multifamily)	EA2a092	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Oil (Multifamily)	EA2a093	18	22	25	0.1	0.1	0.1	1.6	2.0	2.2	-	-	-	0.1	0.1	0.1	141.0	152.3	155.5	2,114.6	2,283.8	2,332.9
A2a - Home Performance (	Air Sealing, Propane (Multifamily)	EA2a094	5	6	7	0.3	0.4	0.4	4.6	5.5	6.2	-	-	-	0.2	0.2	0.2	31.1	33.6	34.3	466.5	503.8	514.7
A2a - Home Performance (	Insulation, Electric (Multifamily)	EA2a095	18	22	25	26.2	31.4	35.6	653.8	784.6	890.5	4.1	4.9	5.6	6.9	8.3	9.4	-	-	-	-	-	-
A2a - Home Performance (	Insulation, Gas (Multifamily)	EA2a096	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Oil (Multifamily)	EA2a097	18	22	25	1.4	1.6	1.9	34.3	41.2	46.8	-	-	-	0.8	0.9	1.0	228.5	246.8	252.1	5,712.8	6,169.8	6,302.5
A2a - Home Performance (	Insulation, Propane (Multifamily)	EA2a098	5	6	7	0.7	0.8	0.9	17.3	20.8	23.6	-	-	-	0.4	0.5	0.5	58.1	62.7	64.1	1,452.0	1,568.1	1,601.9
A2a - Home Performance (	LED Bulb, General Service Lamps (Multifamily)	EA2a099	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Linear (Multifamily)	EA2a100	266	319	362	83.4	100.1	113.6	584.0	700.8	795.4	18.0	21.6	24.5	11.6	13.9	15.8	(197.4)	(236.9)	(268.9)	(1,382.1)	(1,658.5)	(1,882.4)
A2a - Home Performance (	LED Bulb, Other Specialty (Multifamily)	EA2a101	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Reflector (Multifamily)	EA2a102	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	LED Fixture (Multifamily)	EA2a103	-	-	-													-	-	-	-	-	-
A2a - Home Performance (	Refrigerator (Multifamily)	EA2a104	13	15	17	6.7	7.7	8.8	80.7	92.8	105.3	0.8	0.9	1.0	0.9	1.1	1.2	-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Gas	EA2b001	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Kerosene	EA2b002	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Oil	EA2b003	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Propane	EA2b004	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Gas	EA2b005	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Kerosene	EA2b006	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Oil	EA2b007	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Propane	EA2b008	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Electric	EA2b009	33	34	37	7.9	8.2	8.8	118.1	122.8	132.0	6.0	6.2	6.7	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Gas	EA2b010	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Kerosene	EA2b011	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	4.6	4.8	5.1	69.7	72.5	76.2
A2b - Home Performance (	Programmable Thermostat, Oil	EA2b012	101	105	110	-	-	-	-	-	-	-	-	-	-	-	-	236.0	245.4	257.7	3,539.3	3,680.9	3,865.0
A2b - Home Performance (	Programmable Thermostat, Propane	EA2b013	21	22	23	-	-	-	-	-	-	-	-	-	-	-	-	48.8	50.8	53.3	732.3	761.6	799.7
A2b - Home Performance (	Programmable Thermostat, Wood Pellets	EA2b014	11	11	12	-	-	-	-	-	-	-	-	-	-	-	-	25.6	26.6	27.9	383.6	399.0	418.9
A2b - Home Performance (	Wifi Thermostat, Electric	EA2b015	64	67	70	25.5	26.5	27.8	382.3	397.6	417.5	-	-	-	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Gas	EA2b016	-	-	-													-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Kerosene	EA2b017	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	7.0	7.3	7.6	105.0	109.2	114.6
A2b - Home Performance (	Wifi Thermostat, Oil	EA2b018	859	893	938	-	-	-	-	-	-	-	-	-	-	-	-	5,719.9	5,948.7	6,246.1	85,797.9	89,229.8	93,691.3
A2b - Home Performance (	Wifi Thermostat, Propane	EA2b019	291	303	318	-	-	-	-	-	-	-	-	-	-	-	-	1,904.9	1,981.0	2,080.1	28,572.8	29,715.7	31,201.5
A2b - Home Performance (	Wifi Thermostat, Wood Pellets	EA2b020	6	6	7	-	-	-	-	-	-	-	-	-	-	-	-	21.0	21.8	22.9	314.9	327.5	343.8
A2b - Home Performance (	ES Central AC	EA2b021	11	11	20	4.1	4.3	7.5	73.8	76.7	134.1	-	-	-	2.3	2.4	4.1	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Boiler Circulator Pump	EA2b022	707	735	772	57.8	60.1	63.1	1,097.9	1,141.9	1,198.9	17.0	17.7	18.6	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Furnace	EA2b023	323	336	353	2.8	2.9	3.0	49.7	51.7	54.3	0.8	0.8	0.9	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Central AC	EA2b024	124	129	135	6.1	6.4	6.7	110.3	114.7	120.4	-	-	-	3.4	3.5	3.7	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Room AC	EA2b025	542	564	592	26.7	27.7	29.1	479.9	499.1	524.1	-	-	-	13.8	14.4	15.1	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Mini-Split AC / HP	EA2b026	-	-	-													-	-	-	-	-	-
	Home Performance with Energy Star Subtotal					**670.6**	**717.9**	**772.7**	**12,756.9**	**13,510.1**	**14,423.2**	**92.7**	**100.3**	**108.1**	**181.8**	**192.8**	**207.7**	**34,537.1**	**35,632.8**	**36,521.7**	**660,733.2**	**681,803.6**	**698,040.8**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A3b - ES Appliances and F	LED Bulb, General Service Lamps	EA3a001	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Linear	EA3a002	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Other Specialty	EA3a003	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Reflector	EA3a004	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, General Service Lamps (Hard to Reach)	EA3a005	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Linear (Hard to Reach)	EA3a006	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Other Specialty (Hard to Reach)	EA3a007	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Bulb, Reflector (Hard to Reach)	EA3a008	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Fixture	EA3a009	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	LED Fixture (Hard to Reach)	EA3a010	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	Advanced Power Strip, Tier I	EA3b001	702	1,053	1,580	56.3	84.4	126.6	281.4	422.1	633.2	4.6	6.9	10.4	3.1	4.7	7.0	-	-	-	-	-	-
A3b - ES Appliances and F	Advanced Power Strip, Tier II	EA3b002	248	372	558	39.2	58.8	88.2	196.0	294.0	441.0	3.9	5.9	8.8	2.6	4.0	6.0	-	-	-	-	-	-
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (cooling)	EA3b003	92	106	120	14.8	17.0	19.2	265.7	305.6	345.3	-	-	-	8.1	9.4	10.6	-	-	-	-	-	-
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (heating)	EA3b004	92	106	120	58.1	66.8	75.5	1,045.4	1,202.2	1,358.5	26.4	30.4	34.3	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (cooling)	EA3b005	2,692	3,096	3,498	249.2	286.6	323.9	4,486.1	5,159.0	5,829.7	-	-	-	115.2	132.5	149.7	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (heating)	EA3b006	2,692	3,096	3,498	765.2	879.9	994.3	13,772.9	15,838.8	17,897.8	347.8	400.0	452.0	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Downstream	EA3b007	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Downstream	EA3b008	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	Heat Pump Swimming Pool Heater	EA3b009	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	ES Clothes Dryers	EA3b010	1,306	1,502	1,652	209.5	240.9	265.0	2,513.8	2,890.9	3,179.9	35.7	41.1	45.2	27.5	31.6	34.8	-	-	-	-	-	-
A3b - ES Appliances and F	Dryer Heat Pump	EA3b011	65	70	77	27.4	29.3	32.2	328.5	351.5	386.6	4.7	5.0	5.5	3.6	3.8	4.2	-	-	-	-	-	-
A3b - ES Appliances and F	Dryer Hybrid	EA3b012	8	9	9	1.7	1.8	2.0	20.5	21.9	24.1	0.3	0.3	0.3	0.2	0.2	0.3	-	-	-	-	-	-
A3b - ES Appliances and F	ECM Motor for FWH Circulating Pump	EA3b013	177	189	208	8.3	8.9	9.8	124.6	133.3	146.6	2.9	3.1	3.4	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	ES AC (central) 3 ton	EA3b015	134	143	157	24.8	26.5	29.2	445.9	477.2	524.9	-	-	-	13.7	14.6	16.1	-	-	-	-	-	-
A3b - ES Appliances and F	Room Air Conditioner	EA3b016	507	542	597	18.3	19.5	21.5	164.3	175.8	193.4	-	-	-	9.5	10.1	11.1	-	-	-	-	-	-
A3b - ES Appliances and F	ES Clothes Washers	EA3b017	1,239	1,326	1,459	111.4	119.2	131.1	1,225.6	1,311.4	1,442.5	15.6	16.7	18.4	14.8	15.8	17.4	86.8	92.8	102.1	954.3	1,021.1	1,123.2
A3b - ES Appliances and F	Washer Tier CEE Tier 2+	EA3b018	893	955	1,051	124.0	132.7	145.9	1,363.9	1,459.4	1,605.3	17.4	18.6	20.5	16.4	17.6	19.3	428.5	458.5	504.3	4,713.3	5,043.2	5,547.5
A3b - ES Appliances and F	ES Dehumidifier	EA3b019	1,094	1,171	1,288	90.1	96.4	106.0	1,080.8	1,156.4	1,272.1	3.6	3.9	4.3	17.3	18.5	20.3	-	-	-	-	-	-
A3b - ES Appliances and F	ES Dishwasher	EA3b020	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	ES Freezers	EA3b021	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and F	Refrigerator	EA3b022	1,425	1,525	1,678	63.0	67.4	74.2	756.0	808.9	889.8	7.2	7.7	8.5	8.8	9.4	10.4	-	-	-	-	-	-
A3b - ES Appliances and F	Refrigerator CEE Tier 2+	EA3b023	469	502	552	45.2	48.4	53.3	542.9	580.9	639.0	5.2	5.5	6.1	6.3	6.8	7.5	-	-	-	-	-	-
A3b - ES Appliances and F	ES Pool Pumps (Variable Speed)	EA3b024	403	431	475	63.6	68.0	74.8	381.4	408.1	448.9	-	-	-	36.7	39.3	43.2	-	-	-	-	-	-
A3b - ES Appliances and F	Room Air Purifier	EA3b025	569	608	669	393.3	420.8	462.9	3,539.7	3,787.4	4,166.2	44.9	48.0	52.8	44.9	48.0	52.8	-	-	-	-	-	-
A3c - ES HVAC Systems	Wifi Thermostat (Heating & Cooling)	EA3b026	343	367	404	15.8	16.9	18.6	236.7	253.2	278.6	2.5	2.7	2.9	-	-	-	1,687.6	1,805.7	1,986.3	25,313.4	27,085.3	29,793.9
A3b - ES Appliances and F	Primary Refrigerator Recycling	EA3b027	650	780	858	653.3	783.9	862.3	3,266.3	3,919.5	4,311.5	74.6	89.5	98.5	91.5	109.8	120.8	-	-	-	-	-	-
A3b - ES Appliances and F	Secondary Refrigerator Recycling	EA3b028	365	438	482	366.8	440.2	484.2	1,834.1	2,201.0	2,421.0	34.4	41.2	45.4	57.3	68.8	75.6	-	-	-	-	-	-
A3b - ES Appliances and F	Secondary Freezer Recycling	EA3b029	213	255	281	160.0	192.0	211.2	640.1	768.1	844.9	20.1	24.1	26.5	27.1	32.6	35.8	-	-	-	-	-	-
A3b - ES Appliances and F	Room Air Conditioner Recycling	EA3b030	180	216	238	20.3	24.4	26.8	61.0	73.2	80.5	-	-	-	14.8	17.7	19.5	-	-	-	-	-	-
A3b - ES Appliances and F	Dehumidifier Recycling	EA3b037	180	216	238	90.0	108.0	118.8	360.0	432.0	475.2	3.6	4.3	4.8	17.3	20.7	22.8	-	-	-	-	-	-
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit Resistance	EA3b031	300	381	417	1,419.9	1,803.3	1,973.7	25,558.1	32,458.7	35,525.7	1,100.4	1,397.5	1,529.5	514.7	653.7	715.4	-	-	-	-	-	-
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit HP	EA3b032	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit HP	EA3b033	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit Resistance	EA3b034	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Midstream	EA3b035	1,168	1,285	1,414	864.2	950.7	1,046.3	12,963.7	14,260.1	15,694.8	141.8	156.0	171.7	78.4	86.3	94.9	1,932.6	2,125.9	2,339.8	28,989.6	31,888.6	35,096.8
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Midstream	EA3b036	172	189	208	74.6	82.1	90.5	1,119.5	1,231.4	1,357.4	12.2	13.5	14.9	6.8	7.4	8.2	283.9	312.3	344.2	4,258.0	4,683.8	5,162.8
	ES Products Subtotal					**6,028.2**	**7,074.8**	**7,867.9**	**78,574.7**	**92,382.0**	**102,414.4**	**1,910.0**	**2,322.1**	**2,564.7**	**1,136.7**	**1,363.3**	**1,503.8**	**4,419.3**	**4,795.2**	**5,276.7**	**64,228.6**	**69,722.1**	**76,724.2**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Compressed Air Retro	EC1a001	2	2	2	624.9	606.1	587.9	9,372.8	9,091.6	8,818.9	69.4	67.3	65.3	69.4	67.3	65.3	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Hot Water Retro	EC1a002	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large HVAC Retro	EC1a003	5	5	5	65.3	63.4	61.5	620.6	602.0	584.0	21.7	9.3	9.0	17.9	7.6	7.4	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Interior	EC1a004	52	50	49	6,714.4	6,513.0	6,317.6	33,571.9	32,564.8	31,587.8	820.0	795.4	771.5	1,075.4	1,043.1	1,011.8	(4,040.5)	(3,919.3)	(3,801.7)	(20,202.6)	(19,596.6)	(19,008.7)
C1a - LCI Retrofit	Custom Large Lighting Retro - Exterior	EC1a047	21	21	20	2,706.4	2,625.2	2,546.4	10,825.5	10,500.7	10,185.7	541.8	525.6	509.8	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Controls	EC1a048	3	3	3	27.0	26.2	25.4	242.6	235.4	228.3	0.4	0.3	0.3	0.4	0.4	0.4	(64.1)	(62.1)	(60.3)	(576.5)	(559.2)	(542.4)
C1a - LCI Retrofit	Custom Large Motors Retro	EC1a005	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Process Retro	EC1a006	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Refrigeration Retro	EC1a007	15	14	14	1,113.0	1,079.6	1,047.2	10,455.8	10,142.1	9,837.9	157.5	118.8	115.2	143.2	108.0	104.7	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Other Retro	EC1a008	5	5	5	2,660.4	2,580.6	2,503.1	30,559.0	29,642.2	28,752.9	293.0	274.1	265.9	277.0	259.1	251.3	-	-	-	-	-	-
C1a - LCI Retrofit	Daylight Dimming	EC1a009	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC1a010	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC1a011	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/ Controls	EC1a012	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/o Controls	EC1a013	28	27	26	598.7	580.7	563.3	2,993.4	2,903.6	2,816.5	46.6	45.2	43.9	60.4	58.6	56.8	(414.1)	(401.7)	(389.6)	(2,070.5)	(2,008.4)	(1,948.2)
C1a - LCI Retrofit	Lighting Occupancy Sensors	EC1a014	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Case Motor Replacement	EC1a016	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Cooler Night Cover	EC1a017	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Demand Control Ventilation	EC1a018	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Door Heater Controls	EC1a019	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC1a020	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Duct Sealing, Electric	EC1a021	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Ductless Mini Split Heat Pump	EC1a022	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC1a023	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Electronic Defrost Control	EC1a024	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Management System, Electric	EC1a025	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Star Wifi Thermostat, Electric	EC1a026	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Evaporator Fan Control	EC1a027	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Faucet Aerator, Electric	EC1a028	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Hotel Occupancy Sensor	EC1a031	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low Pressure Drop Filter	EC1a032	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC1a033	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low-Flow Showerhead, Electric	EC1a034	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Open Drip	EC1a035	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC1a036	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Novelty Cooler Shutoff	EC1a037	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Heating, Electric	EC1a038	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Hot Water, Electric	EC1a039	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pre Rinse Spray Valve, Electric	EC1a040	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Programmable Thermostat, Electric	EC1a041	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Steam Trap, Electric	EC1a042	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive	EC1a043	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive with Motor	EC1a044	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Vending Miser	EC1a045	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Zero Loss Condensate Drain	EC1a046	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Large Retrocommissioning	EC1a049	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC1a050	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Compressed Air New	EC1b001	2	2	2	1,444.9	1,401.5	1,359.5	21,177.4	20,542.1	19,925.8	165.0	155.7	151.1	165.0	155.7	151.1	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Hot Water New	EC1b002	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large HVAC New	EC1b003	16	15	15	215.3	208.8	202.5	4,153.0	4,028.4	3,907.5	8.9	13.9	13.4	23.2	35.9	34.9	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Lighting New - Interior	EC1b004	48	46	44	1,568.9	1,506.2	1,461.0	23,534.2	22,592.9	21,915.1	191.6	183.9	178.4	251.3	241.2	234.0	(221.7)	(212.9)	(206.5)	(3,326.0)	(3,192.9)	(3,097.1)
C1b - LCI New Equipment	Custom Large Lighting New - Exterior	EC1b054	11	10	10	185.0	177.6	172.2	2,774.5	2,663.5	2,583.6	37.0	35.5	34.5	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Lighting New - Controls	EC1b055	1	1	1	2.1	2.0	2.0	21.2	20.4	19.8	0.0	0.0	0.0	0.0	0.0	0.0	(5.0)	(4.8)	(4.7)	(50.4)	(48.4)	(47.0)
C1b - LCI New Equipment	Custom Large Motors New	EC1b005	4	4	4	76.4	73.3	71.1	1,145.7	1,099.9	1,066.9	2.1	6.5	6.3	2.5	7.7	7.5	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Process New	EC1b006	6	6	6	598.3	574.4	557.2	8,974.8	8,615.8	8,357.3	50.2	41.9	40.6	105.9	88.4	85.7	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Refrigeration New	EC1b007	1	1	1	45.5	43.7	42.4	682.9	655.6	635.9	5.8	3.9	3.8	5.8	3.9	3.8	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Other New	EC1b008	11	10	10	2,568.0	2,465.3	2,391.3	36,483.5	35,024.2	33,973.5	253.3	261.9	254.0	239.4	247.5	240.1	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Comprehensive Design	EC1b056	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Daylight Dimming	EC1b009	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Exterior w/ Controls	EC1b010	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Exterior w/o Controls	EC1b011	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Interior w/ Controls	EC1b012	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Interior w/o Controls	EC1b013	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Lighting Occupancy Sensors	EC1b014	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Advanced Power Strip	EC1b015	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Air Compressor	EC1b016	2	2	2	107.0	102.7	99.6	1,604.8	1,540.6	1,494.4	26.5	10.1	9.8	31.7	12.0	11.7	-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1b - LCI New Equipment	Air Nozzle	EC1b017	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Circulator Pump	EC1b018	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Combination Oven, Electric	EC1b019	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Compressor Storage	EC1b020	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Convection Oven, Electric	EC1b021	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Door Type	EC1b022	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Multi Tank Conveyor	EC1b023	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Pot, Pan, Utensil	EC1b024	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Single Tank Conveyor	EC1b025	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Under Counter	EC1b026	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Door Type	EC1b027	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Multi Tank Conveyor	EC1b028	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Single Tank Conveyor	EC1b029	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Under Counter	EC1b030	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Faucet Aerator, Electric	EC1b031	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Fryer Large Vat, Electric	EC1b032	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Fryer Standard Vat, Electric	EC1b033	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Griddle, Electric	EC1b034	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Ground Source Heat Pump	EC1b035	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet 3/4 Size	EC1b036	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet Full Size	EC1b037	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet Half Size	EC1b038	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Ice Making Head	EC1b039	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Remote Cond./Split Unit - Batch	EC1b040	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Remote Cond./Split Unit - Continuous	EC1b041	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Self Contained	EC1b042	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Low Pressure Drop Filter	EC1b043	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Thermostatic Shut-Off Valve, Electric	EC1b044	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Low-Flow Showerhead, Electric	EC1b045	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Pre Rinse Spray Valve, Electric	EC1b046	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Refrigerated Air Dryer	EC1b047	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Steam Cooker, Electric	EC1b048	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Unitary Air Conditioner	EC1b049	5	5	5	49.3	47.3	45.9	591.1	567.4	550.4	-	-	-	3.4	3.2	3.1	-	-	-	-	-	-
C1b - LCI New Equipment	Water Source Heat Pump	EC1b050	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Zero Loss Condensate Drain	EC1b051	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	High Efficiency Chiller - FL	EC1b052	2	2	2	71.3	68.4	66.4	1,638.9	1,573.3	1,526.1	4.4	3.5	3.4	37.6	30.2	29.3	-	-	-	-	-	-
C1b - LCI New Equipment	High Efficiency Chiller - IPLV	EC1b053	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	C&I Large New Construction Code Compliance	EC1b057	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Induction Cooktop Displacing Electric Resistance	EC1b058	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment	Compressed Air Leak Detection	EC1b059	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Circulator Pump	EC1c001	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Demand Control Ventilation	EC1c002	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream DMSHP Systems	EC1c003	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC1c004	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream ECM Fan Motors	EC1c005	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Systems	EC1c006	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Unitary Air Conditioners	EC1c007	10	9	9	8.7	8.3	8.0	104.2	100.1	96.1	-	-	-	0.6	0.6	0.5	-	-	-	-	-	-
C1c - LCI Midstream	Midstream VRF	EC1c008	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Water Source Heat Pump Systems	EC1c009	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Downlight	EC1c010	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Exterior	EC1c011	117	112	108	298.0	286.1	274.6	1,191.9	1,144.3	1,098.5	60.3	57.8	55.5	-	-	-	-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED High Bay/Low Bay	EC1c012	110	106	102	2,311.2	2,218.8	2,130.0	13,867.5	13,312.8	12,780.3	402.2	386.1	370.7	513.6	493.1	473.3	(501.2)	(481.2)	(461.9)	(3,007.4)	(2,887.1)	(2,771.6)
C1c - LCI Midstream	Midstream LED Linear Fixture	EC1c013	209	201	193	469.5	450.8	432.7	2,347.7	2,253.8	2,163.6	53.8	51.6	49.6	68.7	65.9	63.3	(67.0)	(64.3)	(61.8)	(335.1)	(321.7)	(308.8)
C1c - LCI Midstream	Midstream LED Linear Fixture with Controls	EC1c014	53	51	49	356.8	342.5	328.8	1,784.1	1,712.7	1,644.2	40.9	39.2	37.7	52.2	50.1	48.1	(50.9)	(48.9)	(46.9)	(254.6)	(244.5)	(234.7)
C1c - LCI Midstream	Midstream LED Linear Lamp	EC1c015	60	58	56	184.5	177.1	170.1	922.6	885.7	850.3	21.1	20.3	19.5	27.0	25.9	24.9	(26.3)	(25.3)	(24.3)	(131.7)	(126.4)	(121.4)
C1c - LCI Midstream	Midstream LED Screw In	EC1c016	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Stairwell Kit	EC1c017	15	14	14	69.9	67.1	64.4	279.6	268.4	257.7	11.6	11.1	10.7	11.6	11.1	10.7	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Combination Oven, Electric	EC1c018	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Convection Oven, Electric	EC1c019	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Conveyor Broiler	EC1c047	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Deck Oven, Electric	EC1c050	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Door Type	EC1c020	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Multi Tank Convey	EC1c021	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC1c022	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Single Tank Conve	EC1c023	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC1c024	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC1c025	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Conveyo	EC1c026	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conve	EC1c027	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC1c028	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Solid Door	EC1c029	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Glass Door	EC1c030	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Large Vat, Electric	EC1c031	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Standard Vat, Electric	EC1c032	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Griddle, Electric	EC1c033	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hand-Wrap Machine	EC1c051	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream High Efficiency Condensing Unit	EC1c052	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC1c034	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC1c035	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC1c036	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Ice Making Head	EC1c037	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC1c038	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Continu	EC1c039	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Self Contained	EC1c040	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerated Chef Base	EC1c053	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Glass Door	EC1c041	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Solid Door	EC1c042	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Steam Cooker, Electric	EC1c043	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ultra Low-Temp Freezer	EC1c048	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC1c044	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC1c045	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC1c046	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Room Air Purifier	EC1c054	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 1	EC1c055	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 2	EC1c056	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead, Electric	EC1c057	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, E	EC1c058	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC1c059	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Faucet Aerator, Electric	EC1c060	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pipe Wrap, Electric	EC1c061	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC1c062	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP ES Dehumidifier	EC1c063	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Induction Cooktop Displacing Electric Resist	EC1c064	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Compressed Air Direct Install	EC1d001	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Hot Water Direct Install	EC1d002	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large HVAC Direct Install	EC1d003	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Interior	EC1d004	15	14	14	1,260.6	1,210.1	1,173.8	6,302.8	6,050.6	5,869.1	153.9	147.8	143.4	201.9	193.8	188.0	(4,478.9)	(4,299.8)	(4,170.8)	(22,394.7)	(21,498.9)	(20,853.9)
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Exterior	EC1d005	5	5	5	176.7	169.6	164.6	706.8	678.6	658.2	35.4	34.0	32.9	-	-	-	-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Controls	EC1d006	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Motors Direct Install	EC1d007	1	1	1	148.5	142.5	138.2	2,226.9	2,137.9	2,073.7	-	-	-	-	-	-	-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Process Direct Install	EC1d008	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Refrigeration Direct Install	EC1d009	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Other Direct Install	EC1d010	4	4	4	115.7	111.1	107.7	1,708.0	1,639.7	1,590.5	2.6	2.5	2.4	2.5	2.4	2.3	-	-	-	-	-	-
C1d - LCI Direct Install	Daylight Dimming	EC1d011	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC1d012	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC1d013	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/ Controls	EC1d014	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/o Controls	EC1d015	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Occupancy Sensors	EC1d016	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Case Motor Replacement	EC1d018	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Cooler Night Cover	EC1d019	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Demand Control Ventilation	EC1d020	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Door Heater Controls	EC1d021	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC1d022	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Duct Sealing, Electric	EC1d023	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Ductless Mini Split Heat Pump	EC1d024	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC1d025	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Electronic Defrost Control	EC1d026	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Management System, Electric	EC1d027	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Star Wifi Thermostat, Electric	EC1d028	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Evaporator Fan Control	EC1d029	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Faucet Aerator, Electric	EC1d030	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1d - LCI Direct Install	Hotel Occupancy Sensor	EC1d031	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Low Pressure Drop Filter	EC1d032	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC1d033	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Low-Flow Showerhead, Electric	EC1d034	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Open Drip	EC1d035	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC1d036	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Novelty Cooler Shutoff	EC1d037	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Heating, Electric	EC1d038	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Hot Water, Electric	EC1d039	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pre Rinse Spray Valve, Electric	EC1d040	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Programmable Thermostat, Electric	EC1d041	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Steam Trap, Electric	EC1d042	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive	EC1d043	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive with Motor	EC1d044	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Vending Miser	EC1d045	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Zero Loss Condensate Drain	EC1d046	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC1d047	-	-	-													-	-	-	-	-	-
	Large Business Energy Solutions Subtotal					**26,842.0**	**25,930.0**	**25,116.6**	**232,865.8**	**224,790.9**	**217,850.4**	**3,477.0**	**3,303.3**	**3,198.5**	**3,387.5**	**3,212.9**	**3,110.1**	**(9,869.9)**	**(9,520.3)**	**(9,228.5)**	**(52,349.5)**	**(50,484.0)**	**(48,933.7)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Custom Small Compressed Air Retro	EC2a001	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Hot Water Retro	EC2a002	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small HVAC Retro	EC2a003	5	5	5	5.4	5.2	5.1	64.9	63.0	61.4	0.8	0.8	0.7	0.7	0.6	0.6	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Interior	EC2a004	133	129	125	3,035.0	2,944.0	2,870.4	15,175.2	14,720.0	14,352.0	347.4	336.9	328.5	455.5	441.9	430.8	(1,711.6)	(1,660.3)	(1,618.8)	(8,558.1)	(8,301.3)	(8,093.8)
C2a - SCI Retrofit	Custom Small Lighting Retro - Exterior	EC2a047	19	19	18	233.5	226.5	220.8	933.8	905.8	883.2	45.5	44.1	43.0	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Controls	EC2a048	28	27	26	11.1	10.7	10.5	101.5	98.4	96.0	0.1	0.1	0.1	0.2	0.2	0.2	(39.3)	(38.1)	(37.1)	(360.2)	(349.4)	(340.7)
C2a - SCI Retrofit	Custom Small Motors Retro	EC2a005	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Process Retro	EC2a006	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Refrigeration Retro	EC2a007	2	2	2	19.1	18.6	18.1	191.3	185.6	180.9	2.7	2.0	2.0	2.4	1.9	1.8	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Other Retro	EC2a008	5	5	5	1.7	1.7	1.6	29.5	28.6	27.9	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Daylight Dimming	EC2a009	2	2	2	9.9	9.6	9.3	88.8	86.1	84.0	0.1	0.1	0.1	0.2	0.2	0.2	(40.2)	(39.0)	(38.1)	(362.2)	(351.3)	(342.5)
C2a - SCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC2a010	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC2a011	14	13	13	167.7	162.6	158.6	670.6	650.5	634.2	32.6	31.7	30.9	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/ Controls	EC2a012	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/o Controls	EC2a013	1,279	1,241	1,210	2,069.1	2,007.1	1,956.9	10,345.6	10,035.3	9,784.4	151.0	146.5	142.8	222.1	215.4	210.0	(1,341.2)	(1,301.0)	(1,268.5)	(6,706.2)	(6,505.0)	(6,342.4)
C2a - SCI Retrofit	Lighting Occupancy Sensors	EC2a014	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Case Motor Replacement	EC2a016	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Cooler Night Cover	EC2a017	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Demand Control Ventilation	EC2a018	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Door Heater Controls	EC2a019	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC2a020	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Duct Sealing, Electric	EC2a021	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Ductless Mini Split Heat Pump	EC2a022	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC2a023	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Electronic Defrost Control	EC2a024	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Management System, Electric	EC2a025	8	8	8	97.4	94.4	92.1	973.6	944.4	920.7	27.5	9.4	9.2	26.1	9.0	8.7	-	-	-	-	-	-
C2a - SCI Retrofit	Energy Star Wifi Thermostat, Electric	EC2a026	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Evaporator Fan Control	EC2a027	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Faucet Aerator, Electric	EC2a028	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Hotel Occupancy Sensor	EC2a031	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Low Pressure Drop Filter	EC2a032	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC2a033	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Low-Flow Showerhead, Electric	EC2a034	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Open Drip	EC2a035	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC2a036	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Novelty Cooler Shutoff	EC2a037	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Heating, Electric	EC2a038	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Hot Water, Electric	EC2a039	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pre Rinse Spray Valve, Electric	EC2a040	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Programmable Thermostat, Electric	EC2a041	2	2	2	1.5	1.5	1.5	23.0	22.3	21.8	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Steam Trap, Electric	EC2a042	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive	EC2a043	14	13	13	217.4	210.8	205.6	3,260.5	3,162.7	3,083.6	72.9	12.3	12.0	65.2	11.0	10.8	-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive with Motor	EC2a044	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Vending Miser	EC2a045	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Zero Loss Condensate Drain	EC2a046	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Small Retrocommissioning	EC2a049	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC2a050	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Compressed Air New	EC2b001	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Hot Water New	EC2b002	3	3	3	9.5	9.2	9.0	137.1	133.0	129.7	-	-	-	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small HVAC New	EC2b003	22	22	21	149.9	145.4	141.8	2,123.5	2,059.8	2,008.3	15.3	9.6	9.4	39.8	25.0	24.4	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Lighting New - Interior	EC2b004	127	123	120	1,030.4	999.5	974.5	15,456.2	14,992.5	14,617.7	117.9	114.4	111.5	154.7	150.0	146.3	(136.5)	(132.4)	(129.1)	(2,047.0)	(1,985.6)	(1,936.0)
C2b - SCI New Equipment	Custom Small Lighting New - Exterior	EC2b054	7	7	7	28.7	27.8	27.1	429.8	416.9	406.5	5.6	5.4	5.3	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Lighting New - Controls	EC2b055	116	112	109	51.4	49.8	48.6	513.7	498.3	485.9	0.7	0.6	0.6	0.8	0.7	0.7	(182.4)	(176.9)	(172.5)	(1,823.5)	(1,768.8)	(1,724.6)
C2b - SCI New Equipment	Custom Small Motors New	EC2b005	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Process New	EC2b006	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Refrigeration New	EC2b007	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Other New	EC2b008	6	6	6	19.5	18.9	18.4	351.5	340.9	332.4	3.1	0.9	0.9	3.4	1.0	1.0	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Comprehensive Design	EC2b056	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Daylight Dimming	EC2b009	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Exterior w/ Controls	EC2b010	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Exterior w/o Controls	EC2b011	60	59	57	203.3	197.2	192.3	3,049.5	2,958.0	2,884.1	39.6	38.4	37.4	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Interior w/ Controls	EC2b012	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Interior w/o Controls	EC2b013	1,007	977	953	1,667.1	1,617.1	1,576.7	25,006.7	24,256.5	23,650.1	121.7	118.0	115.1	178.9	173.6	169.2	(253.8)	(246.2)	(240.0)	(3,806.8)	(3,692.6)	(3,600.3)
C2b - SCI New Equipment	Lighting Occupancy Sensors	EC2b014	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Advanced Power Strip	EC2b015	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Air Compressor	EC2b016	6	6	6	261.9	254.0	247.7	3,928.0	3,810.2	3,714.9	51.1	24.9	24.3	61.0	29.7	29.0	-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2b - SCI New Equipment	Air Nozzle	EC2b017	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Circulator Pump	EC2b018	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Combination Oven, Electric	EC2b019	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Compressor Storage	EC2b020	1	1	1	4.8	4.6	4.5	81.0	78.6	76.6	0.6	0.6	0.6	0.7	0.7	0.7	-	-	-	-	-	-
C2b - SCI New Equipment	Convection Oven, Electric	EC2b021	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Door Type	EC2b022	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Multi Tank Conveyor	EC2b023	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Pot, Pan, Utensil	EC2b024	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Single Tank Conveyor	EC2b025	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Under Counter	EC2b026	1	1	1	3.4	3.3	3.2	33.6	32.6	31.8	0.5	0.4	0.4	0.5	0.4	0.4	-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Door Type	EC2b027	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Multi Tank Conveyor	EC2b028	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Single Tank Conveyor	EC2b029	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Under Counter	EC2b030	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Faucet Aerator, Electric	EC2b031	1	1	1	0.3	0.3	0.3	3.3	3.2	3.1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C2b - SCI New Equipment	Fryer Large Vat, Electric	EC2b032	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Fryer Standard Vat, Electric	EC2b033	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Griddle, Electric	EC2b034	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Ground Source Heat Pump	EC2b035	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet 3/4 Size	EC2b036	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet Full Size	EC2b037	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet Half Size	EC2b038	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Ice Making Head	EC2b039	1	1	1	1.2	1.1	1.1	9.5	9.2	9.0	0.3	0.3	0.3	0.3	0.3	0.3	-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Remote Cond./Split Unit - Batch	EC2b040	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Remote Cond./Split Unit - Continuous	EC2b041	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Self Contained	EC2b042	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Low Pressure Drop Filter	EC2b043	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Thermostatic Shut-Off Valve, Electric	EC2b044	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Low-Flow Showerhead, Electric	EC2b045	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Pre Rinse Spray Valve, Electric	EC2b046	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Refrigerated Air Dryer	EC2b047	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Steam Cooker, Electric	EC2b048	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Unitary Air Conditioner	EC2b049	7	7	7	85.4	82.8	80.8	1,024.6	993.9	969.0	-	-	-	31.8	5.7	5.5	-	-	-	-	-	-
C2b - SCI New Equipment	Water Source Heat Pump	EC2b050	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Zero Loss Condensate Drain	EC2b051	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	High Efficiency Chiller - FL	EC2b052	3	3	3	10.3	10.0	9.8	237.8	230.6	224.9	0.5	0.5	0.5	4.7	4.4	4.3	-	-	-	-	-	-
C2b - SCI New Equipment	High Efficiency Chiller - IPLV	EC2b053	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	C&I Small New Construction Code Compliance	EC2b057	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Induction Cooktop Displacing Electric Resistance	EC2b058	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment	Compressed Air Leak Detection	EC2b059	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Circulator Pump	EC2c001	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Demand Control Ventilation	EC2c002	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream DMSHP Systems	EC2c003	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC2c004	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream ECM Fan Motors	EC2c005	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Systems	EC2c006	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Unitary Air Conditioners	EC2c007	8	8	7	39.6	38.0	37.0	474.7	455.7	444.3	-	-	-	2.7	2.6	2.5	-	-	-	-	-	-
C2c - SCI Midstream	Midstream VRF	EC2c008	16	15	15	114.2	109.6	106.9	1,370.3	1,315.5	1,282.6	-	-	-	7.8	7.5	7.3	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Water Source Heat Pump Systems	EC2c009	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Downlight	EC2c010	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Exterior	EC2c011	398	382	368	972.5	933.6	900.9	3,889.9	3,734.3	3,603.6	196.7	188.8	182.2	-	-	-	-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED High Bay/Low Bay	EC2c012	1,504	1,444	1,400	16,038.1	15,396.5	14,934.6	96,228.4	92,379.2	89,607.9	2,791.1	2,679.5	2,599.1	3,564.0	3,421.5	3,318.8	(3,478.1)	(3,339.0)	(3,238.8)	(20,868.8)	(20,034.1)	(19,433.0)
C2c - SCI Midstream	Midstream LED Linear Fixture	EC2c013	1,803	1,731	1,671	3,780.9	3,629.7	3,504.4	18,904.5	18,148.3	17,522.2	433.1	415.7	401.4	553.0	530.9	512.5	(539.7)	(518.1)	(500.2)	(2,698.3)	(2,590.3)	(2,501.0)
C2c - SCI Midstream	Midstream LED Linear Fixture with Controls	EC2c014	8	8	8	41.4	39.8	38.6	207.2	198.9	192.9	4.7	4.6	4.4	6.1	5.8	5.6	(5.9)	(5.7)	(5.5)	(29.6)	(28.4)	(27.5)
C2c - SCI Midstream	Midstream LED Linear Lamp	EC2c015	200	192	187	1,079.1	1,036.0	1,004.9	5,395.7	5,179.8	5,024.4	123.6	118.7	115.1	157.8	151.5	147.0	(154.0)	(147.9)	(143.4)	(770.1)	(739.3)	(717.1)
C2c - SCI Midstream	Midstream LED Screw In	EC2c016	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Stairwell Kit	EC2c017	25	24	24	10.9	10.5	10.2	43.7	41.9	40.7	1.8	1.7	1.7	1.8	1.7	1.7	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Combination Oven, Electric	EC2c018	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Convection Oven, Electric	EC2c019	2	2	1	2.7	2.6	2.5	32.8	31.5	30.6	0.6	0.5	0.5	0.6	0.5	0.5	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Conveyor Broiler	EC2c047	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Deck Oven, Electric	EC2c050	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Door Type	EC2c020	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Multi Tank Convey	EC2c021	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC2c022	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Single Tank Conve	EC2c023	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC2c024	3	3	3	8.7	8.3	8.1	86.8	83.3	80.8	1.2	1.1	1.1	1.2	1.1	1.1	-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC2c025	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Conveyo	EC2c026	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conve	EC2c027	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC2c028	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Solid Door	EC2c029	6	6	6	1.2	1.1	1.1	13.9	13.4	13.0	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Glass Door	EC2c030	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Large Vat, Electric	EC2c031	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Standard Vat, Electric	EC2c032	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Griddle, Electric	EC2c033	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hand-Wrap Machine	EC2c051	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream High Efficiency Condensing Unit	EC2c052	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC2c034	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC2c035	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC2c036	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Ice Making Head	EC2c037	5	5	4	4.6	4.4	4.3	36.7	35.2	34.2	1.1	1.1	1.0	1.1	1.1	1.0	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC2c038	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Continu	EC2c039	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Self Contained	EC2c040	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerated Chef Base	EC2c053	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Glass Door	EC2c041	3	3	3	0.7	0.6	0.6	8.0	7.7	7.5	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Solid Door	EC2c042	6	6	6	0.9	0.9	0.9	11.2	10.7	10.4	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Steam Cooker, Electric	EC2c043	3	3	3	17.9	17.2	16.7	215.1	206.5	200.3	5.6	5.4	5.2	5.6	5.4	5.2	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ultra Low-Temp Freezer	EC2c048	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC2c044	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC2c045	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC2c046	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Room Air Purifier	EC2c054	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 1	EC2c055	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 2	EC2c056	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead, Electric	EC2c057	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, E	EC2c058	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC2c059	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Faucet Aerator, Electric	EC2c060	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pipe Wrap, Electric	EC2c061	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC2c062	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP ES Dehumidifier	EC2c063	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Induction Cooktop Displacing Electric Resist	EC2c064	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Compressed Air Direct Install	EC2d001	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Hot Water Direct Install	EC2d002	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small HVAC Direct Install	EC2d003	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Interior	EC2d004	533	517	502	1,372.1	1,330.9	1,291.0	6,860.5	6,654.7	6,455.1	157.0	152.3	147.8	205.9	199.8	193.8	(4,568.9)	(4,431.8)	(4,298.9)	(22,844.4)	(22,159.1)	(21,494.3)
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Exterior	EC2d005	54	52	51	209.6	203.3	197.2	838.2	813.1	788.7	40.8	39.6	38.4	-	-	-	-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Controls	EC2d006	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Motors Direct Install	EC2d007	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Process Direct Install	EC2d008	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Refrigeration Direct Install	EC2d009	20	20	19	194.2	188.3	182.7	1,941.5	1,883.3	1,826.8	21.4	20.7	20.1	19.4	18.8	18.3	-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Other Direct Install	EC2d010	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Daylight Dimming	EC2d011	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC2d012	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC2d013	24	24	23	198.8	192.9	187.1	994.2	964.3	935.4	38.7	37.6	36.4	-	-	-	-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Interior w/ Controls	EC2d014	12	11	11	517.1	501.6	486.5	4,653.7	4,514.0	4,378.6	37.7	36.6	35.5	55.5	53.8	52.2	(1,979.0)	(1,919.7)	(1,862.1)	(17,811.4)	(17,277.0)	(16,758.7)
C2d - SCI Direct Install	Lighting Fixture - Interior w/o Controls	EC2d015	31	30	29	88.9	86.3	83.7	355.7	345.1	334.7	6.5	6.3	6.1	9.5	9.3	9.0	(340.4)	(330.2)	(320.3)	(1,361.5)	(1,320.7)	(1,281.0)
C2d - SCI Direct Install	Lighting Occupancy Sensors	EC2d016	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Case Motor Replacement	EC2d018	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Cooler Night Cover	EC2d019	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Demand Control Ventilation	EC2d020	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Door Heater Controls	EC2d021	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC2d022	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Duct Sealing, Electric	EC2d023	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Ductless Mini Split Heat Pump	EC2d024	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC2d025	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Electronic Defrost Control	EC2d026	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Management System, Electric	EC2d027	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Star Wifi Thermostat, Electric	EC2d028	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Evaporator Fan Control	EC2d029	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Faucet Aerator, Electric	EC2d030	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2d - SCI Direct Install	Hotel Occupancy Sensor	EC2d031	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Low Pressure Drop Filter	EC2d032	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC2d033	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Low-Flow Showerhead, Electric	EC2d034	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Open Drip	EC2d035	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC2d036	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Novelty Cooler Shutoff	EC2d037	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Heating, Electric	EC2d038	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Hot Water, Electric	EC2d039	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pre Rinse Spray Valve, Electric	EC2d040	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Programmable Thermostat, Electric	EC2d041	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Steam Trap, Electric	EC2d042	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive	EC2d043	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive with Motor	EC2d044	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Vending Miser	EC2d045	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Zero Loss Condensate Drain	EC2d046	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC2d047	-	-	-													-	-	-	-	-	-
	Small Business Energy Solutions Subtotal					**34,089.7**	**32,845.9**	**31,885.8**	**226,806.6**	**218,733.3**	**212,488.4**	**4,899.8**	**4,609.1**	**4,472.5**	**5,841.2**	**5,483.3**	**5,321.8**	**(14,771.0)**	**(14,286.1)**	**(13,873.1)**	**(90,048.1)**	**(87,102.9)**	**(84,593.0)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Custom Muni Compressed Air Retro	EC3a001	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Hot Water Retro	EC3a002	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni HVAC Retro	EC3a003	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Lighting Retro - Interior	EC3a004	18	18	20	1,267.8	1,242.4	1,428.8	6,338.8	6,212.0	7,143.8	145.1	142.2	163.5	190.3	186.5	214.4	(715.0)	(700.7)	(805.8)	(3,574.8)	(3,503.3)	(4,028.8)
C3a - Muni Retrofit	Custom Muni Lighting Retro - Exterior	EC3a091	7	7	8	227.8	223.2	256.7	1,139.0	1,116.2	1,283.6	44.4	43.5	50.0	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Lighting Retro - Controls	EC3a092	1	1	1	10.3	10.1	11.6	93.0	91.1	104.8	0.1	0.1	0.2	0.2	0.2	0.2	(36.7)	(35.9)	(41.3)	(330.1)	(323.5)	(372.0)
C3a - Muni Retrofit	Custom Muni Motors Retro	EC3a005	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Process Retro	EC3a006	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Refrigeration Retro	EC3a007	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Other Retro	EC3a008	2	2	2	91.1	89.3	102.7	1,708.3	1,674.1	1,925.3	2.6	12.9	14.8	2.9	14.3	16.4	-	-	-	-	-	-
C3a - Muni Retrofit	Daylight Dimming	EC3a009	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Exterior w/ Controls	EC3a010	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Exterior w/o Controls	EC3a011	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Interior w/ Controls	EC3a012	1	1	1	498.6	488.6	561.9	4,487.6	4,397.8	5,057.5	36.4	35.7	41.0	53.5	52.4	60.3	(323.2)	(316.7)	(364.3)	(2,908.9)	(2,850.7)	(3,278.3)
C3a - Muni Retrofit	Lighting Fixture - Interior w/o Controls	EC3a013	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Occupancy Sensors	EC3a014	1	1	1	21.6	21.2	24.3	194.4	190.5	219.0	0.3	0.3	0.3	0.4	0.4	0.4	(88.1)	(86.3)	(99.3)	(793.0)	(777.1)	(893.7)
C3a - Muni Retrofit	Air Sealing, Electric	EC3a015	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Gas	EC3a016	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Oil	EC3a017	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Propane	EC3a018	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Gas	EC3a019	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Oil	EC3a020	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Propane	EC3a021	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Case Motor Replacement	EC3a022	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Cooler Night Cover	EC3a023	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Demand Control Ventilation	EC3a024	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Door Heater Controls	EC3a025	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC3a026	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Electric	EC3a027	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Gas	EC3a028	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Oil	EC3a029	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Propane	EC3a030	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Electric	EC3a031	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Gas	EC3a032	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Oil	EC3a033	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Propane	EC3a034	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Ductless Mini Split Heat Pump	EC3a035	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC3a036	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Electronic Defrost Control	EC3a037	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Management System, Electric	EC3a038	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Electric	EC3a039	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Gas	EC3a040	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Oil	EC3a041	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Propane	EC3a042	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Evaporator Fan Control	EC3a043	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Electric	EC3a044	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Gas	EC3a045	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Oil	EC3a046	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Propane	EC3a047	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Hotel Occupancy Sensor	EC3a050	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Electric	EC3a051	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Gas	EC3a052	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Oil	EC3a053	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Propane	EC3a054	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low Pressure Drop Filter	EC3a055	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Electric	EC3a056	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Gas	EC3a057	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Oil	EC3a058	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Propane	EC3a059	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Electric	EC3a060	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Gas	EC3a061	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Oil	EC3a062	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Propane	EC3a063	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Motors, Open Drip	EC3a064	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Motors, Totally Enclosed Fan Cooled	EC3a065	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Novelty Cooler Shutoff	EC3a066	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Pipe Wrap - Heating, Electric	EC3a067	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Gas	EC3a068	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Oil	EC3a069	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Propane	EC3a070	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Electric	EC3a071	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Gas	EC3a072	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Oil	EC3a073	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Propane	EC3a074	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Electric	EC3a075	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Gas	EC3a076	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Oil	EC3a077	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Propane	EC3a078	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Electric	EC3a079	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Gas	EC3a080	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Oil	EC3a081	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Propane	EC3a082	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Electric	EC3a083	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Gas	EC3a084	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Oil	EC3a085	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Propane	EC3a086	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Variable Frequency Drive	EC3a087	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Variable Frequency Drive with Motor	EC3a088	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Vending Miser	EC3a089	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Zero Loss Condensate Drain	EC3a090	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Induction Cooktop Displacing Electric Resistance	EC3a093	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Compressed Air New	EC3b001	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Hot Water New	EC3b002	1	1	1	2.3	2.3	2.5	35.1	34.4	37.9	-	-	-	-	-	-	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni HVAC New	EC3b003	10	10	11	148.8	145.9	160.5	1,878.7	1,841.2	2,025.3	30.5	6.2	6.9	79.1	16.2	17.8	53.4	52.4	57.6	674.6	661.1	727.2
C3b - Muni New Equipmen	Custom Muni Lighting New - Interior	EC3b004	10	10	11	667.6	654.2	719.7	10,014.0	9,813.7	10,795.1	76.4	74.9	82.4	100.2	98.2	108.0	(88.4)	(86.6)	(95.3)	(1,326.3)	(1,299.7)	(1,429.7)
C3b - Muni New Equipmen	Custom Muni Lighting New - Exterior	EC3b085	2	2	2	19.3	18.9	20.8	289.3	283.5	311.8	3.8	3.7	4.0	-	-	-	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Lighting New - Controls	EC3b086	1	1	1	2.1	2.0	2.2	20.5	20.1	22.1	0.0	0.0	0.0	0.0	0.0	0.0	(7.3)	(7.1)	(7.9)	(72.9)	(71.4)	(78.5)
C3b - Muni New Equipmen	Custom Muni Motors New	EC3b005	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Process New	EC3b006	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Refrigeration New	EC3b007	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Other New	EC3b008	2	2	2	0.7	0.7	0.8	18.0	17.6	19.4	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Comprehensive Design	EC3b087	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Daylight Dimming	EC3b009	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Exterior w/ Controls	EC3b010	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Exterior w/o Controls	EC3b011	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Interior w/ Controls	EC3b012	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Interior w/o Controls	EC3b013	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Lighting Occupancy Sensors	EC3b014	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Advanced Power Strip	EC3b015	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Air Compressor	EC3b016	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Air Nozzle	EC3b017	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1000 to 1700 MBH 90 AFUE, Oil	EC3b018	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1000 to 1700 MBH 90 AFUE, Propane	EC3b019	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1701 to 2000 MBH 85 AFUE, Oil	EC3b020	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1701 to 2000 MBH 90 AFUE, Propane	EC3b021	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 301 to 499 MBH 85 AFUE, Oil	EC3b022	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 301 to 499 MBH 90 AFUE, Propane	EC3b023	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 500 to 999 MBH 85 AFUE, Oil	EC3b024	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 500 to 999 MBH 90 AFUE, Propane	EC3b025	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 85 AFUE, Oil	EC3b026	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 87 AFUE, Oil	EC3b027	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 90 AFUE, Propane	EC3b028	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 95 AFUE, Propane	EC3b029	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Circulator Pump	EC3b030	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Combination Oven, Electric	EC3b031	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Compressor Storage	EC3b032	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Condensing Unit Heater up to 300 MBH, Oil	EC3b033	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Condensing Unit Heater up to 300 MBH, Propane	EC3b034	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Convection Oven, Electric	EC3b035	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - High Temp Door Type	EC3b036	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - High Temp Multi Tank Conveyor	EC3b037	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - High Temp Pot, Pan, Utensil	EC3b038	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3b - Muni New Equipmen	Dishwasher - High Temp Single Tank Conveyor	EC3b039	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - High Temp Under Counter	EC3b040	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - Low Temp Door Type	EC3b041	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - Low Temp Multi Tank Conveyor	EC3b042	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - Low Temp Single Tank Conveyor	EC3b043	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Dishwasher - Low Temp Under Counter	EC3b044	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Faucet Aerator, Electric	EC3b045	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Faucet Aerator, Gas	EC3b046	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Faucet Aerator, Oil	EC3b047	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Faucet Aerator, Propane	EC3b048	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Fryer Large Vat, Electric	EC3b049	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Fryer Standard Vat, Electric	EC3b050	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Furnace w/ ECM 85 AFUE up to 150 MBH, Oil	EC3b051	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Furnace w/ ECM 87 AFUE up to 150 MBH, Oil	EC3b052	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Furnace w/ ECM 95 AFUE up to 150 MBH, Propane	EC3b053	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Furnace w/ ECM 97 AFUE up to 150 MBH, Propane	EC3b054	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Griddle, Electric	EC3b055	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Ground Source Heat Pump	EC3b056	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Hot Food Holding Cabinet 3/4 Size	EC3b057	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Hot Food Holding Cabinet Full Size	EC3b058	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Hot Food Holding Cabinet Half Size	EC3b059	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Ice Machine - Ice Making Head	EC3b060	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Ice Machine - Remote Cond./Split Unit - Batch	EC3b061	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Ice Machine - Remote Cond./Split Unit - Continuous	EC3b062	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Ice Machine - Self Contained	EC3b063	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Infrared Heater	EC3b064	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Low Pressure Drop Filter	EC3b065	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Thermostatic Shut-Off Valve, Electric	EC3b066	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Thermostatic Shut-Off Valve, Gas	EC3b067	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Thermostatic Shut-Off Valve, Oil	EC3b068	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Thermostatic Shut-Off Valve, Propane	EC3b069	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Low-Flow Showerhead, Electric	EC3b070	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Low-Flow Showerhead, Gas	EC3b071	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Low-Flow Showerhead, Oil	EC3b072	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Low-Flow Showerhead, Propane	EC3b073	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Pre Rinse Spray Valve, Electric	EC3b074	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Pre Rinse Spray Valve, Gas	EC3b075	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Pre Rinse Spray Valve, Oil	EC3b076	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Pre Rinse Spray Valve, Propane	EC3b077	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Refrigerated Air Dryer	EC3b078	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Steam Cooker, Electric	EC3b079	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Unitary Air Conditioner	EC3b080	2	2	2	71.0	69.6	76.5	851.7	834.6	918.1	-	-	-	20.9	4.8	5.2	-	-	-	-	-	-
C3b - Muni New Equipmen	Water Source Heat Pump	EC3b081	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Zero Loss Condensate Drain	EC3b082	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	High Efficiency Chiller - FL	EC3b083	2	2	2	0.1	0.1	0.1	1.7	1.6	1.8	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C3b - Muni New Equipmen	High Efficiency Chiller - IPLV	EC3b084	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Induction Cooktop Displacing Electric Resistance	EC3b088	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipmen	Compressed Air Leak Detection	EC3b089	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Compressed Air Direct Install	EC3d001	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Hot Water Direct Install	EC3d002	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni HVAC Direct Install	EC3d003	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Interior	EC3d004	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Exterior	EC3d005	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Controls	EC3d006	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Motors Direct Install	EC3d007	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Process Direct Install	EC3d008	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Refrigeration Direct Install	EC3d009	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Other Direct Install	EC3d010	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Daylight Dimming	EC3d011	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/ Controls	EC3d012	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/o Controls	EC3d013	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/ Controls	EC3d014	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/o Controls	EC3d015	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Occupancy Sensors	EC3d016	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Electric	EC3d017	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Gas	EC3d018	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3d - Muni Direct Install	Air Sealing, Oil	EC3d019	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Propane	EC3d020	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Gas	EC3d021	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Oil	EC3d022	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Propane	EC3d023	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Case Motor Replacement	EC3d024	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Cooler Night Cover	EC3d025	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Demand Control Ventilation	EC3d026	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Door Heater Controls	EC3d027	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC3d028	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Electric	EC3d029	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Gas	EC3d030	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Oil	EC3d031	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Propane	EC3d032	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Electric	EC3d033	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Gas	EC3d034	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Oil	EC3d035	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Propane	EC3d036	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Ductless Mini Split Heat Pump	EC3d037	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC3d038	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Electronic Defrost Control	EC3d039	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Management System, Electric	EC3d040	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Electric	EC3d041	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Gas	EC3d042	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Oil	EC3d043	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Propane	EC3d044	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Evaporator Fan Control	EC3d045	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Electric	EC3d046	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Gas	EC3d047	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Oil	EC3d048	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Propane	EC3d049	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Hotel Occupancy Sensor	EC3d050	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Electric	EC3d051	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Gas	EC3d052	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Oil	EC3d053	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Propane	EC3d054	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low Pressure Drop Filter	EC3d055	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Electric	EC3d056	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Gas	EC3d057	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Oil	EC3d058	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Propane	EC3d059	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Electric	EC3d060	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Gas	EC3d061	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Oil	EC3d062	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Propane	EC3d063	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Open Drip	EC3d064	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Totally Enclosed Fan Cooled	EC3d065	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Novelty Cooler Shutoff	EC3d066	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Electric	EC3d067	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Gas	EC3d068	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Oil	EC3d069	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Propane	EC3d070	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Electric	EC3d071	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Gas	EC3d072	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Oil	EC3d073	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Propane	EC3d074	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Electric	EC3d075	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Gas	EC3d076	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Oil	EC3d077	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Propane	EC3d078	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Electric	EC3d079	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Gas	EC3d080	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Oil	EC3d081	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Propane	EC3d082	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Electric	EC3d083	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Gas	EC3d084	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3d - Muni Direct Install	Steam Trap, Oil	EC3d085	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Propane	EC3d086	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive	EC3d087	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive with Motor	EC3d088	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Vending Miser	EC3d089	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Zero Loss Condensate Drain	EC3d090	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Induction Cooktop Displacing Electric Resistance	EC3d091	-	-	-													-	-	-	-	-	-
	Municipal Energy Solutions Subtotal					**3,029.1**	**2,968.5**	**3,369.1**	**27,069.9**	**26,528.5**	**29,865.5**	**339.5**	**319.5**	**363.1**	**447.5**	**373.0**	**423.0**	**(1,205.2)**	**(1,181.1)**	**(1,356.2)**	**(8,331.3)**	**(8,164.6)**	**(9,353.8)**

Public Service Company of New Hampshire d/b/a Eversource Energy
2024-2026 System Benefits Charge ("SBC") Calculation
($ in 000's)

Year	EE Total Budget	RSA 125-O:5-a Funding	RGGI Revenues	FCM Revenues	Other Revenues	SBC Revenues	Year End Carryover (under) w/ Interest	Forecasted Sales (MWh)	SBC Rate EE Portion (cents/kWh)	SBC Rate EAP Portion (cents/kWh)	SBC Rate LBR Portion (cents/kWh)	Total SBC Rate (cents/kWh)
Col. A	Col. B*	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M
2024	$ 53,580	$ 293	$ 1,871	$ 3,371	$ -	$ 44,792	$ 8,412	7,762,885	0.577	0.150	0.178	0.905
2025	$ 55,781	$ 292	$ 1,852	$ 3,325	$ -	$ 46,528	$ 4,553	7,716,150	0.603	0.150	0.217	0.970
2026	$ 57,887	$ 292	$ 1,917	$ 3,211	$ -	$ 47,716	$ (630)	7,708,603	0.619	0.150	0.246	1.015

Col. A: Calendar year (January 1 - December 31)
Col. B: Company Forecast (*excludes current year interest)
Col. C: Company Forecast calculated in accordance with RSA 374-F:3 VI-a
Col. D: Company Forecast
Col. E: Company Forecast
Col. F: Company Forecast
Col. G: Pages 4, 5 & 6, Line 1 Col. O
Col. H: Pages 4, 5 & 6, (Line 10, Col. N + Line 12, Col. O) x -1
Col. I: Pages 4, 5 & 6, Line 15 Col. O
Col. J: Company Forecast calculated in accordance with RSA 374-F:3 VI-a
Col. K: EAP Portion of SBC Rate
Col. L: Page 7, Col. G
Col. M: Col. J + Col. K + Col. L

Public Service Company of New Hampshire d/b/a Eversource Energy
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2022 to December 31, 2022
($ in 000's)

Line	Description	Carryover Dec-21	Actual Jan-22	Actual Feb-22	Actual Mar-22	Actual Apr-22	Actual May-22	Actual Jun-22	Actual Jul-22	Actual Aug-22	Actual Sep-22	Actual Oct-22	Actual Nov-22	Actual Dec-22	2022 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		3,280	2,596	2,803	3,162	3,101	3,269	3,648	4,242	3,632	2,930	2,944	3,401	39,008
2	RGGI Revenues		-	-	461	-	-	461	-	-	461	-	-	461	1,842
3	FCM Revenues		374	(17)	407	380	436	446	420	421	835	421	421	420	4,964
4	Other Revenues		-	-	-	-	-	-	-	-	-	-	-	-	-
5	**Total Revenues**		**3,654**	**2,580**	**3,671**	**3,542**	**3,537**	**4,175**	**4,068**	**4,663**	**4,927**	**3,351**	**3,364**	**4,282**	**45,815**
6	RSA 125-O:5-a Funding		24	24	24	24	24	24	24	24	24	24	24	24	290
7	Program Expenses		4,010	1,925	2,453	2,173	3,105	2,716	1,523	2,320	2,110	3,050	2,772	7,892	36,049
8	**Total Program Expenses**		**4,034**	**1,949**	**2,477**	**2,198**	**3,129**	**2,740**	**1,547**	**2,344**	**2,135**	**3,074**	**2,796**	**7,917**	**36,339**
9	Current Month (Over)/Under Recovery		379	(631)	(1,194)	(1,345)	(408)	(1,435)	(2,521)	(2,319)	(2,793)	(276)	(568)	3,634	
10	Cumulative (Over)/Under Recovery	(55)	324	(307)	(1,501)	(2,846)	(3,253)	(4,688)	(7,209)	(9,528)	(12,321)	(12,597)	(13,165)	(9,530)	
11	Interest @ Prime Rate		0.2708%	0.2708%	0.2808%	0.2917%	0.3283%	0.3650%	0.4042%	0.4583%	0.4775%	0.5208%	0.5792%	0.6058%	
12	**Interest on Deferral Balance**		**0**	**0**	**(3)**	**(6)**	**(10)**	**(14)**	**(24)**	**(38)**	**(52)**	**(65)**	**(75)**	**(69)**	**(356)**
13	Monthly Res Sales (MWh)		337,333	329,742	285,379	255,352	240,425	254,949	304,426	372,382	292,011	216,277	224,390	283,850	3,396,517
14	Monthly C&I Sales (MWh)		375,276	365,918	346,857	342,857	346,865	362,867	385,110	429,721	395,351	337,220	332,170	359,794	4,380,007
15	**Total Sales (MWh)**		712,609	695,660	632,237	598,209	587,290	617,815	689,536	802,104	687,362	553,498	556,560	643,644	7,776,524
16	**EE SBC Rate**		0.373	0.373	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	

Line 1: Company Records
Line 2: Company Records
Line 3: Company Records
Line 4: Company Records
Line 5: Sum of Line 1 through Line 4
Line 6: RSA 125-O:5-a Funding
Line 7: Company Records
Line 8: Line 6 + Line 7
Line 9: (Line 5 - Line 8) * -1
Line 10: Prior month Line 10 + Current month Line 9
Line 11: Prime Rate / 12
Line 12: (Prior Month Line 10 + Current Month Line 10) / 2 x Line 11
Line 13: Company Records
Line 14: Company Records
Line 15: Line 13 + Line 14
Line 16: Set per HB 549

Public Service Company of New Hampshire d/b/a Eversource Energy
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2023 to December 31, 2023
($ in 000's)

Line	Description	Carryover Dec-22	Actual Jan-23	Actual Feb-23	Actual Mar-23	Actual Apr-23	Actual May-23	Forecast Jun-23	Forecast Jul-23	Forecast Aug-23	Forecast Sep-23	Forecast Oct-23	Forecast Nov-23	Forecast Dec-23	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		3,622	3,398	3,398	3,359	2,982	3,485	4,022	3,931	3,345	3,303	3,304	3,786	41,935
2	RGGI Revenues		-	-	-	469	-	470	-	-	470	-	-	470	1,879
3	FCM Revenues		435	476	452	423	412	257	257	257	257	257	257	257	3,994
4	Other Revenues		-	-	-	-	-	-	-	-	-	-	-	-	-
5	**Total Revenues**		**4,056**	**3,874**	**3,850**	**4,251**	**3,394**	**4,211**	**4,278**	**4,188**	**4,072**	**3,560**	**3,561**	**4,513**	**47,808**
6	RSA 125-O:5-a Funding		24	24	24	24	24	24	24	24	24	24	24	24	290
7	Program Expenses		925	1,277	2,935	2,099	3,250	5,238	5,238	5,238	5,238	5,238	5,238	5,238	47,154
8	**Total Program Expenses**		**949**	**1,301**	**2,959**	**2,123**	**3,274**	**5,263**	**5,263**	**5,263**	**5,263**	**5,263**	**5,263**	**5,263**	**47,444**
9	Current Month (Over)/Under Recovery		(3,108)	(2,573)	(891)	(2,128)	(119)	1,051	984	1,074	1,191	1,702	1,702	750	
10	Cumulative (Over)/Under Recovery	(9,886)	(12,994)	(15,566)	(16,457)	(18,585)	(18,704)	(17,653)	(16,669)	(15,595)	(14,404)	(12,702)	(11,000)	(10,250)	
11	Interest @ Prime Rate		0.6250%	0.6450%	0.6517%	0.6667%	0.6858%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
12	**Interest on Deferral Balance**		**(71)**	**(92)**	**(104)**	**(117)**	**(128)**	**(125)**	**(118)**	**(111)**	**(103)**	**(93)**	**(81)**	**(73)**	**(1,217)**
13	Monthly Res Sales (MWh)		316,691	278,416	273,707	255,624	214,343	248,780	330,853	311,872	242,674	239,414	258,026	325,470	3,295,871
14	Monthly C&I Sales (MWh)		370,943	339,010	343,564	354,159	326,627	384,784	400,351	402,933	365,536	361,213	342,747	362,867	4,354,734
15	**Total Sales (MWh)**		687,634	617,425	617,271	609,783	540,971	633,565	731,204	714,805	608,210	600,627	600,773	688,338	7,650,604
16	**EE SBC Rate**		0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	

Line 1: Company Records (Actual); (Line 15 x Line 16) / 100 (Forecast)
Line 2: Company Records (Actual); Expected RGGI Revenues (Forecast)
Line 3: Company Records (Actual); Expected FCM Revenues (Forecast)
Line 4: Company Records (Actual); Expected Other Revenues (Forecast)
Line 5: Sum of Line 1 through Line 4
Line 6: RSA 125-O:5-a Funding
Line 7: Company Records (Actual); Budgeted Program Expenses (Forecast)
Line 8: Line 6 + Line 7
Line 9: (Line 5 - Line 8) * -1
Line 10: Prior month Line 10 + Current month Line 9
Line 11: Prime Rate / 12
Line 12: (Prior Month Line 10 + Current Month Line 10) / 2 x Line 11
Line 13: Company Records/Forecast
Line 14: Company Records/Forecast
Line 15: Line 13 + Line 14
Line 16: Set per HB 549

Public Service Company of New Hampshire d/b/a Eversource Energy
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2024 to December 31, 2024
($ in 000's)

Line	Description	Carryover Dec-23	Forecast Jan-24	Forecast Feb-24	Forecast Mar-24	Forecast Apr-24	Forecast May-24	Forecast Jun-24	Forecast Jul-24	Forecast Aug-24	Forecast Sep-24	Forecast Oct-24	Forecast Nov-24	Forecast Dec-24	2024 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		4,109	3,763	3,685	3,337	3,357	3,737	4,286	4,143	3,522	3,449	3,459	3,945	44,792
2	RGGI Revenues		-	-	468	-	-	468	-	-	468	-	-	468	1,871
3	FCM Revenues		281	281	281	281	281	281	281	281	281	281	281	281	3,371
4	Other Revenues		-	-	-	-	-	-	-	-	-	-	-	-	-
5	**Total Revenues**		**4,390**	**4,044**	**4,434**	**3,618**	**3,638**	**4,486**	**4,567**	**4,424**	**4,271**	**3,730**	**3,740**	**4,693**	**50,034**
6	RSA 125-O:5-a Funding		24	24	24	24	24	24	24	24	24	24	24	24	293
7	Program Expenses		4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	53,580
8	**Total Program Expenses**		**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**4,489**	**53,873**
9	Current Month (Over)/Under Recovery		100	445	56	871	851	3	(77)	65	219	760	750	(204)	
10	Cumulative (Over)/Under Recovery	(11,467)	(11,368)	(10,922)	(10,867)	(9,996)	(9,144)	(9,141)	(9,218)	(9,153)	(8,934)	(8,175)	(7,425)	(7,629)	
11	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
12	**Interest on Deferral Balance**		**(78)**	**(77)**	**(75)**	**(72)**	**(66)**	**(63)**	**(63)**	**(63)**	**(62)**	**(59)**	**(54)**	**(52)**	**(783)**
13	Monthly Res Sales (MWh)		353,172	301,306	282,533	251,009	235,108	270,716	339,124	323,740	255,506	236,586	259,470	329,221	3,437,490
14	Monthly C&I Sales (MWh)		358,905	350,888	356,104	327,401	346,710	377,006	403,653	394,297	354,903	361,127	339,967	354,435	4,325,395
15	**Total Sales (MWh)**		712,077	652,194	638,637	578,410	581,818	647,722	742,777	718,038	610,409	597,713	599,437	683,656	7,762,885
16	**EE SBC Rate**		0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	

Line 1: (Line 15 x Line 16) / 100
Line 2: Page 1, Col. D
Line 3: Page 1, Col. E
Line 4: Page 1, Col. F
Line 5: Sum of Line 1 through Line 4
Line 6: RSA 125-O:5-a Funding
Line 7: Page 1, Col. B
Line 8: Line 6 + Line 7
Line 9: (Line 5 - Line 8) * -1
Line 10: Prior month Line 10 + Current month Line 9
Line 11: Prime Rate / 12
Line 12: (Prior Month Line 10 + Current Month Line 10) / 2 x Line 11
Line 13: Company Forecast
Line 14: Company Forecast
Line 15: Line 13 + Line 14
Line 16: Set per HB 549

Public Service Company of New Hampshire d/b/a Eversource Energy
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2025 to December 31, 2025
($ in 000's)

Line	Description	Carryover Dec-24	Forecast Jan-25	Forecast Feb-25	Forecast Mar-25	Forecast Apr-25	Forecast May-25	Forecast Jun-25	Forecast Jul-25	Forecast Aug-25	Forecast Sep-25	Forecast Oct-25	Forecast Nov-25	Forecast Dec-25	2025 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		4,295	3,800	3,849	3,484	3,501	3,898	4,472	4,322	3,670	3,537	3,586	4,113	46,528
2	RGGI Revenues		-	-	463	-	-	463	-	-	463	-	-	463	1,852
3	FCM Revenues		277	277	277	277	277	277	277	277	277	277	277	277	3,325
4	Other Revenues		-	-	-	-	-	-	-	-	-	-	-	-	-
5	**Total Revenues**		**4,573**	**4,077**	**4,589**	**3,762**	**3,778**	**4,639**	**4,749**	**4,599**	**4,411**	**3,814**	**3,863**	**4,854**	**51,706**
6	RSA 125-O:5-a Funding		24	24	24	24	24	24	24	24	24	24	24	24	292
7	Program Expenses		4,648	4,648	4,648	4,648	4,648	4,648	4,648	4,648	4,648	4,648	4,648	4,648	55,781
8	**Total Program Expenses**		**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**4,673**	**56,073**
9	Current Month (Over)/Under Recovery		100	596	84	911	894	34	(76)	74	262	859	809	(181)	
10	Cumulative (Over)/Under Recovery	(8,412)	(8,312)	(7,715)	(7,632)	(6,720)	(5,826)	(5,792)	(5,868)	(5,794)	(5,532)	(4,673)	(3,864)	(4,045)	
11	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
12	**Interest on Deferral Balance**		**(57)**	**(55)**	**(53)**	**(49)**	**(43)**	**(40)**	**(40)**	**(40)**	**(39)**	**(35)**	**(29)**	**(27)**	**(508)**
13	Monthly Res Sales (MWh)		355,332	293,129	284,314	252,673	236,416	272,110	340,723	325,292	256,908	238,174	261,171	330,976	3,447,218
14	Monthly C&I Sales (MWh)		357,008	336,983	353,957	325,178	344,245	374,401	400,901	391,397	351,791	348,321	333,574	351,175	4,268,932
15	**Total Sales (MWh)**		712,340	630,112	638,271	577,852	580,661	646,511	741,624	716,689	608,699	586,494	594,746	682,151	7,716,150
16	**EE SBC Rate**		0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	

Line 1: (Line 15 x Line 16) / 100
Line 2: Page 1, Col. D
Line 3: Page 1, Col. E
Line 4: Page 1, Col. F
Line 5: Sum of Line 1 through Line 4
Line 6: RSA 125-O:5-a Funding
Line 7: Page 1, Col. B
Line 8: Line 6 + Line 7
Line 9: (Line 5 - Line 8) * -1
Line 10: Prior month Line 10 + Current month Line 9
Line 11: Prime Rate / 12
Line 12: (Prior Month Line 10 + Current Month Line 10) / 2 x Line 11
Line 13: Company Forecast
Line 14: Company Forecast
Line 15: Line 13 + Line 14
Line 16: Set per HB 549

Public Service Company of New Hampshire d/b/a Eversource Energy
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2026 to December 31, 2026
($ in 000's)

Line	Description	Carryover Dec-25	Forecast Jan-26	Forecast Feb-26	Forecast Mar-26	Forecast Apr-26	Forecast May-26	Forecast Jun-26	Forecast Jul-26	Forecast Aug-26	Forecast Sep-26	Forecast Oct-26	Forecast Nov-26	Forecast Dec-26	2026 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		4,405	3,893	3,943	3,627	3,601	3,989	4,579	4,425	3,754	3,618	3,670	4,212	47,716
2	RGGI Revenues		-	-	479	-	-	479	-	-	479	-	-	479	1,917
3	FCM Revenues		268	268	268	268	268	268	268	268	268	268	268	268	3,211
4	Other Revenues		-	-	-	-	-	-	-	-	-	-	-	-	-
5	**Total Revenues**		**4,673**	**4,161**	**4,689**	**3,894**	**3,869**	**4,736**	**4,847**	**4,692**	**4,501**	**3,885**	**3,938**	**4,959**	**52,844**
6	RSA 125-O:5-a Funding		24	24	24	24	24	24	24	24	24	24	24	24	292
7	Program Expenses		4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	57,887
8	**Total Program Expenses**		**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**4,848**	**58,180**
9	Current Month (Over)/Under Recovery		176	687	159	954	980	112	1	156	347	963	911	(110)	
10	Cumulative (Over)/Under Recovery	(4,553)	(4,377)	(3,690)	(3,531)	(2,577)	(1,598)	(1,486)	(1,484)	(1,328)	(981)	(18)	892	782	
11	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
12	**Interest on Deferral Balance**		**(31)**	**(28)**	**(25)**	**(21)**	**(14)**	**(11)**	**(10)**	**(10)**	**(8)**	**(3)**	**3**	**6**	**(152)**
13	Monthly Res Sales (MWh)		357,584	295,061	286,191	254,412	237,775	273,579	342,431	326,934	258,331	239,759	262,843	332,720	3,467,622
14	Monthly C&I Sales (MWh)		354,046	333,936	350,739	331,474	343,987	370,907	397,372	387,859	348,196	344,694	330,075	347,696	4,240,981
15	**Total Sales (MWh)**		711,630	628,996	636,931	585,886	581,762	644,486	739,804	714,793	606,527	584,452	592,918	680,417	7,708,603
16	**EE SBC Rate**		0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	

Line 1: (Line 15 x Line 16) / 100
Line 2: Page 1, Col. D
Line 3: Page 1, Col. E
Line 4: Page 1, Col. F
Line 5: Sum of Line 1 through Line 4
Line 6: RSA 125-O:5-a Funding
Line 7: Page 1, Col. B
Line 8: Line 6 + Line 7
Line 9: (Line 5 - Line 8) * -1
Line 10: Prior month Line 10 + Current month Line 9
Line 11: Prime Rate / 12
Line 12: (Prior Month Line 10 + Current Month Line 10) / 2 x Line 11
Line 13: Company Forecast
Line 14: Company Forecast
Line 15: Line 13 + Line 14
Line 16: Set per HB 549

Public Service Company of New Hampshire d/b/a Eversource Energy
2024-2026 System Benefits Charge Calculation (LBR Component)
($ in 000's)

Year	Forecasted LBR Revenue	Prior Year Carryover with Interest	Current Year Interest	Total LBR Revenue	Forecasted Sales (MWh)	SBC Rate LBR Portion (cents/kWh)
Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G
2024	$ 14,475	$ (625)	$ (35)	$ 13,815	7,762,885	0.178
2025	$ 16,743	$ (1)	$ (10)	$ 16,732	7,716,150	0.217
2026	$ 19,011	$ (0)	$ (11)	$ 19,000	7,708,603	0.246

Col. A: Effective year (January 1 - December 31)
Col. B: Pages 10, 11 & 12, Line 22, Col. O / 1000
Col. C: Pages 15, 16 & 17, Line 4, Col. B
Col. D: Pages 15, 16 & 17, Line 6, Col. O
Col. E: Col. B + Col. C + Col. D
Col. F: Company Forecast
Col. G: (Col. E * 100) / Col. F

Public Service Company of New Hampshire d/b/a Eversource Energy
Monthly and Cumulative Savings and Lost Base Revenue
January 1, 2022 to December 31, 2022

Line	Description	Cumulative Annual kWh Savings / Monthly kW Savings Dec-21	Actual Jan-22	Actual Feb-22	Actual Mar-22	Actual Apr-22	Actual May-22	Actual Jun-22	Actual Jul-22	Actual Aug-22	Actual Sep-22	Actual Oct-22	Actual Nov-22	Actual Dec-22	2022 Annual kWh and Monthly kW Savings	Cumulative Annual kWh Savings / Monthly kW Savings 12/31/2022
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O	Col. P
1	Residential Annual kWh Savings (2018-2022)	68,846,728	566,601	263,060	620,652	743,780	482,817	382,155	903,299	823,360	578,581	724,354	712,326	1,085,739	7,886,725	73,095,379
2	C&I Annual kWh Savings (2018)	38,157,478	-	-	-	-	-	-	-	-	-	-	-	-	-	38,157,478
3	C&I Annual kWh Savings (2019-2022)	215,490,430	6,799,437	2,475,327	1,446,248	1,207,018	4,196,185	3,077,312	2,520,581	1,192,172	4,088,559	5,004,211	6,254,584	14,529,169	52,790,803	268,281,233
4	C&I Monthly Installed kW Savings	33,439	858	415	189	204	651	384	432	114	483	801	645	2,069	7,245	40,684

Line	Description		Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Total 2022 Lost Base Revenue
5	Monthly Residential Savings (2022)		47,217	21,922	51,721	61,982	40,235	31,846	75,275	68,613	48,215	60,363	59,360	90,478	657,227
6	Retired Measures		27,546	27,913	34,891	41,502	40,768	35,259	28,280	26,077	28,648	12,288	-	-	303,173
7	Cumulative Residential Savings	5,737,227	5,756,898	5,750,907	5,767,736	5,788,216	5,787,682	5,784,270	5,831,264	5,873,801	5,893,368	5,941,443	6,000,803	6,091,282	
8	Average Residential kWh Distribution Rate		0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	
9	Total Lost Residential Revenue		$ 294,966	$ 294,659	$ 295,521	$ 296,570	$ 296,543	$ 296,368	$ 298,776	$ 300,956	$ 301,958	$ 304,421	$ 307,463	$ 312,099	$ 3,600,301
10	Monthly C&I Savings (2018)	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	
11	Average C&I kWh Distribution Rate		0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	
12	Lost C&I kWh Revenue		$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 1,172,883
13	Monthly C&I Savings (2022)		566,620	206,277	120,521	100,585	349,682	256,443	210,048	99,348	340,713	417,018	521,215	1,210,764	
14	Cumulative C&I Savings	17,957,536	18,524,156	18,730,433	18,850,953	18,951,538	19,301,220	19,557,663	19,767,712	19,867,059	20,207,772	20,624,790	21,146,005	22,356,769	
15	Average C&I kWh Distribution Rate		0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	
16	Lost C&I kWH Revenue		$ 208,245	$ 210,564	$ 211,919	$ 213,049	$ 216,980	$ 219,863	$ 222,225	$ 223,342	$ 227,172	$ 231,860	$ 237,719	$ 251,330	$ 2,674,268
17	Monthly C&I kW Savings (2022)		858	415	189	204	651	384	432	114	483	801	645	2,069	
18	Cumulative Monthly C&I kW Savings	33,439	34,297	34,711	34,900	35,104	35,755	36,139	36,571	36,685	37,168	37,969	38,615	40,684	
19	Average C&I Demand Rate		8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	
20	Lost C&I Demand Revenue		$ 291,297	$ 294,818	$ 296,422	$ 298,153	$ 303,684	$ 306,948	$ 310,618	$ 311,583	$ 315,687	$ 322,491	$ 327,972	$ 345,549	$ 3,725,221
21	Total Lost C&I kWh and Demand Revenue		$ 597,282	$ 603,122	$ 606,080	$ 608,943	$ 618,405	$ 624,552	$ 630,583	$ 632,665	$ 640,599	$ 652,091	$ 663,431	$ 694,619	$ 7,572,372
22	**Total Lost Revenue**		**$ 892,248**	**$ 897,781**	**$ 901,602**	**$ 905,513**	**$ 914,948**	**$ 920,920**	**$ 929,359**	**$ 933,620**	**$ 942,557**	**$ 956,512**	**$ 970,894**	**$ 1,006,718**	**$ 11,172,673**

Lines 1-4: Company Records
Line 5: Line 1 / 12
Line 6: Company Records
Line 7: Prior Month Line 7 + Current Month Line 5 - Current Month Line 6
Line 8: Page 18, Column 8
Line 9: Line 7 x Line 8
Line 10: Line 1, Column B / 12
Line 11: Page 18, Column 8
Line 12: Line 10 x Line 11
Line 13: Line 3 / 12
Line 14: Prior Month Line 14 + Current Month Line 13
Line 15: Page 18, Column 7
Line 16: Line 14 x Line 15
Line 17: Line 4
Line 18: Prior Month Line 18 + Current Month Line 17
Line 19: Page 18, Column 6
Line 20: Line 18 x Line 19
Line 21: Line 12 + Line 16 + Line 20
Line 22: Line 9 + Line 21

Public Service Company of New Hampshire d/b/a Eversource Energy
Monthly and Cumulative Savings and Lost Base Revenue
January 1, 2023 to December 31, 2023

Line	Description	Cumulative Annual kWh Savings / Monthly kW Savings Dec-22	Estimate Jan-23	Estimate Feb-23	Estimate Mar-23	Estimate Apr-23	Estimate May-23	Forecast Jun-23	Forecast Jul-23	Forecast Aug-23	Forecast Sep-23	Forecast Oct-23	Forecast Nov-23	Forecast Dec-23	2023 Annual kWh and Monthly kW Savings	Cumulative Annual kWh Savings / Monthly kW Savings 12/31/2023
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O	Col. P
1	Residential Annual kWh Savings (2018-2023)	73,095,379	118,565	502,878	845,590	577,094	547,709	1,203,010	1,203,010	1,203,010	1,203,010	1,203,010	1,203,010	1,203,010	11,012,907	84,108,286
2	C&I Annual kWh Savings (2018)	38,157,478	-	-	-	-	-	-	-	-	-	-	-	-	-	38,157,478
3	C&I Annual kWh Savings (2019-2023)	268,281,233	934,415	2,148,764	1,976,655	2,013,853	3,122,446	5,180,951	5,180,951	5,180,951	5,180,951	5,180,951	5,180,951	5,180,951	46,462,788	314,744,021
4	C&I Monthly Installed kW Savings	40,684	148	374	344	306	490	733	733	733	733	733	733	733	6,794	47,478
			Jan-23	**Feb-23**	**Mar-23**	**Apr-23**	**May-23**	**Jun-23**	**Jul-23**	**Aug-23**	**Sep-23**	**Oct-23**	**Nov-23**	**Dec-23**	**Total 2023 Lost Base Revenue**	
5	Monthly Residential Savings (2023)		9,880	41,907	70,466	48,091	45,642	50,125	50,125	50,125	50,125	50,125	50,125	50,125	566,864	
6	Retired Measures		-	-	-	-	-	-	-	-	-	-	-	-	-	
7	Cumulative Residential Savings	6,091,282	6,101,162	6,143,068	6,213,534	6,261,625	6,307,268	6,357,393	6,407,519	6,457,644	6,507,769	6,557,895	6,608,020	6,658,146		
8	Average Residential kWh Distribution Rate		0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124		
9	Total Lost Residential Revenue		$ 312,605	$ 314,752	$ 318,362	$ 320,827	$ 323,165	$ 325,733	$ 328,302	$ 330,870	$ 333,438	$ 336,006	$ 338,575	$ 341,143	$ 3,923,779	
10	Monthly C&I Savings (2018)	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790		
11	Average C&I kWh Distribution Rate		0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074		
12	Lost C&I kWh Revenue		$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 1,172,883	
13	Monthly C&I Savings (2023)		77,868	179,064	164,721	167,821	260,204	215,873	215,873	215,873	215,873	215,873	215,873	215,873		
14	Cumulative C&I Savings	22,356,769	22,434,637	22,613,701	22,778,422	22,946,243	23,206,447	23,422,320	23,638,193	23,854,066	24,069,939	24,285,812	24,501,685	24,717,558		
15	Average C&I kWh Distribution Rate		0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124		
16	Lost C&I kWH Revenue		$ 252,206	$ 254,219	$ 256,070	$ 257,957	$ 260,882	$ 263,309	$ 265,736	$ 268,163	$ 270,589	$ 273,016	$ 275,443	$ 277,870	$ 3,175,460	
17	Monthly C&I kW Savings (2023)		148	374	344	306	490	367	367	367	367	367	367	367		
18	Cumulative Monthly C&I kW Savings	40,684	40,832	41,205	41,549	41,855	42,345	42,712	43,078	43,445	43,812	44,178	44,545	44,912		
19	Average C&I Demand Rate		8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49		
20	Lost C&I Demand Revenue		$ 346,804	$ 349,976	$ 352,894	$ 355,497	$ 359,657	$ 362,771	$ 365,885	$ 368,999	$ 372,113	$ 375,227	$ 378,341	$ 381,456	$ 4,369,620	
21	Total Lost C&I kWh and Demand Revenue		$ 696,749	$ 701,935	$ 706,705	$ 711,195	$ 718,279	$ 723,820	$ 729,361	$ 734,902	$ 740,443	$ 745,984	$ 751,525	$ 757,066	$ 8,717,963	
22	**Total Lost Revenue**		**$ 1,009,354**	**$ 1,016,687**	**$ 1,025,067**	**$ 1,032,021**	**$ 1,041,444**	**$ 1,049,553**	**$ 1,057,663**	**$ 1,065,772**	**$ 1,073,881**	**$ 1,081,990**	**$ 1,090,100**	**$ 1,098,209**	**$ 12,641,742**	

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Public Service Company of New Hampshire d/b/a Eversource Energy
Monthly and Cumulative Savings and Lost Base Revenue
January 1, 2024 to December 31, 2024

Line	Description	Cumulative Annual kWh Savings / Monthly kW Savings Dec-23	Forecast Jan-24	Forecast Feb-24	Forecast Mar-24	Forecast Apr-24	Forecast May-24	Forecast Jun-24	Forecast Jul-24	Forecast Aug-24	Forecast Sep-24	Forecast Oct-24	Forecast Nov-24	Forecast Dec-24	2024 Annual kWh and Monthly kW Savings	Cumulative Annual kWh Savings / Monthly kW Savings 12/31/2024
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O	Col. P
1	Residential Annual kWh Savings (2018-2024)	84,108,286	919,779	919,779	919,779	919,779	919,779	919,779	919,779	919,779	919,779	919,779	919,779	919,779	11,037,349	95,145,634
2	C&I Annual kWh Savings (2018)	38,157,478	-	-	-	-	-	-	-	-	-	-	-	-	-	38,157,478
3	C&I Annual kWh Savings (2019-2024)	314,744,021	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	5,330,073	63,960,871	378,704,892
4	C&I Monthly Installed kW Savings	47,478	806	806	806	806	806	806	806	806	806	806	806	806	9,676	57,154
			Jan-24	**Feb-24**	**Mar-24**	**Apr-24**	**May-24**	**Jun-24**	**Jul-24**	**Aug-24**	**Sep-24**	**Oct-24**	**Nov-24**	**Dec-24**	**Total 2024 Lost Base Revenue**	
5	Monthly Residential Savings (2024)		38,324	38,324	38,324	38,324	38,324	38,324	38,324	38,324	38,324	38,324	38,324	38,324	459,890	
6	Retired Measures		-	-	-	-	-	-	-	-	-	-	-	-	-	
7	Cumulative Residential Savings	7,009,024	7,047,348	7,085,672	7,123,996	7,162,320	7,200,644	7,238,969	7,277,293	7,315,617	7,353,941	7,392,265	7,430,589	7,468,913		
8	Average Residential kWh Distribution Rate		0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124		
9	Total Lost Residential Revenue		$ 361,085	$ 363,048	$ 365,012	$ 366,975	$ 368,939	$ 370,903	$ 372,866	$ 374,830	$ 376,793	$ 378,757	$ 380,721	$ 382,684	$ 4,462,613	
10	Monthly C&I Savings (2018)	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790		
11	Average C&I kWh Distribution Rate		0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074		
12	Lost C&I kWh Revenue		$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 1,172,883	
13	Monthly C&I Savings (2024)		222,086	222,086	222,086	222,086	222,086	222,086	222,086	222,086	222,086	222,086	222,086	222,086		
14	Cumulative C&I Savings	26,228,668	26,450,755	26,672,841	26,894,927	27,117,014	27,339,100	27,561,187	27,783,273	28,005,359	28,227,446	28,449,532	28,671,618	28,893,705		
15	Average C&I kWh Distribution Rate		0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124		
16	Lost C&I kWH Revenue		$ 297,354	$ 299,851	$ 302,347	$ 304,844	$ 307,341	$ 309,837	$ 312,334	$ 314,831	$ 317,327	$ 319,824	$ 322,321	$ 324,817	$ 3,733,028	
17	Monthly C&I kW Savings (2024)		403	403	403	403	403	403	403	403	403	403	403	403		
18	Cumulative Monthly C&I kW Savings	47,478	47,881	48,285	48,688	49,091	49,494	49,897	50,300	50,704	51,107	51,510	51,913	52,316		
19	Average C&I Demand Rate		8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49		
20	Lost C&I Demand Revenue		$ 406,679	$ 410,103	$ 413,528	$ 416,952	$ 420,376	$ 423,801	$ 427,225	$ 430,649	$ 434,074	$ 437,498	$ 440,922	$ 444,347	$ 5,106,154	
21	Total Lost C&I kWh and Demand Revenue		$ 801,773	$ 807,694	$ 813,615	$ 819,536	$ 825,457	$ 831,378	$ 837,299	$ 843,220	$ 849,141	$ 855,062	$ 860,983	$ 866,904	$ 10,012,065	
22	**Total Lost Revenue**		**$ 1,162,858**	**$ 1,170,742**	**$ 1,178,627**	**$ 1,186,512**	**$ 1,194,396**	**$ 1,202,281**	**$ 1,210,165**	**$ 1,218,050**	**$ 1,225,935**	**$ 1,233,819**	**$ 1,241,704**	**$ 1,249,588**	**$ 14,474,678**	

Lines 1-4: Company Forecast
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Public Service Company of New Hampshire d/b/a Eversource Energy
Monthly and Cumulative Savings and Lost Base Revenue
January 1, 2025 to December 31, 2025

Line	Description	Cumulative Annual kWh Savings / Monthly kW Savings Dec-24	Forecast Jan-25	Forecast Feb-25	Forecast Mar-25	Forecast Apr-25	Forecast May-25	Forecast Jun-25	Forecast Jul-25	Forecast Aug-25	Forecast Sep-25	Forecast Oct-25	Forecast Nov-25	Forecast Dec-25	2025 Annual kWh and Monthly kW Savings	Cumulative Annual kWh Savings / Monthly kW Savings 12/31/2025
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O	Col. P
1	Residential Annual kWh Savings (2018-2025)	95,145,634	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	1,046,313	12,555,750	107,701,384
2	C&I Annual kWh Savings (2018)	38,157,478	-	-	-	-	-	-	-	-	-	-	-	-	-	38,157,478
3	C&I Annual kWh Savings (2019-2025)	378,704,892	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	5,145,374	61,744,484	440,449,375
4	C&I Monthly Installed kW Savings	57,154	756	756	756	756	756	756	756	756	756	756	756	756	9,069	66,224
			Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Total 2025 Lost Base Revenue	
5	Monthly Residential Savings (2025)		43,596	43,596	43,596	43,596	43,596	43,596	43,596	43,596	43,596	43,596	43,596	43,596	523,156	
6	Retired Measures		-	-	-	-	-	-	-	-	-	-	-	-	-	
7	Cumulative Residential Savings	7,928,803	7,972,399	8,015,996	8,059,592	8,103,188	8,146,785	8,190,381	8,233,977	8,277,574	8,321,170	8,364,766	8,408,363	8,451,959		
8	Average Residential kWh Distribution Rate		0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124		
9	Total Lost Residential Revenue		$ 408,481	$ 410,715	$ 412,949	$ 415,183	$ 417,416	$ 419,650	$ 421,884	$ 424,118	$ 426,351	$ 428,585	$ 430,819	$ 433,053	$ 5,049,203	
10	Monthly C&I Savings (2018)	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790		
11	Average C&I kWh Distribution Rate		0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074		
12	Lost C&I kWh Revenue		$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 1,172,883	
13	Monthly C&I Savings (2025)		214,391	214,391	214,391	214,391	214,391	214,391	214,391	214,391	214,391	214,391	214,391	214,391		
14	Cumulative C&I Savings	31,558,741	31,773,132	31,987,522	32,201,913	32,416,303	32,630,694	32,845,084	33,059,475	33,273,866	33,488,256	33,702,647	33,917,037	34,131,428		
15	Average C&I kWh Distribution Rate		0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124		
16	Lost C&I kWH Revenue		$ 357,187	$ 359,597	$ 362,007	$ 364,418	$ 366,828	$ 369,238	$ 371,648	$ 374,058	$ 376,468	$ 378,878	$ 381,289	$ 383,699	$ 4,445,315	
17	Monthly C&I kW Savings (2025)		378	378	378	378	378	378	378	378	378	378	378	378		
18	Cumulative Monthly C&I kW Savings	57,154	57,532	57,910	58,288	58,666	59,044	59,422	59,800	60,177	60,555	60,933	61,311	61,689		
19	Average C&I Demand Rate		8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49		
20	Lost C&I Demand Revenue		$ 488,648	$ 491,858	$ 495,067	$ 498,277	$ 501,486	$ 504,696	$ 507,906	$ 511,115	$ 514,325	$ 517,534	$ 520,744	$ 523,953	$ 6,075,609	
21	Total Lost C&I kWh and Demand Revenue		$ 943,576	$ 949,195	$ 954,815	$ 960,435	$ 966,054	$ 971,674	$ 977,294	$ 982,914	$ 988,533	$ 994,153	$ 999,773	$ 1,005,392	$ 11,693,808	
22	**Total Lost Revenue**		**$ 1,352,057**	**$ 1,359,910**	**$ 1,367,764**	**$ 1,375,617**	**$ 1,383,471**	**$ 1,391,324**	**$ 1,399,178**	**$ 1,407,031**	**$ 1,414,885**	**$ 1,422,738**	**$ 1,430,591**	**$ 1,438,445**	**$ 16,743,011**	

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Line 21: Line 12 + Line 16 + Line 20
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Public Service Company of New Hampshire d/b/a Eversource Energy
Monthly and Cumulative Savings and Lost Base Revenue
January 1, 2026 to December 31, 2026

Line	Description	Cumulative Annual kWh Savings / Monthly kW Savings Dec-25	Forecast Jan-26	Forecast Feb-26	Forecast Mar-26	Forecast Apr-26	Forecast May-26	Forecast Jun-26	Forecast Jul-26	Forecast Aug-26	Forecast Sep-26	Forecast Oct-26	Forecast Nov-26	Forecast Dec-26	2026 Annual kWh and Monthly kW Savings	Cumulative Annual kWh Savings / Monthly kW Savings 12/31/2026
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O	Col. P
1	Residential Annual kWh Savings (2018-2025)	107,701,384	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	1,142,849	13,714,182	121,415,567
2	C&I Annual kWh Savings (2018)	38,157,478	-	-	-	-	-	-	-	-	-	-	-	-	-	38,157,478
3	C&I Annual kWh Savings (2019-2025)	440,449,375	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	5,030,967	60,371,601	500,820,977
4	C&I Monthly Installed kW Savings	66,224	738	738	738	738	738	738	738	738	738	738	738	738	8,855	75,078
			Jan-26	**Feb-26**	**Mar-26**	**Apr-26**	**May-26**	**Jun-26**	**Jul-26**	**Aug-26**	**Sep-26**	**Oct-26**	**Nov-26**	**Dec-26**	**Total 2026 Lost Base Revenue**	
5	Monthly Residential Savings (2026)		47,619	47,619	47,619	47,619	47,619	47,619	47,619	47,619	47,619	47,619	47,619	47,619	571,424	
6	Retired Measures		-	-	-	-	-	-	-	-	-	-	-	-	-	
7	Cumulative Residential Savings	8,975,115	9,022,734	9,070,353	9,117,971	9,165,590	9,213,209	9,260,827	9,308,446	9,356,065	9,403,684	9,451,302	9,498,921	9,546,540		
8	Average Residential kWh Distribution Rate		0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124	0.05124		
9	Total Lost Residential Revenue		$ 462,297	$ 464,737	$ 467,177	$ 469,617	$ 472,057	$ 474,496	$ 476,936	$ 479,376	$ 481,816	$ 484,256	$ 486,696	$ 489,136	$ 5,708,597	
10	Monthly C&I Savings (2018)	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790	3,179,790		
11	Average C&I kWh Distribution Rate		0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074	0.03074		
12	Lost C&I kWh Revenue		$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 97,740	$ 1,172,883	
13	Monthly C&I Savings (2026)		209,624	209,624	209,624	209,624	209,624	209,624	209,624	209,624	209,624	209,624	209,624	209,624		
14	Cumulative C&I Savings	36,704,115	36,913,738	37,123,362	37,332,985	37,542,609	37,752,233	37,961,856	38,171,480	38,381,104	38,590,727	38,800,351	39,009,974	39,219,598		
15	Average C&I kWh Distribution Rate		0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124	0.01124		
16	Lost C&I kWH Revenue		$ 414,977	$ 417,333	$ 419,690	$ 422,047	$ 424,403	$ 426,760	$ 429,116	$ 431,473	$ 433,829	$ 436,186	$ 438,542	$ 440,899	$ 5,135,255	
17	Monthly C&I kW Savings (2026)		369	369	369	369	369	369	369	369	369	369	369	369		
18	Cumulative Monthly C&I kW Savings	66,224	66,593	66,961	67,330	67,699	68,068	68,437	68,806	69,175	69,544	69,913	70,282	70,651		
19	Average C&I Demand Rate		8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49		
20	Lost C&I Demand Revenue		$ 565,602	$ 568,735	$ 571,869	$ 575,003	$ 578,136	$ 581,270	$ 584,404	$ 587,538	$ 590,671	$ 593,805	$ 596,939	$ 600,072	$ 6,994,044	
21	Total Lost C&I kWh and Demand Revenue		$ 1,078,319	$ 1,083,809	$ 1,089,299	$ 1,094,790	$ 1,100,280	$ 1,105,770	$ 1,111,260	$ 1,116,751	$ 1,122,241	$ 1,127,731	$ 1,133,221	$ 1,138,711	$ 13,302,182	
22	**Total Lost Revenue**		**$ 1,540,616**	**$ 1,548,546**	**$ 1,556,476**	**$ 1,564,406**	**$ 1,572,336**	**$ 1,580,267**	**$ 1,588,197**	**$ 1,596,127**	**$ 1,604,057**	**$ 1,611,987**	**$ 1,619,917**	**$ 1,627,847**	**$ 19,010,779**	

Lines 1-4: Company Forecast
Line 5: Line 1 / 12
Line 6: Company Forecast
Line 7: Prior Month Line 7 + Current Month Line 5 - Current Month Line 6
Line 8: Page 18, Column 8
Line 9: Line 7 x Line 8
Line 10: Line 1, Column B / 12
Line 11: Page 18, Column 8
Line 12: Line 10 x Line 11
Line 13: Line 3 / 12
Line 14: Prior Month Line 14 + Current Month Line 13
Line 15: Page 18, Column 7
Line 16: Line 14 x Line 15
Line 17: Line 4
Line 18: Prior Month Line 18 + Current Month Line 17
Line 19: Page 18, Column 6
Line 20: Line 18 x Line 19
Line 21: Line 12 + Line 16 + Line 20
Line 22: Line 9 + Line 21

Public Service Company of New Hampshire d/b/a Eversource Energy
Lost Base Revenue Reconciliation
January 1, 2022 to December 31, 2022
($ in 000's)

Line	Description	Actual Carryover Dec-21	Actual Jan-22	Actual Feb-22	Actual Mar-22	Actual Apr-22	Actual May-22	Actual Jun-22	Actual Jul-22	Actual Aug-22	Actual Sep-22	Actual Oct-22	Actual Nov-22	Actual Dec-22	2022 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	Total Revenue Recovery		463	452	411	389	706	1,143	1,276	1,484	1,272	1,024	1,030	1,191	10,839
2	Total Lost Revenues		892	898	902	906	915	921	929	934	943	957	971	1,007	11,173
3	Current Month (Over)/Under Recovery		429	446	491	517	209	(222)	(346)	(550)	(329)	(67)	(59)	(184)	333
4	Cumulative (Over)/Under Recovery	1,883	2,312	2,757	3,248	3,765	3,974	3,752	3,405	2,855	2,526	2,459	2,400	2,216	
5	Carrying Charge Rate (Prime Rate)		0.2708%	0.2708%	0.2808%	0.2917%	0.3283%	0.3650%	0.4042%	0.4583%	0.4775%	0.5208%	0.5792%	0.6058%	
6	Carrying Charge on Deferral Balance		6	7	8	10	13	14	14	14	13	13	14	14	141
7	Cumulative (Over)/Under Recovery Incl Carrying Charge		2,317	2,770	3,269	3,796	4,018	3,810	3,478	2,942	2,626	2,571	2,527	2,356	
8	Total Sales (MWh)		712,609	695,660	632,237	598,209	587,290	617,815	689,536	802,104	687,362	553,498	556,560	643,644	7,776,524
9	**SBC Rate (LBR Component in cents per kWh)**		0.065	0.065	0.065	0.065	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	

Line 1: Company Records
Line 2: Page 8, Line 22 / 1000
Line 3: Line 2 - Line 1
Line 4: Prior month Line 4 + Current month Line 3
Line 5: Prime Rate / 12
Line 6: (Prior Month Line 4 + Current Month Line 4) / 2 x Line 5
Line 7: Line 4 + Line 6
Line 8: Company Records
Line 9: Approved Rate

Public Service Company of New Hampshire d/b/a Eversource Energy
Lost Base Revenue Reconciliation (Preliminary)
January 1, 2023 to December 31, 2023
($ in 000's)

Line	Description	Actual Carryover Dec-22	Estimate Jan-23	Estimate Feb-23	Estimate Mar-23	Estimate Apr-23	Estimate May-23	Forecast Jun-23	Forecast Jul-23	Forecast Aug-23	Forecast Sep-23	Forecast Oct-23	Forecast Nov-23	Forecast Dec-23	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	Total Revenue Recovery		1,410	1,266	1,265	1,250	1,109	1,299	1,499	1,465	1,247	1,231	1,232	1,411	15,684
2	Total Lost Revenues		1,009	1,017	1,025	1,032	1,041	1,050	1,058	1,066	1,074	1,082	1,090	1,098	12,642
3	Current Month (Over)/Under Recovery		(400)	(249)	(240)	(218)	(68)	(249)	(441)	(400)	(173)	(149)	(141)	(313)	(3,042)
4	Cumulative (Over)/Under Recovery	2,356	1,956	1,707	1,467	1,249	1,181	932	491	91	(82)	(231)	(373)	(686)	
5	Carrying Charge Rate (Prime Rate)		0.6250%	0.6450%	0.6517%	0.6667%	0.6858%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
6	Carrying Charge on Deferral Balance		13	12	10	9	8	7	5	2	0	(1)	(2)	(4)	60
7	Cumulative (Over)/Under Recovery Incl Carrying Cha		1,970	1,732	1,502	1,293	1,234	992	556	158	(15)	(165)	(309)	(625)	
8	Total Sales (MWh)		687,634	617,425	617,271	609,783	540,971	633,565	731,204	714,805	608,210	600,627	600,773	688,338	7,650,604
9	**SBC Rate (LBR Component in cents per kWh)**		0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	

Line 1: Company Records; (Line 8 x Line 9) / 100
Line 2: Page 9, Line 22 / 1000
Line 3: Line 2 - Line 1
Line 4: Prior month Line 4 + Current month Line 3
Line 5: Prime Rate / 12
Line 6: (Prior Month Line 4 + Current Month Line 4) / 2 x Line 5
Line 7: Line 4 + Line 6
Line 8: Company Records/Forecast
Line 9: Approved Rate

Public Service Company of New Hampshire d/b/a Eversource Energy
Lost Base Revenue Reconciliation (Preliminary)
January 1, 2024 to December 31, 2024
($ in 000's)

Line	Description	Forecast Carryover Dec-23	Forecast Jan-24	Forecast Feb-24	Forecast Mar-24	Forecast Apr-24	Forecast May-24	Forecast Jun-24	Forecast Jul-24	Forecast Aug-24	Forecast Sep-24	Forecast Oct-24	Forecast Nov-24	Forecast Dec-24	2024 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	Total Revenue Recovery		1,267	1,161	1,137	1,029	1,035	1,153	1,322	1,278	1,086	1,064	1,067	1,217	13,816
2	Total Lost Revenues		1,163	1,171	1,179	1,187	1,194	1,202	1,210	1,218	1,226	1,234	1,242	1,250	14,475
3	Current Month (Over)/Under Recovery		(104)	10	42	157	159	50	(112)	(60)	140	170	175	33	659
4	Cumulative (Over)/Under Recovery	(625)	(730)	(719)	(677)	(520)	(361)	(312)	(424)	(483)	(344)	(174)	1	34	
5	Carrying Charge Rate (Prime Rate)		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
6	Carrying Charge on Deferral Balance		(5)	(5)	(5)	(4)	(3)	(2)	(3)	(3)	(3)	(2)	(1)	0	(35)
7	Cumulative (Over)/Under Recovery Incl Carrying Charge		(734)	(729)	(692)	(539)	(383)	(336)	(450)	(513)	(376)	(208)	(34)	(1)	
8	Total Sales (MWh)		712,077	652,194	638,637	578,410	581,818	647,722	742,777	718,038	610,409	597,713	599,437	683,656	7,762,885
9	**SBC Rate (LBR Component in cents per kWh)**		0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	

Line 1: (Line 8 x Line 9) / 100
Line 2: Page 10, Line 22 / 1000
Line 3: Line 2 - Line 1
Line 4: Prior month Line 4 + Current month Line 3
Line 5: Prime Rate / 12
Line 6: (Prior Month Line 4 + Current Month Line 4) / 2 x Line 5
Line 7: Line 4 + Line 6
Line 8: Company Forecast
Line 9: Estimated/Proposed Rate

Public Service Company of New Hampshire d/b/a Eversource Energy
Lost Base Revenue Reconciliation (Preliminary)
January 1, 2025 to December 31, 2025
($ in 000's)

Line	Description	Forecast Carryover Dec-24	Forecast Jan-25	Forecast Feb-25	Forecast Mar-25	Forecast Apr-25	Forecast May-25	Forecast Jun-25	Forecast Jul-25	Forecast Aug-25	Forecast Sep-25	Forecast Oct-25	Forecast Nov-25	Forecast Dec-25	2025 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	Total Revenue Recovery		1,545	1,366	1,384	1,253	1,259	1,402	1,608	1,554	1,320	1,272	1,290	1,479	16,732
2	Total Lost Revenues		1,352	1,360	1,368	1,376	1,383	1,391	1,399	1,407	1,415	1,423	1,431	1,438	16,743
3	Current Month (Over)/Under Recovery		(193)	(6)	(16)	123	124	(11)	(209)	(147)	95	151	141	(41)	11
4	Cumulative (Over)/Under Recovery	(1)	(193)	(200)	(216)	(94)	31	20	(189)	(336)	(241)	(90)	51	10	
5	Carrying Charge Rate (Prime Rate)		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
6	Carrying Charge on Deferral Balance		(1)	(1)	(1)	(1)	(0)	0	(1)	(2)	(2)	(1)	(0)	0	(10)
7	Cumulative (Over)/Under Recovery Incl Carrying Charge		(194)	(202)	(220)	(98)	26	16	(194)	(343)	(250)	(100)	40	(0)	
8	Total Sales (MWh)		712,340	630,112	638,271	577,852	580,661	646,511	741,624	716,689	608,699	586,494	594,746	682,151	7,716,150
9	**SBC Rate (LBR Component in cents per kWh)**		0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	

Line 1: (Line 8 x Line 9) / 100
Line 2: Page 11, Line 22 / 1000
Line 3: Line 2 - Line 1
Line 4: Prior month Line 4 + Current month Line 3
Line 5: Prime Rate / 12
Line 6: (Prior Month Line 4 + Current Month Line 4) / 2 x Line 5
Line 7: Line 4 + Line 6
Line 8: Company Forecast
Line 9: Estimated/Proposed Rate

Public Service Company of New Hampshire d/b/a Eversource Energy
Lost Base Revenue Reconciliation (Preliminary)
January 1, 2026 to December 31, 2026
($ in 000's)

Line	Description	Forecast Carryover Dec-25	Forecast Jan-26	Forecast Feb-26	Forecast Mar-26	Forecast Apr-26	Forecast May-26	Forecast Jun-26	Forecast Jul-26	Forecast Aug-26	Forecast Sep-26	Forecast Oct-26	Forecast Nov-26	Forecast Dec-26	2026 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	Total Revenue Recovery		1,754	1,550	1,570	1,444	1,434	1,588	1,823	1,762	1,495	1,441	1,461	1,677	18,999
2	Total Lost Revenues		1,541	1,549	1,556	1,564	1,572	1,580	1,588	1,596	1,604	1,612	1,620	1,628	19,011
3	Current Month (Over)/Under Recovery		(213)	(2)	(13)	120	138	(8)	(235)	(166)	109	171	159	(49)	11
4	Cumulative (Over)/Under Recovery	(0)	(213)	(215)	(229)	(108)	30	22	(213)	(379)	(270)	(98)	60	11	
5	Carrying Charge Rate (Prime Rate)		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
6	Carrying Charge on Deferral Balance		(1)	(1)	(2)	(1)	(0)	0	(1)	(2)	(2)	(1)	(0)	0	(11)
7	Cumulative (Over)/Under Recovery Incl Carrying Charge		(214)	(217)	(232)	(113)	25	17	(219)	(386)	(280)	(109)	49	0	
8	Total Sales (MWh)		711,630	628,996	636,931	585,886	581,762	644,486	739,804	714,793	606,527	584,452	592,918	680,417	7,708,603
9	**SBC Rate (LBR Component in cents per kWh)**		0.246	0.246	0.246	0.246	0.246	0.246	0.246	0.246	0.246	0.246	0.246	0.246	

Line 1: (Line 8 x Line 9) / 100
Line 2: Page 12, Line 22 / 1000
Line 3: Line 2 - Line 1
Line 4: Prior month Line 4 + Current month Line 3
Line 5: Prime Rate / 12
Line 6: (Prior Month Line 4 + Current Month Line 4) / 2 x Line 5
Line 7: Line 4 + Line 6
Line 8: Company Forecast
Line 9: Estimated/Proposed Rate

Public Service Company of New Hampshire d/b/a Eversource Energy
Calculation of Forecasted Average Distribution Rate for Lost Revenue
Based on Actual Billing Determinants and Distribution Rates*

For the Period 01/01/2022 Through 12/31/2022

	(1)	(2)	(3) = (1) + (2)	(4)	(5)	(6) = (2) / (4)	(7) = (2) / (5)	(8) = (3) / (5)
	Revenue							
Rate Class	Demand Charges	kWh Charges	Total Demand and kWh Charges	Delivery kW	Delivery kWh	Average Distribution Rate $/kW	Average Distribution Rate $/kWh[(a)]	Average Distribution Rate $/kWh[(b)]
Residential	$ -	$ 173,956,689	$ 173,956,689	$ -	3,395,141,862	**N/A**	**N/A**	**$ 0.05124**
General Service Rate G	$ 40,446,960	$ 32,596,024	$ 73,042,984	3,439,722	1,616,163,985	$ 9.48	$ 0.02017	$ 0.04520
Primary General Service Rate GV	$ 27,901,596	$ 10,426,507	$ 38,328,103	4,067,414	1,595,794,474	$ 2.56	$ 0.00653	$ 0.02402
Large General Service Rate LG	$ 16,201,617	$ 5,730,473	$ 21,932,090	2,447,591	1,124,802,700	$ 2.34	$ 0.00509	$ 0.01950
Commercial and Industrial	$ 84,550,173	$ 48,753,003	$ 133,303,176	9,954,727	4,336,761,158	**$ 8.49**	**$ 0.01124**	**$ 0.03074**

* Excludes the outdoor lighting rates (Rate OL and Rate EOL), the Customer/Meter charge revenue from each rate, and the on/off peak kWh associated with Rate B >= 115 kV under Rate LG.

Public Service Company of New Hampshire d/b/a Eversource Energy
Bill Impacts of Changes in System Benefits Charge

Line	Description	Current Rates*	2024	2025	2026
1	Total System Benefits Charge ($/kWh) (A)	$ 0.00905	$ 0.00905	$ 0.00970	$ 0.01015
2	Bill per month, including PSNH default energy service				
3	Residential Rate R (625 kWh/month)	$ 199.04	$ 199.03	$ 199.44	$ 199.73
4	General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)	$ 3,117.49	$ 3,117.48	$ 3,123.97	$ 3,128.53
5	Change from previous rate level - $ per month				
6	Residential Rate R (625 kWh/month)		$ (0.00)	$ 0.41	$ 0.29
7	General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		$ (0.00)	$ 6.48	$ 4.56
8	Change from previous rate level - %				
9	Residential Rate R (625 kWh/month)		0.0%	0.2%	0.1%
10	General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		0.0%	0.2%	0.1%

* Stated at Eversource's rate levels effective February 1, 2023

		Current Rates*	2024	2025	2026
(A)	System Benefits Charge (SBC) Rate				
	EE Rate	$ 0.00550	$ 0.00577	$ 0.00603	$ 0.00619
	EAP Rate	$ 0.00150	$ 0.00150	$ 0.00150	$ 0.00150
	LBR Rate	$ 0.00205	$ 0.00178	$ 0.00217	$ 0.00246
	Total SBC Rate	$ 0.00905	$ 0.00905	$ 0.00970	$ 0.01015

Public Service Company of New Hampshire d/b/a Eversource Energy
Calculation of Distribution Revenue at the Rate Levels in Effect January 1 - December 31, 2022
Based on Billing Determinants for the Twelve Months Ending December 2022

Residential Rate R

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Rate	Source	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Revenue
Standard	Customer Charge	451,917	$ 13.81	$ 6,240,974	4,078,183	$ 13.81	$ 56,319,707	907,444	$ 13.81	$ 12,531,802	5,437,544	$ 75,092,483
	All kWh	324,103,559	$ 0.05177	$ 16,778,841	2,468,644,162	$ 0.05196	$ 128,270,751	489,695,808	$ 0.05410	$ 26,492,543	3,282,443,529	$ 171,542,135
Uncontrolled Water Heating	Customer Charge	39,383	$ 4.87	$ 191,795	351,860	$ 4.87	$ 1,713,558	77,124	$ 4.87	$ 375,594	468,367	$ 2,280,947
	All kWh	8,098,796	$ 0.02393	$ 193,804	59,675,020	$ 0.02404	$ 1,434,587	13,249,299	$ 0.02504	$ 331,762	81,023,115	$ 1,960,154
Controlled Water Heating	Customer Charge	211	$ 4.87	$ 1,028	1,878	$ 4.87	$ 9,146	396	$ 4.87	$ 1,929	2,485	$ 12,102
	All kWh	42,732	$ 0.02393	$ 1,022.6	319,759	$ 0.02404	$ 7,687.0	68,916	$ 0.02504	$ 1,725.7	431,407	$ 10,435.2
LCS - Radio-controlled	Customer Charge	3,242	$ 6.99	$ 22,662	28,868	$ 6.99	$ 201,787	6,348	$ 6.99	$ 44,373	38,458	$ 268,821
	All kWh	4,817,810	$ 0.01273	$ 61,331	20,418,782	$ 0.01284	$ 262,177	4,829,399	$ 0.01384	$ 66,839	30,065,991	$ 390,347
LCS - 8 Hour	Customer Charge	96	$ 4.87	$ 468	871	$ 4.87	$ 4,242	159	$ 4.87	$ 774	1,126	$ 5,484
	All kWh	44,554	$ 0.02393	$ 1,066	335,787	$ 0.02404	$ 8,072	(45,217)	$ 0.02504	$ (1,132)	335,124	$ 8,006
LCS - 10,11 Hour	Customer Charge	79	$ 4.87	$ 385	688	$ 4.87	$ 3,351	136	$ 4.87	$ 662	903	$ 4,398
	All kWh	20,751	$ 0.02393	$ 497	153,694	$ 0.02404	$ 3,695	32,592	$ 0.02504	$ 816	207,037	$ 5,007
Time of Day	Customer Charge	44	$ 32.08	$ 1,412	439	$ 32.08	$ 14,083	109	$ 32.08	$ 3,497	592	$ 18,991
	On Peak kWh	21,302	$ 0.15076	$ 3,211	142,958	$ 0.15095	$ 21,580	77,196	$ 0.15288	$ 11,802	241,456	$ 36,593
	Off Peak kWh	36,700	$ 0.00818	$ 300	308,760	$ 0.00818	$ 2,526	35,013	$ 0.01011	$ 354	380,473	$ 3,180
Time of Day 2	Customer Charge	-	$ -	$ -	-	$ -	$ -	8	$ 16.50	$ 132	8	$ 132
	On Peak kWh	-	$ -	$ -	-	$ -	$ -	10,080	$ 0.06518	$ 657	10,080	$ 657
	Off Peak kWh	-	$ -	$ -	-	$ -	$ -	3,650	$ 0.04780	$ 174	3,650	$ 174
Total Residential	Customer/Meter	494,972		$ 6,457,310	4,462,787		$ 58,251,791	991,724		$ 12,955,265	5,949,483	$ 77,683,358
	Demand	-		-	-		-	-		-	-	-
	kWh	337,186,204		$ 17,036,561	2,549,998,922		$ 129,986,969	507,956,736		$ 26,893,386	3,395,141,862	$ 173,956,689
				$ 23,493,872			$ 188,238,760			$ 39,848,651		$ 251,640,047

General Service Rate G

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Rate	Source	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Revenue
Standard	Single Phase Customer Charge	57,584	$ 16.21	$ 933,437	520,517	$ 16.21	$ 8,437,581	115,588	$ 16.21	$ 1,873,681	693,689	$ 11,244,699
	Three Phase Customer Charge	20,509	$ 32.39	$ 664,287	185,240	$ 32.39	$ 5,999,924	41,244	$ 32.39	$ 1,335,893	246,993	$ 8,000,103
	Demand Charge > 5 kW	261,720	$ 11.69	$ 3,059,508	2,879,851	$ 11.69	$ 33,665,452	288,044	$ 12.39	$ 3,568,860	3,429,614	$ 40,293,821
	First 500 kWh Charge	25,019,488	$ 0.02805	$ 701,797	206,647,203	$ 0.02820	$ 5,827,451	45,677,440	$ 0.02820	$ 1,288,104	277,344,131	$ 7,817,352
	Next 1,000 kWh Charge	25,884,845	$ 0.02268	$ 587,068	213,770,688	$ 0.02283	$ 4,880,385	45,320,931	$ 0.02283	$ 1,034,677	284,976,464	$ 6,502,130
	All Additional kWh Charge	90,812,048	$ 0.01709	$ 1,551,978	799,253,446	$ 0.01724	$ 13,779,129	152,582,641	$ 0.01724	$ 2,630,525	1,042,648,135	$ 17,961,632
Time of Day	Single Phase Customer Charge	15	$ 41.98	$ 630	135	$ 41.98	$ 5,667	28	$ 41.98	$ 1,175	178	$ 7,472
	Three Phase Customer Charge	19	$ 60.00	$ 1,140	173	$ 60.00	$ 10,380	42	$ 60.00	$ 2,520	234	$ 14,040
	Demand Charge	265	$ 15.12	$ 3,999	9,411	$ 15.12	$ 142,290	433	$ 15.82	$ 6,850	10,108	$ 153,139
	On peak kWh	10,444	$ 0.05335	$ 557	218,515	$ 0.05350	$ 11,691	74,864	$ 0.05350	$ 4,005	303,823	$ 16,253
	Off peak kWh	16,822	$ 0.00836	$ 141	452,047	$ 0.00851	$ 3,847	34,466	$ 0.00851	$ 293	503,335	$ 4,281
Space Heating	Meter Charge	381	$ 3.24	$ 1,234	3,358	$ 3.24	$ 10,880	740	$ 3.24	$ 2,398	4,479	$ 14,512
	All kWh	604,924	$ 0.04124	$ 24,947	3,188,571	$ 0.04135	$ 131,847	615,418	$ 0.04315	$ 26,555	4,408,913	$ 183,350
Uncontolled Water Heating	Customer Charge	1,161	$ 4.87	$ 5,654	10,359	$ 4.87	$ 50,448	2,268	$ 4.87	$ 11,045	13,788	$ 67,148
	All kWh	278,945	$ 0.02393	$ 6,675	2,151,086	$ 0.02404	$ 51,712	474,109	$ 0.02504	$ 11,872	2,904,140	$ 70,259
Contolled Water Heating	Customer Charge	-	4,87	$ -	-	$ 4.87	$ -	-	$ 4.87	$ -	-	$ -
	All kWh	-	$ 0.23930	$ -	-	$ 0.02404	$ -	-	$ 0.02504	$ -	-	$ -
LCS - Radio-controlled	Customer Charge	145	$ 6.99	$ 1,014	1,270	$ 6.99	$ 8,877	265	$ 6.99	$ 1,852	1,680	$ 11,743
	All kWh	460,836	$ 0.01273	$ 5,866	2,032,193	$ 0.01283	$ 26,073	507,379	$ 0.01384	$ 7,022	3,000,408	$ 38,962
LCS - 8 Hour	Customer Charge	4	$ 4.87	$ 19	27	$ 4.87	$ 131	8	$ 4.87	$ 39	39	$ 190
	All kWh	5,901	$ 0.02393	$ 141	14,415	$ 0.02404	$ 347	8,541	$ 0.02504	$ 214	28,857	$ 702
LCS - 10,11 Hour	Customer Charge	1	$ 4.87	$ 5	18	$ 4.87	$ 88	2	$ 4.87	$ 10	21	$ 102
	All kWh	600	$ 0.02393	$ 14	40,979	$ 0.02404	$ 985	4,200	$ 0.02504	$ 105	45,779	$ 1,105
Total General Service	Customer/Meter	79,819		$ 1,607,419	721,097		$ 14,523,976	160,185		$ 3,228,614	961,101	$ 19,360,009
	Demand	261,985		$ 3,063,507	2,889,261		$ 33,807,742	288,477		$ 3,575,710	3,439,722	$ 40,446,960
	kWh	143,094,853		$ 2,879,185	1,227,769,143		$ 24,713,467	245,299,989		$ 5,003,372	1,616,163,985	$ 32,596,024
				$ 7,550,111			$ 73,045,185			$ 11,807,696		$ 92,402,993

Primary General Service Rate GV

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Rate	Source	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Revenue
Standard	Customer Charge	1,428	$ 211.21	$ 301,608	12,910	$ 211.21	$ 2,726,721	2,890	$ 211.21	$ 610,397	17,228	$ 3,638,726
	First 100 kW Demand Charge	131,925	$ 6.98	$ 920,837	1,219,748	$ 6.98	$ 8,513,841	265,452	$ 7.27	$ 1,929,836	1,617,125	$ 11,364,514
	All Additional kW Demand Charge	197,773	$ 6.72	$ 1,329,035	1,829,672	$ 6.72	$ 12,295,396	389,342	$ 7.01	$ 2,729,287	2,416,787	$ 16,353,718
	First 200,000 kWh	118,201,764	$ 0.00656	$ 775,404	1,054,912,947	$ 0.00663	$ 6,994,073	223,653,876	$ 0.00663	$ 1,482,825	1,396,768,587	$ 9,252,302
	All Additional kWh	20,743,824	$ 0.00583	$ 120,936	142,342,898	$ 0.00590	$ 839,823	32,982,302	$ 0.00590	$ 194,596	196,069,024	$ 1,155,355
Rate B < 115 KV	Administrative Charge	9	$ 372.10	$ 3,349	77	$ 372.10	$ 28,652	16	$ 372.10	$ 5,954	102	$ 37,954
	Translation Charge	1	$ 62.42	$ 62	15	$ 62.42	$ 62	4	$ 62.42	$ 62	20	$ 1,248
	Demand Charge	2,639	$ 5.43	$ 14,330	25,067	$ 5.43	$ 136,114	5,796	$ 5.68	$ 32,921	33,502	$ 183,365
	First 200,000 kWh	144,435	$ 0.00656	$ 947	2,222,635	$ 0.00663	$ 14,736	259,356	$ 0.00663	$ 1,720	2,626,426	$ 17,403
	All Additional kWh	-	$ 0.00583	$ -	-	$ 0.00590	$ -	-	$ 0.00590	$ -	-	$ -
Rate B >= 115 KV	Administrative Charge	2	$ 372.10	$ 744	18	$ 372.10	$ 6,698	4	$ 372.10	$ 1,488	24	$ 8,930
	Translation Charge	-	$ 62.42	$ -	-	$ 62.42	$ -	-	$ 62.42	$ -	-	$ -
	Demand Charge	1,380	$ -	$ -	18,046	$ -	$ -	5,676	$ -	$ -	25,102	$ -
	First 200,000 kWh	30,261	$ 0.00656	$ 199	279,305	$ -	$ -	20,871	$ -	$ -	330,437	$ 199
	All Additional kWh	-	$ 0.00583	$ -	-	$ -	$ -	-	$ -	$ -	-	$ -
Total GV	Customer/Meter	1,439		$ 305,763	13,005		$ 2,762,071	2,910		$ 617,839	17,354	$ 3,685,610
	Demand	332,337		$ 2,264,201	3,074,487		$ 20,945,351	660,590		$ 4,692,045	4,067,414	$ 27,901,596
	kWh	139,120,284		$ 897,486	1,199,757,785		$ 7,848,632	256,916,405		$ 1,679,140	1,595,794,474	$ 10,426,507
				$ 3,467,450			$ 31,556,053			$ 6,989,024		$ 42,013,714

Public Service Company of New Hampshire d/b/a Eversource Energy
Calculation of Distribution Revenue at the Rate Levels in Effect January 1 - December 31, 2022
Based on Billing Determinants for the Twelve Months Ending December 2022

Large General Service Rate LG

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Rate	Source	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge
Standard	Customer Charge	104	$ 660.15	$ 68,656	945	$ 660.15	$ 623,842	212	$ 660.15	$ 139,952	1,261	$ 832,449.15
	Demand Charge	184,803	$ 5.92	$ 1,094,034	1,868,718	$ 5.92	$ 11,062,811	198,162	$ 6.18	$ 1,224,641	2,251,683	$ 13,381,485.48
	On peak kWh	36,804,740	$ 0.00554	$ 203,898	366,207,945	$ 0.00559	$ 2,047,102	74,187,642	$ 0.00559	$ 414,709	477,200,327	$ 2,665,709.59093
	Off Peak kWh	48,426,477	$ 0.00468	$ 226,636	472,651,989	$ 0.00473	$ 2,235,644	101,684,420	$ 0.00473	$ 480,967	622,762,886	$ 2,943,247.12693
Rate B < 115 KV	Administrative Charge	9	$ 372.10	$ 3,349	66	$ 372.10	$ 24,559	14	$ 660.15	$ 9,242	89	$ 37,149.60
	Translation Charge	1		$ -	14		$ -	4		$ -	19	$ -
	Demand charge	18,484	$ 4.55	$ 84,102	146,320	$ 5.43	$ 794,518	31,104	$ 62.42	$ 1,941,512	195,908	$ 2,820,131.48
	On peak kWh	810,473	$ 0.00554	$ 4,490	5,283,285	$ 0.00559	$ 29,534	2,533,489	$ 0.00506	$ 12,819	8,627,247	$ 46,843.03791
	Off Peak kWh	1,504,904	$ 0.00468	$ 7,043	10,499,261	$ 0.00473	$ 49,662	4,208,075	$ 0.00427	$ 17,968	16,212,240	$ 74,672.93550
Rate B >= 115 KV	Administrative Charge	5	$ 372.10	$ 1,861	45	$ 372.10	$ 16,745	10	$ 372.10	$ 3,721	60	$ 22,326.00
	Translation Charge	-	$ 62.42	$ -	-	$ 62.42	$ -	-	$ 62.42	$ -	-	$ -
	Demand charge	91,600	$ -	$ -	830,126	$ -	$ -	83,032	$ -	$ -	1,004,758	$ -
	On peak kWh	1,141,784	$ -	$ -	3,793,091	$ -	$ -	979,928	$ -	$ -	5,914,803	$ -
	Off Peak kWh	1,981,572	$ -	$ -	11,781,202	$ -	$ -	1,544,262	$ -	$ -	15,307,036	$ -
Total LG	Customer/Meter	118		$ 73,865	1,056		$ 665,145	236		$ 152,915	1,410	$ 891,925
	Demand	294,887		$ 1,178,136	2,845,164		$ 11,857,328	312,298		$ 3,166,153	3,452,349	$ 16,201,617
	kWh	90,669,950		$ 442,067	870,216,773		$ 4,361,941	185,137,816		$ 926,464	1,146,024,539	$ 5,730,473
				$ 1,694,068			$ 16,884,414			$ 4,245,532		$ 22,824,014

Outdoor Lighting Rate OL

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Type	Fixture	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge
High Pressure Sodium	4,000 Lumens	3,320	$ 15.55	$ 51,626	30,802	$ 15.59	$ 480,206	6,691	$ 16.04	$ 107,331	40,814	$ 639,163
	5,800 Lumens	470	$ 15.55	$ 7,313	5,107	$ 15.59	$ 79,615	1,093	$ 16.04	$ 17,537	6,670	$ 104,464
	9,500 Lumens	779	$ 20.68	$ 16,115	8,177	$ 20.73	$ 169,515	1,833	$ 21.33	$ 39,099	10,790	$ 224,728
	16,000 Lumens	761	$ 29.25	$ 22,266	7,308	$ 29.32	$ 214,257	1,653	$ 30.16	$ 49,846	9,721	$ 286,368
	30,000 Lumens	1,159	$ 29.97	$ 34,743	11,677	$ 30.05	$ 350,897	2,651	$ 30.91	$ 81,930	15,487	$ 467,570
	50,000 Lumens	1,659	$ 30.31	$ 50,287	16,884	$ 30.39	$ 513,094	3,875	$ 31.25	$ 121,079	22,417	$ 684,461
	130,000 Lumens	266	$ 48.64	$ 12,953	3,672	$ 48.76	$ 179,067	803	$ 50.15	$ 40,296	4,742	$ 232,315
	12,000 Lumens	7	$ 21.39	$ 150	73	$ 21.45	$ 1,566	17	$ 22.06	$ 375	97	$ 2,091
	34,200 Lumens	4	$ 27.38	$ 110	46	$ 27.45	$ 1,266	11	$ 28.23	$ 311	61	$ 1,686
Mercury	3,500 Lumens	3,991	$ 13.71	$ 54,717	39,198	$ 13.74	$ 538,578	8,586	$ 14.14	$ 121,406	51,775	$ 714,701
	7,000 Lumens	751	$ 16.50	$ 12,387	7,748	$ 16.55	$ 128,230	1,747	$ 17.02	$ 29,730	10,245	$ 170,346
	11,000 Lumens	30	$ 20.40	$ 612	485	$ 20.46	$ 9,923	111	$ 21.04	$ 2,327	626	$ 12,862
	15,000 Lumens	3	$ 23.34	$ 70	27	$ 23.40	$ 632	6	$ 24.07	$ 144	36	$ 846
	20,000 Lumens	317	$ 25.20	$ 7,982	3,430	$ 25.26	$ 86,633	773	$ 25.99	$ 20,096	4,520	$ 114,710
	56,000 Lumens	103	$ 40.05	$ 4,125	1,172	$ 40.16	$ 47,076	275	$ 41.30	$ 11,344	1,550	$ 62,545
Metal Halide	5,000 Lumens	194	$ 16.22	$ 3,147	1,913	$ 16.26	$ 31,109	423	$ 16.73	$ 7,082	2,531	$ 41,337
	8,000 Lumens	107	$ 22.20	$ 2,375	1,063	$ 22.26	$ 23,654	238	$ 22.90	$ 5,455	1,408	$ 31,484
	13,000 Lumens	7	$ 30.46	$ 213	168	$ 30.54	$ 5,131	41	$ 31.42	$ 1,295	216	$ 6,638
	13,500 Lumens	110	$ 31.11	$ 3,423	1,158	$ 31.19	$ 36,111	266	$ 32.08	$ 8,532	1,534	$ 48,066
	20,000 Lumens	245	$ 31.11	$ 7,634	2,357	$ 31.19	$ 73,505	516	$ 32.08	$ 16,553	3,118	$ 97,692
	36,000 Lumens	369	$ 31.40	$ 11,574	3,679	$ 31.48	$ 115,821	840	$ 32.38	$ 27,193	4,888	$ 154,588
	100,000 Lumens	191	$ 47.07	$ 8,989	1,645	$ 47.19	$ 77,606	361	$ 48.54	$ 17,504	2,196	$ 104,098
Incandescent	600 Lumens	2	$ 8.96	$ 18	429	$ 8.98	$ 3,854	96	$ 9.24	$ 887	527	$ 4,759
	1,000 Lumens	12	$ 10.00	$ 120	1,390	$ 10.03	$ 13,937	305	$ 10.31	$ 3,140	1,706	$ 17,197
	2,500 Lumens	1	$ 12.83	$ 13	20	$ 12.86	$ 251	6	$ 22.73	$ 136	27	$ 400
	6,000 Lumens	-	$ 22.05	$ -	-	$ 22.10	$ -	-	$ 22.35	$ -	-	$ -
Fluorescent	20,000 Lumens	2	$ 34.18	$ 68	18	$ 25.26	$ 455	4	$ 34.65	$ 141	24	$ 664
LED's	2,500 Lumens	0	$ 10.26	$ -	25	$ 10.29	$ 259	17	$ 10.58	$ 177	42	$ 435
	4,100 Lumens	0	$ 10.24	$ -	4	$ 10.27	$ 41	3	$ 10.56	$ 34	7	$ 75
	4,800 Lumens	0	$ 10.41	$ -	92	$ 10.44	$ 961	56	$ 10.73	$ 601	148	$ 1,561
	8,500 Lumens	0	$ 11.44	$ -	5	$ 11.47	$ 54	2	$ 11.80	$ 24	7	$ 78
	13,300 Lumens	0	$ 12.54	$ -	25	$ 12.67	$ 318	22	$ 13.03	$ 283	47	$ 601
	24,500 Lumens	3	$ 15.85	$ 41	478	$ 15.89	$ 7,587	7	$ 16.34	$ 115	487	$ 7,744
Total Rate OL	Fixtures	14,863		$ 313,070	150,272		$ 3,191,205	33,327		$ 732,000	198,463	4,236,276
	Demand											
	kWh	1,561,689			9,795,357			3,008,705			14,365,751	
				$ 313,070			$ 3,191,205			$ 732,000		$ 4,236,276

Outdoor Lighting Rate EOL

		January 1, 2022 - January 31, 2022			February 1, 2022 - October 31, 2022			November 1, 2022 - December 31, 2022			2022 Total	
Type	Fixture	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge	Revenue	Units	Rate/Charge
High Pressure Sodium	4,000 Lumens	2,109	$ 6.34	$ 13,371	18,407	$ 6.36	$ 117,069	3,202	$ 8.39	$ 26,865	23,718	$ 157,304
	5,800 Lumens	120	$ 6.65	$ 798	919	$ 6.67	$ 6,130	174	$ 8.39	$ 1,460	1,213	$ 8,388
	9,500 Lumens	279	$ 7.07	$ 1,973	2,122	$ 7.09	$ 15,045	364	$ 10.32	$ 3,756	2,765	$ 20,774
	16,000 Lumens	424	$ 7.73	$ 3,278	3,674	$ 7.75	$ 28,474	752	$ 11.35	$ 8,535	4,850	$ 40,286
	30,000 Lumens	1,029	$ 8.95	$ 9,210	9,422	$ 8.98	$ 84,610	1,929	$ 11.35	$ 21,894	12,380	$ 115,713
	50,000 Lumens	111	$ 10.66	$ 1,183	980	$ 10.69	$ 10,476	199	$ 11.71	$ 2,330	1,290	$ 13,990
	130,000 Lumens	55	$ 17.33	$ 953	491	$ 17.38	$ 8,534	108	$ 22.23	$ 2,401	654	$ 11,888
Metal Halide	5,000 Lumens	442	$ 6.67	$ 2,948	4,083	$ 6.69	$ 27,315	882	$ 8.72	$ 7,691	5,407	$ 37,954
	8,000 Lumens	23	$ 7.01	$ 161	213	$ 7.03	$ 1,497	48	$ 11.52	$ 553	284	$ 2,212
	13,000 Lumens	-	$ 7.74	$ -	-	$ 7.76	$ -	-	$ 12.30	$ -	-	$ -
	13,500 Lumens	28	$ 7.91	$ 221	261	$ 7.93	$ 2,070	56	$ 12.95	$ 725	345	$ 3,016
	20,000 Lumens	32	$ 8.78	$ 281	264	$ 8.80	$ 2,323	50	$ 13.17	$ 659	346	$ 3,263
	36,000 Lumens	12	$ 10.49	$ 126	100	$ 10.52	$ 1,052	22	$ 13.54	$ 298	134	$ 1,476
	100,000 Lumens	103	$ 17.15	$ 1,766	927	$ 17.20	$ 15,944	206	$ 24.12	$ 4,969	1,236	$ 22,680
LED's	Per Fixture	36,190	$ 3.23	$ 116,894	328,385	$ 3.24	$ 1,063,967	74,547	$ 3.36	$ 250,478	439,122	$ 1,431,339
	Per Watt	1,461,929	$0.01	$ 15,496	13,281,914	$0.01	$ 134,944	3,011,740	$0.05	$ 153,900	17,755,583	$ 304,341
Total Rate EOL	Fixtures	40,957		$ 168,659	370,248		$ 1,519,450	82,539		$ 486,514	493,744	2,174,623
	Demand	-		$ -	-		$ -	-		$ -	-	
	kWh	976,457		$ -	6,172,232		$ -	1,884,552		$ -	9,033,241	$ -
				$ 168,659			$ 1,519,450			$ 486,514		$ 2,174,623

Total Retail

		January 1, 2022 - January 31, 2022		February 1, 2022 - October 31, 2022		November 1, 2022 - December 31, 2022		2022 Total	
Type	Source	Units	Revenue	Units	Revenue	Units	Revenue	Units	
Total Retail	Customer/Meter	576,348	$ 8,926,088	5,197,945	$ 80,913,638	1,155,055	$ 18,173,147	6,929,348	$ 108,031,801
	Fixtures	55,820	$ 481,730	520,520	$ 4,710,655	115,866	$ 1,218,514	692,207	$ 6,410,899
	Demand	889,209	$ 6,505,844	8,808,912	$ 66,610,421	1,261,365	$ 11,433,908	10,959,485	$ 84,550,173
	kWh	712,609,437	$ 21,255,300	5,863,710,212	$ 166,911,010	1,200,204,202	$ 34,502,362	7,776,523,852	$ 222,709,692
			$ 37,168,961		$ 319,145,724		$ 65,327,931		$ 421,702,565

Lost Base Revenue
Summary of Data Included in the Calculation of the Average Distribution Rates*

		January 1, 2022 - January 31, 2022		February 1, 2022 - October 31, 2022		November 1, 2022 - December 31, 2022		2022 Total	
Type	Source	Units	Revenue	Units	Revenue	Units	Revenue	Units	
Total Residential	Demand	-	$ -	-	$ -	-	$ -	-	$ -
	kWh	337,186,204	$ 17,036,561	2,549,998,922	$ 129,986,969	507,956,736	$ 26,893,386	3,395,141,862	$ 173,956,689
			$ 17,036,561		$ 129,986,969		$ 26,893,386		$ 173,956,689
Total General Service	Demand	261,985	$ 3,063,507	2,889,261	$ 33,807,742	288,477	$ 3,575,710	3,439,722	$ 40,446,960
	kWh	143,094,853	$ 2,879,185	1,227,769,143	$ 24,713,467	245,299,989	$ 5,003,372	1,616,163,985	$ 32,596,024
			$ 5,942,692		$ 58,521,209		$ 8,579,082		$ 73,042,984
Total GV	Demand	332,337	$ 2,264,201	3,074,487	$ 20,945,351	660,590	$ 4,692,045	4,067,414	$ 27,901,596
	kWh	139,120,284	$ 897,486	1,199,757,785	$ 7,848,632	256,916,405	$ 1,679,140	1,595,794,474	$ 10,426,507
			$ 3,161,687		$ 28,793,983		$ 6,371,185		$ 38,328,103
Total LG	Demand	203,287	$ 1,178,136	2,015,038	$ 11,857,328	229,266	$ 3,166,153	2,447,591	$ 16,201,617
	kWh	87,546,594	$ 442,067	854,642,480	$ 4,361,941	182,613,626	$ 926,464	1,124,802,700	$ 5,730,473
			$ 1,620,203		$ 16,219,270		$ 4,092,617		$ 21,932,090
Total	Demand	797,609	$ 6,505,844	7,978,786	$ 66,610,421	1,178,333	$ 11,433,908	9,954,727	$ 84,550,173
	kWh	706,947,935	$ 21,255,300	5,832,168,330	$ 166,911,010	1,192,786,756	$ 34,502,362	7,731,903,020	$ 222,709,692
			$ 27,761,144		$ 233,521,431		$ 45,936,270		$ 307,259,865

* The Lost Base Revenue calculation excludes the outdoor lighting rates (Rate OL and Rate EOL), the Customer/Meter charge revenue from each rate, and the on/off peak kWh associated with Rate B >= 115 kV under Rate LG.

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	1.98	*1.98*	2,339.8	*2,339.8*	1,180.4	-	103.2	1,209.5	13.5	18.2	82	2,301.8	49,421.1
B2a - IE Education	-	-	-	-	26.7	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	63.5	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.84**	***1.84***	**2,339.8**	***2,339.8***	**1,270.6**	**-**	**103.2**	**1,209.5**	**13.5**	**18.2**	**82**	**2,301.8**	**49,421.1**
Residential Programs													
A1 - Energy Star Homes	5.35	*3.60*	1,203.4	*1,498.7*	225.0	190.9	11.1	200.1	4.7	4.2	89	1,420.6	32,951.9
A2 - Home Performance	2.29	*2.35*	1,249.0	*1,552.9*	545.3	115.2	20.1	421.6	3.2	5.2	56	2,108.1	42,938.0
A3 - Energy Star Products	1.35	*1.19*	597.4	*737.8*	442.3	178.5	444.1	4,552.8	70.2	69.5	1,391	403.9	5,839.2
A4 - Residential Behavior	2.08	*2.60*	259.9	*324.9*	125.0	-	2,300.0	2,300.0	496.5	320.3	8,000	-	-
A5 - Residential Active Demand Response	0.87	*0.87*	131.8	*131.8*	151.7	-	-	-	-	600.0	800	-	-
A6a - Res Education	-	-	-	-	32.0	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	80.1	-	-	-	-	-		-	-
Sub-Total Residential	**2.15**	***2.04***	**3,441.7**	***4,246.2***	**1,601.3**	**484.5**	**2,775.3**	**7,474.5**	**574.6**	**999.3**	**10,336**	**3,932.6**	**81,729.1**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	1.97	*1.23*	2,787.7	*3,066.6*	1,413.4	1,086.7	2,492.2	30,977.7	229.2	280.1	1,344	(323.4)	(2,969.2)
C2 - Small Business Energy Solutions	1.84	*1.33*	2,277.2	*2,499.2*	1,235.1	645.3	1,756.3	25,531.5	146.9	205.4	868	(321.9)	(3,701.7)
C3 - Municipal Energy Solutions	1.09	*0.81*	194.5	*213.8*	177.6	85.1	126.5	1,069.9	19.4	3.9	426	115.1	2,890.4
C5 - C&I Active Demand Response	2.88	*2.88*	734.5	*734.5*	255.0	-	-	-	-	3,343.2	34	-	-
C6a - C&I Education	-	-	-	-	45.0	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	164.5	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.82**	***1.28***	**5,993.8**	***6,514.1***	**3,290.7**	**1,817.0**	**4,375.0**	**57,579.1**	**395.5**	**3,832.5**	**2,673**	**(530.1)**	**(3,780.6)**
Total	**1.91**	***1.55***	**11,775.3**	***13,100.0***	**6,162.6**	**2,301.6**	**7,253.5**	**66,263.1**	**983.6**	**4,850.1**	**13,092**	**5,704.3**	**127,369.6**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.

Annual kWh Savings	7,253,536	81.3%	**kWh > 65%**	**Lifetime** kWh Savings	66,263,146	64.0%
Annual MMBTU Savings (in kWh)	1,671,753	18.7%		**Lifetime** MMBTU Savings (in kWh)	37,328,361	36.0%
	8,925,290	100.0%			**103,591,507**	100.0%

Annual Net Savings as a % of 2022 Sales	0.82%

Spending per Customer	Low-Income	$ 1,033.86
	Residential	$ 43.04
	C&I	$ 394.66

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 2,340**	*$ 2,340*	$ 12	$ -	$ 20	$ 23	$ -	$ 21	$ 23	$ 13	$ 13	$ 6	**$ 130**	$ 1,396	$ 13	**$ 1,539**	$ 33	$ 767	**$ 800**	**$ 48**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,340**	*$ 2,340*	**$ 12**	**$ -**	**$ 20**	**$ 23**	**$ -**	**$ 21**	**$ 23**	**$ 13**	**$ 13**	**$ 6**	**$ 130**	**$ 1,396**	**$ 13**	**$ 1,539**	**$ 33**	**$ 767**	**$ 800**	**$ 48**
Residential Programs																				
A1 - Energy Star Homes	**$ 1,203**	*$ 1,499*	$ 3	$ -	$ 5	$ 6	$ -	$ 4	$ 4	$ 2	$ 1	$ 1	**$ 26**	$ 1,156	$ 2	**$ 1,184**	$ 20	$ 295	**$ 315**	**$ 6**
A2 - Home Performance	**$ 1,249**	*$ 1,553*	$ 5	$ -	$ 8	$ 10	$ -	$ 6	$ 7	$ 5	$ 4	$ 1	**$ 48**	$ 1,168	$ 5	**$ 1,220**	$ 29	$ 304	**$ 333**	**$ 13**
A3 - Energy Star Products	**$ 597**	*$ 738*	$ 28	$ -	$ 50	$ 59	$ -	$ 101	$ 106	$ 37	$ 34	$ 23	**$ 439**	$ 122	$ 32	**$ 594**	$ 4	$ 140	**$ 144**	**$ 190**
A4 - Residential Behavior	**$ 260**	*$ 325*	$ 14	$ -	$ 31	$ 36	$ -	$ 64	$ 55	$ 25	$ 19	$ 16	**$ 260**	$ -	$ -	**$ 260**	$ -	$ 65	**$ 65**	**$ 146**
A5 - Residential Active Demand Response	**$ 132**	*$ 132*	$ 4	$ -	$ 58	$ 68	$ -	$ -	$ -	$ -	$ -	$ 2	**$ 132**	$ -	$ -	**$ 132**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,442**	*$ 4,246*	**$ 54**	**$ -**	**$ 153**	**$ 179**	**$ -**	**$ 175**	**$ 173**	**$ 68**	**$ 59**	**$ 43**	**$ 904**	**$ 2,446**	**$ 40**	**$ 3,389**	**$ 52**	**$ 804**	**$ 857**	**$ 354**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 2,788**	*$ 3,067*	$ 210	$ -	$ 344	$ 403	$ -	$ 489	$ 441	$ 444	$ 377	$ 136	**$ 2,843**	$ (53)	$ -	**$ 2,790**	$ (2)	$ 279	**$ 277**	**$ 1,243**
C2 - Small Business Energy Solutions	**$ 2,277**	*$ 2,499*	$ 157	$ -	$ 259	$ 304	$ -	$ 504	$ 343	$ 367	$ 244	$ 107	**$ 2,285**	$ (65)	$ 59	**$ 2,280**	$ (2)	$ 222	**$ 220**	**$ 969**
C3 - Municipal Energy Solutions	**$ 195**	*$ 214*	$ 2	$ -	$ 3	$ 3	$ -	$ 23	$ 22	$ 11	$ 10	$ 6	**$ 80**	$ 113	$ -	**$ 193**	$ 2	$ 19	**$ 21**	**$ 51**
C5 - C&I Active Demand Response	**$ 734**	*$ 734*	$ 22	$ -	$ 324	$ 379	$ -	$ -	$ -	$ -	$ -	$ 10	**$ 734**	$ -	$ -	**$ 734**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 5,994**	*$ 6,514*	**$ 390**	**$ -**	**$ 930**	**$ 1,090**	**$ -**	**$ 1,015**	**$ 806**	**$ 822**	**$ 631**	**$ 259**	**$ 5,943**	**$ (6)**	**$ 59**	**$ 5,996**	**$ (3)**	**$ 520**	**$ 518**	**$ 2,263**
Total	**$ 11,775**	*$ 13,100*	**$ 457**	**$ -**	**$ 1,102**	**$ 1,292**	**$ -**	**$ 1,212**	**$ 1,001**	**$ 904**	**$ 703**	**$ 307**	**$ 6,977**	**$ 3,836**	**$ 112**	**$ 10,925**	**$ 83**	**$ 2,092**	**$ 2,175**	**$ 2,665**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	66,263,146	*49,697,359*		-	1.925%	-	$ 118,630	*$ 148,288*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	7,253,536	*5,440,152*		-	0.550%	-	$ 33,894	*$ 42,368*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW[4]	907	*589*		-	0.660%	-	$ 40,673	*$ 50,842*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	984	*639*		-	0.440%	-	$ 27,115	*$ 33,894*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 10,925,210			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 6,162,612			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 4,762,598	*$ 3,571,949*		-	1.925%	-	$ 118,630	*$ 148,288*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 338,944	*$ 423,680*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
9	Total Benefits	$ 11,775,292		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 338,944	$ -	from row 8 above
11	Total Utility Costs	$ 6,162,612	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.81**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2025 Plan

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.12	*2.12*	2,342.6	*2,342.6*	1,103.8	-	83.3	948.8	11.0	15.2	81	2,242.2	48,277.9
B2a - IE Education	-	-	-	-	26.2	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	59.5	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.97**	***1.97***	**2,342.6**	***2,342.6***	**1,189.4**	**-**	**83.3**	**948.8**	**11.0**	**15.2**	**81**	**2,242.2**	**48,277.9**
Residential Programs													
A1 - Energy Star Homes	5.91	*4.02*	1,231.4	*1,533.4*	208.2	173.6	11.1	200.1	4.7	4.2	88	1,407.7	32,653.9
A2 - Home Performance	2.52	*2.60*	1,283.2	*1,595.3*	508.5	105.3	20.1	420.9	3.2	5.2	56	2,090.7	42,541.4
A3 - Energy Star Products	1.42	*1.29*	592.0	*731.5*	417.3	147.7	421.7	4,454.4	69.8	64.5	1,304	380.5	5,509.3
A4 - Residential Behavior	2.18	*2.72*	261.4	*326.8*	120.1	-	2,300.0	2,300.0	496.5	320.3	8,000	-	-
A5 - Residential Active Demand Response	1.68	*1.68*	202.9	*202.9*	120.6	-	-	-	-	900.0	1,200	-	-
A6a - Res Education	-	-	-	-	30.5	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	74.0	-	-	-	-	-		-	-
Sub-Total Residential	**2.41**	***2.30***	**3,570.8**	***4,389.9***	**1,479.1**	**426.6**	**2,752.9**	**7,375.5**	**574.2**	**1,294.2**	**10,647**	**3,878.9**	**80,704.6**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	1.91	*1.20*	2,411.6	*2,652.9*	1,265.7	949.1	2,300.3	27,435.3	214.1	224.0	1,314	(315.4)	(2,880.0)
C2 - Small Business Energy Solutions	1.80	*1.33*	1,967.9	*2,158.8*	1,091.2	526.8	1,542.8	21,968.0	129.0	165.6	805	(306.1)	(3,478.1)
C3 - Municipal Energy Solutions	1.24	*0.96*	189.3	*208.0*	152.1	64.9	110.9	910.3	16.5	3.7	408	115.3	2,893.2
C5 - C&I Active Demand Response	3.22	*3.22*	1,130.3	*1,130.3*	351.0	-	-	-	-	5,014.8	51	-	-
C6a - C&I Education	-	-	-	-	42.5	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	152.8	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.87**	***1.34***	**5,699.0**	***6,150.0***	**3,055.3**	**1,540.8**	**3,954.0**	**50,313.6**	**359.6**	**5,408.2**	**2,579**	**(506.1)**	**(3,464.9)**
Total	**2.03**	***1.67***	**11,612.5**	***12,882.6***	**5,723.8**	**1,967.3**	**6,790.3**	**58,637.9**	**944.8**	**6,717.6**	**13,307**	**5,614.9**	**125,517.7**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

Annual kWh Savings	6,790,294	80.5%	**kWh > 65%**	**Lifetime** kWh Savings	58,637,921	61.5%
Annual MMBTU Savings (in kWh)	1,645,578	19.5%		**Lifetime** MMBTU Savings (in kWh)	36,785,603	38.5%
	8,435,872	100.0%			**95,423,524**	100.0%

Annual Net Savings as a % of 2022 Sales	0.76%

Spending per Customer	Low-Income	$ 967.78
	Residential	$ 39.75
	C&I	$ 366.43

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 2,343**	*$ 2,343*	$ 10	$ -	$ 17	$ 19	$ -	$ 17	$ 18	$ 11	$ 11	$ 4	**$ 107**	$ 1,417	$ 12	**$ 1,536**	$ 34	$ 773	**$ 806**	**$ 36**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,343**	*$ 2,343*	**$ 10**	**$ -**	**$ 17**	**$ 19**	**$ -**	**$ 17**	**$ 18**	**$ 11**	**$ 11**	**$ 4**	**$ 107**	**$ 1,417**	**$ 12**	**$ 1,536**	**$ 34**	**$ 773**	**$ 806**	**$ 36**
Residential Programs																				
A1 - Energy Star Homes	**$ 1,231**	*$ 1,533*	$ 3	$ -	$ 5	$ 6	$ -	$ 4	$ 5	$ 2	$ 1	$ 1	**$ 26**	$ 1,182	$ 3	**$ 1,211**	$ 21	$ 302	**$ 323**	**$ 6**
A2 - Home Performance	**$ 1,283**	*$ 1,595*	$ 6	$ -	$ 9	$ 10	$ -	$ 6	$ 7	$ 5	$ 5	$ 1	**$ 49**	$ 1,199	$ 5	**$ 1,253**	$ 30	$ 312	**$ 342**	**$ 12**
A3 - Energy Star Products	**$ 592**	*$ 731*	$ 29	$ -	$ 49	$ 58	$ -	$ 102	$ 108	$ 36	$ 33	$ 23	**$ 438**	$ 120	$ 30	**$ 588**	$ 4	$ 140	**$ 143**	**$ 177**
A4 - Residential Behavior	**$ 261**	*$ 327*	$ 14	$ -	$ 32	$ 37	$ -	$ 64	$ 55	$ 25	$ 19	$ 16	**$ 261**	$ -	$ -	**$ 261**	$ -	$ 65	**$ 65**	**$ 152**
A5 - Residential Active Demand Response	**$ 203**	*$ 203*	$ 6	$ -	$ 89	$ 105	$ -	$ -	$ -	$ -	$ -	$ 3	**$ 203**	$ -	$ -	**$ 203**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,571**	*$ 4,390*	**$ 58**	**$ -**	**$ 184**	**$ 215**	**$ -**	**$ 176**	**$ 175**	**$ 68**	**$ 58**	**$ 44**	**$ 978**	**$ 2,501**	**$ 37**	**$ 3,516**	**$ 54**	**$ 819**	**$ 873**	**$ 348**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 2,412**	*$ 2,653*	$ 161	$ -	$ 258	$ 303	$ -	$ 467	$ 421	$ 396	$ 332	$ 129	**$ 2,467**	$ (54)	$ -	**$ 2,414**	$ (2)	$ 241	**$ 239**	**$ 1,090**
C2 - Small Business Energy Solutions	**$ 1,968**	*$ 2,159*	$ 128	$ -	$ 207	$ 242	$ -	$ 449	$ 317	$ 319	$ 215	$ 97	**$ 1,973**	$ (64)	$ 61	**$ 1,970**	$ (2)	$ 191	**$ 188**	**$ 815**
C3 - Municipal Energy Solutions	**$ 189**	*$ 208*	$ 2	$ -	$ 3	$ 3	$ -	$ 21	$ 19	$ 10	$ 8	$ 5	**$ 71**	$ 116	$ -	**$ 187**	$ 2	$ 19	**$ 21**	**$ 42**
C5 - C&I Active Demand Response	**$ 1,130**	*$ 1,130*	$ 35	$ -	$ 498	$ 583	$ -	$ -	$ -	$ -	$ -	$ 15	**$ 1,130**	$ -	$ -	**$ 1,130**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 5,699**	*$ 6,150*	**$ 325**	**$ -**	**$ 965**	**$ 1,131**	**$ -**	**$ 937**	**$ 758**	**$ 724**	**$ 555**	**$ 245**	**$ 5,641**	**$ (1)**	**$ 61**	**$ 5,702**	**$ (3)**	**$ 451**	**$ 448**	**$ 1,947**
Total	**$ 11,612**	*$ 12,883*	**$ 394**	**$ -**	**$ 1,166**	**$ 1,366**	**$ -**	**$ 1,130**	**$ 950**	**$ 804**	**$ 624**	**$ 293**	**$ 6,727**	**$ 3,917**	**$ 111**	**$ 10,754**	**$ 86**	**$ 2,043**	**$ 2,128**	**$ 2,330**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2025

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	58,637,921	*43,978,441*		-	1.925%	-	$ 119,274	*$ 149,093*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	6,790,294	*5,092,720*		-	0.550%	-	$ 34,078	*$ 42,598*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	803	*522*		-	0.660%	-	$ 40,894	*$ 51,117*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	945	*614*		-	0.440%	-	$ 27,263	*$ 34,078*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 10,754,338			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 6,196,058			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 4,558,280	*$ 3,418,710*	$ -	-	1.925%	-	$ 119,274	*$ 149,093*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 340,783	*$ 425,979*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 11,612,470		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 340,783	$ -	from row 8 above
11	Total Utility Costs	$ 6,196,058	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.78**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2026 Plan

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	Granite State Test	*Total Resource Cost Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs													
B1 - Home Energy Assistance	2.38	*2.38*	2,346.1	*2,346.1*	984.6	-	102.7	1,196.6	13.5	18.0	82	2,081.1	44,044.0
B2a - IE Education	-	-	-	-	23.3	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	53.0	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.21**	***2.21***	**2,346.1**	***2,346.1***	**1,061.0**	**-**	**102.7**	**1,196.6**	**13.5**	**18.0**	**82**	**2,081.1**	**44,044.0**
Residential Programs													
A1 - Energy Star Homes	6.60	*4.49*	1,246.8	*1,552.6*	188.8	156.7	10.7	189.4	4.5	4.2	85	1,382.2	32,065.1
A2 - Home Performance	2.78	*2.87*	1,320.5	*1,641.7*	474.5	96.7	20.1	420.5	3.2	5.2	55	2,080.5	42,309.4
A3 - Energy Star Products	1.56	*1.43*	602.8	*745.5*	386.0	134.3	418.5	4,411.4	69.2	64.1	1,279	375.2	5,450.4
A4 - Residential Behavior	2.34	*2.92*	269.2	*336.6*	115.2	-	2,300.0	2,300.0	496.5	320.3	8,000	-	-
A5 - Residential Active Demand Response	2.08	*2.08*	259.9	*259.9*	125.2	-	-	-	-	1,125.0	1,500	-	-
A6a - Res Education	-	-	-	-	29.0	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	69.4	-	-	-	-	-		-	-
Sub-Total Residential	**2.66**	***2.55***	**3,699.2**	***4,536.2***	**1,388.1**	**387.7**	**2,749.3**	**7,321.3**	**573.4**	**1,518.8**	**10,920**	**3,837.9**	**79,824.9**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	1.95	*1.31*	2,133.9	*2,347.5*	1,096.0	696.2	1,964.4	23,838.9	186.3	177.7	1,192	(278.5)	(2,546.7)
C2 - Small Business Energy Solutions	1.87	*1.42*	1,824.1	*2,001.4*	973.1	437.4	1,381.8	19,740.7	118.0	146.6	753	(280.3)	(3,100.1)
C3 - Municipal Energy Solutions	1.37	*1.08*	192.4	*211.5*	140.5	56.0	107.5	872.2	16.0	3.6	398	115.5	2,896.0
C5 - C&I Active Demand Response	3.77	*3.77*	1,737.5	*1,737.5*	460.8	-	-	-	-	7,522.2	77	-	-
C6a - C&I Education	-	-	-	-	40.1	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	142.7	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.06**	***1.56***	**5,888.0**	***6,297.9***	**2,853.2**	**1,189.6**	**3,453.7**	**44,451.8**	**320.3**	**7,850.1**	**2,420**	**(443.3)**	**(2,750.9)**
Total	**2.25**	***1.92***	**11,933.3**	***13,180.2***	**5,302.3**	**1,577.2**	**6,305.7**	**52,969.7**	**907.2**	**9,386.8**	**13,422**	**5,475.7**	**121,118.0**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

Annual kWh Savings	6,305,682	79.7%	**kWh > 65%**	**Lifetime** kWh Savings	52,969,666	59.9%
Annual MMBTU Savings (in kWh)	1,604,770	20.3%		**Lifetime** MMBTU Savings (in kWh)	35,496,185	40.1%
	7,910,452	100.0%			**88,465,850**	100.0%

Annual Net Savings as a % of 2022 Sales	0.71%

Spending per Customer	Low-Income	$ 863.29
	Residential	$ 37.31
	C&I	$ 342.19

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 2,346**	*$ 2,346*	$ 13	$ -	$ 20	$ 24	$ -	$ 22	$ 24	$ 14	$ 14	$ 6	**$ 136**	$ 1,364	$ 13	**$ 1,513**	$ 32	$ 800	**$ 833**	**$ 43**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,346**	*$ 2,346*	**$ 13**	**$ -**	**$ 20**	**$ 24**	**$ -**	**$ 22**	**$ 24**	**$ 14**	**$ 14**	**$ 6**	**$ 136**	**$ 1,364**	**$ 13**	**$ 1,513**	**$ 32**	**$ 800**	**$ 833**	**$ 43**
Residential Programs																				
A1 - Energy Star Homes	**$ 1,247**	*$ 1,553*	$ 3	$ -	$ 5	$ 6	$ -	$ 4	$ 4	$ 2	$ 1	$ 1	**$ 27**	$ 1,197	$ 3	**$ 1,226**	$ 21	$ 306	**$ 327**	**$ 6**
A2 - Home Performance	**$ 1,321**	*$ 1,642*	$ 6	$ -	$ 9	$ 10	$ -	$ 6	$ 7	$ 5	$ 5	$ 1	**$ 51**	$ 1,234	$ 5	**$ 1,289**	$ 31	$ 321	**$ 352**	**$ 12**
A3 - Energy Star Products	**$ 603**	*$ 746*	$ 31	$ -	$ 50	$ 59	$ -	$ 104	$ 111	$ 37	$ 34	$ 23	**$ 449**	$ 123	$ 28	**$ 599**	$ 4	$ 143	**$ 147**	**$ 167**
A4 - Residential Behavior	**$ 269**	*$ 337*	$ 16	$ -	$ 33	$ 38	$ -	$ 66	$ 56	$ 26	$ 19	$ 16	**$ 269**	$ -	$ -	**$ 269**	$ -	$ 67	**$ 67**	**$ 146**
A5 - Residential Active Demand Response	**$ 260**	*$ 260*	$ 8	$ -	$ 114	$ 134	$ -	$ -	$ -	$ -	$ -	$ 3	**$ 260**	$ -	$ -	**$ 260**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,699**	*$ 4,536*	**$ 64**	**$ -**	**$ 211**	**$ 247**	**$ -**	**$ 181**	**$ 178**	**$ 70**	**$ 59**	**$ 45**	**$ 1,055**	**$ 2,553**	**$ 35**	**$ 3,643**	**$ 56**	**$ 837**	**$ 893**	**$ 330**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 2,134**	*$ 2,347*	$ 143	$ -	$ 222	$ 260	$ -	$ 416	$ 377	$ 356	$ 300	$ 112	**$ 2,185**	$ (49)	$ -	**$ 2,136**	$ (2)	$ 214	**$ 212**	**$ 893**
C2 - Small Business Energy Solutions	**$ 1,824**	*$ 2,001*	$ 121	$ -	$ 190	$ 222	$ -	$ 428	$ 299	$ 284	$ 198	$ 89	**$ 1,832**	$ (59)	$ 53	**$ 1,826**	$ (2)	$ 177	**$ 175**	**$ 694**
C3 - Municipal Energy Solutions	**$ 192**	*$ 211*	$ 2	$ -	$ 3	$ 3	$ -	$ 21	$ 19	$ 10	$ 8	$ 5	**$ 70**	$ 120	$ -	**$ 191**	$ 2	$ 19	**$ 21**	**$ 39**
C5 - C&I Active Demand Response	**$ 1,737**	*$ 1,737*	$ 54	$ -	$ 765	$ 896	$ -	$ -	$ -	$ -	$ -	$ 23	**$ 1,737**	$ -	$ -	**$ 1,737**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 5,888**	*$ 6,298*	**$ 320**	**$ -**	**$ 1,179**	**$ 1,381**	**$ -**	**$ 865**	**$ 695**	**$ 649**	**$ 506**	**$ 229**	**$ 5,824**	**$ 12**	**$ 53**	**$ 5,890**	**$ (2)**	**$ 410**	**$ 408**	**$ 1,625**
Total	**$ 11,933**	*$ 13,180*	**$ 397**	**$ -**	**$ 1,410**	**$ 1,652**	**$ -**	**$ 1,068**	**$ 897**	**$ 733**	**$ 579**	**$ 280**	**$ 7,016**	**$ 3,929**	**$ 102**	**$ 11,047**	**$ 86**	**$ 2,047**	**$ 2,134**	**$ 1,999**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2026									
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	52,969,666	*39,727,249*		-	1.925%	-	$ 119,605	*$ 149,506*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	6,305,682	*4,729,262*		-	0.550%	-	$ 34,173	*$ 42,716*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	740	*481*		-	0.660%	-	$ 41,007	*$ 51,259*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	907	*590*		-	0.440%	-	$ 27,338	*$ 34,173*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 11,046,520			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 6,213,242			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 4,833,278	*$ 3,624,959*	$ -	-	1.925%	-	$ 119,605	*$ 149,506*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 341,728	*$ 427,160*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 11,933,272		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 341,728	$ -	from row 8 above
11	Total Utility Costs	$ 6,213,242	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.82**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.15	*2.15*	7,028.5	*7,028.5*	3,268.8	-	289.3	3,354.9	37.9	51.4	245	6,625.0	141,743.0
B2a - IE Education	-	-	-	-	76.2	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	176.1	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**2.00**	***2.00***	**7,028.5**	***7,028.5***	**3,521.0**	**-**	**289.3**	**3,354.9**	**37.9**	**51.4**	**245**	**6,625.0**	**141,743.0**
Residential Programs													
A1 - Energy Star Homes	5.92	*4.01*	3,681.6	*4,584.7*	622.0	521.1	33.0	589.7	13.8	12.7	262	4,210.5	97,670.9
A2 - Home Performance	2.52	*2.60*	3,852.8	*4,789.9*	1,528.3	317.1	60.3	1,263.0	9.7	15.7	167	6,279.3	127,788.8
A3 - Energy Star Products	1.44	*1.30*	1,792.2	*2,214.8*	1,245.5	460.5	1,284.3	13,418.6	209.1	198.1	3,974	1,159.7	16,799.0
A4 - Residential Behavior	2.19	*2.74*	790.6	*988.2*	360.3	-	6,900.0	6,900.0	1,489.5	960.8	24,000	-	-
A5 - Residential Active Demand Response	1.50	*1.50*	594.5	*594.5*	397.6	-	-	-	-	2,625.0	3,500	-	-
A6a - Res Education	-	-	-	-	91.5	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	223.4	-	-	-	-	-	-	-	-
Sub-Total Residential	**2.40**	***2.28***	**10,711.7**	***13,172.2***	**4,468.6**	**1,298.8**	**8,277.6**	**22,171.3**	**1,722.2**	**3,812.3**	**31,903**	**11,649.5**	**242,258.7**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	1.94	*1.24*	7,333.1	*8,067.0*	3,775.1	2,732.0	6,756.9	82,251.9	629.5	681.8	3,851	(917.2)	(8,395.9)
C2 - Small Business Energy Solutions	1.84	*1.36*	6,069.2	*6,659.4*	3,299.4	1,609.4	4,680.9	67,240.3	393.9	517.6	2,426	(908.3)	(10,279.9)
C3 - Municipal Energy Solutions	1.23	*0.94*	576.2	*633.3*	470.3	205.9	344.9	2,852.3	52.0	11.2	1,232	346.0	8,679.6
C5 - C&I Active Demand Response	3.38	*3.38*	3,602.3	*3,602.3*	1,066.9	-	-	-	-	15,880.3	162	-	-
C6a - C&I Education	-	-	-	-	127.6	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	460.0	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**1.91**	***1.38***	**17,580.8**	***18,962.0***	**9,199.1**	**4,547.4**	**11,782.6**	**152,344.5**	**1,075.5**	**17,090.8**	**7,671**	**(1,479.5)**	**(9,996.3)**
Total	**2.05**	***1.70***	**35,321.0**	***39,162.7***	**17,188.7**	**5,846.2**	**20,349.5**	**177,870.7**	**2,835.6**	**20,954.5**	**39,820**	**16,794.9**	**374,005.3**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

Annual kWh Savings	20,349,512	80.5%	**kWh > 65%**	**Lifetime** kWh Savings	177,870,732	61.9%
Annual MMBTU Savings (in kWh)	4,922,102	19.5%		**Lifetime** MMBTU Savings (in kWh)	109,610,148	38.1%
	25,271,614	100.0%			**287,480,880**	100.0%

Annual Net Savings as a % of 2022 Sales	2.29%

Spending per Customer	Low-Income	$ 2,864.93
	Residential	$ 120.09
	C&I	$ 1,103.28

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 7,029**	*$ 7,029*	$ 35	$ -	$ 56	$ 66	$ -	$ 60	$ 64	$ 39	$ 38	$ 16	**$ 374**	$ 4,177	$ 38	**$ 4,589**	$ 99	$ 2,340	**$ 2,439**	**$ 127**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 7,029**	*$ 7,029*	**$ 35**	**$ -**	**$ 56**	**$ 66**	**$ -**	**$ 60**	**$ 64**	**$ 39**	**$ 38**	**$ 16**	**$ 374**	**$ 4,177**	**$ 38**	**$ 4,589**	**$ 99**	**$ 2,340**	**$ 2,439**	**$ 127**
Residential Programs																				
A1 - Energy Star Homes	**$ 3,682**	*$ 4,585*	$ 9	$ -	$ 15	$ 17	$ -	$ 13	$ 13	$ 5	$ 4	$ 2	**$ 79**	$ 3,534	$ 8	**$ 3,620**	$ 61	$ 903	**$ 965**	**$ 18**
A2 - Home Performance	**$ 3,853**	*$ 4,790*	$ 17	$ -	$ 26	$ 30	$ -	$ 19	$ 21	$ 16	$ 14	$ 4	**$ 147**	$ 3,601	$ 14	**$ 3,763**	$ 90	$ 937	**$ 1,027**	**$ 36**
A3 - Energy Star Products	**$ 1,792**	*$ 2,215*	$ 88	$ -	$ 149	$ 175	$ -	$ 306	$ 325	$ 111	$ 102	$ 70	**$ 1,326**	$ 364	$ 90	**$ 1,780**	$ 12	$ 423	**$ 434**	**$ 534**
A4 - Residential Behavior	**$ 791**	*$ 988*	$ 44	$ -	$ 95	$ 112	$ -	$ 195	$ 166	$ 75	$ 56	$ 48	**$ 791**	$ -	$ -	**$ 791**	$ -	$ 198	**$ 198**	**$ 444**
A5 - Residential Active Demand Response	**$ 595**	*$ 595*	$ 18	$ -	$ 262	$ 307	$ -	$ -	$ -	$ -	$ -	$ 8	**$ 595**	$ -	$ -	**$ 595**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 10,712**	*$ 13,172*	**$ 176**	**$ -**	**$ 547**	**$ 641**	**$ -**	**$ 532**	**$ 526**	**$ 207**	**$ 176**	**$ 131**	**$ 2,937**	**$ 7,500**	**$ 112**	**$ 10,549**	**$ 163**	**$ 2,461**	**$ 2,624**	**$ 1,032**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 7,333**	*$ 8,067*	$ 513	$ -	$ 824	$ 965	$ -	$ 1,373	$ 1,239	$ 1,196	$ 1,008	$ 376	**$ 7,495**	$ (156)	$ -	**$ 7,339**	$ (6)	$ 734	**$ 728**	**$ 3,226**
C2 - Small Business Energy Solutions	**$ 6,069**	*$ 6,659*	$ 407	$ -	$ 656	$ 769	$ -	$ 1,381	$ 959	$ 969	$ 657	$ 292	**$ 6,090**	$ (188)	$ 174	**$ 6,076**	$ (7)	$ 590	**$ 583**	**$ 2,478**
C3 - Municipal Energy Solutions	**$ 576**	*$ 633*	$ 5	$ -	$ 8	$ 10	$ -	$ 64	$ 59	$ 30	$ 27	$ 17	**$ 221**	$ 349	$ -	**$ 571**	$ 6	$ 57	**$ 63**	**$ 131**
C5 - C&I Active Demand Response	**$ 3,602**	*$ 3,602*	$ 110	$ -	$ 1,586	$ 1,859	$ -	$ -	$ -	$ -	$ -	$ 47	**$ 3,602**	$ -	$ -	**$ 3,602**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 17,581**	*$ 18,962*	**$ 1,035**	**$ -**	**$ 3,074**	**$ 3,602**	**$ -**	**$ 2,818**	**$ 2,258**	**$ 2,195**	**$ 1,692**	**$ 733**	**$ 17,409**	**$ 6**	**$ 174**	**$ 17,588**	**$ (7)**	**$ 1,381**	**$ 1,374**	**$ 5,835**
Total	**$ 35,321**	*$ 39,163*	**$ 1,247**	**$ -**	**$ 3,678**	**$ 4,310**	**$ -**	**$ 3,410**	**$ 2,848**	**$ 2,441**	**$ 1,905**	**$ 880**	**$ 20,720**	**$ 11,682**	**$ 324**	**$ 32,726**	**$ 255**	**$ 6,182**	**$ 6,437**	**$ 6,994**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2024-2026

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	177,870,732	*133,403,049*		-	1.925%	-	$ 357,509	*$ 446,887*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	20,349,512	*15,262,134*		-	0.550%	-	$ 102,146	*$ 127,682*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	2,449	*1,592*		-	0.660%	-	$ 122,575	*$ 153,218*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	2,836	*1,843*		-	0.440%	-	$ 81,716	*$ 102,146*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 32,726,068			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 18,571,912			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 14,154,156	*$ 10,615,617*	$ -	-	1.925%	-	$ 357,509	*$ 446,887*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 1,021,455	*$ 1,276,819*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 35,321,034		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 1,021,455	$ -	from row 8 above
11	Total Utility Costs	$ 18,571,912	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.80**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

ADR Program Cost-Effectiveness

2024	Benefit/Cost Ratios: Granite State Test	Benefit/Cost Ratios: *Total Resource Cost Test*	Benefits ($000): Granite State Test	Benefits ($000): *Total Resource Cost Test*	Utility Costs ($000 - 2024$)[1]	Customer Costs ($000 - 2024$)[1]	Annual MWh Savings	Lifetime MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served
Residential Programs											
A5 - Residential Active Demand Response	0.87	*0.87*	131.8	*131.8*	151.7	-	-	-	-	600.0	800
Sub-Total Residential	**0.87**	***0.87***	**131.8**	***131.8***	**151.7**	**-**	**-**	**-**	**-**	**600.0**	**800**
Commercial, Industrial & Municipal											
C5 - C&I Active Demand Response	2.88	*2.88*	734.5	*734.5*	255.0	-	-	-	-	3,343.2	34
Sub-Total Commercial & Industrial	**2.88**	***2.88***	**734.5**	***734.5***	**255.0**	**-**	**-**	**-**	**-**	**3,343.2**	**34**
Total	**2.13**	***2.13***	**866.3**	***866.3***	**406.7**	**-**	**-**	**-**	**-**	**3,943.2**	**834**

(1) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

2025	Benefit/Cost Ratios: Granite State Test	Benefit/Cost Ratios: *Total Resource Cost Test*	Benefits ($000): Granite State Test	Benefits ($000): *Total Resource Cost Test*	Utility Costs ($000 - 2024$)[1]	Customer Costs ($000 - 2024$)[1]	Annual MWh Savings	Lifetime MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served
Residential Programs											
A5 - Residential Active Demand Response	1.68	*1.68*	202.9	*202.9*	120.6	-	-	-	-	900.0	1,200
Sub-Total Residential	**1.68**	***1.68***	**202.9**	***202.9***	**120.6**	**-**	**-**	**-**	**-**	**900.0**	**1,200**
Commercial, Industrial & Municipal											
C5 - C&I Active Demand Response	3.22	*3.22*	1,130.3	*1,130.3*	351.0	-	-	-	-	5,014.8	51
Sub-Total Commercial & Industrial	**3.22**	***3.22***	**1,130.3**	***1,130.3***	**351.0**	**-**	**-**	**-**	**-**	**5,014.8**	**51**
Total	**2.83**	***2.83***	**1,333.2**	***1,333.2***	**471.7**	**-**	**-**	**-**	**-**	**5,914.8**	**1,251**

(1) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

2026	Benefit/Cost Ratios: Granite State Test	Benefit/Cost Ratios: *Total Resource Cost Test*	Benefits ($000): Granite State Test	Benefits ($000): *Total Resource Cost Test*	Utility Costs ($000 - 2024$)[1]	Customer Costs ($000 - 2024$)[1]	Annual MWh Savings	Lifetime MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served
Residential Programs											
A5 - Residential Active Demand Response	2.08	*2.08*	259.9	*259.9*	125.2	-	-	-	-	1,125.0	8,000
Sub-Total Residential	**2.08**	***2.08***	**259.9**	***259.9***	**125.2**	**-**	**-**	**-**	**-**	**1,125.0**	**8,000**
Commercial, Industrial & Municipal											
C5 - C&I Active Demand Response	3.77	*3.77*	1,737.5	*1,737.5*	460.8	-	-	-	-	7,522.2	77
Sub-Total Commercial & Industrial	**3.77**	***3.77***	**1,737.5**	***1,737.5***	**460.8**	**-**	**-**	**-**	**-**	**7,522.2**	**77**
Total	**3.41**	***3.41***	**1,997.4**	***1,997.4***	**586.1**	**-**	**-**	**-**	**-**	**8,647.2**	**8,077**

(1) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization)	Air Sealing, Cord Wood	EB1a001	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Air Sealing, Electric	EB1a002	4	3	4	2.0	1.5	2.0	30.1	22.6	30.1	0.3	0.2	0.3	0.5	0.4	0.5	-	-	-	-	-	-
B1a - HEA (Weatherization)	Air Sealing, Gas	EB1a003	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Air Sealing, Kerosene	EB1a004	5	5	5	-	-	-	-	-	-	-	-	-	-	-	-	34.1	33.5	34.1	511.9	503.2	511.9
B1a - HEA (Weatherization)	Air Sealing, Oil	EB1a005	39	39	39	-	-	-	-	-	-	-	-	-	-	-	-	268.6	266.2	264.8	4,029.5	3,992.6	3,972.1
B1a - HEA (Weatherization)	Air Sealing, Propane	EB1a006	34	34	34	-	-	-	-	-	-	-	-	-	-	-	-	232.1	232.1	232.1	3,480.8	3,480.8	3,480.8
B1a - HEA (Weatherization)	Air Sealing, Wood Pellets	EB1a007	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Cord Wood	EB1a084	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Electric	EB1a085	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Gas	EB1a086	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Kerosene	EB1a087	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Oil	EB1a088	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Propane	EB1a089	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Sealing, Wood Pellets	EB1a090	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Faucet Aerator, Electric	EB1a009	4	3	4	0.2	0.1	0.2	1.2	0.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization)	Faucet Aerator, Gas	EB1a010	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Faucet Aerator, Kerosene	EB1a011	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Faucet Aerator, Oil	EB1a012	20	20	19	-	-	-	-	-	-	-	-	-	-	-	-	2.8	2.8	2.8	19.6	19.4	19.3
B1a - HEA (Weatherization)	Faucet Aerator, Propane	EB1a013	17	17	17	-	-	-	-	-	-	-	-	-	-	-	-	2.4	2.4	2.4	16.9	16.9	16.9
B1a - HEA (Weatherization)	Tank Wrap, Electric	EB1a091	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Tank Wrap, Gas	EB1a092	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Tank Wrap, Kerosene	EB1a093	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Tank Wrap, Oil	EB1a094	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Tank Wrap, Propane	EB1a095	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hand Held Showerhead, Electric	EB1a016	4	3	4	0.2	0.1	0.2	2.7	2.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization)	Hand Held Showerhead, Gas	EB1a017	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hand Held Showerhead, Kerosene	EB1a018	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	10.8	10.6	10.8
B1a - HEA (Weatherization)	Hand Held Showerhead, Oil	EB1a019	16	16	16	-	-	-	-	-	-	-	-	-	-	-	-	9.1	9.0	8.9	136.0	134.8	134.1
B1a - HEA (Weatherization)	Hand Held Showerhead, Propane	EB1a020	14	14	14	-	-	-	-	-	-	-	-	-	-	-	-	7.8	7.8	7.8	117.5	117.5	117.5
B1a - HEA (Weatherization)	[Open Measure - To Be Assigned]	EB1a021																-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulation, Cord Wood	EB1a022	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulation, Electric	EB1a023	4	3	4	7.3	5.5	7.3	182.0	136.5	182.0	1.1	0.9	1.1	1.9	1.4	1.9	-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulation, Gas	EB1a024	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulation, Kerosene	EB1a025	5	5	5	0.2	0.2	0.2	5.7	5.6	5.7	-	-	-	0.1	0.1	0.1	91.0	89.5	91.0	2,275.0	2,236.6	2,275.0
B1a - HEA (Weatherization)	Insulation, Oil	EB1a026	39	39	28	1.8	1.8	1.3	44.8	44.4	31.9	-	-	-	1.0	1.0	0.7	716.3	709.8	509.6	17,908.7	17,745.0	12,740.0
B1a - HEA (Weatherization)	Insulation, Propane	EB1a027	34	34	34	1.5	1.5	1.5	38.7	38.7	38.7	-	-	-	0.9	0.9	0.9	618.8	618.8	618.8	15,470.0	15,470.0	15,470.0
B1a - HEA (Weatherization)	Insulation, Wood Pellets	EB1a028	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Cord Wood	EB1a077	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Electric	EB1a078	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Gas	EB1a079	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Kerosene	EB1a080	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Oil	EB1a081	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Propane	EB1a082	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Duct Insulation, Wood Pellets	EB1a083	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Low Flow Showerhead, Electric	EB1a030	4	3	4	0.1	0.1	0.1	2.2	1.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization)	Low Flow Showerhead, Gas	EB1a031	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Low Flow Showerhead, Kerosene	EB1a032	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	10.8	10.6	10.8
B1a - HEA (Weatherization)	Low Flow Showerhead, Oil	EB1a033	14	14	14	-	-	-	-	-	-	-	-	-	-	-	-	7.9	7.9	7.8	119.0	117.9	117.3
B1a - HEA (Weatherization)	Low Flow Showerhead, Propane	EB1a034	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	6.8	6.8	6.8	102.3	102.3	102.3
B1a - HEA (Weatherization)	[Open Measure - To Be Assigned]	EB1a035																-	-	-	-	-	-
B1a - HEA (Weatherization)	[Open Measure - To Be Assigned]	EB1a036																-	-	-	-	-	-
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Electric	EB1a037	1	1	1	0.0	0.0	0.0	0.7	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Gas	EB1a038	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Kerosene	EB1a039	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	(0.7)	(0.7)	(0.7)	(10.0)	(9.8)	(10.0)
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Oil	EB1a040	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	27.4	27.1	27.0	411.0	407.2	405.2
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Propane	EB1a041	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-	23.7	23.7	23.7	355.0	355.0	355.0
B1a - HEA (Weatherization)	Hot Water Setback, Electric	EB1a042	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hot Water Setback, Gas	EB1a060	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hot Water Setback, Kerosene	EB1a061	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hot Water Setback, Oil	EB1a062	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	1.5	1.5	1.5
B1a - HEA (Weatherization)	Hot Water Setback, Propane	EB1a063	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	DHW Heat Pump Water Heater	EB1a043	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Stand Alone Water Heater, Electric	EB1a096	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Stand Alone Water Heater, Gas	EB1a097	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Stand Alone Water Heater, Propane	EB1a099	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	5.9	5.9	5.9
B1a - HEA (Weatherization)	Indirect Water Heater, Oil	EB1a098	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, General Service Lamps	EB1a044	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Linear	EB1a045	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Other Specialty	EB1a046	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Reflector	EB1a047	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Fixture	EB1a048	50	40	50	1.8	1.5	1.8	3.6	2.9	3.6	0.4	0.3	0.4	0.3	0.2	0.3	(4.1)	(3.3)	(4.1)	(8.3)	(6.6)	(8.3)
B1a - HEA (Weatherization)	Refrigerator	EB1a049	100	75	100	68.3	51.2	68.3	819.0	614.3	819.0	7.8	5.8	7.8	9.6	7.2	9.6	-	-	-	-	-	-
B1a - HEA (Weatherization)	Freezer	EB1a050	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Clothes Washer	EB1a051	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Clothes Dryer	EB1a052	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Dehumidifier	EB1a053	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization)	Room Air Conditioner	EB1a054	10	10	10	1.0	1.0	1.0	9.3	9.3	9.3	-	-	-	0.5	0.5	0.5	-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Cord Wood	EB1a055	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Electric	EB1a064	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Gas	EB1a065	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Kerosene	EB1a066	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Oil	EB1a067	20	20	20	0.4	0.4	0.4	9.1	9.1	9.1	-	-	-	0.2	0.2	0.2	9.1	9.1	9.1	227.5	227.5	227.5
B1a - HEA (Weatherization)	Window Replacement, Propane	EB1a068	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Wood Pellets	EB1a069	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Cord Wood	EB1a100	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Electric	EB1a101	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Gas	EB1a102	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Kerosene	EB1a103	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Oil	EB1a104	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Propane	EB1a105	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Wood Pellets	EB1a106	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Cord Wood	EB1a070	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Electric	EB1a071	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Gas	EB1a072	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Kerosene	EB1a073	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Oil	EB1a074	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Propane	EB1a075	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Wood Pellets	EB1a076	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Visual Audit	EB1a056	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Baseload Audit - SF	EB1a057	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Baseload Audit - MF	EB1a058	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Low Income Kits	EB1a059	200	200	200	15.8	15.8	15.8	15.8	15.8	15.8	3.4	3.4	3.4	2.2	2.2	2.2	-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Boiler Replacement, Gas	EB1b001	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Boiler Replacement, Kerosene	EB1b002	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Boiler Replacement, Oil	EB1b003	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	118.4	78.9	118.4	2,248.7	1,499.1	2,248.7
B1b - HEA (HVAC Systems)	Boiler Replacement, Propane	EB1b004	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	9.9	9.9	9.9
B1b - HEA (HVAC Systems)	Furnace Replacement, Gas	EB1b005	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Furnace Replacement, Kerosene	EB1b006	1	1	1	0.1	0.1	0.1	1.4	1.4	1.4	0.0	0.0	0.0	-	-	-	8.6	8.6	8.6	145.9	145.9	145.9
B1b - HEA (HVAC Systems)	Furnace Replacement, Oil	EB1b007	2	2	2	0.2	0.2	0.2	4.0	4.0	4.0	0.1	0.1	0.1	-	-	-	14.1	14.1	14.1	239.8	239.8	239.8
B1b - HEA (HVAC Systems)	Furnace Replacement, Propane	EB1b008	1	1	1	0.1	0.1	0.1	2.0	2.0	2.0	0.0	0.0	0.0	-	-	-	9.9	9.9	9.9	167.8	167.8	167.8
B1b - HEA (HVAC Systems)	Programmable Thermostat, Electric	EB1b009	1	1	1	0.2	0.2	0.2	3.4	3.4	3.4	0.2	0.2	0.2	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Programmable Thermostat, Gas	EB1b010	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Programmable Thermostat, Kerosene	EB1b011	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.9	1.9	28.1	28.1	28.1
B1b - HEA (HVAC Systems)	Programmable Thermostat, Oil	EB1b012	20	15	15	-	-	-	-	-	-	-	-	-	-	-	-	37.7	28.3	28.3	565.1	423.8	423.8
B1b - HEA (HVAC Systems)	Programmable Thermostat, Propane	EB1b013	15	15	15	-	-	-	-	-	-	-	-	-	-	-	-	28.1	28.1	28.1	421.8	421.8	421.8
B1b - HEA (HVAC Systems)	Programmable Thermostat, Wood Pellets	EB1b014	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Wifi Thermostat, Electric	EB1b015	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Wifi Thermostat, Gas	EB1b016	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Wifi Thermostat, Kerosene	EB1b017	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Wifi Thermostat, Oil	EB1b018	5	5	5	-	-	-	-	-	-	-	-	-	-	-	-	26.8	26.8	26.8	402.7	402.7	402.7
B1b - HEA (HVAC Systems)	Wifi Thermostat, Propane	EB1b019	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Wifi Thermostat, Wood Pellets	EB1b020	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Mini Split HP (cooling)	EB1b021	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Mini Split HP (heating)	EB1b022	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	ES Central AC	EB1b023	1	1	1	1.9	1.9	1.9	33.8	33.8	33.8	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Oil K1 HVAC Repair or Cleaning	EB1b024	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Gas LP HVAC Repair or Cleaning	EB1b025	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	GSHP HVAC Repair or Cleaning	EB1b026	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	ASHP HVAC Repair or Cleaning	EB1b027	-	-	-													-	-	-	-	-	-
	Home Energy Assistance Subtotal					**103.2**	**83.3**	**102.7**	**1,209.5**	**948.8**	**1,196.6**	**13.5**	**11.0**	**13.5**	**18.2**	**15.2**	**18.0**	**2,301.8**	**2,242.2**	**2,081.1**	**49,421.1**	**48,277.9**	**44,044.0**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	EA1a001	4	4	4	1.0	1.0	1.0	25.0	25.0	25.0	-	-	-	0.6	0.6	0.6	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, SF	EA1a002	3	3	3	1.5	1.5	1.5	37.5	37.5	37.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, SF	EA1a003	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Oil, SF	EA1a004	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, SF	EA1a005	50	50	49	-	-	-	-	-	-	-	-	-	-	-	-	1,004.6	1,000.0	983.7	25,115.9	25,000.0	24,591.6
A1a - ES Homes	Heating, Wood Pellets, SF	EA1a006	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, SF	EA1a007	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, SF	EA1a008	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Oil, SF	EA1a009	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, SF	EA1a010	40	40	40	-	-	-	-	-	-	-	-	-	-	-	-	200.0	200.0	197.5	3,000.0	3,000.0	2,962.5
A1a - ES Homes	Hot Water, Wood Pellets, SF	EA1a011	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Cooling, Electric, MF	EA1a012	3	3	3	0.8	0.8	0.8	18.8	18.8	18.8	-	-	-	0.4	0.4	0.4	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, MF	EA1a013	4	4	3	2.0	2.0	1.6	50.0	50.0	39.3	0.6	0.6	0.5	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, MF	EA1a014	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Oil, MF	EA1a015	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, MF	EA1a016	32	31	30	-	-	-	-	-	-	-	-	-	-	-	-	160.0	154.2	150.0	4,000.0	3,855.4	3,750.0
A1a - ES Homes	Heating, Wood Pellets, MF	EA1a017	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, MF	EA1a018	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, MF	EA1a019	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Oil, MF	EA1a020	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, MF	EA1a021	22	21	20	-	-	-	-	-	-	-	-	-	-	-	-	55.0	52.5	50.0	825.0	787.5	750.0
A1a - ES Homes	Hot Water, Wood Pellets, MF	EA1a022	-	-	-													-	-	-	-	-	-
A1a - ES Homes	LED Bulb	EA1a023	-	-	-													-	-	-	-	-	-
A1a - ES Homes	LED Fixture	EA1a024	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Refrigerator	EA1a025	20	20	20	0.9	0.9	0.9	10.6	10.6	10.6	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	EA1a026	20	20	20	1.8	1.8	1.8	19.8	19.8	19.8	2.9	2.9	2.9	2.7	2.7	2.7	1.0	1.0	1.0	11.0	11.0	11.0
A1a - ES Homes	Clothes Dryer	EA1a027	20	20	20	3.2	3.2	3.2	38.5	38.5	38.5	0.5	0.5	0.5	0.4	0.4	0.4	-	-	-	-	-	-
A1a - ES Homes	HERS - Lighting and Appliances	EA1a028	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Residential New Construction Code Compliance	EA1a029	-	-	-													-	-	-	-	-	-
	ES Homes Subtotal					**11.1**	**11.1**	**10.7**	**200.1**	**200.1**	**189.4**	**4.7**	**4.7**	**4.5**	**4.2**	**4.2**	**4.2**	**1,420.6**	**1,407.7**	**1,382.2**	**32,951.9**	**32,653.9**	**32,065.1**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (Weatherization)	Air Sealing, Cord Wood	EA2a001	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	5.6	5.6	5.6	84.6	84.6	84.6
A2a - Home Performance (Weatherization)	Air Sealing, Electric	EA2a002	5	5	5	2.4	2.4	2.4	35.6	35.6	35.6	0.4	0.4	0.4	0.6	0.6	0.6	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Gas	EA2a003	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Kerosene	EA2a004	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Oil	EA2a005	32	32	31	-	-	-	-	-	-	-	-	-	-	-	-	181.5	178.1	176.1	2,722.1	2,671.0	2,641.1
A2a - Home Performance (Weatherization)	Air Sealing, Propane	EA2a006	16	16	16	-	-	-	-	-	-	-	-	-	-	-	-	90.3	90.3	90.3	1,354.3	1,354.3	1,354.3
A2a - Home Performance (Weatherization)	Air Sealing, Wood Pellets	EA2a007	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Cord Wood	EA2a070	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Electric	EA2a071	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Gas	EA2a072	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Kerosene	EA2a073	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Oil	EA2a074	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Propane	EA2a075	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Sealing, Wood Pellets	EA2a076	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Faucet Aerator, Electric	EA2a009	2	2	2	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Faucet Aerator, Gas	EA2a010	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Faucet Aerator, Kerosene	EA2a011	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Faucet Aerator, Oil	EA2a012	11	11	11	-	-	-	-	-	-	-	-	-	-	-	-	2.0	1.9	1.9	13.9	13.6	13.5
A2a - Home Performance (Weatherization)	Faucet Aerator, Propane	EA2a013	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	6.9	6.9	6.9
A2a - Home Performance (Weatherization)	Tank Wrap, Electric	EA2a077	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Tank Wrap, Gas	EA2a078	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Tank Wrap, Kerosene	EA2a079	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Tank Wrap, Oil	EA2a080	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	3.2	3.2	3.2
A2a - Home Performance (Weatherization)	Tank Wrap, Propane	EA2a081	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Electric	EA2a016	1	1	1	0.1	0.1	0.1	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Gas	EA2a017	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Kerosene	EA2a018	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Oil	EA2a019	8	8	8	-	-	-	-	-	-	-	-	-	-	-	-	5.7	5.6	5.6	86.2	84.5	83.6
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Propane	EA2a020	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	2.9	2.9	2.9	42.9	42.9	42.9
A2a - Home Performance (Weatherization)	[Open Measure - To Be Assigned]	EA2a021																-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Cord Wood	EA2a022	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	22.6	22.6	22.6	564.3	564.3	564.3
A2a - Home Performance (Weatherization)	Insulation, Electric	EA2a023	5	5	5	9.5	9.5	9.5	237.6	237.6	237.6	1.5	1.5	1.5	2.5	2.5	2.5	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Gas	EA2a024	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Kerosene	EA2a025	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Oil	EA2a026	32	32	31	1.5	1.5	1.5	38.2	37.5	37.1	-	-	-	0.8	0.8	0.8	725.9	712.3	704.3	18,147.3	17,806.8	17,607.7
A2a - Home Performance (Weatherization)	Insulation, Propane	EA2a027	16	16	16	0.8	0.8	0.8	19.0	19.0	19.0	-	-	-	0.4	0.4	0.4	361.2	361.2	361.2	9,028.8	9,028.8	9,028.8
A2a - Home Performance (Weatherization)	Insulation, Wood Pellets	EA2a028	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Cord Wood	EA2a063	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Electric	EA2a064	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Gas	EA2a065	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Kerosene	EA2a066	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Oil	EA2a067	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Propane	EA2a068	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Wood Pellets	EA2a069	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Electric	EA2a030	1	1	1	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Gas	EA2a031	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Kerosene	EA2a032	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Oil	EA2a033	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2.3	2.3	2.2	34.5	33.8	33.4
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Propane	EA2a034	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	17.1	17.1	17.1
A2a - Home Performance (Weatherization)	[Open Measure - To Be Assigned]	EA2a035																-	-	-	-	-	-
A2a - Home Performance (Weatherization)	[Open Measure - To Be Assigned]	EA2a036																-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Electric	EA2a037	3	3	3	0.1	0.1	0.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Gas	EA2a038	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Kerosene	EA2a039	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Oil	EA2a040	16	16	16	-	-	-	-	-	-	-	-	-	-	-	-	9.1	8.9	8.8	136.1	133.6	132.1
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Propane	EA2a041	8	8	8	-	-	-	-	-	-	-	-	-	-	-	-	4.5	4.5	4.5	67.7	67.7	67.7
A2a - Home Performance (Weatherization)	Hot Water Setback, Electric	EA2a042	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hot Water Setback, Gas	EA2a059	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hot Water Setback, Kerosene	EA2a060	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hot Water Setback, Oil	EA2a061	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Hot Water Setback, Propane	EA2a062	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	DHW Heat Pump Water Heater	EA2a043	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Indirect Water Heater, Oil	EA2a082	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Indirect Water Heater, Propane	EA2a083	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, General Service Lamps	EA2a044	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Linear	EA2a045	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Other Specialty	EA2a046	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Reflector	EA2a047	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Fixture	EA2a048	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Refrigerator	EA2a049	5	5	5	1.0	1.0	1.0	11.4	11.4	11.4	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Freezer	EA2a053	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Clothes Washer	EA2a054	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Clothes Dryer	EA2a055	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Dehumidifier	EA2a056	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Room Air Conditioner	EA2a057	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Triple Pane Window	EA2a058	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Cord Wood	EA2a084	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Electric	EA2a085	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (Weatherization)	Window Insert, Gas	EA2a086	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Kerosene	EA2a087	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Oil	EA2a088	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Propane	EA2a089	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Window Insert, Wood Pellets	EA2a090	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Visual Audit Oil Savings	EA2a050	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Visual Audit Propane Savings	EA2a051	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Visual Audit Electric Savings	EA2a052	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Electric (Multifamily)	EA2a091	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Gas (Multifamily)	EA2a092	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Air Sealing, Oil (Multifamily)	EA2a093	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	13.5	13.5	13.5	203.1	203.1	203.1
A2a - Home Performance (Weatherization)	Air Sealing, Propane (Multifamily)	EA2a094	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Electric (Multifamily)	EA2a095	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Gas (Multifamily)	EA2a096	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Insulation, Oil (Multifamily)	EA2a097	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	24.8	24.8	24.8	620.7	620.7	620.7
A2a - Home Performance (Weatherization)	Insulation, Propane (Multifamily)	EA2a098	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, General Service Lamps (Multifamily)	EA2a099	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Linear (Multifamily)	EA2a100	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Other Specialty (Multifamily)	EA2a101	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Reflector (Multifamily)	EA2a102	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Fixture (Multifamily)	EA2a103	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Refrigerator (Multifamily)	EA2a104	3	3	3	1.6	1.6	1.6	18.6	18.6	18.6	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Boiler Replacement, Gas	EA2b001	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Boiler Replacement, Kerosene	EA2b002	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Boiler Replacement, Oil	EA2b003	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Boiler Replacement, Propane	EA2b004	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Furnace Replacement, Gas	EA2b005	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Furnace Replacement, Kerosene	EA2b006	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Furnace Replacement, Oil	EA2b007	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Furnace Replacement, Propane	EA2b008	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Electric	EA2b009	3	3	3	0.7	0.7	0.7	10.7	10.7	10.7	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Gas	EA2b010	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Kerosene	EA2b011	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Oil	EA2b012	15	15	15	-	-	-	-	-	-	-	-	-	-	-	-	35.0	35.0	35.0	525.6	525.6	525.6
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Propane	EA2b013	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-	23.2	23.2	23.2	348.7	348.7	348.7
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Wood Pellets	EA2b014	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Electric	EA2b015	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Gas	EA2b016	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Kerosene	EA2b017	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Oil	EA2b018	55	55	55	-	-	-	-	-	-	-	-	-	-	-	-	366.2	366.2	366.2	5,493.5	5,493.5	5,493.5
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Propane	EA2b019	35	35	35	-	-	-	-	-	-	-	-	-	-	-	-	229.1	229.1	229.1	3,436.6	3,436.6	3,436.6
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Wood Pellets	EA2b020	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	ES Central AC	EA2b021	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Boiler Circulator Pump	EA2b022	20	20	20	1.6	1.6	1.6	31.1	31.1	31.1	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Furnace	EA2b023	4	4	4	0.0	0.0	0.0	0.6	0.6	0.6	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Central AC	EA2b024	7	7	7	0.3	0.3	0.3	6.0	6.0	6.0	-	-	-	0.2	0.2	0.2	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Room AC	EA2b025	15	15	15	0.6	0.6	0.6	10.3	10.3	10.3	-	-	-	0.3	0.3	0.3	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Mini-Split AC / HP	EA2b026	-	-	-													-	-	-	-	-	-
	Home Performance Subtotal					**20.1**	**20.1**	**20.1**	**421.6**	**420.9**	**420.5**	**3.2**	**3.2**	**3.2**	**5.2**	**5.2**	**5.2**	**2,108.1**	**2,090.7**	**2,080.5**	**42,938.0**	**42,541.4**	**42,309.4**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A3b - ES Appliances and Products	LED Bulb, General Service Lamps	EA3a001	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Linear	EA3a002	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Other Specialty	EA3a003	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Reflector	EA3a004	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, General Service Lamps (Hard to Reach)	EA3a005	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Linear (Hard to Reach)	EA3a006	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Other Specialty (Hard to Reach)	EA3a007	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Bulb, Reflector (Hard to Reach)	EA3a008	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Fixture	EA3a009	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	LED Fixture (Hard to Reach)	EA3a010	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Advanced Power Strip, Tier I	EA3b001	25	23	23	2.0	1.8	1.8	10.0	9.2	9.2	0.2	0.2	0.2	0.1	0.1	0.1	-	-	-	-	-	-
A3b - ES Appliances and Products	Advanced Power Strip, Tier II	EA3b002	25	23	23	4.0	3.6	3.6	19.8	18.2	18.2	0.4	0.4	0.4	0.3	0.2	0.2	-	-	-	-	-	-
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (cooling)	EA3b003	12	12	12	1.9	1.9	1.9	34.5	34.5	34.5	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (heating)	EA3b004	12	12	12	7.6	7.6	7.6	135.9	135.9	135.9	3.4	3.4	3.4	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (cooling)	EA3b005	231	249	246	21.4	23.1	22.8	385.3	415.1	410.0	-	-	-	9.9	10.7	10.5	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (heating)	EA3b006	231	249	246	65.7	70.8	69.9	1,183.0	1,274.3	1,258.7	29.9	32.2	31.8	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Downstream	EA3b007	20	20	20	19.2	19.2	19.2	288.3	288.3	288.3	3.2	3.2	3.2	1.7	1.7	1.7	43.0	43.0	43.0	644.7	644.7	644.7
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Downstream	EA3b008	20	20	20	11.3	11.3	11.3	169.5	169.5	169.5	1.9	1.9	1.9	1.0	1.0	1.0	43.0	43.0	43.0	644.7	644.7	644.7
A3b - ES Appliances and Products	Heat Pump Swimming Pool Heater	EA3b009	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	ES Clothes Dryers	EA3b010	120	120	120	19.2	19.2	19.2	231.0	231.0	231.0	3.3	3.3	3.3	2.5	2.5	2.5	-	-	-	-	-	-
A3b - ES Appliances and Products	Dryer Heat Pump	EA3b011	3	2	3	1.3	0.8	1.3	15.2	10.1	15.2	0.2	0.1	0.2	0.2	0.1	0.2	-	-	-	-	-	-
A3b - ES Appliances and Products	Dryer Hybrid	EA3b012	2	2	2	0.4	0.4	0.4	5.1	5.1	5.1	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
A3b - ES Appliances and Products	ECM Motor for FWH Circulating Pump	EA3b013	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	[Open Measure - To Be Assigned]	EA3b014																-	-	-	-	-	-
A3c - ES HVAC Systems	ES AC (central) 3 ton	EA3b015	5	4	4	0.9	0.7	0.7	16.7	13.3	13.3	-	-	-	0.5	0.4	0.4	-	-	-	-	-	-
A3b - ES Appliances and Products	Room Air Conditioner	EA3b016	40	35	35	1.4	1.3	1.3	13.0	11.3	11.3	-	-	-	0.7	0.7	0.7	-	-	-	-	-	-
A3b - ES Appliances and Products	ES Clothes Washers	EA3b017	100	93	85	9.0	8.4	7.6	98.9	92.0	84.1	1.3	1.2	1.1	1.2	1.1	1.0	7.0	6.5	6.0	77.0	71.6	65.5
A3b - ES Appliances and Products	Washer Tier CEE Tier 2+	EA3b018	100	90	80	13.9	12.5	11.1	152.8	137.5	122.2	2.0	1.8	1.6	1.8	1.7	1.5	48.0	43.2	38.4	528.0	475.2	422.4
A3b - ES Appliances and Products	ES Dehumidifier	EA3b019	100	90	85	8.2	7.4	7.0	98.8	88.9	83.9	0.3	0.3	0.3	1.6	1.4	1.3	-	-	-	-	-	-
A3b - ES Appliances and Products	ES Dishwasher	EA3b020	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	ES Freezers	EA3b021	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Refrigerator	EA3b022	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Refrigerator CEE Tier 2+	EA3b023	99	85	85	9.6	8.2	8.2	115.1	98.0	98.7	1.1	0.9	0.9	1.3	1.1	1.2	-	-	-	-	-	-
A3b - ES Appliances and Products	ES Pool Pumps (Variable Speed)	EA3b024	40	28	28	6.3	4.4	4.4	37.8	26.5	26.5	-	-	-	3.6	2.6	2.6	-	-	-	-	-	-
A3b - ES Appliances and Products	Room Air Purifier	EA3b025	43	40	40	29.9	27.7	27.7	268.9	249.0	249.0	3.4	3.2	3.2	3.4	3.2	3.2	-	-	-	-	-	-
A3c - ES HVAC Systems	Wifi Thermostat (Heating & Cooling)	EA3b026	40	38	38	1.8	1.7	1.7	27.6	26.2	26.2	-	-	-	-	-	-	196.8	187.0	187.0	2,952.0	2,804.4	2,804.4
A3b - ES Appliances and Products	Primary Refrigerator Recycling	EA3b027	50	45	45	50.3	45.2	45.2	251.3	226.1	226.1	5.7	5.2	5.2	7.0	6.3	6.3	-	-	-	-	-	-
A3b - ES Appliances and Products	Secondary Refrigerator Recycling	EA3b028	45	42	42	45.2	42.2	42.2	226.1	211.1	211.1	4.2	4.0	4.0	7.1	6.6	6.6	-	-	-	-	-	-
A3b - ES Appliances and Products	Secondary Freezer Recycling	EA3b029	30	28	28	22.6	21.1	21.1	90.4	84.3	84.3	2.8	2.6	2.6	3.8	3.6	3.6	-	-	-	-	-	-
A3b - ES Appliances and Products	Room Air Conditioner Recycling	EA3b030	100	90	90	11.3	10.2	10.2	33.9	30.5	30.5	-	-	-	8.2	7.4	7.4	-	-	-	-	-	-
A3b - ES Appliances and Products	Dehumidifier Recycling	EA3b037	100	90	90	50.0	45.0	45.0	200.0	180.0	180.0	2.0	1.8	1.8	9.6	8.6	8.6	-	-	-	-	-	-
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit Resistance	EA3b031	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit HP	EA3b032	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit HP	EA3b033	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit Resistance	EA3b034	-	-	-													-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Midstream	EA3b035	40	35	35	29.6	25.9	25.9	444.0	388.5	388.5	4.9	4.3	4.3	2.7	2.4	2.4	66.2	57.9	57.9	992.8	868.7	868.7
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Midstream	EA3b036	-	-	-													-	-	-	-	-	-
		ES Products Subtotal				**444.1**	**421.7**	**418.5**	**4,552.8**	**4,454.4**	**4,411.4**	**70.2**	**69.8**	**69.2**	**69.5**	**64.5**	**64.1**	**403.9**	**380.5**	**375.2**	**5,839.2**	**5,509.3**	**5,450.4**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A4a - Residential Behavior	Home Energy Reports	EA4a001	8,000	8,000	8,000	2,300.0	2,300.0	2,300.0	2,300.0	2,300.0	2,300.0	496.5	496.5	496.5	320.3	320.3	320.3	-	-	-	-	-	-
	Residential Behavior Subtotal					**2,300.0**	**2,300.0**	**2,300.0**	**2,300.0**	**2,300.0**	**2,300.0**	**496.5**	**496.5**	**496.5**	**320.3**	**320.3**	**320.3**	**-**	**-**	**-**	**-**	**-**	**-**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Compressed Air Retro	EC1a001	3	3	2	55.6	55.6	37.1	556.2	556.2	370.8	6.2	6.2	4.1	6.2	6.2	4.1	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Hot Water Retro	EC1a002	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large HVAC Retro	EC1a003	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Interior	EC1a004	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Exterior	EC1a047	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Controls	EC1a048	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Motors Retro	EC1a005	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Process Retro	EC1a006	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Refrigeration Retro	EC1a007	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Other Retro	EC1a008	3	3	2	94.3	91.0	60.7	754.6	728.0	485.3	10.0	9.7	6.4	9.5	9.1	6.1	-	-	-	-	-	-
C1a - LCI Retrofit	Daylight Dimming	EC1a009	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC1a010	10	8	6	85.3	68.3	51.2	768.1	614.5	460.9	17.1	13.7	10.3	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC1a011	250	243	221	377.2	366.0	334.0	1,885.9	1,829.9	1,670.2	75.5	73.3	66.9	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/ Controls	EC1a012	200	194	150	196.8	190.9	147.6	1,770.9	1,717.8	1,328.2	15.3	14.9	11.5	19.9	19.3	14.9	(136.1)	(132.0)	(102.1)	(1,224.9)	(1,188.2)	(918.7)
C1a - LCI Retrofit	Lighting Fixture - Interior w/o Controls	EC1a013	700	693	650	94.1	93.2	87.4	470.5	465.8	436.9	7.3	7.3	6.8	9.5	9.4	8.8	(65.1)	(64.4)	(60.4)	(325.4)	(322.2)	(302.2)
C1a - LCI Retrofit	Lighting Occupancy Sensors	EC1a014	5	5	5	25.3	25.3	25.3	227.4	227.4	227.4	0.3	0.3	0.3	0.3	0.3	0.3	(69.0)	(69.0)	(69.0)	(621.0)	(621.0)	(621.0)
C1a - LCI Retrofit	[Open Measure - To Be Assigned]	EC1a015																-	-	-	-	-	-
C1a - LCI Retrofit	Case Motor Replacement	EC1a016	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Cooler Night Cover	EC1a017	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Demand Control Ventilation	EC1a018	2	2	1	158.1	158.1	79.1	1,581.2	1,581.2	790.6	3.6	3.6	1.8	58.7	58.7	29.4	-	-	-	-	-	-
C1a - LCI Retrofit	Door Heater Controls	EC1a019	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC1a020	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Duct Sealing, Electric	EC1a021	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Ductless Mini Split Heat Pump	EC1a022	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC1a023	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Electronic Defrost Control	EC1a024	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Management System, Electric	EC1a025	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Star Wifi Thermostat, Electric	EC1a026	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Evaporator Fan Control	EC1a027	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Faucet Aerator, Electric	EC1a028	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Hotel Occupancy Sensor	EC1a031	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low Pressure Drop Filter	EC1a032	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC1a033	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low-Flow Showerhead, Electric	EC1a034	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Open Drip	EC1a035	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC1a036	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Novelty Cooler Shutoff	EC1a037	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Heating, Electric	EC1a038	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Hot Water, Electric	EC1a039	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pre Rinse Spray Valve, Electric	EC1a040	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Programmable Thermostat, Electric	EC1a041	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Steam Trap, Electric	EC1a042	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive	EC1a043	3	3	3	120.0	120.0	120.0	1,799.9	1,799.9	1,799.9	7.0	7.0	7.0	6.3	6.3	6.3	-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive with Motor	EC1a044	5	5	4	357.0	357.0	285.6	5,355.0	5,355.0	4,284.0	20.9	20.9	16.7	18.7	18.7	14.9	-	-	-	-	-	-
C1a - LCI Retrofit	Vending Miser	EC1a045	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Zero Loss Condensate Drain	EC1a046	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Large Retrocommissioning	EC1a049	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC1a050	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Compressed Air New	EC1b001	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Hot Water New	EC1b002	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large HVAC New	EC1b003	3	3	3	32.0	32.0	32.0	479.8	479.8	479.8	2.1	2.1	2.1	5.5	5.5	5.5	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Lighting New - Interior	EC1b004	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Lighting New - Exterior	EC1b054	2	2	2	59.3	59.3	59.3	889.4	889.4	889.4	11.9	11.9	11.9	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Lighting New - Controls	EC1b055	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Motors New	EC1b005	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Process New	EC1b006	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Refrigeration New	EC1b007	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Other New	EC1b008	6	6	5	189.7	176.2	158.1	2,845.2	2,642.7	2,371.0	20.1	18.7	16.8	19.0	17.7	15.9	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Comprehensive Design	EC1b056	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Daylight Dimming	EC1b009	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Performance Lighting - Exterior w/ Controls	EC1b010	6	6	6	14.1	14.1	14.1	212.1	212.1	212.1	2.8	2.8	2.8	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Performance Lighting - Exterior w/o Controls	EC1b011	76	74	72	51.6	50.2	48.8	773.4	753.0	732.7	0.3	0.3	0.3	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Performance Lighting - Interior w/ Controls	EC1b012	10	8	6	26.4	21.1	15.8	395.8	316.6	237.5	2.1	1.6	1.2	2.7	2.1	1.6	(4.3)	(3.4)	(2.6)	(64.3)	(51.4)	(38.6)
C1b - LCI New Equipment and Construction	Performance Lighting - Interior w/o Controls	EC1b013	47	45	43	301.1	286.2	273.4	4,515.9	4,292.4	4,101.6	13.8	13.2	12.6	17.9	17.1	16.3	(48.9)	(46.5)	(44.4)	(733.6)	(697.3)	(666.3)
C1b - LCI New Equipment and Construction	Lighting Occupancy Sensors	EC1b014	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Advanced Power Strip	EC1b015	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Air Compressor	EC1b016	1	1	1	6.4	6.4	6.4	95.3	95.3	95.3	0.6	0.6	0.6	0.7	0.7	0.7	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Air Nozzle	EC1b017	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Circulator Pump	EC1b018	1	1	1	2.6	2.6	2.6	51.6	51.6	51.6	-	-	-	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Combination Oven, Electric	EC1b019	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Compressor Storage	EC1b020	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Convection Oven, Electric	EC1b021	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - High Temp Door Type	EC1b022	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - High Temp Multi Tank Conveyor	EC1b023	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - High Temp Pot, Pan, Utensil	EC1b024	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - High Temp Single Tank Conveyor	EC1b025	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - High Temp Under Counter	EC1b026	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - Low Temp Door Type	EC1b027	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1b - LCI New Equipment and Construction	Dishwasher - Low Temp Multi Tank Conveyor	EC1b028	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - Low Temp Single Tank Conveyor	EC1b029	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Dishwasher - Low Temp Under Counter	EC1b030	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Faucet Aerator, Electric	EC1b031	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Fryer Large Vat, Electric	EC1b032	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Fryer Standard Vat, Electric	EC1b033	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Griddle, Electric	EC1b034	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Ground Source Heat Pump	EC1b035	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Hot Food Holding Cabinet 3/4 Size	EC1b036	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Hot Food Holding Cabinet Full Size	EC1b037	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Hot Food Holding Cabinet Half Size	EC1b038	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Ice Machine - Ice Making Head	EC1b039	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Batch	EC1b040	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Continuous	EC1b041	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Ice Machine - Self Contained	EC1b042	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Low Pressure Drop Filter	EC1b043	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Thermostatic Shut-Off Valve, Electric	EC1b044	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Low-Flow Showerhead, Electric	EC1b045	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Pre Rinse Spray Valve, Electric	EC1b046	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Refrigerated Air Dryer	EC1b047	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Steam Cooker, Electric	EC1b048	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Unitary Air Conditioner	EC1b049	8	8	7	8.7	8.7	7.6	104.0	104.0	91.0	-	-	-	0.6	0.6	0.5	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Water Source Heat Pump	EC1b050	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Zero Loss Condensate Drain	EC1b051	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	High Efficiency Chiller - FL	EC1b052	2	1	1	236.8	118.4	118.4	5,445.6	2,722.8	2,722.8	12.2	6.1	6.1	104.6	52.3	52.3	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	High Efficiency Chiller - IPLV	EC1b053	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	TA Studies	EC1b057	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Induction Cooktop Displacing Electric Resistance	EC1b058	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Compressed Air Leak Detection	EC1b059	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Circulator Pump	EC1c001	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Demand Control Ventilation	EC1c002	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream DMSHP Systems	EC1c003	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC1c004	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream ECM Fan Motors	EC1c005	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Systems	EC1c006	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Unitary Air Conditioners	EC1c007	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream VRF	EC1c008	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Water Source Heat Pump Systems	EC1c009	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Downlight	EC1c010	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Exterior	EC1c011	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED High Bay/Low Bay	EC1c012	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Linear Fixture	EC1c013	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Linear Fixture with Controls	EC1c014	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Linear Lamp	EC1c015	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Screw In	EC1c016	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Stairwell Kit	EC1c017	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Combination Oven, Electric	EC1c018	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Convection Oven, Electric	EC1c019	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Conveyor Broiler	EC1c047	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Deck Oven, Electric	EC1c050	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Door Type	EC1c020	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Multi Tank Conveyor	EC1c021	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC1c022	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Single Tank Conveyor	EC1c023	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC1c024	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC1c025	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Conveyor	EC1c026	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conveyor	EC1c027	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC1c028	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Solid Door	EC1c029	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Glass Door	EC1c030	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Large Vat, Electric	EC1c031	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Standard Vat, Electric	EC1c032	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Griddle, Electric	EC1c033	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hand-Wrap Machine	EC1c051	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream High Efficiency Condensing Unit	EC1c052	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC1c034	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC1c035	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC1c036	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Ice Making Head	EC1c037	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC1c038	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Continuous	EC1c039	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Self Contained	EC1c040	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerated Chef Base	EC1c053	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Glass Door	EC1c041	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Solid Door	EC1c042	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Steam Cooker, Electric	EC1c043	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ultra Low-Temp Freezer	EC1c048	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC1c044	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC1c045	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC1c046	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Room Air Purifier	EC1c054	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 1	EC1c055	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 2	EC1c056	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead, Electric	EC1c057	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, Electric	EC1c058	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC1c059	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Faucet Aerator, Electric	EC1c060	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pipe Wrap, Electric	EC1c061	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC1c062	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP ES Dehumidifier	EC1c063	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Induction Cooktop Displacing Electric Resistance	EC1c064	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Compressed Air Direct Install	EC1d001	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Hot Water Direct Install	EC1d002	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large HVAC Direct Install	EC1d003	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Interior	EC1d004	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Exterior	EC1d005	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Controls	EC1d006	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Motors Direct Install	EC1d007	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Process Direct Install	EC1d008	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Refrigeration Direct Install	EC1d009	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Other Direct Install	EC1d010	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Daylight Dimming	EC1d011	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC1d012	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC1d013	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/ Controls	EC1d014	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/o Controls	EC1d015	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Occupancy Sensors	EC1d016	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	[Open Measure - To Be Assigned]	EC1d017																-	-	-	-	-	-
C1d - LCI Direct Install	Case Motor Replacement	EC1d018	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Cooler Night Cover	EC1d019	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Demand Control Ventilation	EC1d020	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Door Heater Controls	EC1d021	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC1d022	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Duct Sealing, Electric	EC1d023	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Ductless Mini Split Heat Pump	EC1d024	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC1d025	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Electronic Defrost Control	EC1d026	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Management System, Electric	EC1d027	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Star Wifi Thermostat, Electric	EC1d028	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Evaporator Fan Control	EC1d029	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Faucet Aerator, Electric	EC1d030	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Hotel Occupancy Sensor	EC1d031	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Low Pressure Drop Filter	EC1d032	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC1d033	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Low-Flow Showerhead, Electric	EC1d034	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Open Drip	EC1d035	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC1d036	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Novelty Cooler Shutoff	EC1d037	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Heating, Electric	EC1d038	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Hot Water, Electric	EC1d039	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Pre Rinse Spray Valve, Electric	EC1d040	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Programmable Thermostat, Electric	EC1d041	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Steam Trap, Electric	EC1d042	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive	EC1d043	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive with Motor	EC1d044	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Vending Miser	EC1d045	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Zero Loss Condensate Drain	EC1d046	-	-	-													-	-	-	-	-	-
C1d - LCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC1d047	-	-	-													-	-	-	-	-	-
	Large Business Energy Solutions Subtotal					**2,492.2**	**2,300.3**	**1,964.4**	**30,977.7**	**27,435.3**	**23,838.9**	**229.2**	**214.1**	**186.3**	**280.1**	**224.0**	**177.7**	**(323.4)**	**(315.4)**	**(278.5)**	**(2,969.2)**	**(2,880.0)**	**(2,546.7)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Custom Small Compressed Air Retro	EC2a001	1	1	1	43.4	43.4	43.4	564.0	564.0	564.0	4.8	4.8	4.8	4.8	4.8	4.8	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Hot Water Retro	EC2a002	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small HVAC Retro	EC2a003	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Interior	EC2a004	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Exterior	EC2a047	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Controls	EC2a048	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Motors Retro	EC2a005	2	2	2	5.0	5.0	5.0	74.3	74.3	74.3	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Process Retro	EC2a006	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Refrigeration Retro	EC2a007	3	3	3	7.1	7.1	7.1	71.5	71.5	71.5	0.8	0.8	0.8	0.7	0.7	0.7	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Other Retro	EC2a008	4	4	4	12.8	13.0	13.0	128.3	130.2	130.2	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Daylight Dimming	EC2a009	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC2a010	20	18	22	34.8	31.3	38.1	312.8	281.5	342.7	6.8	6.1	7.4	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC2a011	100	92	86	57.9	53.3	49.8	289.6	266.4	249.1	11.3	10.4	9.7	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/ Controls	EC2a012	80	72	64	12.0	10.8	9.6	108.2	97.4	86.6	0.9	0.8	0.7	1.3	1.2	1.0	(7.8)	(7.0)	(6.2)	(70.2)	(63.1)	(56.1)
C2a - SCI Retrofit	Lighting Fixture - Interior w/o Controls	EC2a013	75	67	63	13.2	11.7	11.0	65.8	58.7	55.2	1.0	0.9	0.8	1.4	1.3	1.2	(8.5)	(7.6)	(7.2)	(42.6)	(38.1)	(35.8)
C2a - SCI Retrofit	Lighting Occupancy Sensors	EC2a014	40	40	40	2.3	2.3	2.3	20.3	20.3	20.3	0.0	0.0	0.0	0.0	0.0	0.0	(9.2)	(9.2)	(9.2)	(82.8)	(82.8)	(82.8)
C2a - SCI Retrofit	[Open Measure - To Be Assigned]	EC2a015																-	-	-	-	-	-
C2a - SCI Retrofit	Case Motor Replacement	EC2a016	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Cooler Night Cover	EC2a017	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Demand Control Ventilation	EC2a018	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Door Heater Controls	EC2a019	4	4	4	23.3	23.3	23.3	233.1	233.1	233.1	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC2a020	6	6	6	23.7	23.7	23.7	237.3	237.3	237.3	-	-	-	8.1	8.1	8.1	-	-	-	-	-	-
C2a - SCI Retrofit	Duct Sealing, Electric	EC2a021	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Ductless Mini Split Heat Pump	EC2a022	10	10	10	10.0	10.0	10.0	120.0	120.0	120.0	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC2a023	4	4	4	6.3	6.3	6.3	93.9	93.9	93.9	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Electronic Defrost Control	EC2a024	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Management System, Electric	EC2a025	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Star Wifi Thermostat, Electric	EC2a026	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Evaporator Fan Control	EC2a027	4	4	4	13.7	13.7	13.7	136.9	136.9	136.9	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Faucet Aerator, Electric	EC2a028	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Hotel Occupancy Sensor	EC2a031	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Low Pressure Drop Filter	EC2a032	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC2a033	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Low-Flow Showerhead, Electric	EC2a034	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Open Drip	EC2a035	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC2a036	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Novelty Cooler Shutoff	EC2a037	2	2	2	1.8	1.8	1.8	18.0	18.0	18.0	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Heating, Electric	EC2a038	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Hot Water, Electric	EC2a039	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pre Rinse Spray Valve, Electric	EC2a040	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Programmable Thermostat, Electric	EC2a041	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Steam Trap, Electric	EC2a042	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive	EC2a043	4	4	4	67.0	67.0	67.0	1,005.3	1,005.3	1,005.3	3.9	3.9	3.9	3.5	3.5	3.5	-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive with Motor	EC2a044	2	2	2	3.3	3.3	3.3	49.1	49.1	49.1	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Vending Miser	EC2a045	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Zero Loss Condensate Drain	EC2a046	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Small Retrocommissioning	EC2a049	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC2a050	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Compressed Air New	EC2b001	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Hot Water New	EC2b002	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small HVAC New	EC2b003	3	3	3	2.6	2.6	2.6	31.5	31.5	31.5	0.2	0.2	0.2	0.5	0.5	0.5	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Lighting New - Interior	EC2b004	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Lighting New - Exterior	EC2b054	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Lighting New - Controls	EC2b055	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Motors New	EC2b005	3	2	2	69.2	46.1	46.1	1,037.3	691.6	691.6	9.1	6.0	6.0	10.8	7.2	7.2	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Process New	EC2b006	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Refrigeration New	EC2b007	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Other New	EC2b008	20	20	20	117.8	117.8	117.8	1,861.1	1,861.1	1,861.1	5.6	5.6	5.6	6.2	6.2	6.2	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Comprehensive Design	EC2b056	3	2	3	104.4	80.7	104.4	2,088.3	1,614.7	2,088.3	13.8	10.7	13.8	13.8	10.7	13.8	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Daylight Dimming	EC2b009	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Performance Lighting - Exterior w/ Controls	EC2b010	5	5	5	23.7	23.7	23.7	354.8	354.8	354.8	4.6	4.6	4.6	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Performance Lighting - Exterior w/o Controls	EC2b011	140	130	120	56.8	52.7	48.7	851.5	790.6	729.8	11.1	10.3	9.5	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Performance Lighting - Interior w/ Controls	EC2b012	180	170	160	27.1	25.6	24.0	405.8	383.3	360.7	2.0	1.9	1.8	2.9	2.7	2.6	(4.1)	(3.9)	(3.7)	(61.8)	(58.3)	(54.9)
C2b - SCI New Equipment and Construction	Performance Lighting - Interior w/o Controls	EC2b013	30	26	19	685.4	594.0	434.1	10,280.9	8,910.1	6,511.3	50.0	43.4	31.7	73.6	63.8	46.6	(104.3)	(90.4)	(66.1)	(1,565.1)	(1,356.4)	(991.2)
C2b - SCI New Equipment and Construction	Lighting Occupancy Sensors	EC2b014	10	10	10	46.1	46.1	46.1	460.6	460.6	460.6	0.6	0.6	0.6	0.8	0.8	0.8	(187.9)	(187.9)	(187.9)	(1,879.2)	(1,879.2)	(1,879.2)
C2b - SCI New Equipment and Construction	Advanced Power Strip	EC2b015	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2b - SCI New Equipment and Construction	Air Compressor	EC2b016	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Air Nozzle	EC2b017	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Circulator Pump	EC2b018	8	8	8	7.4	7.4	7.4	148.0	148.0	148.0	-	-	-	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Combination Oven, Electric	EC2b019	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Compressor Storage	EC2b020	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Convection Oven, Electric	EC2b021	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - High Temp Door Type	EC2b022	4	4	4	47.5	47.5	47.5	711.8	711.8	711.8	6.5	6.5	6.5	6.5	6.5	6.5	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - High Temp Multi Tank Conveyor	EC2b023	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - High Temp Pot, Pan, Utensil	EC2b024	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - High Temp Single Tank Conveyor	EC2b025	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - High Temp Under Counter	EC2b026	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - Low Temp Door Type	EC2b027	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - Low Temp Multi Tank Conveyor	EC2b028	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - Low Temp Single Tank Conveyor	EC2b029	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Dishwasher - Low Temp Under Counter	EC2b030	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Faucet Aerator, Electric	EC2b031	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Fryer Large Vat, Electric	EC2b032	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Fryer Standard Vat, Electric	EC2b033	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Griddle, Electric	EC2b034	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Ground Source Heat Pump	EC2b035	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Hot Food Holding Cabinet 3/4 Size	EC2b036	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Hot Food Holding Cabinet Full Size	EC2b037	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Hot Food Holding Cabinet Half Size	EC2b038	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Ice Machine - Ice Making Head	EC2b039	4	4	4	4.5	4.5	4.5	35.7	35.7	35.7	1.1	1.1	1.1	1.1	1.1	1.1	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Batch	EC2b040	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Continuous	EC2b041	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Ice Machine - Self Contained	EC2b042	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Low Pressure Drop Filter	EC2b043	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Thermostatic Shut-Off Valve, Electric	EC2b044	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Low-Flow Showerhead, Electric	EC2b045	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Pre Rinse Spray Valve, Electric	EC2b046	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Refrigerated Air Dryer	EC2b047	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Steam Cooker, Electric	EC2b048	4	4	3	26.2	26.2	19.7	314.4	314.4	235.8	8.2	8.2	6.2	8.2	8.2	6.2	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Unitary Air Conditioner	EC2b049	18	15	12	13.6	11.3	9.0	162.8	135.0	108.0	-	-	-	0.9	0.8	0.6	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Water Source Heat Pump	EC2b050	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Zero Loss Condensate Drain	EC2b051	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	High Efficiency Chiller - FL	EC2b052	2	1	1	92.5	46.3	46.3	2,127.6	1,063.8	1,063.8	4.8	2.4	2.4	40.9	20.4	20.4	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	High Efficiency Chiller - IPLV	EC2b053	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	TA Studies	EC2b057	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Induction Cooktop Displacing Electric Resistance	EC2b058	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Compressed Air Leak Detection	EC2b059	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Circulator Pump	EC2c001	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Demand Control Ventilation	EC2c002	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream DMSHP Systems	EC2c003	15	15	15	9.4	9.4	9.4	112.2	112.2	112.2	-	-	-	1.9	1.9	1.9	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC2c004	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream ECM Fan Motors	EC2c005	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Systems	EC2c006	57	50	42	84.9	74.2	62.4	1,018.9	890.9	748.3	-	-	-	17.4	15.2	12.8	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Unitary Air Conditioners	EC2c007	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream VRF	EC2c008	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Water Source Heat Pump Systems	EC2c009	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Downlight	EC2c010	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Exterior	EC2c011	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED High Bay/Low Bay	EC2c012	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Linear Fixture	EC2c013	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Linear Fixture with Controls	EC2c014	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Linear Lamp	EC2c015	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Screw In	EC2c016	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Stairwell Kit	EC2c017	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Combination Oven, Electric	EC2c018	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Convection Oven, Electric	EC2c019	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Conveyor Broiler	EC2c047	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Deck Oven, Electric	EC2c050	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Door Type	EC2c020	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Multi Tank Conveyor	EC2c021	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC2c022	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Single Tank Conveyor	EC2c023	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC2c024	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC2c025	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Conveyor	EC2c026	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conveyor	EC2c027	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC2c028	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Solid Door	EC2c029	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Glass Door	EC2c030	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Large Vat, Electric	EC2c031	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Standard Vat, Electric	EC2c032	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Griddle, Electric	EC2c033	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hand-Wrap Machine	EC2c051	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream High Efficiency Condensing Unit	EC2c052	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC2c034	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC2c035	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC2c036	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Ice Making Head	EC2c037	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC2c038	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Continuous	EC2c039	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Self Contained	EC2c040	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerated Chef Base	EC2c053	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Glass Door	EC2c041	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Solid Door	EC2c042	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Steam Cooker, Electric	EC2c043	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ultra Low-Temp Freezer	EC2c048	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC2c044	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC2c045	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC2c046	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Room Air Purifier	EC2c054	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 1	EC2c055	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 2	EC2c056	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead, Electric	EC2c057	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, Electric	EC2c058	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC2c059	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Faucet Aerator, Electric	EC2c060	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pipe Wrap, Electric	EC2c061	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC2c062	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP ES Dehumidifier	EC2c063	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Induction Cooktop Displacing Electric Resistance	EC2c064	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Compressed Air Direct Install	EC2d001	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Hot Water Direct Install	EC2d002	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small HVAC Direct Install	EC2d003	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Interior	EC2d004	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Exterior	EC2d005	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Controls	EC2d006	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Motors Direct Install	EC2d007	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Process Direct Install	EC2d008	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Refrigeration Direct Install	EC2d009	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Other Direct Install	EC2d010	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Daylight Dimming	EC2d011	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC2d012	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC2d013	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Interior w/ Controls	EC2d014	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Interior w/o Controls	EC2d015	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Occupancy Sensors	EC2d016	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	[Open Measure - To Be Assigned]	EC2d017																-	-	-	-	-	-
C2d - SCI Direct Install	Case Motor Replacement	EC2d018	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Cooler Night Cover	EC2d019	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Demand Control Ventilation	EC2d020	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Door Heater Controls	EC2d021	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC2d022	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Duct Sealing, Electric	EC2d023	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Ductless Mini Split Heat Pump	EC2d024	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC2d025	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Electronic Defrost Control	EC2d026	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Management System, Electric	EC2d027	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Star Wifi Thermostat, Electric	EC2d028	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Evaporator Fan Control	EC2d029	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Faucet Aerator, Electric	EC2d030	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Hotel Occupancy Sensor	EC2d031	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Low Pressure Drop Filter	EC2d032	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC2d033	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Low-Flow Showerhead, Electric	EC2d034	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Open Drip	EC2d035	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC2d036	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Novelty Cooler Shutoff	EC2d037	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Heating, Electric	EC2d038	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Hot Water, Electric	EC2d039	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Pre Rinse Spray Valve, Electric	EC2d040	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Programmable Thermostat, Electric	EC2d041	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Steam Trap, Electric	EC2d042	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive	EC2d043	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive with Motor	EC2d044	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Vending Miser	EC2d045	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Zero Loss Condensate Drain	EC2d046	-	-	-													-	-	-	-	-	-
C2d - SCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC2d047	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
	Small Business Energy Solutions Subtotal					**1,756.3**	**1,542.8**	**1,381.8**	**25,531.5**	**21,968.0**	**19,740.7**	**146.9**	**129.0**	**118.0**	**205.4**	**165.6**	**146.6**	**(321.9)**	**(306.1)**	**(280.3)**	**(3,701.7)**	**(3,478.1)**	**(3,100.1)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Custom Muni Compressed Air Retro	EC3a001	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Hot Water Retro	EC3a002	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni HVAC Retro	EC3a003	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Lighting Retro - Interior	EC3a004	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Lighting Retro - Exterior	EC3a091	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Lighting Retro - Controls	EC3a092	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Motors Retro	EC3a005	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Process Retro	EC3a006	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Refrigeration Retro	EC3a007	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Muni Other Retro	EC3a008	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Daylight Dimming	EC3a009	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Exterior w/ Controls	EC3a010	2	1	1	29.0	16.3	14.5	260.7	147.1	130.3	5.6	3.2	2.8	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Exterior w/o Controls	EC3a011	100	100	100	38.6	38.6	38.6	193.1	193.1	193.1	7.5	7.5	7.5	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Interior w/ Controls	EC3a012	2	2	2	0.3	0.3	0.3	2.7	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.0	(0.2)	(0.2)	(0.2)	(1.8)	(1.8)	(1.8)
C3a - Muni Retrofit	Lighting Fixture - Interior w/o Controls	EC3a013	199	200	199	19.0	19.0	18.9	94.8	95.2	94.7	1.4	1.4	1.4	2.0	2.0	2.0	(12.3)	(12.3)	(12.3)	(61.5)	(61.7)	(61.4)
C3a - Muni Retrofit	Lighting Occupancy Sensors	EC3a014	50	50	50	9.4	9.4	9.4	84.6	84.6	84.6	0.1	0.1	0.1	0.2	0.2	0.2	(38.4)	(38.4)	(38.4)	(345.2)	(345.2)	(345.2)
C3a - Muni Retrofit	Air Sealing, Electric	EC3a015	2	2	2	10.0	10.0	10.0	150.0	150.0	150.0	3.2	3.2	3.2	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Gas	EC3a016	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Oil	EC3a017	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Propane	EC3a018	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Gas	EC3a019	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Oil	EC3a020	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Propane	EC3a021	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Case Motor Replacement	EC3a022	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Cooler Night Cover	EC3a023	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Demand Control Ventilation	EC3a024	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Door Heater Controls	EC3a025	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC3a026	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Electric	EC3a027	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Gas	EC3a028	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Oil	EC3a029	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Insulation, Propane	EC3a030	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Electric	EC3a031	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Gas	EC3a032	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Oil	EC3a033	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Duct Sealing, Propane	EC3a034	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Ductless Mini Split Heat Pump	EC3a035	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC3a036	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Electronic Defrost Control	EC3a037	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Management System, Electric	EC3a038	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Electric	EC3a039	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Gas	EC3a040	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Oil	EC3a041	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Propane	EC3a042	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Evaporator Fan Control	EC3a043	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Electric	EC3a044	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Gas	EC3a045	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Oil	EC3a046	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Propane	EC3a047	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Hotel Occupancy Sensor	EC3a050	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Electric	EC3a051	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Gas	EC3a052	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Oil	EC3a053	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Propane	EC3a054	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low Pressure Drop Filter	EC3a055	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Electric	EC3a056	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Gas	EC3a057	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Oil	EC3a058	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Propane	EC3a059	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Electric	EC3a060	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Gas	EC3a061	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Oil	EC3a062	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low-Flow Showerhead, Propane	EC3a063	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Motors, Open Drip	EC3a064	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Motors, Totally Enclosed Fan Cooled	EC3a065	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Novelty Cooler Shutoff	EC3a066	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Electric	EC3a067	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Gas	EC3a068	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Oil	EC3a069	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Heating, Propane	EC3a070	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Electric	EC3a071	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Gas	EC3a072	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Oil	EC3a073	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Propane	EC3a074	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Electric	EC3a075	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Gas	EC3a076	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Oil	EC3a077	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Propane	EC3a078	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Programmable Thermostat, Electric	EC3a079	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Gas	EC3a080	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Oil	EC3a081	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Propane	EC3a082	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Electric	EC3a083	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Gas	EC3a084	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Oil	EC3a085	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Propane	EC3a086	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Variable Frequency Drive	EC3a087	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Variable Frequency Drive with Motor	EC3a088	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Vending Miser	EC3a089	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Zero Loss Condensate Drain	EC3a090	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Induction Cooktop Displacing Electric Resistance	EC3a093	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Compressed Air New	EC3b001	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Hot Water New	EC3b002	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni HVAC New	EC3b003	2	2	2	7.7	7.7	7.7	102.0	102.0	102.0	0.3	0.3	0.3	0.9	0.9	0.9	-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Lighting New - Interior	EC3b004	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Lighting New - Exterior	EC3b085	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Lighting New - Controls	EC3b086	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Motors New	EC3b005	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Process New	EC3b006	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Refrigeration New	EC3b007	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Other New	EC3b008	2	2	2	0.1	0.1	0.1	2.7	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Muni Comprehensive Design	EC3b087	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Daylight Dimming	EC3b009	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Performance Lighting - Exterior w/ Controls	EC3b010	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Performance Lighting - Exterior w/o Controls	EC3b011	20	12	11	4.3	2.6	2.3	65.2	39.1	34.4	0.8	0.5	0.4	-	-	-	-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Performance Lighting - Interior w/ Controls	EC3b012	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Performance Lighting - Interior w/o Controls	EC3b013	40	30	22	5.4	4.1	3.0	81.2	60.9	44.6	0.4	0.3	0.2	0.6	0.4	0.3	(0.8)	(0.6)	(0.5)	(12.4)	(9.3)	(6.8)
C3b - Muni New Equipment and Construction	Lighting Occupancy Sensors	EC3b014	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Advanced Power Strip	EC3b015	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Air Compressor	EC3b016	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Air Nozzle	EC3b017	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 1000 to 1700 MBH 90 AFUE, Oil	EC3b018	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 1000 to 1700 MBH 90 AFUE, Propane	EC3b019	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 1701 to 2000 MBH 85 AFUE, Oil	EC3b020	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 1701 to 2000 MBH 90 AFUE, Propane	EC3b021	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 301 to 499 MBH 85 AFUE, Oil	EC3b022	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 301 to 499 MBH 90 AFUE, Propane	EC3b023	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 500 to 999 MBH 85 AFUE, Oil	EC3b024	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 500 to 999 MBH 90 AFUE, Propane	EC3b025	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 85 AFUE, Oil	EC3b026	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 87 AFUE, Oil	EC3b027	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 90 AFUE, Propane	EC3b028	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 95 AFUE, Propane	EC3b029	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	44.1	44.1	44.1	1,102.5	1,102.5	1,102.5
C3b - Muni New Equipment and Construction	Circulator Pump	EC3b030	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Combination Oven, Electric	EC3b031	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Compressor Storage	EC3b032	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Condensing Unit Heater up to 300 MBH, Oil	EC3b033	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Condensing Unit Heater up to 300 MBH, Propane	EC3b034	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	122.7	122.7	122.7	2,208.6	2,208.6	2,208.6
C3b - Muni New Equipment and Construction	Convection Oven, Electric	EC3b035	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - High Temp Door Type	EC3b036	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - High Temp Multi Tank Conveyor	EC3b037	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - High Temp Pot, Pan, Utensil	EC3b038	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - High Temp Single Tank Conveyor	EC3b039	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - High Temp Under Counter	EC3b040	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - Low Temp Door Type	EC3b041	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - Low Temp Multi Tank Conveyor	EC3b042	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - Low Temp Single Tank Conveyor	EC3b043	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Dishwasher - Low Temp Under Counter	EC3b044	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Faucet Aerator, Electric	EC3b045	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Faucet Aerator, Gas	EC3b046	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Faucet Aerator, Oil	EC3b047	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Faucet Aerator, Propane	EC3b048	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Fryer Large Vat, Electric	EC3b049	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Fryer Standard Vat, Electric	EC3b050	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 85 AFUE up to 150 MBH, Oil	EC3b051	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 87 AFUE up to 150 MBH, Oil	EC3b052	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 95 AFUE up to 150 MBH, Propane	EC3b053	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 97 AFUE up to 150 MBH, Propane	EC3b054	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Griddle, Electric	EC3b055	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Ground Source Heat Pump	EC3b056	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Hot Food Holding Cabinet 3/4 Size	EC3b057	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Hot Food Holding Cabinet Full Size	EC3b058	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Hot Food Holding Cabinet Half Size	EC3b059	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Ice Machine - Ice Making Head	EC3b060	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Batch	EC3b061	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Ice Machine - Remote Cond./Split Unit - Continuous	EC3b062	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3b - Muni New Equipment and Construction	Ice Machine - Self Contained	EC3b063	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Infrared Heater	EC3b064	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low Pressure Drop Filter	EC3b065	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Thermostatic Shut-Off Valve, Electric	EC3b066	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Thermostatic Shut-Off Valve, Gas	EC3b067	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Thermostatic Shut-Off Valve, Oil	EC3b068	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Thermostatic Shut-Off Valve, Propane	EC3b069	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low-Flow Showerhead, Electric	EC3b070	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low-Flow Showerhead, Gas	EC3b071	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low-Flow Showerhead, Oil	EC3b072	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low-Flow Showerhead, Propane	EC3b073	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Pre Rinse Spray Valve, Electric	EC3b074	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Pre Rinse Spray Valve, Gas	EC3b075	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Pre Rinse Spray Valve, Oil	EC3b076	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Pre Rinse Spray Valve, Propane	EC3b077	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Refrigerated Air Dryer	EC3b078	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Steam Cooker, Electric	EC3b079	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Unitary Air Conditioner	EC3b080	1	1	1	2.8	2.8	2.8	33.0	33.0	33.0	-	-	-	0.2	0.2	0.2	-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Water Source Heat Pump	EC3b081	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Zero Loss Condensate Drain	EC3b082	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	High Efficiency Chiller - FL	EC3b083	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	High Efficiency Chiller - IPLV	EC3b084	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Induction Cooktop Displacing Electric Resistance	EC3b088	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Compressed Air Leak Detection	EC3b089	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Compressed Air Direct Install	EC3d001	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Hot Water Direct Install	EC3d002	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni HVAC Direct Install	EC3d003	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Interior	EC3d004	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Exterior	EC3d005	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Controls	EC3d006	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Motors Direct Install	EC3d007	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Process Direct Install	EC3d008	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Refrigeration Direct Install	EC3d009	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Other Direct Install	EC3d010	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Daylight Dimming	EC3d011	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/ Controls	EC3d012	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/o Controls	EC3d013	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/ Controls	EC3d014	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/o Controls	EC3d015	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Occupancy Sensors	EC3d016	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Electric	EC3d017	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Gas	EC3d018	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3d - Muni Direct Install	Air Sealing, Oil	EC3d019	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Propane	EC3d020	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Gas	EC3d021	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Oil	EC3d022	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Propane	EC3d023	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Case Motor Replacement	EC3d024	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Cooler Night Cover	EC3d025	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Demand Control Ventilation	EC3d026	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Door Heater Controls	EC3d027	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC3d028	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Electric	EC3d029	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Gas	EC3d030	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Oil	EC3d031	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Propane	EC3d032	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Electric	EC3d033	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Gas	EC3d034	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Oil	EC3d035	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Propane	EC3d036	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Ductless Mini Split Heat Pump	EC3d037	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC3d038	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Electronic Defrost Control	EC3d039	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Management System, Electric	EC3d040	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Electric	EC3d041	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Gas	EC3d042	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Oil	EC3d043	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Propane	EC3d044	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Evaporator Fan Control	EC3d045	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Electric	EC3d046	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Gas	EC3d047	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Oil	EC3d048	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Propane	EC3d049	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Hotel Occupancy Sensor	EC3d050	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Electric	EC3d051	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Gas	EC3d052	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Oil	EC3d053	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Propane	EC3d054	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low Pressure Drop Filter	EC3d055	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Electric	EC3d056	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Gas	EC3d057	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Oil	EC3d058	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Propane	EC3d059	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Electric	EC3d060	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Gas	EC3d061	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Oil	EC3d062	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Propane	EC3d063	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Open Drip	EC3d064	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Totally Enclosed Fan Cooled	EC3d065	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Novelty Cooler Shutoff	EC3d066	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Electric	EC3d067	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Gas	EC3d068	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Oil	EC3d069	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Propane	EC3d070	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Electric	EC3d071	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Gas	EC3d072	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Oil	EC3d073	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Propane	EC3d074	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Electric	EC3d075	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Gas	EC3d076	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Oil	EC3d077	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Propane	EC3d078	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Electric	EC3d079	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Gas	EC3d080	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Oil	EC3d081	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Propane	EC3d082	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Electric	EC3d083	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Gas	EC3d084	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Oil	EC3d085	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Propane	EC3d086	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive	EC3d087	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive with Motor	EC3d088	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Vending Miser	EC3d089	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Zero Loss Condensate Drain	EC3d090	-	-	-													-	-	-	-	-	-
C3d - Muni Direct Install	Induction Cooktop Displacing Electric Resistance	EC3d091	-	-	-													-	-	-	-	-	-

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
	Municipal Energy Solutions Subtotal					**126.5**	**110.9**	**107.5**	**1,069.9**	**910.3**	**872.2**	**19.4**	**16.5**	**16.0**	**3.9**	**3.7**	**3.6**	**115.1**	**115.3**	**115.5**	**2,890.4**	**2,893.2**	**2,896.0**

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
2024-2026 System Benefits Charge ("SBC") Calculation

Year	EE Total Budget	RGGI Revenues	FCM Revenues	Carryforward with Interest	Current Year Interest	SBC Requirement	Forecasted Distribution (MWH)	SBC Rate EE Portion (cents/kWh)	SBC Rate EAP Portion (cents/kWh)	Yearly Total SBC Rate (cents/kWh)
Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K
2024	$6,501,555	$212,737	$284,546	$644,055	$3,237	$5,360,217	920,392	0.577	0.150	0.727
2025	$6,536,841	$210,601	$302,782	$351,303	$5,654	$5,672,156	935,088	0.603	0.150	0.753
2026	$6,554,970	$217,969	$323,042	$175,651	$9,948	$5,838,308	948,997	0.619	0.150	0.769

Col. A: Effective year
Col. B: Company Forecast
Col. C: Company Forecast
Col. D: Company Forecast
Col. E: Company Forecast Carryforward
Col. F: Page 2, Line 11 Column O
Col. G: Col. B - Col. C - Col. D - Col. E - Col. F
Col. H: Company Forecast
Col. I: Per Order No. 26,579
Col. J: EAP Portion of SBC Rate
Col. K: Col. I + J

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2022 to December 31, 2022
($ in 000's)

Line	Description	Carryover 2021	Actual Jan-22	Actual Feb-22	Actual Mar-22	Actual Apr-22	Actual May-22	Actual Jun-22	Actual Jul-22	Actual Aug-22	Actual Sep-22	Actual Oct-22	Actual Nov-22	Actual Dec-22	2022 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		$360	$290	$330	$376	$347	$386	$440	$475	$440	$276	$275	$381	$4,376
2	RGGI Revenues		$54	$0	$0	$0	$53	$0	$53	$0	$0	$53	$0	$53	$266
3	FCM Revenues		$54	$54	$54	$54	$54	$60	$47	$41	$46	$21	$38	$31	$552
4	Carryover	($485)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	Interest		$7	$7	$7	$7	$7	$7	$7	$7	$7	$7	$7	$7	$86
6	**Total Revenues**		**$475**	**$351**	**$391**	**$436**	**$461**	**$453**	**$547**	**$523**	**$493**	**$357**	**$321**	**$473**	**$5,280**
7	Program Expenses		$32	$169	$228	$215	$257	$347	$166	$604	$394	$198	$107	$1,636	$4,353
8	Performance Incentive 2022		$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$240
9	**Total Program Expenses**		**$52**	**$189**	**$248**	**$235**	**$277**	**$367**	**$186**	**$624**	**$414**	**$218**	**$127**	**$1,656**	**$4,593**
10	Current Month (Over)/Under Recovery		($423)	($162)	($143)	($201)	($184)	($86)	($361)	$102	($78)	($139)	($194)	$1,183	($686)
11	Cumulative (Over)/Under Recovery		($423)	($585)	($728)	($930)	($1,113)	($1,199)	($1,561)	($1,459)	($1,537)	($1,676)	($1,869)	($686)	($1,171)
12	Interest @ Prime		0.27%	0.27%	0.27%	0.29%	0.29%	0.33%	0.40%	0.46%	0.46%	0.52%	0.52%	0.58%	
13	**Interest on Deferral Balance**		**($1)**	**($1)**	**($2)**	**($2)**	**($3)**	**($4)**	**($5)**	**($7)**	**($7)**	**($8)**	**($9)**	**($7)**	**($57)**
14	**Monthly Sales (MWh)**		78,299	77,253	74,311	71,430	65,761	73,045	83,413	90,027	67,197	52,314	52,103	88,262	873,415
15	**EE SBC Rate**		0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	0.528	

Line 1: Actual data
Line 2: Actual data
Line 3: Actual data
Line 4: Actual data
Line 5: Per IR 22-042 Filing May 31, 2023
Line 6: Sum of Lines 1 through Lines 5
Line 7: Company data
Line 8: Per IR 22-042 Filing May 31, 2023
Line 9: Sum of Lines 7 through 8
Line 10 Line 9 - Line 6
Line 11 Prior month Line 11 + Current month Line 10
Line 12 Prime Rate / 12
Line 13 (Prior Month Line 11 + Current Month Line 11) / 2 x Line 12
Line 14 Company Forecast
Line 15 Approved in Order No. 26,579

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2023 to December 31, 2023
($ in 000's)

Line	Description	Carryover 2022	Actual Jan-23	Actual Feb-23	Actual Mar-23	Actual Apr-23	Forecast May-23	Forecast Jun-23	Forecast Jul-23	Forecast Aug-23	Forecast Sep-23	Forecast Oct-23	Forecast Nov-23	Forecast Dec-23	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		$411	$469	$408	$385	$399	$435	$491	$492	$417	$406	$403	$436	$5,153
2	RGGI Revenues		$0	$0	$53	$0	$0	$53	$0	$0	$55	$0	$0	$55	$216
3	FCM Revenues		$36	$37	$29	$29	$29	$29	$29	$29	$29	$29	$29	$29	$365
4	Carryover	$1,171	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	**Total Revenues**		**$447**	**$506**	**$490**	**$414**	**$429**	**$517**	**$521**	**$521**	**$501**	**$436**	**$432**	**$520**	**$5,734**
6	Program Expenses		$266	$280	$298	$352	$343	$244	$466	$466	$466	$466	$466	$466	$4,579
7	**Total Program Expenses**		**$266**	**$280**	**$298**	**$352**	**$343**	**$244**	**$466**	**$466**	**$466**	**$466**	**$466**	**$466**	**$4,579**
8	Current Month (Over)/Under Recovery		($182)	($226)	($192)	($62)	($85)	($273)	($55)	($55)	($35)	$30	$34	($54)	($1,155)
9	Cumulative (Over)/Under Recovery		($182)	($408)	($600)	($662)	($747)	($1,020)	($1,075)	($1,130)	($1,165)	($1,134)	($1,100)	($1,155)	
10	Interest @ Prime		0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	
11	**Interest on Deferral Balance**		**($0)**	**($1)**	**($1)**	**($2)**	**($2)**	**($2)**	**($3)**	**($3)**	**($3)**	**($3)**	**($3)**	**($3)**	**($27)**
12	**Monthly Sales (MWh)**		74,795	85,349	74,108	69,932	72,596	79,072	89,327	89,414	75,808	73,884	73,245	79,334	936,863
13	**EE SBC Rate**		0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	

Line 1: Actual data
Line 2: Actual data
Line 3: Actual data
Line 4: Actual data
Line 5: Sum of Lines 1 through Lines 4
Line 6: Company data
Line 7: Sum of Line 6
Line 8: Line 5 - Line 7
Line 9: Prior month Line 9 + Current month Line 8
Line 10 Prime Rate / 12
Line 11 (Prior Month Line 9 + Current Month Line 9) / 2 x Line 10
Line 12 Company Forecast
Line 13 Page 1, Col. I

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2024 to December 31, 2024
($ in 000's)

Line	Description	2022 Carryover	Forecast Jan-24	Forecast Feb-24	Forecast Mar-24	Forecast Apr-24	Forecast May-24	Forecast Jun-24	Forecast Jul-24	Forecast Aug-24	Forecast Sep-24	Forecast Oct-24	Forecast Nov-24	Forecast Dec-24	2024 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		$460	$416	$432	$397	$421	$456	$518	$510	$444	$426	$418	$459	$5,360
2	RGGI Revenues		$0	$0	$53	$0	$0	$53	$0	$0	$53	$0	$0	$53	$213
3	FCM Revenues		$24	$24	$24	$24	$24	$24	$24	$24	$24	$24	$24	$24	$285
4	Carryover	$644	$54	$54	$54	$54	$54	$54	$54	$54	$54	$54	$54	$54	$644
5	**Total Revenues**		**$537**	**$494**	**$563**	**$475**	**$499**	**$587**	**$595**	**$588**	**$575**	**$504**	**$496**	**$590**	**$6,502**
6	Program Expenses		$542	$542	$542	$542	$542	$542	$542	$542	$542	$542	$542	$542	$6,502
7	**Total Program Expenses**		**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$542**	**$6,502**
8	Current Month (Over)/Under Recovery		$4	$48	($21)	$67	$43	($45)	($54)	($46)	($33)	$38	$46	($48)	$0
9	Cumulative (Over)/Under Recovery		$4	$52	$31	$98	$141	$97	$43	($3)	($36)	$2	$48	$0	
10	Interest @ Prime		0.63%	0.65%	0.65%	0.67%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	
11	**Interest on Deferral Balance**		**$0**	**$0**	**$0**	**$0**	**$1**	**$1**	**$0**	**$0**	**($0)**	**($0)**	**$0**	**$0**	**$3**
12	**Monthly Sales (MWh)**		80,239	72,661	75,443	69,397	73,540	79,537	90,303	88,961	77,503	74,392	73,013	80,100	935,088
13	**EE SBC Rate**		0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	0.5770	

Line 1: Forecast data
Line 2: Forecast data
Line 3: Forecast data
Line 4: 2022 Carryover at 55%
Line 5: Sum of Lines 1 through Lines 4
Line 6: Company data
Line 7: Sum of Line 6
Line 8: Line 5 - Line 7
Line 9: Prior month Line 9 + Current month Line 8
Line 10: Prime Rate / 12
Line 11 (Prior Month Line 9 + Current Month Line 9) / 2 x Line 10
Line 12 Company Forecast
Line 13 Page 1, Col. I

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2025 to December 31, 2025
($ in 000's)

Line	Description	022 Carryove	Forecast Jan-25	Forecast Feb-25	Forecast Mar-25	Forecast Apr-25	Forecast May-25	Forecast Jun-25	Forecast Jul-25	Forecast Aug-25	Forecast Sep-25	Forecast Oct-25	Forecast Nov-25	Forecast Dec-25	2025 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues		$491	$441	$461	$423	$449	$485	$547	$539	$468	$448	$439	$481	$5,672
2	RGGI Revenues		$0	$0	$53	$0	$0	$53	$0	$0	$53	$0	$0	$53	$211
3	FCM Revenues		$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$303
4	Carryover	$351	$29	$29	$29	$29	$29	$29	$29	$29	$29	$29	$29	$29	$351
5	**Total Revenues**		**$545**	**$496**	**$568**	**$478**	**$503**	**$592**	**$602**	**$593**	**$575**	**$503**	**$493**	**$588**	**$6,537**
6	Program Expenses		$545	$545	$545	$545	$545	$545	$545	$545	$545	$545	$545	$545	$6,537
7	**Total Program Expenses**		**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$545**	**$6,537**
8	Current Month (Over)/Under Recovery		($1)	$49	($23)	$67	$42	($47)	($57)	($48)	($30)	$42	$51	($44)	$0
9	Cumulative (Over)/Under Recovery		($1)	$48	$25	$92	$134	$86	$29	($19)	($50)	($8)	$44	$0	
10	Interest @ Prime		0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	
11	**Interest on Deferral Balance**		**($0)**	**$0**	**$0**	**$0**	**$1**	**$1**	**$0**	**$0**	**($0)**	**($0)**	**$0**	**$0**	**$6**
12	**Monthly Sales (MWh)**		81,910	73,671	76,868	70,707	74,896	80,919	91,284	89,824	78,098	74,827	73,293	80,303	946,599
13	**EE SBC Rate**		0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	0.6030	

Line 1: Forecast data
Line 2: Forecast data
Line 3: Forecast data
Line 4: 2022 Carryover at 30%
Line 5: Sum of Lines 1 through Lines 4
Line 6: Company data
Line 7: Sum of Line 6
Line 8: Line 5 - Line 7
Line 9: Prior month Line 9 + Current month Line 8
Line 10: Prime Rate / 12
Line 11 (Prior Month Line 9 + Current Month Line 9) / 2 x Line 10
Line 12 Company Forecast
Line 13 Page 1, Col. I

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2026 to December 31, 2026
($ in 000's)

Line	Description	022 Carryove	Forecast Jan-26	Forecast Feb-26	Forecast Mar-26	Forecast Apr-26	Forecast May-26	Forecast Jun-26	Forecast Jul-26	Forecast Aug-26	Forecast Sep-26	Forecast Oct-26	Forecast Nov-26	Forecast Dec-26	2026 Total
	Col. A		Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. M	Col. N	Col. O
1	SBC Revenues		$505	$454	$474	$436	$462	$499	$564	$555	$482	$461	$452	$495	$5,838
2	RGGI Revenues		$0	$0	$54	$0	$0	$54	$0	$0	$54	$0	$0	$54	$218
3	FCM Revenues		$27	$27	$27	$27	$27	$27	$27	$27	$27	$27	$27	$27	$323
4	Carryover	$176	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$176
5	**Total Revenues**		**$532**	**$481**	**$555**	**$462**	**$489**	**$581**	**$591**	**$582**	**$563**	**$488**	**$479**	**$577**	**$6,555**
6	Program Expenses		$546	$546	$546	$546	$546	$546	$546	$546	$546	$546	$546	$546	$6,555
7	**Total Program Expenses**		**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$546**	**$6,555**
8	Current Month (Over)/Under Recovery		$14	$65	($9)	$84	$58	($34)	($45)	($35)	($17)	$58	$68	($31)	$176
9	Cumulative (Over)/Under Recovery		$14	$79	$70	$154	$212	$177	$133	$97	$81	$139	$206	$176	
10	Interest @ Prime		0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	
11	**Interest on Deferral Balance**		**$0**	**$0**	**$1**	**$1**	**$1**	**$1**	**$1**	**$1**	**$1**	**$1**	**$1**	**$1**	**$10**
12	**Monthly Sales (MWh)**		82,114	73,808	77,048	70,848	75,077	81,137	91,576	90,109	78,301	75,013	73,456	80,509	948,997
13	**EE SBC Rate**		0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	0.6190	

Line 1: Forecast data
Line 2: Forecast data
Line 3: Forecast data
Line 4: 2022 Carryover at 15%
Line 5: Sum of Lines 1 through Lines 4
Line 6: Company data
Line 7: Sum of Line 6
Line 8: Line 5 - Line 7
Line 9: Prior month Line 9 + Current month Line 8
Line 10: Prime Rate / 12
Line 11 (Prior Month Line 9 + Current Month Line 9) / 2 x Line 10
Line 12 Company Forecast
Line 13 Page 1, Col. I

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty
Bill Impacts of Changes in System Benefits Charge

	Current Rates*	2024 Res	2024 C&I	2025 Res	2025 C&I	2026 Res	2026 C&I
System Benefits Charge ($/kWh)	$0.00700	$0.00727	$0.00727	$0.00753	$0.00753	$0.00769	$0.00769
Bill per month, including GSE default energy service							
Residential Rate D (650 kWh/month)	$223.63	$223.81		$223.98		$224.08	
Rate G-2, 25 kW, 9,000 kWh per month	$1,100.34		$1,103.04		$1,105.64		$1,107.24
Change from previous rate level - $ per month							
Residential Rate D (650 kWh/month)		$0.18		$0.17		$0.10	
Rate G-2, 25 kW, 9,000 kWh per month			$2.70		$2.60		$1.60
Change from previous rate level - %							
Residential Rate D (650 kWh/month)		0.08%		0.08%		0.05%	
Rate G-2, 25 kW, 9,000 kWh per month			0.25%		0.24%		0.14%

* Stated at Liberty's most recent rate levels (effective June 1, 2023). Rate G-2 energy service rate is based on June 1, 2023 rate.

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	Granite State Test	*Total Resource Cost Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs													
B1 - Home Energy Assistance	2.24	*2.24*	2,113.0	*2,113.0*	942.3	-	240.3	4,793.7	38.2	57.4	114	894.1	20,074.9
B2a - IE Education	-	-	-	-	25.6	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	47.1	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.08**	***2.08***	**2,113.0**	***2,113.0***	**1,015.0**	**-**	**240.3**	**4,793.7**	**38.2**	**57.4**	**114**	**894.1**	**20,074.9**
Residential Programs													
A1 - Energy Star Homes	6.26	*7.80*	3,013.4	*3,757.5*	481.5	-	662.2	15,898.2	185.3	12.4	128	2,464.4	57,582.8
A2 - Home Performance	2.48	*2.43*	1,491.2	*1,855.6*	600.7	161.9	57.6	456.3	9.1	13.6	71	2,864.4	55,475.8
A3 - Energy Star Products	2.49	*2.31*	3,295.6	*4,094.0*	1,325.0	450.3	1,470.8	17,850.2	294.0	190.8	5,734	4,715.1	70,374.1
A6a - Res Education	-	-	-	-	47.5	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	125.6	-	-	-	-	-		-	-
Sub-Total Residential	**3.02**	***3.04***	**7,800.1**	***9,707.2***	**2,580.3**	**612.2**	**2,190.5**	**34,204.6**	**488.4**	**216.9**	**5,933**	**10,043.8**	**183,432.7**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.80	*1.11*	1,990.1	*2,189.1*	711.4	1,267.3	2,891.3	22,943.3	389.0	222.7	19	(105.9)	(1,031.2)
C2 - Small Business Energy Solutions	1.89	*0.96*	1,195.8	*1,315.8*	632.2	740.0	1,800.3	14,165.6	194.6	200.6	158	(853.8)	(6,412.1)
C3 - Municipal Energy Solutions	0.60	*0.39*	148.5	*163.4*	246.7	174.3	212.8	1,864.1	16.1	21.5	15	(130.0)	(1,148.6)
C6a - C&I Education	-	-	-	-	89.6	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	95.8	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.88**	***0.93***	**3,334.3**	***3,668.3***	**1,775.6**	**2,181.6**	**4,904.4**	**38,973.0**	**599.7**	**444.8**	**192**	**(1,089.6)**	**(8,591.9)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-		-	-
Total	**2.47**	***1.90***	**13,247.5**	***15,488.5***	**5,370.9**	**2,793.7**	**7,335.3**	**77,971.4**	**1,126.3**	**719.1**	**6,240**	**9,848.3**	**194,915.6**

Notes:
(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for
(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.
(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.

Annual kWh Savings	7,335,266	71.8%	**kWh > 65%**	**Lifetime** kWh Savings	77,971,410	57.7%
Annual MMBTU Savings (in kWh)	2,886,261	28.2%		**Lifetime** MMBTU Savings (in kWh)	57,124,138	42.3%
	10,221,528	100.0%			**135,095,548**	100.0%

Annual Net Savings as a % of 2022 Sales	0.96%

Spending per Customer	Low-Income	
	Residential	31.22
	C&I	$ 266.53

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000): Electric: CAPACITY					Electric: ENERGY					
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit
Income Eligible Programs													
B1 - Home Energy Assistance	**$ 2,113**	*$ 2,113*	$ 56	$ -	$ 88	$ 103	$ -	$ 78	$ 88	$ 51	$ 45	$ 15	**$ 524**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Sub-Total Income Eligible	**$ 2,113**	*$ 2,113*	**$ 56**	**$ -**	**$ 88**	**$ 103**	**$ -**	**$ 78**	**$ 88**	**$ 51**	**$ 45**	**$ 15**	**$ 524**
Residential Programs													
A1 - Energy Star Homes	**$ 3,013**	*$ 3,758*	$ 10	$ -	$ 17	$ 20	$ -	$ 373	$ 473	$ 12	$ 9	$ 46	**$ 960**
A2 - Home Performance	**$ 1,491**	*$ 1,856*	$ 5	$ -	$ 8	$ 9	$ -	$ 7	$ 8	$ 5	$ 5	$ 2	**$ 49**
A3 - Energy Star Products	**$ 3,296**	*$ 4,094*	$ 93	$ -	$ 162	$ 190	$ -	$ 398	$ 440	$ 131	$ 118	$ 84	**$ 1,617**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Sub-Total Residential	**$ 7,800**	*$ 9,707*	**$ 109**	**$ -**	**$ 187**	**$ 219**	**$ -**	**$ 778**	**$ 921**	**$ 148**	**$ 132**	**$ 132**	**$ 2,626**
Commercial/Industrial Programs													
C1 - Large Business Energy Solutions	**$ 1,990**	*$ 2,189*	$ 97	$ -	$ 172	$ 202	$ -	$ 413	$ 407	$ 293	$ 282	$ 145	**$ 2,009**
C2 - Small Business Energy Solutions	**$ 1,196**	*$ 1,316*	$ 74	$ -	$ 136	$ 159	$ -	$ 282	$ 205	$ 227	$ 145	$ 90	**$ 1,317**
C3 - Municipal Energy Solutions	**$ 148**	*$ 163*	$ 9	$ -	$ 17	$ 19	$ -	$ 40	$ 24	$ 33	$ 17	$ 12	**$ 170**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Sub-Total Commercial & Industrial	**$ 3,334**	*$ 3,668*	**$ 180**	**$ -**	**$ 324**	**$ 380**	**$ -**	**$ 734**	**$ 635**	**$ 552**	**$ 444**	**$ 246**	**$ 3,497**
C6d - Smart Start	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Total	**$ 13,247**	*$ 15,488*	**$ 345**	**$ -**	**$ 599**	**$ 702**	**$ -**	**$ 1,590**	**$ 1,644**	**$ 751**	**$ 620**	**$ 393**	**$ 6,646**

	Resource Benefits ($000): Non-Electric			Non-Resource Benefits ($000)			Environ-mental
	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	Benefits ($000)[3]
Income Eligible Programs							
B1 - Home Energy Assistance	$ 509	$ 2	**$ 1,035**	$ 13	$ 1,065	**$ 1,078**	**$ 143**
B2a - IE Education	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 509**	**$ 2**	**$ 1,035**	**$ 13**	**$ 1,065**	**$ 1,078**	**$ 143**
Residential Programs							
A1 - Energy Star Homes	$ 2,017	$ 2	**$ 2,979**	$ 35	$ 744	**$ 779**	**$ 384**
A2 - Home Performance	$ 1,409	$ -	**$ 1,458**	$ 33	$ 364	**$ 398**	**$ 16**
A3 - Energy Star Products	$ 1,577	$ 55	**$ 3,249**	$ 47	$ 798	**$ 845**	**$ 698**
A6a - Res Education	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 5,002**	**$ 57**	**$ 7,685**	**$ 115**	**$ 1,907**	**$ 2,022**	**$ 1,098**
Commercial/Industrial Programs							
C1 - Large Business Energy Solutions	$ (19)	$ 0	**$ 1,991**	$ (1)	$ 199	**$ 198**	**$ 1,163**
C2 - Small Business Energy Solutions	$ (117)	$ -	**$ 1,200**	$ (4)	$ 120	**$ 116**	**$ 707**
C3 - Municipal Energy Solutions	$ (21)	$ -	**$ 149**	$ (1)	$ 15	**$ 14**	**$ 91**
C6a - C&I Education	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ (157)**	**$ 0**	**$ 3,340**	**$ (5)**	**$ 334**	**$ 329**	**$ 1,961**
C6d - Smart Start	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 5,355**	**$ 59**	**$ 12,060**	**$ 122**	**$ 3,306**	**$ 3,429**	**$ 3,202**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2024

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	77,971,410	*58,478,557*		-	1.925%	-	$ 103,390	*$ 129,237*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	7,335,266	*5,501,450*		-	0.550%	-	$ 29,540	*$ 36,925*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	719	*467*		-	0.660%	-	$ 35,448	*$ 44,310*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,126	*732*		-	0.440%	-	$ 23,632	*$ 29,540*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 12,059,919			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,2,3]	$ 5,370,884			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 6,689,035	*$ 5,016,776*		-	1.925%	-	$ 103,390	*$ 129,237*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 295,399	*$ 369,248*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
9	Total Benefits	$ 13,247,460		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 295,399	$ -	from row 8 above
11	Total Utility Costs	$ 5,370,884	$ -	from row 6 above
12	**Portfolio GST BCR**	**2.34**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Semand kW excludes active demand from Demand Response programs

Program Cost-Effectiveness - 2025 Plan

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.51	*2.51*	2,293.1	*2,293.1*	915.1	-	253.4	5,054.7	40.3	60.5	121	942.5	21,167.6
B2a - IE Education	-	-	-	-	24.8	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	35.7	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.35**	***2.35***	**2,293.1**	***2,293.1***	**975.6**	**-**	**253.4**	**5,054.7**	**40.3**	**60.5**	**121**	**942.5**	**21,167.6**
Residential Programs													
A1 - Energy Star Homes	6.99	*8.71*	3,340.3	*4,165.0*	478.0	-	711.5	17,084.1	199.2	13.4	138	2,648.4	61,882.8
A2 - Home Performance	2.80	*2.73*	1,666.6	*2,073.8*	595.8	163.4	59.9	494.7	9.5	14.1	78	3,082.6	59,907.8
A3 - Energy Star Products	3.00	*2.81*	3,944.0	*4,903.2*	1,313.5	430.4	1,776.6	23,210.4	384.0	230.8	5,834	4,822.5	71,985.8
A6a - Res Education	-	-	-	-	48.4	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	97.9	-	-	-	-	-		-	-
Sub-Total Residential	**3.53**	***3.56***	**8,950.9**	***11,142.0***	**2,533.6**	**593.8**	**2,548.0**	**40,789.1**	**592.6**	**258.2**	**6,049**	**10,553.6**	**193,776.4**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	3.13	*1.24*	2,187.8	*2,406.6*	699.7	1,242.9	3,069.4	24,356.4	417.3	240.8	20	(112.4)	(1,094.7)
C2 - Small Business Energy Solutions	1.99	*1.04*	1,255.7	*1,381.8*	631.7	698.1	1,838.6	14,467.1	198.7	204.9	162	(871.9)	(6,548.6)
C3 - Municipal Energy Solutions	0.67	*0.43*	104.2	*114.7*	156.1	109.9	145.3	1,272.9	11.0	14.7	10	(88.8)	(784.3)
C6a - C&I Education	-	-	-	-	88.7	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	72.7	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.15**	***1.05***	**3,547.7**	***3,903.0***	**1,648.8**	**2,050.9**	**5,053.4**	**40,096.4**	**627.1**	**460.3**	**192**	**(1,073.1)**	**(8,427.6)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-		-	-
Total	**2.87**	***2.22***	**14,791.7**	***17,338.1***	**5,158.0**	**2,644.7**	**7,854.7**	**85,940.3**	**1,260.0**	**779.1**	**6,362**	**10,422.9**	**206,516.4**

Notes:
(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for
(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.
(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

Annual kWh Savings	7,854,695	72.0%	**kWh > 65%**	**Lifetime** kWh Savings	85,940,266	58.7%
Annual MMBTU Savings (in kWh)	3,054,665	28.0%		**Lifetime** MMBTU Savings (in kWh)	60,523,986	41.3%
	10,909,360	100.0%			**146,464,252**	100.0%

Annual Net Savings as a % of 2022 Sales	1.03%

Spending per Customer	Low-Income		
	Residential		30.65
	C&I	$	247.50

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 2,293**	*$ 2,293*	$ 63	$ -	$ 95	$ 112	$ -	$ 84	$ 96	$ 55	$ 49	$ 16	**$ 569**	$ 556	$ 2	**$ 1,128**	$ 15	$ 1,151	**$ 1,166**	**$ 145**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,293**	*$ 2,293*	**$ 63**	**$ -**	**$ 95**	**$ 112**	**$ -**	**$ 84**	**$ 96**	**$ 55**	**$ 49**	**$ 16**	**$ 569**	**$ 556**	**$ 2**	**$ 1,128**	**$ 15**	**$ 1,151**	**$ 1,166**	**$ 145**
Residential Programs																				
A1 - Energy Star Homes	**$ 3,340**	*$ 4,165*	$ 12	$ -	$ 18	$ 22	$ -	$ 413	$ 523	$ 13	$ 10	$ 51	**$ 1,062**	$ 2,237	$ 2	**$ 3,301**	$ 39	$ 825	**$ 864**	**$ 395**
A2 - Home Performance	**$ 1,667**	*$ 2,074*	$ 5	$ -	$ 9	$ 10	$ -	$ 8	$ 9	$ 6	$ 5	$ 2	**$ 55**	$ 1,574	$ -	**$ 1,629**	$ 38	$ 407	**$ 445**	**$ 17**
A3 - Energy Star Products	**$ 3,944**	*$ 4,903*	$ 134	$ -	$ 223	$ 261	$ -	$ 526	$ 592	$ 174	$ 154	$ 108	**$ 2,171**	$ 1,665	$ 56	**$ 3,893**	$ 51	$ 959	**$ 1,010**	**$ 848**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 8,951**	*$ 11,142*	**$ 152**	**$ -**	**$ 250**	**$ 293**	**$ -**	**$ 947**	**$ 1,125**	**$ 193**	**$ 169**	**$ 161**	**$ 3,288**	**$ 5,476**	**$ 59**	**$ 8,823**	**$ 128**	**$ 2,191**	**$ 2,319**	**$ 1,260**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 2,188**	*$ 2,407*	$ 113	$ -	$ 192	$ 225	$ -	$ 449	$ 442	$ 322	$ 308	$ 157	**$ 2,209**	$ (20)	$ 0	**$ 2,189**	$ (1)	$ 219	**$ 218**	**$ 1,199**
C2 - Small Business Energy Solutions	**$ 1,256**	*$ 1,382*	$ 82	$ -	$ 142	$ 166	$ -	$ 294	$ 215	$ 239	$ 152	$ 94	**$ 1,384**	$ (124)	$ -	**$ 1,260**	$ (4)	$ 126	**$ 122**	**$ 703**
C3 - Municipal Energy Solutions	**$ 104**	*$ 115*	$ 7	$ -	$ 12	$ 14	$ -	$ 28	$ 16	$ 23	$ 12	$ 8	**$ 119**	$ (15)	$ -	**$ 105**	$ (1)	$ 10	**$ 10**	**$ 60**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 3,548**	*$ 3,903*	**$ 202**	**$ -**	**$ 346**	**$ 405**	**$ -**	**$ 772**	**$ 673**	**$ 584**	**$ 472**	**$ 260**	**$ 3,713**	**$ (159)**	**$ 0**	**$ 3,553**	**$ (6)**	**$ 355**	**$ 350**	**$ 1,963**
C6d - Smart Start	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 14,792**	*$ 17,338*	**$ 416**	**$ -**	**$ 691**	**$ 809**	**$ -**	**$ 1,803**	**$ 1,894**	**$ 832**	**$ 690**	**$ 436**	**$ 7,570**	**$ 5,874**	**$ 60**	**$ 13,504**	**$ 136**	**$ 3,697**	**$ 3,834**	**$ 3,368**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2025										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	85,940,266	*64,455,199*		-	1.925%	-	$ 107,483	*$ 134,354*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	7,854,695	*5,891,022*		-	0.550%	-	$ 30,709	*$ 38,387*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	779	*506*		-	0.660%	-	$ 36,851	*$ 46,064*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,260	*819*		-	0.440%	-	$ 24,568	*$ 30,709*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 13,504,267			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,2,3]	$ 5,583,542			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 7,920,725	*$ 5,940,544*	$ -	-	1.925%	-	$ 107,483	*$ 134,354*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 307,095	*$ 383,868*	$ -	

		Granite State Test		
		Planned	**Actual**	**Source**
10	Total Benefits	$ 14,791,657		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 307,095	$ -	from row 9 above
12	Total Utility Costs	$ 5,583,542	$ -	from row 7 above
13	**Portfolio GST BCR**	**2.51**	-	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Semand kW excludes active demand from Demand Response programs

Program Cost-Effectiveness - 2026 Plan

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.81	*2.81*	2,455.7	*2,455.7*	872.6	-	263.6	5,259.4	41.9	63.0	125	980.8	22,026.9
B2a - IE Education	-	-	-	-	23.8	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	34.1	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.64**	***2.64***	**2,455.7**	***2,455.7***	**930.5**	**-**	**263.6**	**5,259.4**	**41.9**	**63.0**	**125**	**980.8**	**22,026.9**
Residential Programs													
A1 - Energy Star Homes	7.84	*9.77*	3,554.8	*4,432.4*	453.5	-	735.4	17,648.7	205.7	13.8	142	2,729.2	63,826.3
A2 - Home Performance	3.16	*3.07*	1,784.5	*2,220.4*	565.2	157.1	61.0	513.1	9.6	14.3	81	3,187.7	62,041.5
A3 - Energy Star Products	3.34	*3.14*	4,167.5	*5,181.3*	1,246.0	405.3	1,824.2	23,982.0	395.2	235.5	5,914	4,887.0	72,952.9
A6a - Res Education	-	-	-	-	46.6	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	93.0	-	-	-	-	-		-	-
Sub-Total Residential	**3.95**	***3.99***	**9,506.8**	***11,834.0***	**2,404.4**	**562.4**	**2,620.6**	**42,143.8**	**610.5**	**263.7**	**6,137**	**10,803.9**	**198,820.7**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	3.13	*1.33*	2,068.0	*2,274.9*	661.1	1,049.7	2,806.1	22,266.9	381.5	220.1	18	(102.7)	(1,000.8)
C2 - Small Business Energy Solutions	2.21	*1.16*	1,316.8	*1,449.0*	597.1	653.6	1,863.3	14,661.3	201.4	207.6	164	(883.6)	(6,636.5)
C3 - Municipal Energy Solutions	0.75	*0.48*	108.3	*119.2*	144.2	102.1	146.1	1,279.8	11.1	14.8	10	(89.2)	(788.6)
C6a - C&I Education	-	-	-	-	84.1	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.35**	***1.17***	**3,493.1**	***3,843.0***	**1,486.5**	**1,805.3**	**4,815.5**	**38,208.0**	**594.0**	**442.5**	**193**	**(1,075.6)**	**(8,425.8)**
C6d - Smart Start	-	-	-	-	68.4	-	-	-	-	-		-	-
Total	**3.16**	***2.50***	**15,455.6**	***18,132.7***	**4,889.8**	**2,367.7**	**7,699.8**	**85,611.2**	**1,246.4**	**769.1**	**6,455**	**10,709.1**	**212,421.8**

Notes:

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(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

Annual kWh Savings	7,699,780	71.0%	**kWh > 65%**	**Lifetime** kWh Savings	85,611,248	57.9%
Annual MMBTU Savings (in kWh)	3,138,517	29.0%		**Lifetime** MMBTU Savings (in kWh)	62,254,678	42.1%
	10,838,297	100.0%			**147,865,926**	100.0%

Annual Net Savings as a % of 2022 Sales	1.01%

Spending per Customer	Low-Income		
	Residential		29.09
	C&I	$	223.13

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 2,456**	*$ 2,456*	$ 69	$ -	$ 102	$ 119	$ -	$ 90	$ 103	$ 60	$ 53	$ 17	**$ 612**	$ 599	$ 2	**$ 1,213**	$ 16	$ 1,227	**$ 1,243**	**$ 144**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,456**	*$ 2,456*	**$ 69**	**$ -**	**$ 102**	**$ 119**	**$ -**	**$ 90**	**$ 103**	**$ 60**	**$ 53**	**$ 17**	**$ 612**	**$ 599**	**$ 2**	**$ 1,213**	**$ 16**	**$ 1,227**	**$ 1,243**	**$ 144**
Residential Programs																				
A1 - Energy Star Homes	**$ 3,555**	*$ 4,432*	$ 13	$ -	$ 19	$ 23	$ -	$ 440	$ 558	$ 14	$ 11	$ 54	**$ 1,132**	$ 2,378	$ 2	**$ 3,513**	$ 42	$ 878	**$ 920**	**$ 387**
A2 - Home Performance	**$ 1,785**	*$ 2,220*	$ 6	$ -	$ 9	$ 11	$ -	$ 9	$ 10	$ 6	$ 6	$ 2	**$ 58**	$ 1,685	$ -	**$ 1,743**	$ 41	$ 436	**$ 477**	**$ 16**
A3 - Energy Star Products	**$ 4,167**	*$ 5,181*	$ 147	$ -	$ 235	$ 275	$ -	$ 562	$ 631	$ 186	$ 164	$ 114	**$ 2,313**	$ 1,742	$ 58	**$ 4,113**	$ 55	$ 1,014	**$ 1,068**	**$ 833**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 9,507**	*$ 11,834*	**$ 166**	**$ -**	**$ 263**	**$ 308**	**$ -**	**$ 1,010**	**$ 1,199**	**$ 206**	**$ 180**	**$ 170**	**$ 3,503**	**$ 5,805**	**$ 60**	**$ 9,369**	**$ 138**	**$ 2,327**	**$ 2,465**	**$ 1,236**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 2,068**	*$ 2,275*	$ 111	$ -	$ 180	$ 211	$ -	$ 423	$ 417	$ 306	$ 292	$ 147	**$ 2,088**	$ (19)	$ 0	**$ 2,069**	$ (1)	$ 207	**$ 206**	**$ 1,050**
C2 - Small Business Energy Solutions	**$ 1,317**	*$ 1,449*	$ 90	$ -	$ 147	$ 173	$ -	$ 307	$ 225	$ 252	$ 160	$ 98	**$ 1,452**	$ (130)	$ -	**$ 1,322**	$ (5)	$ 132	**$ 127**	**$ 684**
C3 - Municipal Energy Solutions	**$ 108**	*$ 119*	$ 7	$ -	$ 12	$ 14	$ -	$ 29	$ 17	$ 24	$ 12	$ 9	**$ 124**	$ (15)	$ -	**$ 109**	$ (1)	$ 11	**$ 10**	**$ 58**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 3,493**	*$ 3,843*	**$ 209**	**$ -**	**$ 339**	**$ 398**	**$ -**	**$ 759**	**$ 659**	**$ 582**	**$ 465**	**$ 254**	**$ 3,664**	**$ (165)**	**$ 0**	**$ 3,499**	**$ (6)**	**$ 350**	**$ 344**	**$ 1,792**
C6d - Smart Start	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 15,456**	*$ 18,133*	**$ 444**	**$ -**	**$ 704**	**$ 825**	**$ -**	**$ 1,860**	**$ 1,960**	**$ 848**	**$ 698**	**$ 440**	**$ 7,780**	**$ 6,239**	**$ 62**	**$ 14,081**	**$ 147**	**$ 3,904**	**$ 4,052**	**$ 3,172**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2026										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	85,611,248	*64,208,436*		-	1.925%	-	$ 108,756	*$ 135,945*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	7,699,780	*5,774,835*		-	0.550%	-	$ 31,073	*$ 38,841*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	769	*500*		-	0.660%	-	$ 37,288	*$ 46,610*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,246	*810*		-	0.440%	-	$ 24,858	*$ 31,073*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 14,080,903			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,2,3]	$ 5,649,643			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 8,431,259	*$ 6,323,445*	$ -	-	1.925%	-	$ 108,756	*$ 135,945*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 310,730	*$ 388,413*	$ -	

		Granite State Test		
		Planned	**Actual**	**Source**
10	Total Benefits	$ 15,455,564		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 310,730	$ -	from row 9 above
12	Total Utility Costs	$ 5,649,643	$ -	from row 7 above
13	**Portfolio GST BCR**	**2.59**	-	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Semand kW excludes active demand from Demand Response programs

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.51	*2.51*	6,861.8	*6,861.8*	2,730.0	-	757.3	15,107.9	120.3	180.8	360	2,817.4	63,269.4
B2a - IE Education	-	-	-	-	74.1	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	116.9	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**2.35**	***2.35***	**6,861.8**	***6,861.8***	**2,921.0**	**-**	**757.3**	**15,107.9**	**120.3**	**180.8**	**360**	**2,817.4**	**63,269.4**
Residential Programs													
A1 - Energy Star Homes	7.01	*8.74*	9,908.5	*12,355.0*	1,413.1	-	2,109.1	50,631.0	590.1	39.6	408	7,842.0	183,291.9
A2 - Home Performance	2.81	*2.74*	4,942.2	*6,149.8*	1,761.7	482.3	178.5	1,464.1	28.2	42.0	230	9,134.7	177,425.1
A3 - Energy Star Products	2.94	*2.74*	11,407.0	*14,178.5*	3,884.4	1,286.0	5,071.6	65,042.5	1,073.2	657.2	17,482	14,424.6	215,312.8
A6a - Res Education	-	-	-	-	142.5	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	316.5	-	-	-	-	-	-	-	-
Sub-Total Residential	**3.49**	***3.52***	**26,257.8**	***32,683.2***	**7,518.3**	**1,768.4**	**7,359.1**	**117,137.6**	**1,691.6**	**738.8**	**18,120**	**31,401.3**	**576,029.8**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	3.01	*1.22*	6,245.9	*6,870.6*	2,072.1	3,559.9	8,766.9	69,566.7	1,187.8	683.6	57	(321.0)	(3,126.7)
C2 - Small Business Energy Solutions	2.02	*1.05*	3,768.3	*4,146.5*	1,860.9	2,091.6	5,502.3	43,294.0	594.7	613.1	484	(2,609.3)	(19,597.2)
C3 - Municipal Energy Solutions	0.66	*0.43*	361.0	*397.2*	546.9	386.3	504.2	4,416.7	38.2	51.0	36	(308.0)	(2,721.5)
C6a - C&I Education	-	-	-	-	262.4	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	168.5	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**2.11**	***1.04***	**10,375.1**	***11,414.4***	**4,910.9**	**6,037.8**	**14,773.3**	**117,277.4**	**1,820.8**	**1,347.7**	**577**	**(3,238.3)**	**(25,445.4)**
C6d - Smart Start	-	-	-	-	68.4	-	-	-	-	-	-	-	-
Total	**2.82**	***2.19***	**43,494.7**	***50,959.3***	**15,418.6**	**7,806.1**	**22,889.7**	**249,522.9**	**3,632.6**	**2,267.3**	**19,057**	**30,980.3**	**613,853.8**

Notes:
(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per
(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.
(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

Annual kWh Savings	22,889,741	71.6%	**kWh > 65%**	**Lifetime** kWh Savings	249,522,924	58.1%
Annual MMBTU Savings (in kWh)	9,079,443	28.4%		**Lifetime** MMBTU Savings (in kWh)	179,902,802	41.9%
	31,969,185	100.0%			**429,425,726**	100.0%

Annual Net Savings as a % of 2022 Sales	2.99%

Spending per Customer	Low-Income		
	Residential		90.96
	C&I	$	737.16

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 6,862**	*$ 6,862*	$ 187	$ -	$ 285	$ 334	$ -	$ 252	$ 286	$ 166	$ 147	$ 47	**$ 1,705**	$ 1,664	$ 5	**$ 3,375**	$ 43	$ 3,443	**$ 3,487**	**$ 432**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 6,862**	*$ 6,862*	**$ 187**	**$ -**	**$ 285**	**$ 334**	**$ -**	**$ 252**	**$ 286**	**$ 166**	**$ 147**	**$ 47**	**$ 1,705**	**$ 1,664**	**$ 5**	**$ 3,375**	**$ 43**	**$ 3,443**	**$ 3,487**	**$ 432**
Residential Programs																				
A1 - Energy Star Homes	**$ 9,908**	*$ 12,355*	$ 35	$ -	$ 55	$ 64	$ -	$ 1,226	$ 1,555	$ 39	$ 30	$ 151	**$ 3,154**	$ 6,632	$ 7	**$ 9,793**	$ 115	$ 2,446	**$ 2,562**	**$ 1,165**
A2 - Home Performance	**$ 4,942**	*$ 6,150*	$ 16	$ -	$ 26	$ 30	$ -	$ 24	$ 28	$ 17	$ 15	$ 5	**$ 162**	$ 4,668	$ -	**$ 4,830**	$ 112	$ 1,208	**$ 1,320**	**$ 49**
A3 - Energy Star Products	**$ 11,407**	*$ 14,178*	$ 375	$ -	$ 619	$ 726	$ -	$ 1,486	$ 1,662	$ 491	$ 436	$ 306	**$ 6,101**	$ 4,984	$ 169	**$ 11,255**	$ 152	$ 2,771	**$ 2,924**	**$ 2,379**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 26,258**	*$ 32,683*	**$ 426**	**$ -**	**$ 700**	**$ 820**	**$ -**	**$ 2,736**	**$ 3,245**	**$ 547**	**$ 481**	**$ 463**	**$ 9,417**	**$ 16,284**	**$ 176**	**$ 25,878**	**$ 380**	**$ 6,425**	**$ 6,806**	**$ 3,593**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 6,246**	*$ 6,871*	$ 321	$ -	$ 544	$ 638	$ -	$ 1,285	$ 1,266	$ 920	$ 882	$ 449	**$ 6,306**	$ (58)	$ 0	**$ 6,248**	$ (2)	$ 625	**$ 623**	**$ 3,412**
C2 - Small Business Energy Solutions	**$ 3,768**	*$ 4,146*	$ 246	$ -	$ 425	$ 498	$ -	$ 884	$ 644	$ 718	$ 457	$ 282	**$ 4,153**	$ (372)	$ -	**$ 3,782**	$ (13)	$ 378	**$ 365**	**$ 2,094**
C3 - Municipal Energy Solutions	**$ 361**	*$ 397*	$ 24	$ -	$ 40	$ 47	$ -	$ 96	$ 57	$ 80	$ 41	$ 29	**$ 414**	$ (51)	$ -	**$ 363**	$ (2)	$ 36	**$ 34**	**$ 210**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 10,375**	*$ 11,414*	**$ 591**	**$ -**	**$ 1,009**	**$ 1,183**	**$ -**	**$ 2,265**	**$ 1,968**	**$ 1,718**	**$ 1,380**	**$ 760**	**$ 10,873**	**$ (481)**	**$ 0**	**$ 10,393**	**$ (17)**	**$ 1,039**	**$ 1,022**	**$ 5,717**
C6d - Smart Start	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 43,495**	*$ 50,959*	**$ 1,204**	**$ -**	**$ 1,994**	**$ 2,337**	**$ -**	**$ 5,253**	**$ 5,498**	**$ 2,431**	**$ 2,008**	**$ 1,270**	**$ 21,996**	**$ 17,468**	**$ 181**	**$ 39,645**	**$ 406**	**$ 10,908**	**$ 11,314**	**$ 9,742**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024-2026									
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	249,522,924	*187,142,193*		-	1.925%	-	$ 319,628	*$ 399,535*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	22,889,741	*17,167,306*		-	0.550%	-	$ 91,322	*$ 114,153*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	2,267	*1,474*		-	0.660%	-	$ 109,587	*$ 136,984*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	3,633	*2,361*		-	0.440%	-	$ 73,058	*$ 91,322*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 39,645,088			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,2,3]	$ 16,604,069			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 23,041,019	*$ 17,280,764*	$ -	-	1.925%	-	$ 319,628	*$ 399,535*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 913,224	*$ 1,141,530*	$ -	

		Granite State Test		
		Planned	Actual	Source
10	Total Benefits	$ 43,494,680		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 913,224	$ -	from row 9 above
12	Total Utility Costs	$ 16,604,069	$ -	from row 7 above
13	**Portfolio GST BCR**	**2.48**	-	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Net of Smart Start.

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Semand kW excludes active demand from Demand Response programs

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization	Air Sealing, Cord Wood	EB1a001	110	116	121	-	-	-	-	-	-	-	-	-	-	-	-	34.0	35.9	37.3	510.2	538.0	559.8
B1a - HEA (Weatherization	Air Sealing, Electric	EB1a002	110	116	121	55.1	58.1	60.4	826.0	871.0	906.2	8.7	9.1	9.5	14.5	15.3	15.9	-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Gas	EB1a003	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Kerosene	EB1a004	110	116	121	-	-	-	-	-	-	-	-	-	-	-	-	41.0	43.2	45.0	615.2	648.7	675.0
B1a - HEA (Weatherization	Air Sealing, Oil	EB1a005	110	116	121	-	-	-	-	-	-	-	-	-	-	-	-	83.0	87.6	91.1	1,245.5	1,313.3	1,366.5
B1a - HEA (Weatherization	Air Sealing, Propane	EB1a006	110	116	121	-	-	-	-	-	-	-	-	-	-	-	-	37.0	39.0	40.6	555.2	585.5	609.2
B1a - HEA (Weatherization	Faucet Aerator, Electric	EB1a009	13	14	14	2.5	2.7	2.8	17.8	18.8	19.6	0.5	0.5	0.5	0.2	0.2	0.2	-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Oil	EB1a012	13	14	14	-	-	-	-	-	-	-	-	-	-	-	-	2.0	2.2	2.2	14.3	15.1	15.7
B1a - HEA (Weatherization	Faucet Aerator, Propane	EB1a013	13	14	14	-	-	-	-	-	-	-	-	-	-	-	-	1.6	1.6	1.7	10.9	11.5	12.0
B1a - HEA (Weatherization	Insulation, Cord Wood	EB1a022	114	121	125	-	-	-	-	-	-	-	-	-	-	-	-	19.4	20.4	21.3	484.8	511.2	531.9
B1a - HEA (Weatherization	Insulation, Electric	EB1a023	114	121	125	135.0	142.3	148.1	3,374.8	3,558.6	3,702.7	21.3	22.4	23.3	35.5	37.5	39.0	-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Kerosene	EB1a025	114	121	125	-	-	-	-	-	-	-	-	-	-	-	-	109.9	115.9	120.6	2,747.5	2,897.1	3,014.4
B1a - HEA (Weatherization	Insulation, Oil	EB1a026	114	121	125	-	-	-	-	-	-	-	-	-	-	-	-	405.8	427.9	445.3	10,145.8	10,698.2	11,131.4
B1a - HEA (Weatherization	Insulation, Propane	EB1a027	114	121	125	-	-	-	-	-	-	-	-	-	-	-	-	83.6	88.1	91.7	2,088.8	2,202.6	2,291.8
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Electric	EB1a037	12	12	13	3.6	3.8	4.0	54.1	57.0	59.3	0.7	0.7	0.8	0.3	0.3	0.3	-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Kerosene	EB1a039	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	(5.9)	(6.2)	(6.3)	(88.4)	(93.2)	(93.9)
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Oil	EB1a040	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.3	1.3	17.9	18.9	19.0
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Propane	EB1a041	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	10.0	10.5	10.6
B1a - HEA (Weatherization	Stand Alone Water Heater, Electric	EB1a096	1	2	2	0.6	0.6	0.6	7.5	7.9	8.2	0.1	0.1	0.1	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, General Service Lamps	EB1a044	114	121	125	8.4	8.9	9.2	8.4	8.9	9.2	1.8	1.9	2.0	1.2	1.2	1.3	(18.8)	(20.2)	(21.0)	(18.8)	(20.2)	(21.0)
B1a - HEA (Weatherization	LED Bulb, Linear	EB1a045	85	90	93	7.7	8.1	8.4	53.8	56.7	59.0	1.7	1.7	1.8	1.1	1.1	1.2	(17.5)	(18.4)	(19.2)	(122.2)	(128.9)	(134.1)
B1a - HEA (Weatherization	LED Fixture	EB1a048	4	5	5	0.4	0.4	0.4	0.8	0.9	0.9	0.1	0.1	0.1	0.1	0.1	0.1	(1.0)	(1.0)	(1.0)	(1.9)	(1.9)	(2.0)
B1a - HEA (Weatherization	Refrigerator	EB1a049	26	28	29	12.9	13.6	14.1	154.3	162.7	169.3	1.5	1.5	1.6	1.8	1.9	2.0	-	-	-	-	-	-
B1a - HEA (Weatherization	Freezer	EB1a050	4	5	5	3.1	3.3	3.4	37.3	39.3	40.9	0.3	0.3	0.3	0.4	0.4	0.4	-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Electric	EB1a064	34	36	38	7.4	7.8	8.1	185.3	195.4	203.3	1.2	1.2	1.3	2.0	2.1	2.1	1.5	1.6	1.6	36.8	38.8	40.4
B1a - HEA (Weatherization	Insulated Door, Electric	EB1a071	18	19	19	1.5	1.6	1.6	37.4	39.4	41.0	0.2	0.2	0.3	0.4	0.4	0.4	-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Kerosene	EB1a073	18	19	19	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	0.4	8.9	9.4	9.8
B1a - HEA (Weatherization	Insulated Door, Oil	EB1a074	18	19	19	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.3	1.3	29.7	31.3	32.6
B1b - HEA (HVAC Systems	Furnace Replacement, Kerosene	EB1b006	7	8	8	2.1	2.2	2.3	36.2	38.2	39.8	0.2	0.2	0.2	-	-	-	80.7	85.0	88.5	1,371.2	1,445.8	1,504.4
B1b - HEA (HVAC Systems	Programmable Thermostat, Oil	EB1b012	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	15.1	16.0	16.6	227.2	239.6	249.3
B1b - HEA (HVAC Systems	Programmable Thermostat, Wood Pellets	EB1b014	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	11.9	12.6	13.1	178.9	188.6	196.3
B1b - HEA (HVAC Systems	Oil K1 HVAC Repair or Cleaning	EB1b024	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	7.2	7.6	7.9	7.2	7.6	7.9
	Home Energy Assistance Subtotal					**240.3**	**253.4**	**263.6**	**4,793.7**	**5,054.7**	**5,259.4**	**38.2**	**40.3**	**41.9**	**57.4**	**60.5**	**63.0**	**894.1**	**942.5**	**980.8**	**20,074.9**	**21,167.6**	**22,026.9**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	EA1a001	26	28	28	2.7	2.9	3.0	68.4	73.5	76.0	-	-	-	1.5	1.6	1.7	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, SF	EA1a002	26	28	28	433.9	466.3	481.7	10,846.8	11,656.7	12,041.5	137.7	148.0	152.9	-	-	-	550.4	591.5	611.0	13,759.1	14,786.6	15,274.6
A1a - ES Homes	Heating, Propane, SF	EA1a005	13	14	14	26.5	28.5	29.5	663.7	713.3	736.8	-	-	-	-	-	-	950.7	1,021.7	1,055.4	23,767.2	25,542.0	26,385.0
A1a - ES Homes	Hot Water, Electric, SF	EA1a007	38	41	41	34.9	37.5	37.3	523.3	562.4	559.4	6.9	7.4	7.3	2.6	2.8	2.8	159.3	171.2	170.3	2,389.7	2,568.2	2,554.6
A1a - ES Homes	Cooling, Electric, MF	EA1a012	38	41	43	5.6	6.0	6.2	138.9	149.3	154.2	-	-	-	3.1	3.3	3.4	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, MF	EA1a013	26	28	28	102.2	109.8	113.4	2,554.4	2,745.1	2,835.7	32.4	34.9	36.0	-	-	-	561.1	603.0	622.9	14,027.1	15,074.5	15,572.1
A1a - ES Homes	Heating, Propane, MF	EA1a016	64	69	71	27.5	29.5	30.5	686.3	737.5	761.9	-	-	-	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, MF	EA1a018	90	96	99	23.7	25.5	26.3	355.8	382.4	395.0	4.7	5.0	5.2	1.8	1.9	2.0	241.9	259.9	268.5	3,627.8	3,898.7	4,027.3
A1a - ES Homes	Refrigerator	EA1a025	32	34	36	1.4	1.5	1.6	17.0	18.2	18.8	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	EA1a026	22	23	23	2.0	2.1	2.1	21.5	23.1	23.0	3.2	3.4	3.4	3.0	3.2	3.2	1.1	1.2	1.2	12.0	12.9	12.8
A1a - ES Homes	Clothes Dryer	EA1a027	12	12	24	1.8	1.9	3.9	22.2	22.5	46.5	0.3	0.3	0.7	0.2	0.2	0.5	-	-	-	-	-	-
		ES Homes Subtotal				**662.2**	**711.5**	**735.4**	**15,898.2**	**17,084.1**	**17,648.7**	**185.3**	**199.2**	**205.7**	**12.4**	**13.4**	**13.8**	**2,464.4**	**2,648.4**	**2,729.2**	**57,582.8**	**61,882.8**	**63,826.3**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (	Air Sealing, Cord Wood	EA2a001	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	166.2	181.6	189.0	2,492.9	2,723.7	2,834.8
A2a - Home Performance (	Air Sealing, Electric	EA2a002	71	78	81	6.2	6.7	7.0	92.6	101.2	105.4	1.0	1.1	1.1	1.6	1.8	1.8	-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Kerosene	EA2a004	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	34.5	37.7	39.3	517.8	565.8	588.9
A2a - Home Performance (	Air Sealing, Oil	EA2a005	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	671.2	733.3	763.2	10,067.9	10,999.9	11,448.7
A2a - Home Performance (	Air Sealing, Propane	EA2a006	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	256.9	280.7	292.2	3,853.7	4,210.5	4,382.3
A2a - Home Performance (	Air Sealing, Wood Pellets	EA2a007	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A2a - Home Performance (	Insulation, Cord Wood	EA2a022	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	203.1	221.9	231.0	5,078.1	5,548.2	5,774.5
A2a - Home Performance (	Insulation, Electric	EA2a023	71	78	81	8.5	9.3	9.7	213.3	233.1	242.6	1.3	1.5	1.5	2.2	2.5	2.6	-	-	-	-	-	-
A2a - Home Performance (	Insulation, Kerosene	EA2a025	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	12.8	14.0	14.6	321.1	350.9	365.2
A2a - Home Performance (	Insulation, Oil	EA2a026	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	811.7	886.8	923.0	20,292.3	22,170.9	23,075.3
A2a - Home Performance (	Insulation, Propane	EA2a027	71	78	81	-	-	-	-	-	-	-	-	-	-	-	-	210.3	229.8	239.2	5,258.7	5,745.6	5,980.0
A2a - Home Performance (	LED Bulb, General Service Lamps	EA2a044	32	35	36	3.9	4.3	4.5	3.9	4.3	4.5	0.8	0.9	1.0	0.5	0.6	0.6	(9.3)	(10.2)	(10.6)	(9.3)	(10.2)	(10.6)
A2a - Home Performance (	Visual Audit Oil Savings	EA2a050	74	74	74	-	-	-	-	-	-	-	-	-	-	-	-	386.8	386.8	386.8	5,801.5	5,801.5	5,801.5
A2a - Home Performance (	Visual Audit Propane Savings	EA2a051	74	74	74	-	-	-	-	-	-	-	-	-	-	-	-	120.1	120.1	120.1	1,801.0	1,801.0	1,801.0
A2a - Home Performance (	Visual Audit Electric Savings	EA2a052	74	74	74	32.7	32.7	32.7	41.6	41.6	41.6	5.2	5.2	5.2	8.6	8.6	8.6	-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Electric	EA2b015	7	7	7	2.5	2.7	2.8	36.8	40.2	41.9	-	-	-	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Boiler Circulator Pump	EA2b022	58	63	66	0.5	0.5	0.6	9.4	10.3	10.7	0.1	0.2	0.2	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Furnace	EA2b023	26	29	30	2.1	2.3	2.4	38.6	42.1	43.8	0.6	0.7	0.7	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Room AC	EA2b025	25	28	29	1.1	1.2	1.3	20.0	21.8	22.7	-	-	-	0.6	0.6	0.7	-	-	-	-	-	-
	Home Performance with Energy Star Subtotal					**57.6**	**59.9**	**61.0**	**456.3**	**494.7**	**513.1**	**9.1**	**9.5**	**9.6**	**13.6**	**14.1**	**14.3**	**2,864.4**	**3,082.6**	**3,187.7**	**55,475.8**	**59,907.8**	**62,041.5**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A3b - ES Appliances and P	Advanced Power Strip, Tier I	EA3b001	109	109	109	9.7	9.7	9.7	48.5	48.5	48.5	0.7	0.7	0.7	0.5	0.5	0.5	-	-	-	-	-	-
A3b - ES Appliances and P	Advanced Power Strip, Tier II	EA3b002	80	80	80	10.6	10.6	10.6	53.1	53.1	53.1	1.3	1.3	1.3	0.9	0.9	0.9	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (cooling)	EA3b005	2,000	2,050	2,100	112.8	189.8	194.4	2,030.6	3,416.4	3,499.7	-	-	-	52.1	87.7	89.9	-	-	-	-	-	-
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (heating)	EA3b006	2,000	2,050	2,100	401.9	582.7	596.9	7,235.0	10,488.6	10,744.5	182.7	264.9	271.3	-	-	-	-	-	-	-	-	-
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Downstream	EA3b007	200	250	280	192.2	240.3	269.1	2,883.0	3,603.8	4,036.2	31.5	39.4	44.2	17.4	21.8	24.4	429.8	537.3	601.7	6,447.0	8,058.8	9,025.8
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Downstream	EA3b008	30	30	30	17.0	17.0	17.0	254.3	254.3	254.3	2.8	2.8	2.8	1.5	1.5	1.5	64.5	64.5	64.5	967.1	967.1	967.1
A3b - ES Appliances and P	ES Clothes Dryers	EA3b010	213	213	213	34.2	34.2	34.2	410.6	410.6	410.6	5.8	5.8	5.8	4.5	4.5	4.5	-	-	-	-	-	-
A3b - ES Appliances and P	Dryer Heat Pump	EA3b011	53	53	53	22.5	22.5	22.5	269.5	269.5	269.5	3.8	3.8	3.8	2.9	2.9	2.9	-	-	-	-	-	-
A3b - ES Appliances and P	Dryer Hybrid	EA3b012	27	27	27	5.7	5.7	5.7	68.2	68.2	68.2	1.0	1.0	1.0	0.7	0.7	0.7	-	-	-	-	-	-
A3b - ES Appliances and P	ECM Motor for FWH Circulating Pump	EA3b013	27	27	27	1.3	1.3	1.3	18.8	18.8	18.8	0.4	0.4	0.4	-	-	-	-	-	-	-	-	-
A3b - ES Appliances and P	Room Air Conditioner	EA3b016	160	160	160	5.3	5.3	5.3	47.5	47.5	47.5	-	-	-	2.7	2.7	2.7	-	-	-	-	-	-
A3b - ES Appliances and P	ES Clothes Washers	EA3b017	213	213	213	19.2	19.2	19.2	210.9	210.9	210.9	2.7	2.7	2.7	2.5	2.5	2.5	14.9	14.9	14.9	164.2	164.2	164.2
A3b - ES Appliances and P	Washer Tier CEE Tier 2+	EA3b018	152	152	152	21.1	21.1	21.1	232.6	232.6	232.6	3.0	3.0	3.0	2.8	2.8	2.8	73.1	73.1	73.1	803.8	803.8	803.8
A3b - ES Appliances and P	ES Dehumidifier	EA3b019	320	320	320	26.3	26.3	26.3	316.0	316.0	316.0	1.1	1.1	1.1	5.0	5.0	5.0	-	-	-	-	-	-
A3b - ES Appliances and P	Refrigerator	EA3b022	267	267	267	11.8	11.8	11.8	141.4	141.4	141.4	1.3	1.3	1.3	1.7	1.7	1.7	-	-	-	-	-	-
A3b - ES Appliances and P	Refrigerator CEE Tier 2+	EA3b023	92	92	92	8.9	8.9	8.9	106.4	106.4	106.4	1.0	1.0	1.0	1.2	1.2	1.2	-	-	-	-	-	-
A3b - ES Appliances and P	ES Pool Pumps (Variable Speed)	EA3b024	35	35	35	5.5	5.5	5.5	32.8	32.8	32.8	-	-	-	3.2	3.2	3.2	-	-	-	-	-	-
A3b - ES Appliances and P	Room Air Purifier	EA3b025	267	267	267	101.0	101.0	101.0	909.0	909.0	909.0	11.5	11.5	11.5	11.5	11.5	11.5	-	-	-	-	-	-
A3c - ES HVAC Systems	Wifi Thermostat (Heating & Cooling)	EA3b026	840	840	840	38.6	38.6	38.6	579.6	579.6	579.6	-	-	-	-	-	-	4,132.8	4,132.8	4,132.8	61,992.0	61,992.0	61,992.0
A3b - ES Appliances and P	Primary Refrigerator Recycling	EA3b027	187	187	187	191.7	191.7	191.7	958.4	958.4	958.4	21.9	21.9	21.9	26.9	26.9	26.9	-	-	-	-	-	-
A3b - ES Appliances and P	Secondary Refrigerator Recycling	EA3b028	133	133	133	136.9	136.9	136.9	684.6	684.6	684.6	12.8	12.8	12.8	21.4	21.4	21.4	-	-	-	-	-	-
A3b - ES Appliances and P	Secondary Freezer Recycling	EA3b029	90	90	90	69.5	69.5	69.5	278.2	278.2	278.2	8.6	8.6	8.6	11.5	11.5	11.5	-	-	-	-	-	-
A3b - ES Appliances and P	Room Air Conditioner Recycling	EA3b030	240	240	240	27.1	27.1	27.1	81.4	81.4	81.4	-	-	-	19.7	19.7	19.7	-	-	-	-	-	-
	ES Products Subtotal					**1,470.8**	**1,776.6**	**1,824.2**	**17,850.2**	**23,210.4**	**23,982.0**	**294.0**	**384.0**	**395.2**	**190.8**	**230.8**	**235.5**	**4,715.1**	**4,822.5**	**4,887.0**	**70,374.1**	**71,985.8**	**72,952.9**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Compressed Air Retro	EC1a001	1	1	1	37.0	39.3	35.9	481.5	511.2	467.3	-	4.4	4.0	-	4.4	4.0	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Other Retro	EC1a008	9	9	8	1,959.1	2,079.8	1,901.4	16,968.5	18,013.7	16,468.3	208.1	220.9	202.0	196.7	208.8	190.9	-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC1a011	3	3	3	711.9	755.8	690.9	3,559.7	3,778.9	3,454.7	162.7	172.7	157.9	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/ Controls	EC1a012	1	1	1	39.7	42.1	38.5	356.9	378.8	346.3	6.3	6.7	6.1	8.2	8.7	8.0	(27.4)	(29.1)	(26.6)	(246.8)	(262.0)	(239.6)
C1a - LCI Retrofit	Lighting Fixture - Interior w/o Controls	EC1a013	3	3	3	113.4	120.4	110.1	1,133.9	1,203.8	1,100.5	10.0	10.6	9.7	12.9	13.7	12.5	(78.4)	(83.3)	(76.1)	(784.3)	(832.7)	(761.2)
C1a - LCI Retrofit	Demand Control Ventilation	EC1a018	0	0	0	0.7	0.7	0.7	6.8	7.2	6.6	-	-	-	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large HVAC New	EC1b003	1	1	1	27.5	29.2	26.7	412.6	438.0	400.4	1.8	1.9	1.8	4.7	5.0	4.6	-	-	-	-	-	-
C1b - LCI New Equipment	Combination Oven, Electric	EC1b019	0	0	0	0.7	0.7	0.7	8.1	8.6	7.9	-	-	-	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Ice Making Head	EC1b039	0	0	0	0.2	0.2	0.2	1.6	1.7	1.5	0.0	0.1	0.0	0.0	0.1	0.0	-	-	-	-	-	-
C1c - LCI Midstream	Midstream VRF	EC1c008	0	0	0	1.0	1.0	0.9	11.6	12.3	11.2	-	-	-	0.1	0.1	0.1	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Solid Door	EC1c029	0	0	0	0.1	0.1	0.1	0.6	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Glass Door	EC1c041	0	0	0	0.0	0.0	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Solid Door	EC1c042	0	0	0	0.1	0.1	0.1	1.2	1.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
	Large Business Energy Solutions Subtotal		**0**			**2,891.3**	**3,069.4**	**2,806.1**	**22,943.3**	**24,356.4**	**22,266.9**	**389.0**	**417.3**	**381.5**	**222.7**	**240.8**	**220.1**	**(105.9)**	**(112.4)**	**(102.7)**	**(1,031.2)**	**(1,094.7)**	**(1,000.8)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC2a010	8	8	8	68.2	69.7	70.6	614.2	627.3	635.7	15.3	15.7	15.9	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC2a011	16	16	16	129.8	132.5	134.3	648.9	662.7	671.6	34.4	35.2	35.6	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/ Controls	EC2a012	24	24	24	826.6	844.2	855.5	7,439.6	7,598.0	7,699.9	64.5	65.8	66.7	94.8	96.8	98.1	(535.8)	(547.2)	(554.6)	(4,822.5)	(4,925.1)	(4,991.2)
C2a - SCI Retrofit	Lighting Fixture - Interior w/o Controls	EC2a013	60	61	62	490.5	500.9	507.6	2,452.3	2,504.5	2,538.1	54.1	55.2	55.9	79.5	81.2	82.3	(317.9)	(324.7)	(329.0)	(1,589.6)	(1,623.5)	(1,645.2)
C2a - SCI Retrofit	Door Heater Controls	EC2a019	13	13	13	77.9	79.6	80.6	779.0	795.6	806.3	3.1	3.2	3.2	3.1	3.2	3.2	-	-	-	-	-	-
C2a - SCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC2a023	9	10	10	31.7	32.4	32.8	475.3	485.5	492.0	6.7	6.8	6.9	6.7	6.8	6.9	-	-	-	-	-	-
C2a - SCI Retrofit	Electronic Defrost Control	EC2a024	2	2	2	2.1	2.1	2.2	21.0	21.4	21.7	1.9	2.0	2.0	1.9	2.0	2.0	-	-	-	-	-	-
C2a - SCI Retrofit	Evaporator Fan Control	EC2a027	19	19	20	127.6	130.3	132.1	1,276.0	1,303.1	1,320.6	14.6	14.9	15.1	14.6	14.9	15.1	-	-	-	-	-	-
C2a - SCI Retrofit	Novelty Cooler Shutoff	EC2a037	8	8	8	45.9	46.9	47.5	459.3	469.1	475.4	-	-	-	-	-	-	-	-	-	-	-	-
	Small Business Energy Solutions Subtotal					**1,800.3**	**1,838.6**	**1,863.3**	**14,165.6**	**14,467.1**	**14,661.3**	**194.6**	**198.7**	**201.4**	**200.6**	**204.9**	**207.6**	**(853.8)**	**(871.9)**	**(883.6)**	**(6,412.1)**	**(6,548.6)**	**(6,636.5)**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Lighting Fixture - Exterior w/ Controls	EC3a010	2	2	2	7.7	5.3	5.3	69.5	47.4	47.7	1.5	1.0	1.0	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Exterior w/o Controls	EC3a011	2	2	2	4.5	3.1	3.1	22.7	15.5	15.6	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-
C3a - Muni Retrofit	Lighting Fixture - Interior w/ Controls	EC3a012	8	5	5	192.3	131.3	132.0	1,730.9	1,182.0	1,188.4	14.0	9.6	9.6	20.6	14.1	14.2	(124.7)	(85.1)	(85.6)	(1,122.0)	(766.2)	(770.3)
C3a - Muni Retrofit	Lighting Fixture - Interior w/o Controls	EC3a013	3	2	2	8.2	5.6	5.6	41.0	28.0	28.2	0.6	0.4	0.4	0.9	0.6	0.6	(5.3)	(3.6)	(3.7)	(26.6)	(18.2)	(18.3)

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
	Municipal Energy Solutions Subtotal					**212.8**	**145.3**	**146.1**	**1,864.1**	**1,272.9**	**1,279.8**	**16.1**	**11.0**	**11.1**	**21.5**	**14.7**	**14.8**	**(130.0)**	**(88.8)**	**(89.2)**	**(1,148.6)**	**(784.3)**	**(788.6)**

New Hampshire Electric Cooperative, Inc.
2424-2426 System Benefits Charge ("SBC") Calculation
($ in 000's)

Year	EE Total Budget	RGGI Revenues	FCM Revenues	Other Revenues	SBC Revenues	Year End Carryover (under) w/ Interest	Distribution (MWH)	SBC Rate EE Portion (cents/kWh)	SBC Rate EAP Portion (cents/kWh)	Total SBC Rate (cents/kWh)
Col. A	Col. B*	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K
2024	$ 5,696	$ 213	$ 100	$ -	$ 4,574	$ 809	792,729	0.577	0.150	0.727
2025	$ 5,921	$ 211	$ 100	$ -	$ 4,801	$ 809	796,118	0.603	0.150	0.753
2026	$ 6,075	$ 218	$ 100	$ -	$ 4,948	$ 809	799,363	0.619	0.150	0.769

Col. A: Calendar year (January 1 - December 31)
Col. B: Company Forecast *Excludes Current Year Interest
Col. C: Company Forecast
Col. D: Company Forecast
Col. E: Company Forecast
Col. F: Pages 4, 5 & 6, Line 1 Col. O
Col. G: Pages 2, 3 & 4, (Line 10, Col. N + Line 12, Col. O) x -1
Col. H: Company Forecast
Col. I: Company Forecast of annual December 1 calculation, per RSA 374-F:3 VI-a.
Col. J: EAP Portion of SBC Rate
Col. K: Page 1, Col. I + Col. J

New Hampshire Electric Cooperative, Inc.
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2024 to December 31, 2025
($ in 000's)

Line	Description	Carryover 12/31/22	Forecast Jan 2023	Forecast Feb 2023	Forecast Mar 2023	Forecast Apr 2023	Forecast May 2023	Forecast June 2023	Forecast Jul 2023	Forecast Aug 2023	Forecast Sep 2023	Forecast Oct 2023	Forecast Nov 2023	Forecast Dec 2023	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues	-	505	472	420	352	296	338	366	400	386	315	334	389	4,574
2	RGGI Revenues		18	18	18	18	18	18	18	18	18	18	18	18	213
3	FCM Revenues		8	8	8	8	8	8	8	8	8	8	8	8	100
4	**Total Revenues**		**532**	**498**	**446**	**378**	**322**	**365**	**392**	**426**	**412**	**341**	**361**	**415**	**4,887**
5	Program Expenses		475	475	475	475	475	475	475	475	475	475	475	475	5,696
6	**Total Program Expenses**		**475**	**475**	**475**	**475**	**475**	**475**	**475**	**475**	**475**	**475**	**475**	**475**	**5,696**
7	HB 549 EE Education Allocation		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**30**
8	Current Month Over/(Under) Recovery		54	21	(31)	(99)	(155)	(113)	(85)	(51)	(65)	(137)	(117)	(62)	
9	Cummulative Over/(Under) Recovery	809	863	884	853	754	599	486	402	350	285	149	32	(30)	
12	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
13	**Interest**		**6**	**6**	**6**	**6**	**5**	**4**	**3**	**3**	**2**	**1**	**1**	**0**	**42**
14	**Monthly Sales (MWh)**		87,607	81,786	72,841	60,989	51,282	58,660	63,466	69,301	66,880	54,516	57,965	67,436	792,729
15	**EE SBC Rate**		0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	0.577	

Line 1: (Line 14 x Line 15) / 100
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Line 14: Company Forecast
Line 15: Page 1, Col. J/K

New Hampshire Electric Cooperative, Inc.
NHSaves Energy Efficiency Programs

New Hampshire Electric Cooperative, Inc.
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2025 to December 31, 2026
($ in 000's)

Line	Description	Carryover 12/31/22	Forecast Jan 2023	Forecast Feb 2023	Forecast Mar 2023	Forecast Apr 2023	Forecast May 2023	Forecast June 2023	Forecast Jul 2023	Forecast Aug 2023	Forecast Sep 2023	Forecast Oct 2023	Forecast Nov 2023	Forecast Dec 2023	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues	-	532	496	441	369	310	355	384	419	405	330	351	409	4,801
2	RGGI Revenues		17	17	17	17	17	17	17	17	17	17	17	17	207
3	FCM Revenues		8	8	8	8	8	8	8	8	8	8	8	8	100
4	**Total Revenues**		**557**	**522**	**467**	**395**	**336**	**380**	**410**	**445**	**430**	**356**	**377**	**434**	**5,108**
5	Program Expenses		493	493	493	493	493	493	493	493	493	493	493	493	5,921
6	**Total Program Expenses**		**493**	**493**	**493**	**493**	**493**	**493**	**493**	**493**	**493**	**493**	**493**	**493**	**5,921**
7	HB 549 EE Education Allocation		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**30**
8	Current Month Over/(Under) Recovery		61	26	(29)	(101)	(160)	(116)	(86)	(51)	(66)	(140)	(119)	(62)	
9	Cummulative Over/(Under) Recovery	809	870	896	867	766	606	490	404	353	287	147	28	(34)	
12	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
13	**Interest**		**6**	**6**	**6**	**6**	**5**	**4**	**3**	**3**	**2**	**1**	**1**	**(0)**	**42**
14	**Monthly Sales (MWh)**		88,162	82,269	73,134	61,260	51,439	58,819	63,675	69,544	67,112	54,711	58,222	67,770	796,118
15	**EE SBC Rate**		0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	0.603	

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Line 15: Page 1, Col. J/K

New Hampshire Electric Cooperative, Inc.
Energy Efficiency Expense & SBC Revenue Reconcilliation
January 1, 2026 to December 31, 2027
($ in 000's)

Line	Description	Carryover 12/31/22	Forecast Jan 2023	Forecast Feb 2023	Forecast Mar 2023	Forecast Apr 2023	Forecast May 2023	Forecast June 2023	Forecast Jul 2023	Forecast Aug 2023	Forecast Sep 2023	Forecast Oct 2023	Forecast Nov 2023	Forecast Dec 2023	2023 Total
	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G	Col. H	Col. I	Col. J	Col. K	Col. L	Col. M	Col. N	Col. O
1	SBC Revenues	-	549	512	455	381	319	365	395	432	417	340	362	422	4,948
2	RGGI Revenues		17	17	17	17	17	17	17	17	17	17	17	17	207
3	FCM Revenues		8	8	8	8	8	8	8	8	8	8	8	8	100
4	**Total Revenues**		**574**	**537**	**480**	**406**	**345**	**391**	**421**	**458**	**442**	**365**	**388**	**447**	**5,256**
5	Program Expenses		506	506	506	506	506	506	506	506	506	506	506	506	6,075
6	**Total Program Expenses**		**506**	**506**	**506**	**506**	**506**	**506**	**506**	**506**	**506**	**506**	**506**	**506**	**6,075**
7	HB 549 EE Education Allocation		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**30**
8	Current Month Over/(Under) Recovery		65	29	(28)	(102)	(164)	(118)	(88)	(51)	(66)	(143)	(121)	(62)	
9	Cummulative Over/(Under) Recovery	809	874	903	875	772	609	491	403	352	286	142	21	(40)	
12	Interest @ Prime Rate		0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	0.6875%	
13	**Interest**		**6**	**6**	**6**	**6**	**5**	**4**	**3**	**3**	**2**	**1**	**1**	**(0)**	**42**
14	**Monthly Sales (MWh)**		88,612	82,679	73,480	61,498	51,613	58,979	63,884	69,786	67,343	54,905	58,478	68,106	799,363
15	**EE SBC Rate**		0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619	

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Bill Impacts of Changes in System Benefits Charge - New Hampshire Electric Cooperative, Inc.

	2023	2024	2025	2026
System Benefits Charge ($/kWh)	$ 0.00550	$ 0.00577	0.00603	0.00619
<u>Bill per month, including NHEC default energy service</u>				
Residential Rate B (625 kWh/month)	$ 132.96	$ 133.13	$ 133.29	$ 133.39
Commercial B3, three-phase service (<50 kW, 10,000 kWh/month)	$ 2,314.90	$ 2,317.60	$ 2,320.20	$ 2,321.80
<u>Change from previous rate level - $ per month</u>				
Residential Rate B (625 kWh/month)		$ 0.17	$ 0.16	$ 0.10
General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		$ 2.70	$ 2.60	$ 1.60
<u>Change from previous rate level - %</u>				
Residential Rate B (625 kWh/month)		0.1%	0.1%	0.1%
General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		0.1%	0.1%	0.1%

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios				Benefits ($000)												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs																	
B1 - Home Energy Assistance	1.28	*1.28*	*0.12*	*1.32*	1,644.2	*1,644.2*	*157.1*	*1,702.5*	1,285.1	-	122.2	1,537.4	20.5	20.3	65	1,386.3	30,114.0
B2a - IE Education	-	-	-	-	-	-	-	-	23.7	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	59.9	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.20**	***1.20***	***0.11***	***1.24***	**1,644.2**	***1,644.2***	***157.1***	***1,702.5***	**1,368.7**	**-**	**122.2**	**1,537.4**	**20.5**	**20.3**	**65**	**1,386.3**	**30,114.0**
Residential Programs																	
A1 - Energy Star Homes	1.47	*1.28*	*0.22*	*1.31*	792.3	*986.0*	*120.1*	*1,013.1*	537.4	233.8	45.5	889.0	10.8	18.2	80	1,046.3	23,755.0
A2 - Home Performance	1.53	*1.61*	*0.15*	*1.64*	1,114.5	*1,387.4*	*111.7*	*1,419.0*	729.2	133.5	57.3	1,053.7	10.2	13.0	65	1,493.1	33,946.1
A3 - Energy Star Products	1.38	*1.21*	*1.14*	*1.55*	899.2	*1,115.2*	*743.2*	*1,430.8*	653.4	268.4	875.0	7,579.3	155.7	146.6	6,200	54.6	5,740.4
A4 - Residential Behavior	1.50	*1.88*	*1.50*	*2.74*	321.7	*402.1*	*321.7*	*586.2*	213.8	-	2,904.5	2,904.5	627.0	404.5	26,800	-	-
A5 - Residential Active Demand Response	2.00	*2.00*	*2.00*	*2.00*	140.1	*140.1*	*140.1*	*140.1*	70.0	-	-	-	-	637.5	750	-	-
A6a - Res Education	-	-	-	-	-	-	-	-	40.8	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	112.3	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.39**	***1.35***	***0.61***	***1.53***	**3,267.8**	***4,030.8***	***1,436.7***	***4,589.1***	**2,356.9**	**635.7**	**3,882.4**	**12,426.6**	**803.7**	**1,219.7**	**33,895**	**2,594.0**	**63,441.4**
Commercial, Industrial & Municipal																	
C1 - Large Business Energy Solutions	1.77	*1.15*	*1.81*	*1.79*	2,237.5	*2,455.6*	*2,295.3*	*3,821.5*	1,264.7	872.2	3,570.8	29,353.3	415.9	240.9	49	(1,169.3)	(6,085.2)
C2 - Small Business Energy Solutions	1.63	*1.09*	*1.71*	*1.63*	2,054.0	*2,256.3*	*2,152.1*	*3,384.0*	1,257.2	818.3	3,587.0	22,001.2	410.5	451.4	130	(1,284.8)	(6,938.5)
C3 - Municipal Energy Solutions	1.07	*0.71*	*1.12*	*1.02*	230.1	*253.1*	*240.3*	*366.7*	214.3	144.4	272.1	2,715.3	23.3	23.6	6	(84.7)	(538.3)
C5 - C&I Active Demand Response	3.32	*3.32*	*3.32*	*3.32*	700.8	*700.8*	*700.8*	*700.8*	211.3	-	-	-	-	3,190.0	20	-	-
C6a - C&I Education	-	-	-	-	-	-	-	-	38.1	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	154.4	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.66**	***1.14***	***1.72***	***1.66***	**5,222.4**	***5,665.9***	***5,388.6***	***8,273.0***	**3,140.0**	**1,835.0**	**7,429.9**	**54,069.8**	**849.7**	**3,905.9**	**205**	**(2,538.8)**	**(13,562.0)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Total	**1.48**	***1.21***	***1.02***	***1.56***	**10,134.4**	***11,341.0***	***6,982.4***	***14,564.5***	**6,865.6**	**2,470.6**	**11,434.5**	**68,033.8**	**1,673.9**	**5,145.9**	**34,165**	**1,441.5**	**79,993.4**

Notes:
(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.
(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.
(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.
(4) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not in fact cumulative.

Annual kWh Savings	11,434,467	96.4%	**kWh > 65%**
Annual MMBTU Savings (in kWh)	422,460	3.6%	
	11,856,927	100.0%	

Lifetime kWh Savings	68,033,820	74.4%
Lifetime MMBTU Savings (in kWh)	23,443,742	25.6%
	91,477,562	100.0%

Annual Net Savings as a % of 2022 Sales	0.98%

Spending per Customer	Low-Income	$ 254.79
	Residential	$ 34.91
	C&I	$ 282.22

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]: Granite State Test	Total Benefits ($000)[1]: *Total Resource Cost Test*	Total Benefits ($000)[1]: *Utility Cost Test*	Total Benefits ($000)[1]: *Secondary Granite State Test*	Resource Benefits ($000) – Electric – CAPACITY: Summer Generation	CAPACITY: Winter Generation	CAPACITY: Transmission	CAPACITY: Distribution	CAPACITY: Reliability	ENERGY: Winter Peak	ENERGY: Winter Off Peak	ENERGY: Summer Peak	ENERGY: Summer Off Peak	Electric DRIPE	Total Electric Benefit	Non-Electric: Other Fuels	Non-Electric: Water Benefit	Total Resource Benefits	Non-Resource Benefits ($000): Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	Environmental Benefits ($000)[3]
Income Eligible Programs																						
B1 - Home Energy Assistance	**$ 1,644**	*$ 1,644*	*$ 157*	*$ 1,702*	$ 12	$ -	$ 23	$ 27	$ -	$ 30	$ 29	$ 16	$ 14	$ 7	**$ 157**	$ 861	$ 1	**$ 1,019**	$ 20	$ 606	**$ 626**	**$ 58**
B2a - IE Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 1,644**	*$ 1,644*	*$ 157*	*$ 1,702*	**$ 12**	**$ -**	**$ 23**	**$ 27**	**$ -**	**$ 30**	**$ 29**	**$ 16**	**$ 14**	**$ 7**	**$ 157**	**$ 861**	**$ 1**	**$ 1,019**	**$ 20**	**$ 606**	**$ 626**	**$ 58**
Residential Programs																						
A1 - Energy Star Homes	**$ 792**	*$ 986*	*$ 120*	*$ 1,013*	$ 14	$ -	$ 26	$ 31	$ -	$ 12	$ 12	$ 13	$ 11	$ 3	**$ 120**	$ 655	$ 4	**$ 779**	$ 14	$ 194	**$ 207**	**$ 27**
A2 - Home Performance	**$ 1,115**	*$ 1,387*	*$ 112*	*$ 1,419*	$ 10	$ -	$ 19	$ 23	$ -	$ 15	$ 17	$ 13	$ 11	$ 3	**$ 112**	$ 980	$ 1	**$ 1,092**	$ 22	$ 273	**$ 295**	**$ 32**
A3 - Energy Star Products	**$ 899**	*$ 1,115*	*$ 743*	*$ 1,431*	$ 43	$ -	$ 91	$ 107	$ -	$ 165	$ 183	$ 60	$ 56	$ 38	**$ 743**	$ 121	$ 31	**$ 895**	$ 4	$ 216	**$ 220**	**$ 316**
A4 - Residential Behavior	**$ 322**	*$ 402*	*$ 322*	*$ 586*	$ 13	$ -	$ 39	$ 46	$ -	$ 81	$ 70	$ 31	$ 24	$ 18	**$ 322**	$ -	$ -	**$ 322**	$ -	$ 80	**$ 80**	**$ 184**
A5 - Residential Active Demand Response	**$ 140**	*$ 140*	*$ 140*	*$ 140*	$ 4	$ -	$ 62	$ 72	$ -	$ -	$ -	$ -	$ -	$ 2	**$ 140**	$ -	$ -	**$ 140**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,268**	*$ 4,031*	*$ 1,437*	*$ 4,589*	**$ 83**	**$ -**	**$ 238**	**$ 279**	**$ -**	**$ 274**	**$ 281**	**$ 117**	**$ 101**	**$ 64**	**$ 1,437**	**$ 1,756**	**$ 36**	**$ 3,228**	**$ 40**	**$ 763**	**$ 803**	**$ 558**
Commercial/Industrial Programs																						
C1 - Large Business Energy Solutions	**$ 2,237**	*$ 2,456*	*$ 2,295*	*$ 3,821*	$ 69	$ -	$ 151	$ 176	$ -	$ 517	$ 505	$ 382	$ 337	$ 158	**$ 2,295**	$ (114)	$ 60	**$ 2,241**	$ (4)	$ 218	**$ 214**	**$ 1,366**
C2 - Small Business Energy Solutions	**$ 2,054**	*$ 2,256*	*$ 2,152*	*$ 3,384*	$ 120	$ -	$ 257	$ 302	$ -	$ 459	$ 302	$ 363	$ 210	$ 139	**$ 2,152**	$ (129)	$ 35	**$ 2,058**	$ (4)	$ 202	**$ 198**	**$ 1,128**
C3 - Municipal Energy Solutions	**$ 230**	*$ 253*	*$ 240*	*$ 367*	$ 10	$ -	$ 21	$ 24	$ -	$ 99	$ 35	$ 24	$ 12	$ 15	**$ 240**	$ (10)	$ -	**$ 230**	$ (0)	$ 23	**$ 23**	**$ 114**
C5 - C&I Active Demand Response	**$ 701**	*$ 701*	*$ 701*	*$ 701*	$ 21	$ -	$ 309	$ 362	$ -	$ -	$ -	$ -	$ -	$ 9	**$ 701**	$ -	$ -	**$ 701**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 5,222**	*$ 5,666*	*$ 5,389*	*$ 8,273*	**$ 220**	**$ -**	**$ 737**	**$ 864**	**$ -**	**$ 1,075**	**$ 841**	**$ 770**	**$ 559**	**$ 322**	**$ 5,389**	**$ (252)**	**$ 95**	**$ 5,231**	**$ (8)**	**$ 444**	**$ 435**	**$ 2,607**
C6d - Smart Start	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 10,134**	*$ 11,341*	*$ 6,982*	*$ 14,565*	**$ 315**	**$ -**	**$ 998**	**$ 1,169**	**$ -**	**$ 1,379**	**$ 1,152**	**$ 903**	**$ 674**	**$ 392**	**$ 6,982**	**$ 2,364**	**$ 131**	**$ 9,477**	**$ 51**	**$ 1,812**	**$ 1,864**	**$ 3,224**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime kWh Savings	68,033,820	*51,025,365*		-	1.925%	-	$ 132,163	*$ 165,204*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	11,434,467	*8,575,850*		-	0.550%	-	$ 37,761	*$ 47,201*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	1,318	*857*		-	0.660%	-	$ 45,313	*$ 56,641*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,674	*1,088*		-	0.440%	-	$ 30,209	*$ 37,761*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 9,477,343			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,3]	$ 6,865,616			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 2,611,727	*$ 1,958,796*		-	1.925%	-	$ 132,163	*$ 165,204*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 377,609	*$ 472,011*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
9	Total Benefits	$ 10,134,394		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 377,609	$ -	from row 8 above
11	Total Utility Costs	$ 6,865,616	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.40**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Footnote 2 is omitted as it applies to Eversource and the Coop only

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2025 Plan

	Benefit/Cost Ratios				Benefits ($000)												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Granite State Test**	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs																	
B1 - Home Energy Assistance	1.38	*1.38*	*0.13*	*1.43*	1,694.8	*1,694.8*	*161.9*	*1,751.0*	1,225.3	-	122.2	1,537.4	20.5	20.3	65	1,386.3	30,114.0
B2a - IE Education	-	-	-	-	-	-	-	-	22.4	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	51.1	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.30**	***1.30***	***0.12***	***1.35***	**1,694.8**	***1,694.8***	***161.9***	***1,751.0***	**1,298.8**	**-**	**122.2**	**1,537.4**	**20.5**	**20.3**	**65**	**1,386.3**	**30,114.0**
Residential Programs																	
A1 - Energy Star Homes	1.48	*1.33*	*0.22*	*1.36*	817.7	*1,017.6*	*123.8*	*1,043.7*	551.7	215.9	45.5	889.0	10.8	18.2	80	1,046.3	23,755.0
A2 - Home Performance	1.80	*1.88*	*0.18*	*1.92*	1,152.2	*1,434.3*	*115.1*	*1,464.6*	640.0	123.3	57.3	1,053.7	10.2	13.0	65	1,493.1	33,946.1
A3 - Energy Star Products	1.43	*1.29*	*1.18*	*1.63*	945.3	*1,172.5*	*784.0*	*1,483.8*	661.8	246.8	883.6	7,751.3	160.3	147.8	6,200	54.6	5,740.4
A4 - Residential Behavior	1.65	*2.06*	*1.65*	*3.03*	323.5	*404.3*	*323.5*	*596.4*	196.5	-	2,904.5	2,904.5	627.0	404.5	26,800	-	-
A5 - Residential Active Demand Response	2.11	*2.11*	*2.11*	*2.11*	151.0	*151.0*	*151.0*	*151.0*	71.5	-	-	-	-	669.8	788	-	-
A6a - Res Education	-	-	-	-	-	-	-	-	38.9	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	96.9	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.50**	***1.47***	***0.66***	***1.67***	**3,389.6**	***4,179.7***	***1,497.4***	***4,739.5***	**2,257.4**	**586.1**	**3,890.9**	**12,598.5**	**808.3**	**1,253.3**	**33,933**	**2,594.0**	**63,441.4**
Commercial, Industrial & Municipal																	
C1 - Large Business Energy Solutions	1.95	*1.27*	*2.00*	*1.94*	2,289.6	*2,512.9*	*2,350.3*	*3,834.2*	1,172.7	805.8	3,570.8	29,165.5	415.9	240.9	49	(1,169.3)	(6,085.2)
C2 - Small Business Energy Solutions	1.80	*1.20*	*1.89*	*1.78*	2,118.7	*2,327.4*	*2,220.7*	*3,431.4*	1,176.7	755.9	3,587.0	22,001.2	410.5	451.4	130	(1,284.8)	(6,938.5)
C3 - Municipal Energy Solutions	1.08	*0.74*	*1.13*	*1.05*	236.5	*260.2*	*247.1*	*370.3*	218.3	133.4	272.1	2,715.3	23.3	23.6	6	(84.7)	(538.3)
C5 - C&I Active Demand Response	3.62	*3.62*	*3.62*	*3.62*	754.9	*754.9*	*754.9*	*754.9*	208.6	-	-	-	-	3,349.5	21	-	-
C6a - C&I Education	-	-	-	-	-	-	-	-	59.2	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	132.2	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.82**	***1.26***	***1.88***	***1.80***	**5,399.8**	***5,855.5***	***5,573.0***	***8,390.8***	**2,967.7**	**1,695.1**	**7,429.9**	**53,882.0**	**849.7**	**4,065.4**	**206**	**(2,538.8)**	**(13,562.0)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Total	**1.61**	***1.33***	***1.11***	***1.69***	**10,484.2**	***11,730.0***	***7,232.3***	***14,881.2***	**6,523.9**	**2,281.2**	**11,443.0**	**68,017.9**	**1,678.4**	**5,338.9**	**34,204**	**1,441.5**	**79,993.4**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

(4) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not in fact cumulative.

Annual kWh Savings	11,442,968	96.4%	**kWh > 65%**
Annual MMBTU Savings (in kWh)	422,460	3.6%	
	11,865,429	100.0%	

Lifetime kWh Savings	68,017,936	74.4%
Lifetime MMBTU Savings (in kWh)	23,443,742	25.6%
	91,461,678	100.0%

Annual Net Savings as a % of 2022 Sales	0.98%

Spending per Customer	Low-Income	$ 241.77
	Residential	$ 33.44
	C&I	$ 266.74

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]				Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
					Electric											Non-Electric						
					CAPACITY					ENERGY												
	Granite State Test	Total Resource Cost Test	Utility Cost Test	Secondary Granite State Test	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																						
B1 - Home Energy Assistance	$ 1,695	$ 1,695	$ 162	$ 1,751	$ 12	$ -	$ 23	$ 27	$ -	$ 30	$ 30	$ 16	$ 15	$ 7	$ 162	$ 890	$ 1	$ 1,053	$ 21	$ 621	$ 642	$ 56
B2a - IE Education	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
B2b - IE Evaluation, Measurement and Verification	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
B3 - IE TBD Pilots/Demonstrations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Income Eligible	$ 1,695	$ 1,695	$ 162	$ 1,751	$ 12	$ -	$ 23	$ 27	$ -	$ 30	$ 30	$ 16	$ 15	$ 7	$ 162	$ 890	$ 1	$ 1,053	$ 21	$ 621	$ 642	$ 56
Residential Programs																						
A1 - Energy Star Homes	$ 818	$ 1,018	$ 124	$ 1,044	$ 14	$ -	$ 27	$ 32	$ -	$ 12	$ 12	$ 13	$ 11	$ 3	$ 124	$ 676	$ 4	$ 803	$ 14	$ 200	$ 214	$ 26
A2 - Home Performance	$ 1,152	$ 1,434	$ 115	$ 1,465	$ 11	$ -	$ 20	$ 23	$ -	$ 16	$ 18	$ 13	$ 11	$ 3	$ 115	$ 1,013	$ 1	$ 1,129	$ 23	$ 282	$ 305	$ 30
A3 - Energy Star Products	$ 945	$ 1,173	$ 784	$ 1,484	$ 48	$ -	$ 96	$ 113	$ -	$ 174	$ 194	$ 62	$ 57	$ 40	$ 784	$ 125	$ 32	$ 941	$ 4	$ 227	$ 231	$ 311
A4 - Residential Behavior	$ 323	$ 404	$ 323	$ 596	$ 13	$ -	$ 40	$ 47	$ -	$ 81	$ 70	$ 31	$ 23	$ 18	$ 323	$ -	$ -	$ 323	$ -	$ 81	$ 81	$ 192
A5 - Residential Active Demand Response	$ 151	$ 151	$ 151	$ 151	$ 5	$ -	$ 66	$ 78	$ -	$ -	$ -	$ -	$ -	$ 2	$ 151	$ -	$ -	$ 151	$ -	$ -	$ -	$ -
A6a - Res Education	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A6b - Res Evaluation, Measurement and Verification	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A7 - Res TBD Pilots/Demonstrations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Residential	$ 3,390	$ 4,180	$ 1,497	$ 4,739	$ 90	$ -	$ 249	$ 292	$ -	$ 284	$ 294	$ 119	$ 103	$ 66	$ 1,497	$ 1,814	$ 37	$ 3,348	$ 42	$ 790	$ 832	$ 560
Commercial/Industrial Programs																						
C1 - Large Business Energy Solutions	$ 2,290	$ 2,513	$ 2,350	$ 3,834	$ 78	$ -	$ 154	$ 181	$ -	$ 527	$ 514	$ 392	$ 344	$ 161	$ 2,350	$ (118)	$ 61	$ 2,294	$ (4)	$ 223	$ 219	$ 1,321
C2 - Small Business Energy Solutions	$ 2,119	$ 2,327	$ 2,221	$ 3,431	$ 135	$ -	$ 264	$ 309	$ -	$ 469	$ 310	$ 375	$ 216	$ 143	$ 2,221	$ (133)	$ 36	$ 2,123	$ (5)	$ 209	$ 204	$ 1,104
C3 - Municipal Energy Solutions	$ 237	$ 260	$ 247	$ 370	$ 11	$ -	$ 21	$ 25	$ -	$ 102	$ 35	$ 25	$ 13	$ 15	$ 247	$ (10)	$ -	$ 237	$ (0)	$ 24	$ 23	$ 110
C5 - C&I Active Demand Response	$ 755	$ 755	$ 755	$ 755	$ 23	$ -	$ 332	$ 389	$ -	$ -	$ -	$ -	$ -	$ 10	$ 755	$ -	$ -	$ 755	$ -	$ -	$ -	$ -
C6a - C&I Education	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
C6b - C&I Evaluation, Measurement and Verification	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
C6c - C&I Customer Partnerships	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
C7 - C&I TBD Pilots/Demonstrations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Commercial & Industrial	$ 5,400	$ 5,855	$ 5,573	$ 8,391	$ 247	$ -	$ 772	$ 904	$ -	$ 1,098	$ 859	$ 792	$ 573	$ 329	$ 5,573	$ (261)	$ 97	$ 5,409	$ (9)	$ 456	$ 447	$ 2,535
C6d - Smart Start	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 10,484	$ 11,730	$ 7,232	$ 14,881	$ 349	$ -	$ 1,044	$ 1,224	$ -	$ 1,412	$ 1,183	$ 927	$ 690	$ 402	$ 7,232	$ 2,443	$ 135	$ 9,810	$ 54	$ 1,866	$ 1,920	$ 3,151

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2025

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	68,017,936	*51,013,452*		-	1.925%	-	$ 135,946	*$ 169,932*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	11,442,968	*8,582,226*		-	0.550%	-	$ 38,842	*$ 48,552*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	1,320	*858*		-	0.660%	-	$ 46,610	*$ 58,262*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,678	*1,091*		-	0.440%	-	$ 31,073	*$ 38,842*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 9,809,730			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,3]	$ 7,062,107			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 2,747,623	*$ 2,060,717*	$ -	-	1.925%	-	$ 135,946	*$ 169,932*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 388,416	*$ 485,520*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 10,484,214		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 388,416	$ -	from row 8 above
11	Total Utility Costs	$ 7,062,107	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.41**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Footnote 2 is omitted as it applies to Eversource and the Coop only

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2026 Plan

	Benefit/Cost Ratios				Benefits ($000)												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Granite State Test**	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Utility Costs ($000 - 2024$)^2**	**Customer Costs ($000 - 2024$)^2**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs																	
B1 - Home Energy Assistance	1.49	*1.49*	*0.14*	*1.53*	1,746.0	*1,746.0*	*167.3*	*1,799.7*	1,174.3	-	122.2	1,537.4	20.5	20.3	65	1,386.3	30,114.0
B2a - IE Education	-	-	-	-	-	-	-	-	21.1	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	36.4	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.42**	***1.42***	***0.14***	***1.46***	**1,746.0**	***1,746.0***	***167.3***	***1,799.7***	**1,231.8**	**-**	**122.2**	**1,537.4**	**20.5**	**20.3**	**65**	**1,386.3**	**30,114.0**
Residential Programs																	
A1 - Energy Star Homes	1.61	*1.45*	*0.24*	*1.48*	843.5	*1,049.6*	*127.8*	*1,074.4*	524.3	199.5	45.5	889.0	10.8	18.2	80	1,046.3	23,755.0
A2 - Home Performance	1.92	*2.02*	*0.19*	*2.06*	1,190.0	*1,481.2*	*118.9*	*1,510.1*	620.0	113.9	57.3	1,053.7	10.2	13.0	65	1,493.1	33,946.1
A3 - Energy Star Products	1.69	*1.51*	*1.41*	*1.88*	986.9	*1,224.4*	*820.5*	*1,523.8*	582.8	227.5	887.8	7,837.3	162.6	148.4	6,200	54.6	5,740.4
A4 - Residential Behavior	1.82	*2.27*	*1.82*	*3.27*	334.8	*418.6*	*334.8*	*602.7*	184.2	-	2,904.5	2,904.5	627.0	404.5	26,800	-	-
A5 - Residential Active Demand Response	2.38	*2.38*	*2.38*	*2.38*	162.4	*162.4*	*162.4*	*162.4*	68.3	-	-	-	-	703.0	827	-	-
A6a - Res Education	-	-	-	-	-	-	-	-	58.0	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	104.3	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.64**	***1.62***	***0.73***	***1.82***	**3,517.6**	***4,336.1***	***1,564.4***	***4,873.3***	**2,141.9**	**540.9**	**3,895.1**	**12,684.5**	**810.6**	**1,287.0**	**33,972**	**2,594.0**	**63,441.4**
Commercial, Industrial & Municipal																	
C1 - Large Business Energy Solutions	1.83	*1.20*	*1.85*	*1.78*	2,026.5	*2,223.2*	*2,046.5*	*3,292.3*	1,107.1	744.4	3,570.8	24,939.7	415.9	240.9	49	(1,169.3)	(3,941.7)
C2 - Small Business Energy Solutions	1.99	*1.34*	*2.08*	*1.93*	2,202.3	*2,419.4*	*2,308.7*	*3,480.8*	1,109.4	698.3	3,587.0	22,001.1	410.5	451.4	130	(1,284.8)	(6,938.5)
C3 - Municipal Energy Solutions	1.26	*0.85*	*1.31*	*1.18*	244.4	*268.9*	*255.4*	*374.2*	194.3	123.2	272.1	2,715.3	23.3	23.6	6	(84.7)	(538.3)
C5 - C&I Active Demand Response	3.97	*3.97*	*3.97*	*3.97*	810.5	*810.5*	*810.5*	*810.5*	204.4	-	-	-	-	3,509.0	22	-	-
C6a - C&I Education	-	-	-	-	-	-	-	-	59.4	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	107.2	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.90**	***1.32***	***1.95***	***1.83***	**5,283.8**	***5,722.0***	***5,421.1***	***7,957.8***	**2,781.9**	**1,565.9**	**7,429.9**	**49,656.2**	**849.7**	**4,224.9**	**207**	**(2,538.8)**	**(11,418.5)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
Total	**1.71**	***1.43***	***1.16***	***1.77***	**10,547.5**	***11,804.1***	***7,152.7***	***14,630.8***	**6,155.7**	**2,106.8**	**11,447.2**	**63,878.1**	**1,680.7**	**5,532.2**	**34,244**	**1,441.5**	**82,136.8**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits excluding water.

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

(4) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not in fact cumulative.

Annual kWh Savings	11,447,219	96.4%	**kWh > 65%**	**Lifetime** kWh Savings	63,878,120	72.6%
Annual MMBTU Savings (in kWh)	422,460	3.6%		**Lifetime** MMBTU Savings (in kWh)	24,071,935	27.4%
	11,869,680	100.0%			**87,950,055**	100.0%

Annual Net Savings as a % of 2022 Sales	0.98%

Spending per Customer			
	Low-Income	$	229.31
	Residential	$	31.73
	C&I	$	250.04

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]				Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
					Electric											Non-Electric						
					CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																						
B1 - Home Energy Assistance	**$ 1,746**	*$ 1,746*	*$ 167*	*$ 1,800*	$ 13	$ -	$ 24	$ 28	$ -	$ 31	$ 31	$ 17	$ 15	$ 7	**$ 167**	$ 920	$ 1	**$ 1,088**	$ 22	$ 636	**$ 658**	**$ 54**
B2a - IE Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 1,746**	*$ 1,746*	*$ 167*	*$ 1,800*	**$ 13**	**$ -**	**$ 24**	**$ 28**	**$ -**	**$ 31**	**$ 31**	**$ 17**	**$ 15**	**$ 7**	**$ 167**	**$ 920**	**$ 1**	**$ 1,088**	**$ 22**	**$ 636**	**$ 658**	**$ 54**
Residential Programs																						
A1 - Energy Star Homes	**$ 843**	*$ 1,050*	*$ 128*	*$ 1,074*	$ 15	$ -	$ 28	$ 32	$ -	$ 13	$ 12	$ 14	$ 11	$ 3	**$ 128**	$ 697	$ 4	**$ 828**	$ 15	$ 206	**$ 221**	**$ 25**
A2 - Home Performance	**$ 1,190**	*$ 1,481*	*$ 119*	*$ 1,510*	$ 11	$ -	$ 20	$ 24	$ -	$ 16	$ 18	$ 14	$ 12	$ 3	**$ 119**	$ 1,046	$ 1	**$ 1,166**	$ 24	$ 291	**$ 316**	**$ 29**
A3 - Energy Star Products	**$ 987**	*$ 1,224*	*$ 821*	*$ 1,524*	$ 53	$ -	$ 100	$ 117	$ -	$ 182	$ 204	$ 64	$ 59	$ 41	**$ 821**	$ 129	$ 33	**$ 983**	$ 4	$ 237	**$ 242**	**$ 299**
A4 - Residential Behavior	**$ 335**	*$ 419*	*$ 335*	*$ 603*	$ 17	$ -	$ 41	$ 48	$ -	$ 84	$ 70	$ 33	$ 23	$ 19	**$ 335**	$ -	$ -	**$ 335**	$ -	$ 84	**$ 84**	**$ 184**
A5 - Residential Active Demand Response	**$ 162**	*$ 162*	*$ 162*	*$ 162*	$ 5	$ -	$ 71	$ 84	$ -	$ -	$ -	$ -	$ -	$ 2	**$ 162**	$ -	$ -	**$ 162**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,518**	*$ 4,336*	*$ 1,564*	*$ 4,873*	**$ 101**	**$ -**	**$ 260**	**$ 305**	**$ -**	**$ 295**	**$ 305**	**$ 124**	**$ 106**	**$ 68**	**$ 1,564**	**$ 1,872**	**$ 38**	**$ 3,474**	**$ 44**	**$ 818**	**$ 862**	**$ 537**
Commercial/Industrial Programs																						
C1 - Large Business Energy Solutions	**$ 2,027**	*$ 2,223*	*$ 2,046*	*$ 3,292*	$ 67	$ -	$ 129	$ 151	$ -	$ 456	$ 463	$ 337	$ 310	$ 133	**$ 2,046**	$ (80)	$ 63	**$ 2,029**	$ (3)	$ 197	**$ 194**	**$ 1,069**
C2 - Small Business Energy Solutions	**$ 2,202**	*$ 2,419*	*$ 2,309*	*$ 3,481*	$ 151	$ -	$ 270	$ 317	$ -	$ 486	$ 321	$ 392	$ 225	$ 146	**$ 2,309**	$ (138)	$ 37	**$ 2,207**	$ (5)	$ 217	**$ 212**	**$ 1,061**
C3 - Municipal Energy Solutions	**$ 244**	*$ 269*	*$ 255*	*$ 374*	$ 12	$ -	$ 22	$ 26	$ -	$ 105	$ 37	$ 26	$ 13	$ 16	**$ 255**	$ (11)	$ -	**$ 245**	$ (0)	$ 24	**$ 24**	**$ 105**
C5 - C&I Active Demand Response	**$ 811**	*$ 811*	*$ 811*	*$ 811*	$ 25	$ -	$ 357	$ 418	$ -	$ -	$ -	$ -	$ -	$ 11	**$ 811**	$ -	$ -	**$ 811**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 5,284**	*$ 5,722*	*$ 5,421*	*$ 7,958*	**$ 255**	**$ -**	**$ 778**	**$ 912**	**$ -**	**$ 1,046**	**$ 821**	**$ 755**	**$ 549**	**$ 305**	**$ 5,421**	**$ (229)**	**$ 99**	**$ 5,292**	**$ (8)**	**$ 438**	**$ 430**	**$ 2,236**
C6d - Smart Start	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 10,547**	*$ 11,804*	*$ 7,153*	*$ 14,631*	**$ 370**	**$ -**	**$ 1,062**	**$ 1,245**	**$ -**	**$ 1,373**	**$ 1,156**	**$ 896**	**$ 670**	**$ 381**	**$ 7,153**	**$ 2,563**	**$ 138**	**$ 9,854**	**$ 58**	**$ 1,893**	**$ 1,951**	**$ 2,827**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2026

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	63,878,120	*47,908,590*		-	1.925%	-	$ 138,855	*$ 173,568*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	11,447,219	*8,585,414*		-	0.550%	-	$ 39,673	*$ 49,591*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	1,320	*858*		-	0.660%	-	$ 47,607	*$ 59,509*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	1,681	*1,092*		-	0.440%	-	$ 31,738	*$ 39,673*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 9,853,614			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,3]	$ 7,213,233			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 2,640,382	*$ 1,980,286*	$ -	-	1.925%	-	$ 138,855	*$ 173,568*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 396,728	*$ 495,910*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 10,547,451		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 396,728	$ -	from row 8 above
11	Total Utility Costs	$ 7,213,233	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.39**	**-**	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Footnote 2 is omitted as it applies to Eversource and the Coop only

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios				Benefits ($000)												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Granite State Test**	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs																	
B1 - Home Energy Assistance	1.38	*1.38*	*0.13*	*1.43*	5,085.0	*5,085.0*	*486.3*	*5,253.2*	3,684.8	-	366.5	4,612.3	61.4	60.9	195	4,158.8	90,342.0
B2a - IE Education	-	-	-	-	-	-	-	-	67.2	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	147.3	-	-	-	-	-	-	-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**1.30**	***1.30***	***0.12***	***1.35***	**5,085.0**	***5,085.0***	***486.3***	***5,253.2***	**3,899.3**	**-**	**366.5**	**4,612.3**	**61.4**	**60.9**	**195**	**4,158.8**	**90,342.0**
Residential Programs																	
A1 - Energy Star Homes	1.52	*1.35*	*0.23*	*1.38*	2,453.5	*3,053.2*	*371.7*	*3,131.1*	1,613.5	649.2	136.6	2,667.0	32.3	54.7	240	3,139.0	71,264.9
A2 - Home Performance	1.74	*1.82*	*0.17*	*1.86*	3,456.7	*4,302.8*	*345.7*	*4,393.7*	1,989.2	370.8	171.9	3,161.2	30.7	38.9	195	4,479.4	101,838.2
A3 - Energy Star Products	1.49	*1.33*	*1.24*	*1.68*	2,831.4	*3,512.1*	*2,347.7*	*4,438.4*	1,898.0	742.7	2,646.4	23,167.9	478.6	442.9	18,600	163.7	17,221.1
A4 - Residential Behavior	1.65	*2.06*	*1.65*	*3.00*	980.0	*1,225.0*	*980.0*	*1,785.2*	594.5	-	8,713.5	8,713.5	1,881.0	1,213.4	80,400	-	-
A5 - Residential Active Demand Response	2.16	*2.16*	*2.16*	*2.16*	453.4	*453.4*	*453.4*	*453.4*	209.7	-	-	-	-	2,010.3	2,365	-	-
A6a - Res Education	-	-	-	-	-	-	-	-	137.8	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	313.5	-	-	-	-	-	-	-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Residential	**1.51**	***1.47***	***0.67***	***1.67***	**10,175.0**	***12,546.6***	***4,498.5***	***14,201.9***	**6,756.2**	**1,762.7**	**11,668.4**	**37,709.6**	**2,422.6**	**3,760.0**	**101,800**	**7,782.1**	**190,324.1**
Commercial, Industrial & Municipal																	
C1 - Large Business Energy Solutions	1.85	*1.21*	*1.89*	*1.83*	6,553.6	*7,191.7*	*6,692.1*	*10,948.0*	3,544.5	2,422.4	10,712.4	83,458.5	1,247.8	722.8	147	(3,507.8)	(16,112.1)
C2 - Small Business Energy Solutions	1.80	*1.20*	*1.89*	*1.77*	6,375.0	*7,003.1*	*6,681.4*	*10,296.2*	3,543.2	2,272.6	10,761.0	66,003.5	1,231.5	1,354.2	390	(3,854.5)	(20,815.6)
C3 - Municipal Energy Solutions	1.13	*0.76*	*1.18*	*1.08*	711.0	*782.2*	*742.9*	*1,111.2*	627.0	401.0	816.3	8,146.0	69.8	70.7	18	(254.1)	(1,615.0)
C5 - C&I Active Demand Response	3.63	*3.63*	*3.63*	*3.63*	2,266.3	*2,266.3*	*2,266.3*	*2,266.3*	624.3	-	-	-	-	10,048.5	63	-	-
C6a - C&I Education	-	-	-	-	-	-	-	-	156.8	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	-	-	-	-	393.8	-	-	-	-	-	-	-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**1.79**	***1.23***	***1.84***	***1.76***	**15,906.0**	***17,243.4***	***16,382.7***	***24,621.5***	**8,889.6**	**5,096.0**	**22,289.7**	**157,608.0**	**2,549.1**	**12,196.1**	**618**	**(7,616.4)**	**(38,542.6)**
C6d - Smart Start	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**1.59**	***1.32***	***1.09***	***1.67***	**31,166.1**	***34,875.1***	***21,367.4***	***44,076.5***	**19,545.2**	**6,858.6**	**34,324.7**	**199,929.9**	**5,033.0**	**16,017.0**	**102,613**	**4,324.5**	**242,123.6**
									46%								

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

(4) Active Demand kW is summed for the purposes of showing total annual activity over the term, but is not in fact cumulative.

Annual kWh Savings	34,324,654	96.4%	**kWh > 65%**
Annual MMBTU Savings (in kWh)	1,267,381	3.6%	
	35,592,035	100.0%	

Lifetime kWh Savings	199,929,876	73.8%
Lifetime MMBTU Savings (in kWh)	70,959,418	26.2%
	270,889,295	100.0%

Annual Net Savings as a % of 2022 Sales	2.94%

Spending per Customer	Low-Income	$ 725.86
	Residential	$ 100.08
	C&I	$ 799.00

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]				Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
					Electric											Non-Electric						
					CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	*Utility Cost Test*	*Secondary Granite State Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																						
B1 - Home Energy Assistance	**$ 5,085**	*$ 5,085*	*$ 486*	*$ 5,253*	$ 37	$ -	$ 70	$ 82	$ -	$ 91	$ 91	$ 49	$ 44	$ 21	**$ 486**	$ 2,671	$ 3	**$ 3,159**	$ 63	$ 1,862	**$ 1,926**	**$ 168**
B2a - IE Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 5,085**	*$ 5,085*	*$ 486*	*$ 5,253*	**$ 37**	**$ -**	**$ 70**	**$ 82**	**$ -**	**$ 91**	**$ 91**	**$ 49**	**$ 44**	**$ 21**	**$ 486**	**$ 2,671**	**$ 3**	**$ 3,159**	**$ 63**	**$ 1,862**	**$ 1,926**	**$ 168**
Residential Programs																						
A1 - Energy Star Homes	**$ 2,454**	*$ 3,053*	*$ 372*	*$ 3,131*	$ 43	$ -	$ 81	$ 95	$ -	$ 37	$ 36	$ 39	$ 33	$ 8	**$ 372**	$ 2,027	$ 12	**$ 2,410**	$ 43	$ 600	**$ 643**	**$ 78**
A2 - Home Performance	**$ 3,457**	*$ 4,303*	*$ 346*	*$ 4,394*	$ 32	$ -	$ 60	$ 70	$ -	$ 48	$ 54	$ 39	$ 34	$ 9	**$ 346**	$ 3,039	$ 2	**$ 3,387**	$ 70	$ 846	**$ 916**	**$ 91**
A3 - Energy Star Products	**$ 2,831**	*$ 3,512*	*$ 2,348*	*$ 4,438*	$ 144	$ -	$ 287	$ 336	$ -	$ 522	$ 581	$ 187	$ 172	$ 119	**$ 2,348**	$ 375	$ 96	**$ 2,819**	$ 12	$ 681	**$ 693**	**$ 926**
A4 - Residential Behavior	**$ 980**	*$ 1,225*	*$ 980*	*$ 1,785*	$ 42	$ -	$ 120	$ 141	$ -	$ 246	$ 209	$ 95	$ 71	$ 55	**$ 980**	$ -	$ -	**$ 980**	$ -	$ 245	**$ 245**	**$ 560**
A5 - Residential Active Demand Response	**$ 453**	*$ 453*	*$ 453*	*$ 453*	$ 14	$ -	$ 200	$ 234	$ -	$ -	$ -	$ -	$ -	$ 6	**$ 453**	$ -	$ -	**$ 453**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 10,175**	*$ 12,547*	*$ 4,498*	*$ 14,202*	**$ 274**	**$ -**	**$ 747**	**$ 876**	**$ -**	**$ 853**	**$ 880**	**$ 360**	**$ 310**	**$ 198**	**$ 4,498**	**$ 5,441**	**$ 110**	**$ 10,050**	**$ 125**	**$ 2,372**	**$ 2,497**	**$ 1,655**
Commercial/Industrial Programs																						
C1 - Large Business Energy Solutions	**$ 6,554**	*$ 7,192*	*$ 6,692*	*$ 10,948*	$ 214	$ -	$ 434	$ 509	$ -	$ 1,500	$ 1,482	$ 1,111	$ 991	$ 452	**$ 6,692**	$ (311)	$ 183	**$ 6,564**	$ (11)	$ 638	**$ 628**	**$ 3,756**
C2 - Small Business Energy Solutions	**$ 6,375**	*$ 7,003*	*$ 6,681*	*$ 10,296*	$ 407	$ -	$ 791	$ 927	$ -	$ 1,414	$ 932	$ 1,131	$ 651	$ 429	**$ 6,681**	$ (401)	$ 108	**$ 6,389**	$ (14)	$ 628	**$ 614**	**$ 3,293**
C3 - Municipal Energy Solutions	**$ 711**	*$ 782*	*$ 743*	*$ 1,111*	$ 33	$ -	$ 64	$ 75	$ -	$ 306	$ 107	$ 75	$ 38	$ 45	**$ 743**	$ (31)	$ -	**$ 712**	$ (1)	$ 71	**$ 70**	**$ 329**
C5 - C&I Active Demand Response	**$ 2,266**	*$ 2,266*	*$ 2,266*	*$ 2,266*	$ 69	$ -	$ 998	$ 1,169	$ -	$ -	$ -	$ -	$ -	$ 30	**$ 2,266**	$ -	$ -	**$ 2,266**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 15,906**	*$ 17,243*	*$ 16,383*	*$ 24,622*	**$ 722**	**$ -**	**$ 2,287**	**$ 2,680**	**$ -**	**$ 3,219**	**$ 2,521**	**$ 2,317**	**$ 1,680**	**$ 956**	**$ 16,383**	**$ (742)**	**$ 291**	**$ 15,932**	**$ (26)**	**$ 1,337**	**$ 1,312**	**$ 7,378**
C6d - Smart Start	**$ -**	*$ -*	*$ -*	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 31,166**	*$ 34,875*	*$ 21,367*	*$ 44,077*	**$ 1,034**	**$ -**	**$ 3,105**	**$ 3,638**	**$ -**	**$ 4,163**	**$ 3,491**	**$ 2,726**	**$ 2,035**	**$ 1,175**	**$ 21,367**	**$ 7,370**	**$ 404**	**$ 29,141**	**$ 163**	**$ 5,571**	**$ 5,734**	**$ 9,201**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

Portfolio Planned Versus Actual Performance - 2024-2026

	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime kWh Savings	199,929,876	*149,947,407*		-	1.925%	-	$ 406,963	*$ 508,704*	$ -	Planned and Actual from Cost Eff Tab
2	Annual kWh Savings	34,324,654	*25,743,491*		-	0.550%	-	$ 116,275	*$ 145,344*	$ -	Planned and Actual from Cost Eff Tab
3	Summer Peak Demand kW	3,958	*2,573*		-	0.660%	-	$ 139,530	*$ 174,413*	$ -	Planned and Actual from Cost Eff Tab
4	Winter Peak Demand kW	5,033	*3,271*		-	0.440%	-	$ 93,020	*$ 116,275*	$ -	Planned and Actual from Cost Eff Tab
5	Total Resource Benefits	$ 29,140,688			-						Planned and Actual from Benefits Tab
6	Total Utility Costs[1,3]	$ 21,140,956			-						Planned and Actual from Cost Eff Tab
7	Net Benefits	$ 7,999,732	*$ 5,999,799*	$ -	-	1.925%	-	$ 406,963	*$ 508,704*	$ -	Line 5 minus line 6
8	Total					5.500%	-	$ 1,162,753	*$ 1,453,441*	$ -	

		Granite State Test		
		Planned	Actual	Source
9	Total Benefits	$ 31,166,060		Planned and Actual from Cost Eff Tab
10	Performance Incentive	$ 1,162,753	$ -	from row 8 above
11	Total Utility Costs	$ 21,140,956	$ -	from row 6 above
12	**Portfolio GST BCR**	**1.40**	-	row 9 divided by rows 10+11

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[2] Footnote 2 is omitted as it applies to Eversource and the Coop only

[3] Costs and PI expressed in nominal dollars.

[4] Summer Peak Demand kW excludes active demand from Demand Response programs.

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
B1a - HEA (Weatherization	Air Sealing, Cord Wood	EB1a001	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Electric	EB1a002	10	10	10	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	4.6	4.6	4.6	68.3	68.3	68.3	0.7	0.7	0.7	1.2	1.2	1.2	-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Gas	EB1a003	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Air Sealing, Kerosene	EB1a004	15	15	15	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	68.3	68.3	68.3	1,023.8	1,023.8	1,023.8
B1a - HEA (Weatherization	Air Sealing, Oil	EB1a005	20	20	20	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	91.0	91.0	91.0	1,365.0	1,365.0	1,365.0
B1a - HEA (Weatherization	Air Sealing, Propane	EB1a006	20	20	20	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	91.0	91.0	91.0	1,365.0	1,365.0	1,365.0
B1a - HEA (Weatherization	Air Sealing, Wood Pellets	EB1a007	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Cord Wood	EB1a084	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Electric	EB1a085	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Gas	EB1a086	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Kerosene	EB1a087	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Oil	EB1a088	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Propane	EB1a089	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Sealing, Wood Pellets	EB1a090	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Electric	EB1a009	5	5	5	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.2	0.2	0.2	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Gas	EB1a010	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Faucet Aerator, Kerosene	EB1a011	5	5	5	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	5.1	5.1	5.1
B1a - HEA (Weatherization	Faucet Aerator, Oil	EB1a012	5	5	5	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	5.1	5.1	5.1
B1a - HEA (Weatherization	Faucet Aerator, Propane	EB1a013	5	5	5	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	0.7	5.1	5.1	5.1
B1a - HEA (Weatherization	Tank Wrap, Electric	EB1a091	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Gas	EB1a092	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Kerosene	EB1a093	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Oil	EB1a094	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Tank Wrap, Propane	EB1a095	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Electric	EB1a016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Gas	EB1a017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Kerosene	EB1a018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Oil	EB1a019	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hand Held Showerhead, Propane	EB1a020	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Cord Wood	EB1a022	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Electric	EB1a023	10	10	10	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	18.2	18.2	18.2	455.0	455.0	455.0	2.9	2.9	2.9	4.8	4.8	4.8	-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Gas	EB1a024	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulation, Kerosene	EB1a025	15	15	15	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.7	0.7	0.7	17.1	17.1	17.1	-	-	-	0.4	0.4	0.4	232.1	232.1	232.1	5,801.3	5,801.3	5,801.3
B1a - HEA (Weatherization	Insulation, Oil	EB1a026	20	20	20	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.9	0.9	0.9	22.8	22.8	22.8	-	-	-	0.5	0.5	0.5	309.4	309.4	309.4	7,735.0	7,735.0	7,735.0
B1a - HEA (Weatherization	Insulation, Propane	EB1a027	20	20	20	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.9	0.9	0.9	22.8	22.8	22.8	-	-	-	0.5	0.5	0.5	309.4	309.4	309.4	7,735.0	7,735.0	7,735.0
B1a - HEA (Weatherization	Insulation, Wood Pellets	EB1a028	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Cord Wood	EB1a077	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Electric	EB1a078	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Gas	EB1a079	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Kerosene	EB1a080	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Oil	EB1a081	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Propane	EB1a082	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Duct Insulation, Wood Pellets	EB1a083	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Electric	EB1a030	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Gas	EB1a031	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Kerosene	EB1a032	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Oil	EB1a033	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Flow Showerhead, Propane	EB1a034	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Electric	EB1a037	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Gas	EB1a038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Kerosene	EB1a039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Oil	EB1a040	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Pipe Insulation - Hot Water, Propane	EB1a041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Electric	EB1a042	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Gas	EB1a060	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Kerosene	EB1a061	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Oil	EB1a062	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Hot Water Setback, Propane	EB1a063	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	DHW Heat Pump Water Heater	EB1a043	21	21	21	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	18.4	18.4	18.4	275.5	275.5	275.5	3.0	3.0	3.0	1.7	1.7	1.7	41.1	41.1	41.1	616.0	616.0	616.0
B1a - HEA (Weatherization	Stand Alone Water Heater, Electric	EB1a096	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Stand Alone Water Heater, Gas	EB1a097	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Stand Alone Water Heater, Propane	EB1a099	1	1	1	13	13	13	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	5.9	5.9	5.9
B1a - HEA (Weatherization	Indirect Water Heater, Oil	EB1a098	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, General Service Lamps	EB1a044	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, Linear	EB1a045	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, Other Specialty	EB1a046	-	-	-	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Bulb, Reflector	EB1a047	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	LED Fixture	EB1a048	10	10	10	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.4	0.4	0.4	0.7	0.7	0.7	0.1	0.1	0.1	0.1	0.1	0.1	(0.8)	(0.8)	(0.8)	(1.7)	(1.7)	(1.7)
B1a - HEA (Weatherization	Refrigerator	EB1a049	50	50	50	12	12	12	100%	100%	100%	100%	100%	100%	91%	91%	91%	34.1	34.1	34.1	409.5	409.5	409.5	3.9	3.9	3.9	4.8	4.8	4.8	-	-	-	-	-	-
B1a - HEA (Weatherization	Freezer	EB1a050	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Clothes Washer	EB1a051	-	-	-	11	11	11	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Clothes Dryer	EB1a052	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Dehumidifier	EB1a053	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Room Air Conditioner	EB1a054	10	10	10	9	9	9	100%	100%	100%	100%	100%	100%	91%	91%	91%	1.0	1.0	1.0	9.3	9.3	9.3	-	-	-	0.5	0.5	0.5	-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Cord Wood	EB1a055	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Electric	EB1a064	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Gas	EB1a065	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Replacement, Kerosene	EB1a066	10	10	10	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.2	0.2	0.2	4.6	4.6	4.6	-	-	-	0.1	0.1	0.1	4.6	4.6	4.6	113.8	113.8	113.8
B1a - HEA (Weatherization	Window Replacement, Oil	EB1a067	10	10	10	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.2	0.2	0.2	4.6	4.6	4.6	-	-	-	0.1	0.1	0.1	4.6	4.6	4.6	113.8	113.8	113.8
B1a - HEA (Weatherization	Window Replacement, Propane	EB1a068	10	10	10	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.2	0.2	0.2	4.6	4.6	4.6	-	-	-	0.1	0.1	0.1	4.6	4.6	4.6	113.8	113.8	113.8
B1a - HEA (Weatherization	Window Replacement, Wood Pellets	EB1a069	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Cord Wood	EB1a100	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Electric	EB1a101	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Gas	EB1a102	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Kerosene	EB1a103	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Oil	EB1a104	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Window Insert, Propane	EB1a105	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization	Window Insert, Wood Pellets	EB1a106	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Cord Wood	EB1a070	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Electric	EB1a071	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Gas	EB1a072	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Insulated Door, Kerosene	EB1a073	2	2	2	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.0	0.0	0.0	0.9	0.9	0.9	-	-	-	0.0	0.0	0.0	0.9	0.9	0.9	22.8	22.8	22.8
B1a - HEA (Weatherization	Insulated Door, Oil	EB1a074	2	2	2	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.0	0.0	0.0	0.9	0.9	0.9	-	-	-	0.0	0.0	0.0	0.9	0.9	0.9	22.8	22.8	22.8
B1a - HEA (Weatherization	Insulated Door, Propane	EB1a075	2	2	2	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.0	0.0	0.0	0.9	0.9	0.9	-	-	-	0.0	0.0	0.0	0.9	0.9	0.9	22.8	22.8	22.8
B1a - HEA (Weatherization	Insulated Door, Wood Pellets	EB1a076	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Visual Audit	EB1a056	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Baseload Audit - SF	EB1a057	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Baseload Audit - MF	EB1a058	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1a - HEA (Weatherization	Low Income Kits	EB1a059	500	500	500	5	5	5	100%	100%	100%	100%	100%	100%	91%	91%	91%	39.6	39.6	39.6	197.9	197.9	197.9	8.5	8.5	8.5	5.5	5.5	5.5	-	-	-	-	-	-
B1b - HEA (HVAC Systems	Boiler Replacement, Gas	EB1b001	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Boiler Replacement, Kerosene	EB1b002	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Boiler Replacement, Oil	EB1b003	5	5	5	19	19	19	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	54.6	54.6	54.6	1,037.4	1,037.4	1,037.4
B1b - HEA (HVAC Systems	Boiler Replacement, Propane	EB1b004	5	5	5	19	19	19	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	54.6	54.6	54.6	1,037.4	1,037.4	1,037.4
B1b - HEA (HVAC Systems	Furnace Replacement, Gas	EB1b005	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Furnace Replacement, Kerosene	EB1b006	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Furnace Replacement, Oil	EB1b007	5	5	5	17	17	17	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.6	0.6	0.6	10.1	10.1	10.1	0.1	0.1	0.1	-	-	-	54.6	54.6	54.6	928.2	928.2	928.2
B1b - HEA (HVAC Systems	Furnace Replacement, Propane	EB1b008	5	5	5	17	17	17	100%	100%	100%	100%	100%	100%	91%	91%	91%	0.6	0.6	0.6	10.1	10.1	10.1	0.1	0.1	0.1	-	-	-	54.6	54.6	54.6	928.2	928.2	928.2
B1b - HEA (HVAC Systems	Programmable Thermostat, Electric	EB1b009	6	6	6	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	1.4	1.4	1.4	20.6	20.6	20.6	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC Systems	Programmable Thermostat, Gas	EB1b010	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Programmable Thermostat, Kerosene	EB1b011	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Programmable Thermostat, Oil	EB1b012	2	2	2	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	3.8	56.5	56.5	56.5
B1b - HEA (HVAC Systems	Programmable Thermostat, Propane	EB1b013	2	2	2	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	3.7	3.7	3.7	56.2	56.2	56.2
B1b - HEA (HVAC Systems	Programmable Thermostat, Wood Pellets	EB1b014	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Electric	EB1b015	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Gas	EB1b016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Kerosene	EB1b017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Oil	EB1b018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Propane	EB1b019	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Wifi Thermostat, Wood Pellets	EB1b020	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Mini Split HP (cooling)	EB1b021	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Mini Split HP (heating)	EB1b022	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	ES Central AC	EB1b023	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	91%	91%	91%													-	-	-	-	-	-
B1b - HEA (HVAC Systems	Oil K1 HVAC Repair or Cleaning	EB1b024	15	15	15	1	1	1	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B1b - HEA (HVAC Systems	Gas LP HVAC Repair or Cleaning	EB1b025	5	5	5	2	2	2	100%	100%	100%	100%	100%	100%	91%	91%	91%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Home Energy Assistance Subtotal																	**122.2**	**122.2**	**122.2**	**1,537.4**	**1,537.4**	**1,537.4**	**20.5**	**20.5**	**20.5**	**20.3**	**20.3**	**20.3**	**1,386.3**	**1,386.3**	**1,386.3**	**30,114.0**	**30,114.0**	**30,114.0**

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	EA1a001	40	40	40	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Electric, SF	EA1a002	15	15	15	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Gas, SF	EA1a003	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Oil, SF	EA1a004	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Propane, SF	EA1a005	30	30	30	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Wood Pellets, SF	EA1a006	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Electric, SF	EA1a007	15	15	15	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Gas, SF	EA1a008	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Oil, SF	EA1a009	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Propane, SF	EA1a010	30	30	30	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Wood Pellets, SF	EA1a011	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Cooling, Electric, MF	EA1a012	40	40	40	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Electric, MF	EA1a013	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Gas, MF	EA1a014	40	40	40	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Oil, MF	EA1a015	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Propane, MF	EA1a016	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Heating, Wood Pellets, MF	EA1a017	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Electric, MF	EA1a018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Gas, MF	EA1a019	40	40	40	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Oil, MF	EA1a020	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Propane, MF	EA1a021	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Hot Water, Wood Pellets, MF	EA1a022	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	LED Bulb	EA1a023	200	200	200	3	3	3	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	LED Fixture	EA1a024	50	50	50	3	3	3	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Refrigerator	EA1a025	40	40	40	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Clothes Washer	EA1a026	40	40	40	11	11	11	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Clothes Dryer	EA1a027	40	40	40	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	HERS - Lighting and Appliances	EA1a028	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	100%	100%	100%
A1a - ES Homes	Residential New Construction Code Compliance	EA1a029	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	35%	35%	35%
		ES Homes Subtotal															

			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	EA1a001	10.0	10.0	10.0	250.0	250.0	250.0	-	-	-	5.5	5.5	5.5	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, SF	EA1a002	7.5	7.5	7.5	187.5	187.5	187.5	2.4	2.4	2.4	-	-	-	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, SF	EA1a003													-	-	-	-	-	-
A1a - ES Homes	Heating, Oil, SF	EA1a004													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, SF	EA1a005	-	-	-	-	-	-	-	-	-	-	-	-	600.0	600.0	600.0	15,000.0	15,000.0	15,000.0
A1a - ES Homes	Heating, Wood Pellets, SF	EA1a006													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, SF	EA1a007	3.8	3.8	3.8	56.3	56.3	56.3	0.7	0.7	0.7	0.3	0.3	0.3	-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, SF	EA1a008													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Oil, SF	EA1a009													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, SF	EA1a010	-	-	-	-	-	-	-	-	-	-	-	-	150.0	150.0	150.0	2,250.0	2,250.0	2,250.0
A1a - ES Homes	Hot Water, Wood Pellets, SF	EA1a011													-	-	-	-	-	-
A1a - ES Homes	Cooling, Electric, MF	EA1a012	10.0	10.0	10.0	250.0	250.0	250.0	-	-	-	5.5	5.5	5.5	-	-	-	-	-	-
A1a - ES Homes	Heating, Electric, MF	EA1a013													-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, MF	EA1a014	-	-	-	-	-	-	-	-	-	-	-	-	200.0	200.0	200.0	5,000.0	5,000.0	5,000.0
A1a - ES Homes	Heating, Oil, MF	EA1a015													-	-	-	-	-	-
A1a - ES Homes	Heating, Propane, MF	EA1a016													-	-	-	-	-	-
A1a - ES Homes	Heating, Wood Pellets, MF	EA1a017													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Electric, MF	EA1a018													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Gas, MF	EA1a019	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0	1,500.0	1,500.0	1,500.0
A1a - ES Homes	Hot Water, Oil, MF	EA1a020													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Propane, MF	EA1a021													-	-	-	-	-	-
A1a - ES Homes	Hot Water, Wood Pellets, MF	EA1a022													-	-	-	-	-	-
A1a - ES Homes	LED Bulb	EA1a023	1.3	1.3	1.3	3.9	3.9	3.9	0.3	0.3	0.3	0.2	0.2	0.2	(3.0)	(3.0)	(3.0)	(8.9)	(8.9)	(8.9)
A1a - ES Homes	LED Fixture	EA1a024	1.2	1.2	1.2	3.6	3.6	3.6	0.3	0.3	0.3	0.2	0.2	0.2	(2.7)	(2.7)	(2.7)	(8.2)	(8.2)	(8.2)
A1a - ES Homes	Refrigerator	EA1a025	1.8	1.8	1.8	21.2	21.2	21.2	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	EA1a026	3.6	3.6	3.6	39.6	39.6	39.6	5.8	5.8	5.8	5.5	5.5	5.5	2.0	2.0	2.0	22.0	22.0	22.0
A1a - ES Homes	Clothes Dryer	EA1a027	6.4	6.4	6.4	77.0	77.0	77.0	1.1	1.1	1.1	0.8	0.8	0.8	-	-	-	-	-	-
A1a - ES Homes	HERS - Lighting and Appliances	EA1a028													-	-	-	-	-	-
A1a - ES Homes	Residential New Construction Code Compliance	EA1a029													-	-	-	-	-	-
		ES Homes Subtotal	**45.5**	**45.5**	**45.5**	**889.0**	**889.0**	**889.0**	**10.8**	**10.8**	**10.8**	**18.2**	**18.2**	**18.2**	**1,046.3**	**1,046.3**	**1,046.3**	**23,755.0**	**23,755.0**	**23,755.0**

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
A2a - Home Performance (	Air Sealing, Cord Wood	EA2a001	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Electric	EA2a002	15	15	15	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	7.1	7.1	7.1	106.9	106.9	106.9	1.1	1.1	1.1	1.9	1.9	1.9	-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Gas	EA2a003	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Kerosene	EA2a004	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Oil	EA2a005	25	25	25	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	141.1	141.1	141.1	2,116.1	2,116.1	2,116.1
A2a - Home Performance (	Air Sealing, Propane	EA2a006	25	25	25	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	141.1	141.1	141.1	2,116.1	2,116.1	2,116.1
A2a - Home Performance (	Air Sealing, Wood Pellets	EA2a007	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Cord Wood	EA2a070	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Electric	EA2a071	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Gas	EA2a072	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Kerosene	EA2a073	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Oil	EA2a074	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Propane	EA2a075	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Sealing, Wood Pellets	EA2a076	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Electric	EA2a009	5	5	5	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%	0.1	0.1	0.1	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Gas	EA2a010	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Kerosene	EA2a011	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Faucet Aerator, Oil	EA2a012	5	5	5	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	0.9	0.9	0.9	6.3	6.3	6.3
A2a - Home Performance (	Faucet Aerator, Propane	EA2a013	5	5	5	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	0.9	0.9	0.9	6.3	6.3	6.3
A2a - Home Performance (	Tank Wrap, Electric	EA2a077	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Gas	EA2a078	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Kerosene	EA2a079	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Oil	EA2a080	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Tank Wrap, Propane	EA2a081	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Electric	EA2a016	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Gas	EA2a017	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Kerosene	EA2a018	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Oil	EA2a019	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hand Held Showerhead, Propane	EA2a020	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Cord Wood	EA2a022	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Electric	EA2a023	15	15	15	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%	28.5	28.5	28.5	712.8	712.8	712.8	4.5	4.5	4.5	7.5	7.5	7.5	-	-	-	-	-	-
A2a - Home Performance (	Insulation, Gas	EA2a024	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Kerosene	EA2a025	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Oil	EA2a026	25	25	25	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%	1.2	1.2	1.2	29.7	29.7	29.7	-	-	-	0.7	0.7	0.7	564.3	564.3	564.3	14,107.5	14,107.5	14,107.5
A2a - Home Performance (	Insulation, Propane	EA2a027	25	25	25	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%	1.2	1.2	1.2	29.7	29.7	29.7	-	-	-	0.7	0.7	0.7	564.3	564.3	564.3	14,107.5	14,107.5	14,107.5
A2a - Home Performance (	Insulation, Wood Pellets	EA2a028	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Cord Wood	EA2a063	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Electric	EA2a064	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Gas	EA2a065	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Kerosene	EA2a066	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Oil	EA2a067	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Propane	EA2a068	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Wood Pellets	EA2a069	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Electric	EA2a030	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Gas	EA2a031	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Kerosene	EA2a032	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Oil	EA2a033	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Propane	EA2a034	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Electric	EA2a037	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Gas	EA2a038	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Kerosene	EA2a039	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Oil	EA2a040	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Propane	EA2a041	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Electric	EA2a042	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Gas	EA2a059	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Kerosene	EA2a060	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Oil	EA2a061	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback, Propane	EA2a062	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	DHW Heat Pump Water Heater	EA2a043	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Indirect Water Heater, Oil	EA2a082	-	-	-	13	13	13	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Indirect Water Heater, Propane	EA2a083	-	-	-	13	13	13	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, General Service Lamps	EA2a044	150	150	150	1	1	1	100%	100%	100%	99%	99%	99%	96%	96%	96%	5.0	5.0	5.0	5.0	5.0	5.0	1.1	1.1	1.1	0.7	0.7	0.7	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)
A2a - Home Performance (	LED Bulb, Linear	EA2a045	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Other Specialty	EA2a046	75	75	75	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%	3.6	3.6	3.6	7.2	7.2	7.2	0.8	0.8	0.8	0.5	0.5	0.5	(8.5)	(8.5)	(8.5)	(17.1)	(17.1)	(17.1)
A2a - Home Performance (	LED Bulb, Reflector	EA2a047	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Fixture	EA2a048	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Refrigerator	EA2a049	10	10	10	12	12	12	100%	100%	100%	99%	99%	99%	96%	96%	96%	2.9	2.9	2.9	34.2	34.2	34.2	0.3	0.3	0.3	0.4	0.4	0.4	-	-	-	-	-	-
A2a - Home Performance (	Freezer	EA2a053	-	-	-	12	12	12	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Clothes Washer	EA2a054	-	-	-	11	11	11	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Clothes Dryer	EA2a055	-	-	-	12	12	12	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Dehumidifier	EA2a056	-	-	-	12	12	12	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Room Air Conditioner	EA2a057	-	-	-	9	9	9	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Triple Pane Window	EA2a058	-	-	-				100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Cord Wood	EA2a084	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Electric	EA2a085	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Gas	EA2a086	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Kerosene	EA2a087	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Oil	EA2a088	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Propane	EA2a089	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Window Insert, Wood Pellets	EA2a090	-	-	-	4	4	4	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Oil Savings	EA2a050	-	-	-	14	14	14	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Propane Savings	EA2a051	-	-	-	14	14	14	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Visual Audit Electric Savings	EA2a052	-	-	-	5	5	5	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Electric (Multifamily)	EA2a091	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Gas (Multifamily)	EA2a092	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Oil (Multifamily)	EA2a093	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Air Sealing, Propane (Multifamily)	EA2a094	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Electric (Multifamily)	EA2a095	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Gas (Multifamily)	EA2a096	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-

Subprogram	Measure	Measure ID	Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
			2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (	Insulation, Oil (Multifamily)	EA2a097	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Insulation, Propane (Multifamily)	EA2a098	-	-	-	25	25	25	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, General Service Lamps (Multifamily)	EA2a099	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Linear (Multifamily)	EA2a100	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Other Specialty (Multifamily)	EA2a101	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Reflector (Multifamily)	EA2a102	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	LED Fixture (Multifamily)	EA2a103	-	-	-	2	2	2	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2a - Home Performance (	Refrigerator (Multifamily)	EA2a104	-	-	-	12	12	12	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Gas	EA2b001	-	-	-	19	19	19	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Kerosene	EA2b002	-	-	-	19	19	19	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Oil	EA2b003	-	-	-	19	19	19	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Boiler Replacement, Propane	EA2b004	-	-	-	19	19	19	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Gas	EA2b005	-	-	-	17	17	17	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Kerosene	EA2b006	-	-	-	17	17	17	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Oil	EA2b007	-	-	-	17	17	17	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Propane	EA2b008	-	-	-	17	17	17	100%	100%	100%	99%	99%	99%	100%	100%	100%													-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Electric	EA2b009	10	10	10	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	2.4	2.4	2.4	35.8	35.8	35.8	1.8	1.8	1.8	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Gas	EA2b010	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Kerosene	EA2b011	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Oil	EA2b012	10	10	10	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	23.4	23.4	23.4	350.4	350.4	350.4
A2b - Home Performance (	Programmable Thermostat, Propane	EA2b013	5	5	5	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	11.6	11.6	11.6	174.4	174.4	174.4
A2b - Home Performance (	Programmable Thermostat, Wood Pellets	EA2b014	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Electric	EA2b015	5	5	5	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	2.0	2.0	2.0	29.9	29.9	29.9	-	-	-	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Gas	EA2b016	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Kerosene	EA2b017	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Wifi Thermostat, Oil	EA2b018	5	5	5	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	33.3	33.3	33.3	499.4	499.4	499.4
A2b - Home Performance (	Wifi Thermostat, Propane	EA2b019	5	5	5	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%	-	-	-	-	-	-	-	-	-	-	-	-	32.7	32.7	32.7	490.9	490.9	490.9
A2b - Home Performance (	Wifi Thermostat, Wood Pellets	EA2b020	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	ES Central AC	EA2b021	-	-	-	18	18	18	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Boiler Circulator Pump	EA2b022	25	25	25	19	19	19	100%	100%	100%	99%	99%	99%	96%	96%	96%	2.0	2.0	2.0	38.8	38.8	38.8	0.6	0.6	0.6	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Furnace	EA2b023	5	5	5	18	18	18	100%	100%	100%	99%	99%	99%	96%	96%	96%	0.0	0.0	0.0	0.8	0.8	0.8	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Central AC	EA2b024	10	10	10	18	18	18	100%	100%	100%	99%	99%	99%	96%	96%	96%	0.5	0.5	0.5	8.6	8.6	8.6	-	-	-	0.3	0.3	0.3	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Room AC	EA2b025	20	20	20	18	18	18	100%	100%	100%	99%	99%	99%	96%	96%	96%	0.8	0.8	0.8	13.7	13.7	13.7	-	-	-	0.4	0.4	0.4	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Mini-Split AC / HP	EA2b026	-	-	-	18	18	18	100%	100%	100%	99%	99%	99%	96%	96%	96%													-	-	-	-	-	-
	Home Performance with Energy Star Subtotal																	**57.3**	**57.3**	**57.3**	**1,053.7**	**1,053.7**	**1,053.7**	**10.2**	**10.2**	**10.2**	**13.0**	**13.0**	**13.0**	**1,493.1**	**1,493.1**	**1,493.1**	**33,946.1**	**33,946.1**	**33,946.1**

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026
A3b - ES Appliances and P	LED Bulb, General Service Lamps	EA3a001	20,000	20,000	20,000	1	1	1	23%	23%	23%	86%	86%	86%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Linear	EA3a002	-	-	-	7	7	7	23%	23%	23%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Other Specialty	EA3a003	1,000	1,000	1,000	3	3	3	23%	23%	23%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Reflector	EA3a004	5,000	5,000	5,000	1	1	1	23%	23%	23%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, General Service Lamps (Hard to Reach)	EA3a005	-	-	-	1	1	1	43%	43%	43%	86%	86%	86%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Linear (Hard to Reach)	EA3a006	-	-	-	7	7	7	43%	43%	43%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Other Specialty (Hard to Reach)	EA3a007	-	-	-	3	3	3	43%	43%	43%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Bulb, Reflector (Hard to Reach)	EA3a008	-	-	-	1	1	1	43%	43%	43%	89%	89%	89%	100%	100%	100%
A3b - ES Appliances and P	LED Fixture	EA3a009	125	125	125	3	3	3	23%	23%	23%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	LED Fixture (Hard to Reach)	EA3a010	-	-	-	3	3	3	43%	43%	43%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Advanced Power Strip, Tier I	EA3b001	5	5	5	5	5	5	100%	100%	100%	83%	83%	83%	92%	92%	92%
A3b - ES Appliances and P	Advanced Power Strip, Tier II	EA3b002	5	5	5	5	5	5	100%	100%	100%	83%	83%	83%	92%	92%	92%
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (cooling)	EA3b003	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Air Source Heat Pump - Lost Opportunity (heating)	EA3b004	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (cooling)	EA3b005	500	500	500	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Mini Split HP - Lost Opportunity (heating)	EA3b006	500	500	500	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Downstream	EA3b007	50	50	50	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Downstream	EA3b008	10	10	10	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Heat Pump Swimming Pool Heater	EA3b009	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Clothes Dryers	EA3b010	150	150	150	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Dryer Heat Pump	EA3b011	10	10	10	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Dryer Hybrid	EA3b012	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ECM Motor for FWH Circulating Pump	EA3b013	-	-	-	15	15	15	69%	69%	69%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	ES AC (central) 3 ton	EA3b015	30	30	30	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Room Air Conditioner	EA3b016	100	100	100	9	9	9	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Clothes Washers	EA3b017	150	150	150	11	11	11	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Washer Tier CEE Tier 2+	EA3b018	75	75	75	11	11	11	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Dehumidifier	EA3b019	150	150	150	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Dishwasher	EA3b020	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Freezers	EA3b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Refrigerator	EA3b022	150	150	150	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Refrigerator CEE Tier 2+	EA3b023	50	50	50	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	ES Pool Pumps (Variable Speed)	EA3b024	40	30	25	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Room Air Purifier	EA3b025	100	100	100	9	9	9	100%	100%	100%	97%	97%	97%	100%	100%	100%
A3c - ES HVAC Systems	Wifi Thermostat (Heating & Cooling)	EA3b026	50	50	50	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Primary Refrigerator Recycling	EA3b027	100	100	100	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Secondary Refrigerator Recycling	EA3b028	50	50	50	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Secondary Freezer Recycling	EA3b029	50	50	50	4	4	4	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Room Air Conditioner Recycling	EA3b030	300	300	300	3	3	3	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3b - ES Appliances and P	Dehumidifier Recycling	EA3b037	150	150	150	4	4	4	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit Resistance	EA3b031	2	4	5	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Ductless Mini-split Heat Pump - Retrofit HP	EA3b032	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit HP	EA3b033	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Air-source Heat Pump – Retrofit Resistance	EA3b034	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Heat Pump Water Heater, <55 gal - Midstream	EA3b035	-	-	-	15	15	15	77%	77%	77%	100%	100%	100%	100%	100%	100%
A3c - ES HVAC Systems	Heat Pump Water Heater, >55 gal - Midstream	EA3b036	-	-	-	15	15	15	77%	77%	77%	100%	100%	100%	100%	100%	100%
	ES Products Subtotal																

Measure ID	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
EA3a001	121.4	121.4	121.4	121.4	121.4	121.4	26.2	26.2	26.2	16.9	16.9	16.9	(275.9)	(275.9)	(275.9)	(275.9)	(275.9)	(275.9)
EA3a002													-	-	-	-	-	-
EA3a003	5.5	5.5	5.5	16.5	16.5	16.5	1.2	1.2	1.2	0.8	0.8	0.8	(12.5)	(12.5)	(12.5)	(37.4)	(37.4)	(37.4)
EA3a004	33.8	33.8	33.8	33.8	33.8	33.8	7.3	7.3	7.3	4.7	4.7	4.7	(76.7)	(76.7)	(76.7)	(76.7)	(76.7)	(76.7)
EA3a005													-	-	-	-	-	-
EA3a006													-	-	-	-	-	-
EA3a007													-	-	-	-	-	-
EA3a008													-	-	-	-	-	-
EA3a009	0.8	0.8	0.8	2.3	2.3	2.3	0.7	0.7	0.7	0.5	0.5	0.5	(1.7)	(1.7)	(1.7)	(5.2)	(5.2)	(5.2)
EA3a010													-	-	-	-	-	-
EA3b001	0.4	0.4	0.4	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
EA3b002	0.8	0.8	0.8	4.0	4.0	4.0	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
EA3b003													-	-	-	-	-	-
EA3b004													-	-	-	-	-	-
EA3b005	46.3	46.3	46.3	833.3	833.3	833.3	-	-	-	21.4	21.4	21.4	-	-	-	-	-	-
EA3b006	142.1	142.1	142.1	2,558.2	2,558.2	2,558.2	64.6	64.6	64.6	-	-	-	-	-	-	-	-	-
EA3b007	48.1	48.1	48.1	720.8	720.8	720.8	7.9	7.9	7.9	4.4	4.4	4.4	107.5	107.5	107.5	1,611.8	1,611.8	1,611.8
EA3b008	5.7	5.7	5.7	84.8	84.8	84.8	0.9	0.9	0.9	0.5	0.5	0.5	21.5	21.5	21.5	322.4	322.4	322.4
EA3b009													-	-	-	-	-	-
EA3b010	24.1	24.1	24.1	288.7	288.7	288.7	4.1	4.1	4.1	3.2	3.2	3.2	-	-	-	-	-	-
EA3b011	4.2	4.2	4.2	50.5	50.5	50.5	0.7	0.7	0.7	0.6	0.6	0.6	-	-	-	-	-	-
EA3b012													-	-	-	-	-	-
EA3b013													-	-	-	-	-	-
EA3b015	5.6	5.6	5.6	100.1	100.1	100.1	-	-	-	3.1	3.1	3.1	-	-	-	-	-	-
EA3b016	3.6	3.6	3.6	32.4	32.4	32.4	-	-	-	1.9	1.9	1.9	-	-	-	-	-	-
EA3b017	13.5	13.5	13.5	148.3	148.3	148.3	1.9	1.9	1.9	1.8	1.8	1.8	10.5	10.5	10.5	115.5	115.5	115.5
EA3b018	10.4	10.4	10.4	114.6	114.6	114.6	1.5	1.5	1.5	1.4	1.4	1.4	36.0	36.0	36.0	396.0	396.0	396.0
EA3b019	12.3	12.3	12.3	148.1	148.1	148.1	0.5	0.5	0.5	2.4	2.4	2.4	-	-	-	-	-	-
EA3b020													-	-	-	-	-	-
EA3b021													-	-	-	-	-	-
EA3b022	6.6	6.6	6.6	79.6	79.6	79.6	0.8	0.8	0.8	0.9	0.9	0.9	-	-	-	-	-	-
EA3b023	4.8	4.8	4.8	57.8	57.8	57.8	0.6	0.6	0.6	0.7	0.7	0.7	-	-	-	-	-	-
EA3b024	6.3	4.7	3.9	37.8	28.4	23.6	-	-	-	3.6	2.7	2.3	-	-	-	-	-	-
EA3b025	69.2	69.2	69.2	622.4	622.4	622.4	7.9	7.9	7.9	7.9	7.9	7.9	-	-	-	-	-	-
EA3b026	2.3	2.3	2.3	34.5	34.5	34.5	0.4	0.4	0.4	0.6	0.6	0.6	246.0	246.0	246.0	3,690.0	3,690.0	3,690.0
EA3b027	100.5	100.5	100.5	502.5	502.5	502.5	11.5	11.5	11.5	14.1	14.1	14.1	-	-	-	-	-	-
EA3b028	50.3	50.3	50.3	251.3	251.3	251.3	4.7	4.7	4.7	7.9	7.9	7.9	-	-	-	-	-	-
EA3b029	37.7	37.7	37.7	150.6	150.6	150.6	4.7	4.7	4.7	6.4	6.4	6.4	-	-	-	-	-	-
EA3b030	33.9	33.9	33.9	101.7	101.7	101.7	-	-	-	24.6	24.6	24.6	-	-	-	-	-	-
EA3b037	75.0	75.0	75.0	300.0	300.0	300.0	3.0	3.0	3.0	14.4	14.4	14.4	-	-	-	-	-	-
EA3b031	10.1	20.2	25.2	181.4	362.8	453.5	4.6	9.2	11.5	2.1	4.3	5.4	-	-	-	-	-	-
EA3b032													-	-	-	-	-	-
EA3b033													-	-	-	-	-	-
EA3b034													-	-	-	-	-	-
EA3b035													-	-	-	-	-	-
EA3b036													-	-	-	-	-	-
ES Products Subtotal	**875.0**	**883.6**	**887.8**	**7,579.3**	**7,751.3**	**7,837.3**	**155.7**	**160.3**	**162.6**	**146.6**	**147.8**	**148.4**	**54.6**	**54.6**	**54.6**	**5,740.4**	**5,740.4**	**5,740.4**

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Compressed Air Retro	EC1a001	1	1	1	10	10	10	100%	100%	100%	100%	100%	100%	90%	90%	90%	45.0	45.0	45.0	450.0	450.0	450.0	5.0	5.0	5.0	5.0	5.0	5.0	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Hot Water Retro	EC1a002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large HVAC Retro	EC1a003	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	13.5	13.5	13.5	202.5	202.5	202.5	2.0	2.0	2.0	1.6	1.6	1.6	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Interior	EC1a004	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Exterior	EC1a047	4	4	4	8	7	6	94%	94%	94%	100%	100%	100%	100%	100%	100%	187.8	187.8	187.8	1,502.5	1,314.7	1,126.9	37.6	37.6	37.6	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Lighting Retro - Controls	EC1a048	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Motors Retro	EC1a005	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	18.0	18.0	18.0	270.0	270.0	270.0	0.7	0.7	0.7	0.7	0.7	0.7	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Process Retro	EC1a006	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	36.0	36.0	36.0	540.0	540.0	540.0	5.2	5.2	5.2	5.5	5.5	5.5	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Refrigeration Retro	EC1a007	1	1	1	10	10	10	100%	100%	100%	100%	100%	100%	90%	90%	90%	45.0	45.0	45.0	450.0	450.0	450.0	5.0	5.0	5.0	4.5	4.5	4.5	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Other Retro	EC1a008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1a - LCI Retrofit	Daylight Dimming	EC1a009	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC1a010	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC1a011	500	500	500	5	5	3	94%	94%	94%	100%	100%	100%	100%	100%	100%	469.5	469.5	469.5	2,347.7	2,347.7	1,408.6	94.0	94.0	94.0	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/ Controls	EC1a012	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Lighting Fixture - Interior w/o Controls	EC1a013	5,500	5,500	5,500	5	5	3	94%	94%	94%	100%	100%	100%	100%	100%	100%	1,549.4	1,549.4	1,549.4	7,747.2	7,747.2	4,648.3	120.7	120.7	120.7	156.3	156.3	156.3	(1,071.7)	(1,071.7)	(1,071.7)	(5,358.7)	(5,358.7)	(3,215.2)
C1a - LCI Retrofit	Lighting Occupancy Sensors	EC1a014	500	500	500	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%	23.5	23.5	23.5	211.3	211.3	211.3	0.3	0.3	0.3	0.3	0.3	0.3	(64.1)	(64.1)	(64.1)	(577.0)	(577.0)	(577.0)
C1a - LCI Retrofit	Case Motor Replacement	EC1a016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Cooler Night Cover	EC1a017	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Demand Control Ventilation	EC1a018	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Door Heater Controls	EC1a019	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC1a020	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Duct Sealing, Electric	EC1a021	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Ductless Mini Split Heat Pump	EC1a022	4	4	4	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%	0.8	0.8	0.8	9.6	9.6	9.6	-	-	-	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC1a023	10	10	10	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%	4.0	4.0	4.0	59.9	59.9	59.9	-	-	-	-	-	-	-	-	-	-	-	-
C1a - LCI Retrofit	Electronic Defrost Control	EC1a024	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Management System, Electric	EC1a025	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Star Wifi Thermostat, Electric	EC1a026	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Evaporator Fan Control	EC1a027	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Faucet Aerator, Electric	EC1a028	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Hotel Occupancy Sensor	EC1a031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Low Pressure Drop Filter	EC1a032	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC1a033	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Low-Flow Showerhead, Electric	EC1a034	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Open Drip	EC1a035	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC1a036	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Novelty Cooler Shutoff	EC1a037	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Heating, Electric	EC1a038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Hot Water, Electric	EC1a039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Pre Rinse Spray Valve, Electric	EC1a040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Programmable Thermostat, Electric	EC1a041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Steam Trap, Electric	EC1a042	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive	EC1a043	15	15	15	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%	496.7	496.7	496.7	7,449.8	7,449.8	7,449.8	29.1	29.1	29.1	26.0	26.0	26.0	-	-	-	-	-	-
C1a - LCI Retrofit	Variable Frequency Drive with Motor	EC1a044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C1a - LCI Retrofit	Vending Miser	EC1a045	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Zero Loss Condensate Drain	EC1a046	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Large Retrocommissioning	EC1a049	-	-	-	3	3	3	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1a - LCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC1a050	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Compressed Air New	EC1b001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Hot Water New	EC1b002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large HVAC New	EC1b003	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Lighting New - Interior	EC1b004	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Lighting New - Exterior	EC1b054	4	4	4	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%	375.6	375.6	375.6	5,634.4	5,634.4	5,634.4	75.2	75.2	75.2	-	-	-	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Lighting New - Controls	EC1b055	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Motors New	EC1b005	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Process New	EC1b006	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Refrigeration New	EC1b007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Other New	EC1b008	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	22.5	22.5	22.5	337.5	337.5	337.5	2.4	2.4	2.4	2.3	2.3	2.3	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Comprehensive Design	EC1b056	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1b - LCI New Equipment	Daylight Dimming	EC1b009	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Exterior w/ Controls	EC1b010	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Exterior w/o Controls	EC1b011	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Interior w/ Controls	EC1b012	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Performance Lighting - Interior w/o Controls	EC1b013	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Lighting Occupancy Sensors	EC1b014	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Advanced Power Strip	EC1b015	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Air Compressor	EC1b016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Air Nozzle	EC1b017	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Circulator Pump	EC1b018	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Combination Oven, Electric	EC1b019	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Compressor Storage	EC1b020	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Convection Oven, Electric	EC1b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Door Type	EC1b022	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Multi Tank Conveyor	EC1b023	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Pot, Pan, Utensil	EC1b024	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Single Tank Conveyor	EC1b025	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - High Temp Under Counter	EC1b026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Door Type	EC1b027	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Multi Tank Conveyor	EC1b028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Single Tank Conveyor	EC1b029	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Dishwasher - Low Temp Under Counter	EC1b030	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Faucet Aerator, Electric	EC1b031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Fryer Large Vat, Electric	EC1b032	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Fryer Standard Vat, Electric	EC1b033	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Griddle, Electric	EC1b034	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Ground Source Heat Pump	EC1b035	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet 3/4 Size	EC1b036	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet Full Size	EC1b037	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Hot Food Holding Cabinet Half Size	EC1b038	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Ice Making Head	EC1b039	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
C1b - LCI New Equipment	Ice Machine - Remote Cond./Split Unit - Batch	EC1b040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Remote Cond./Split Unit - Continuous	EC1b041	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Ice Machine - Self Contained	EC1b042	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Low Pressure Drop Filter	EC1b043	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Thermostatic Shut-Off Valve, Electric	EC1b044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Low-Flow Showerhead, Electric	EC1b045	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Pre Rinse Spray Valve, Electric	EC1b046	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Refrigerated Air Dryer	EC1b047	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Steam Cooker, Electric	EC1b048	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Unitary Air Conditioner	EC1b049	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Water Source Heat Pump	EC1b050	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Zero Loss Condensate Drain	EC1b051	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	High Efficiency Chiller - FL	EC1b052	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C1b - LCI New Equipment	High Efficiency Chiller - IPLV	EC1b053	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C1b - LCI New Equipment	C&I Large New Construction Code Compliance	EC1b057	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	36%	36%	36%													-	-	-	-	-	-
C1b - LCI New Equipment	Induction Cooktop Displacing Electric Resistance	EC1b058	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1b - LCI New Equipment	Compressed Air Leak Detection	EC1b059	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Circulator Pump	EC1c001	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Demand Control Ventilation	EC1c002	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream DMSHP Systems	EC1c003	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC1c004	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream ECM Fan Motors	EC1c005	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Systems	EC1c006	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Unitary Air Conditioners	EC1c007	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream VRF	EC1c008	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Water Source Heat Pump Systems	EC1c009	-	-	-	25	25	25	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Downlight	EC1c010	400	400	400	1	1	1	84%	84%	84%	86%	86%	86%	127%	127%	127%	36.6	36.6	36.6	36.6	36.6	36.6	2.8	2.8	2.8	4.0	4.0	4.0	(9.5)	(9.5)	(9.5)	(9.5)	(9.5)	(9.5)
C1c - LCI Midstream	Midstream LED Exterior	EC1c011	40	40	40	5	5	5	84%	84%	84%	96%	96%	96%	99%	99%	99%	31.7	31.7	31.7	158.7	158.7	158.7	6.4	6.4	6.4	-	-	-	-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED High Bay/Low Bay	EC1c012	50	50	50	7	7	7	84%	84%	84%	100%	100%	100%	75%	75%	75%	54.7	54.7	54.7	382.8	382.8	382.8	9.5	9.5	9.5	12.2	12.2	12.2	(11.9)	(11.9)	(11.9)	(83.0)	(83.0)	(83.0)
C1c - LCI Midstream	Midstream LED Linear Fixture	EC1c013	400	400	400	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%	37.0	37.0	37.0	222.2	222.2	222.2	4.2	4.2	4.2	5.4	5.4	5.4	(5.3)	(5.3)	(5.3)	(31.7)	(31.7)	(31.7)
C1c - LCI Midstream	Midstream LED Linear Fixture with Controls	EC1c014	-	-	-	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream LED Linear Lamp	EC1c015	400	400	400	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%	25.9	25.9	25.9	155.5	155.5	155.5	3.0	3.0	3.0	3.8	3.8	3.8	(3.7)	(3.7)	(3.7)	(22.2)	(22.2)	(22.2)
C1c - LCI Midstream	Midstream LED Screw In	EC1c016	200	200	200	1	1	1	73%	73%	73%	71%	71%	71%	171%	171%	171%	16.1	16.1	16.1	16.1	16.1	16.1	0.9	0.9	0.9	1.3	1.3	1.3	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)
C1c - LCI Midstream	Midstream LED Stairwell Kit	EC1c017	50	50	50	5	5	5	84%	84%	84%	96%	96%	96%	99%	99%	99%	2.4	2.4	2.4	11.9	11.9	11.9	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Combination Oven, Electric	EC1c018	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Convection Oven, Electric	EC1c019	4	4	4	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	6.9	6.9	6.9	82.6	82.6	82.6	1.4	1.4	1.4	1.4	1.4	1.4	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Conveyor Broiler	EC1c047	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Deck Oven, Electric	EC1c050	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Door Type	EC1c020	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Multi Tank Convey	EC1c021	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC1c022	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Single Tank Conve	EC1c023	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC1c024	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC1c025	5	5	5	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%	69.5	69.5	69.5	1,041.9	1,041.9	1,041.9	9.5	9.5	9.5	9.5	9.5	9.5	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Convey	EC1c026	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conve	EC1c027	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC1c028	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Solid Door	EC1c029	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Freezer - Glass Door	EC1c030	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Large Vat, Electric	EC1c031	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer Standard Vat, Electric	EC1c032	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Griddle, Electric	EC1c033	1	1	1	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	2.7	2.7	2.7	32.8	32.8	32.8	0.6	0.6	0.6	0.6	0.6	0.6	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hand-Wrap Machine	EC1c051	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream High Efficiency Condensing Unit	EC1c052	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC1c034	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC1c035	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC1c036	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Ice Making Head	EC1c037	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC1c038	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Contin	EC1c039	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ice Machine Self Contained	EC1c040	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerated Chef Base	EC1c053	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Glass Door	EC1c041	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Refrigerator - Solid Door	EC1c042	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Steam Cooker, Electric	EC1c043	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Ultra Low-Temp Freezer	EC1c048	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC1c044	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC1c045	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC1c046	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Room Air Purifier	EC1c054	-	-	-	3	3	3	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 1	EC1c055	-	-	-	5	5	5	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Smart Strip, Tier 2	EC1c056	-	-	-	5	5	5	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead, Electric	EC1c057	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, E	EC1c058	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC1c059	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Faucet Aerator, Electric	EC1c060	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pipe Wrap, Electric	EC1c061	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC1c062	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	OMP ES Dehumidifier	EC1c063	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Induction Cooktop Displacing Electric Resist	EC1c064	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Compressed Air Direct Install	EC1d001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Hot Water Direct Install	EC1d002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large HVAC Direct Install	EC1d003	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Interior	EC1d004	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Exterior	EC1d005	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Lighting Direct Install - Controls	EC1d006	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Motors Direct Install	EC1d007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Process Direct Install	EC1d008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Custom Large Refrigeration Direct Install	EC1d009	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1d - LCI Direct Install	Custom Large Other Direct Install	EC1d010	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C1d - LCI Direct Install	Daylight Dimming	EC1d011	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC1d012	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC1d013	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/ Controls	EC1d014	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Fixture - Interior w/o Controls	EC1d015	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Lighting Occupancy Sensors	EC1d016	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Case Motor Replacement	EC1d018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Cooler Night Cover	EC1d019	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Demand Control Ventilation	EC1d020	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Door Heater Controls	EC1d021	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC1d022	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Duct Sealing, Electric	EC1d023	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Ductless Mini Split Heat Pump	EC1d024	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC1d025	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Electronic Defrost Control	EC1d026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Management System, Electric	EC1d027	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Energy Star Wifi Thermostat, Electric	EC1d028	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Evaporator Fan Control	EC1d029	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Faucet Aerator, Electric	EC1d030	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Hotel Occupancy Sensor	EC1d031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Low Pressure Drop Filter	EC1d032	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC1d033	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Low-Flow Showerhead, Electric	EC1d034	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Open Drip	EC1d035	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC1d036	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Novelty Cooler Shutoff	EC1d037	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Heating, Electric	EC1d038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Pipe Wrap - Hot Water, Electric	EC1d039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Pre Rinse Spray Valve, Electric	EC1d040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Programmable Thermostat, Electric	EC1d041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Steam Trap, Electric	EC1d042	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive	EC1d043	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C1d - LCI Direct Install	Variable Frequency Drive with Motor	EC1d044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C1d - LCI Direct Install	Vending Miser	EC1d045	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Zero Loss Condensate Drain	EC1d046	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C1d - LCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC1d047	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
	Large Business Energy Solutions Subtota																	**3,570.8**	**3,570.8**	**3,570.8**	**29,353.3**	**29,165.5**	**24,939.7**	**415.9**	**415.9**	**415.9**	**240.9**	**240.9**	**240.9**	**(1,169.3)**	**(1,169.3)**	**(1,169.3)**	**(6,085.2)**	**(6,085.2)**	**(3,941.7)**

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Custom Small Compressed Air Retro	EC2a001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Hot Water Retro	EC2a002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small HVAC Retro	EC2a003	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	3.8	3.8	3.8	57.4	57.4	57.4	0.6	0.6	0.6	0.5	0.5	0.5	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Interior	EC2a004	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Exterior	EC2a047	4	4	4	5	4	3	94%	94%	94%	100%	100%	100%	103%	103%	103%	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Lighting Retro - Controls	EC2a048	75	75	75	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%	0.4	0.4	0.4	3.2	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	(1.3)	(1.3)	(1.3)	(11.3)	(11.3)	(11.3)
C2a - SCI Retrofit	Custom Small Motors Retro	EC2a005	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	2.5	2.5	2.5	37.1	37.1	37.1	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Process Retro	EC2a006	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Refrigeration Retro	EC2a007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Other Retro	EC2a008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2a - SCI Retrofit	Daylight Dimming	EC2a009	150	150	150	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%	2.8	2.8	2.8	25.4	25.4	25.4	0.0	0.0	0.0	0.0	0.0	0.0	(11.5)	(11.5)	(11.5)	(103.6)	(103.6)	(103.6)
C2a - SCI Retrofit	Lighting Fixture - Exterior w/ Controls	EC2a010	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Exterior w/o Controls	EC2a011	400	400	400	5	5	5	94%	94%	94%	100%	100%	100%	103%	103%	103%	231.7	231.7	231.7	1,158.5	1,158.5	1,158.5	45.1	45.1	45.1	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/ Controls	EC2a012	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2a - SCI Retrofit	Lighting Fixture - Interior w/o Controls	EC2a013	8,000	8,000	8,000	5	5	5	94%	94%	94%	100%	100%	100%	107%	107%	107%	1,402.9	1,402.9	1,402.9	7,014.3	7,014.3	7,014.3	102.4	102.4	102.4	150.6	150.6	150.6	(909.4)	(909.4)	(909.4)	(4,546.8)	(4,546.8)	(4,546.8)
C2a - SCI Retrofit	Lighting Occupancy Sensors	EC2a014	150	150	150	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%	8.5	8.5	8.5	76.1	76.1	76.1	0.1	0.1	0.1	0.2	0.2	0.2	(34.5)	(34.5)	(34.5)	(310.7)	(310.7)	(310.7)
C2a - SCI Retrofit	Case Motor Replacement	EC2a016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Cooler Night Cover	EC2a017	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Demand Control Ventilation	EC2a018	1	1	1	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%	0.1	0.1	0.1	1.3	1.3	1.3	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Door Heater Controls	EC2a019	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC2a020	1	1	1	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%	2.0	2.0	2.0	20.0	20.0	20.0	-	-	-	0.7	0.7	0.7	-	-	-	-	-	-
C2a - SCI Retrofit	Duct Sealing, Electric	EC2a021	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Ductless Mini Split Heat Pump	EC2a022	10	10	10	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%	10.0	10.0	10.0	120.0	120.0	120.0	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC2a023	6	6	6	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%	2.6	2.6	2.6	38.3	38.3	38.3	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Electronic Defrost Control	EC2a024	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Management System, Electric	EC2a025	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Star Wifi Thermostat, Electric	EC2a026	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Evaporator Fan Control	EC2a027	2	2	2	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%	5.5	5.5	5.5	55.0	55.0	55.0	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Faucet Aerator, Electric	EC2a028	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Hotel Occupancy Sensor	EC2a031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Low Pressure Drop Filter	EC2a032	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Thermostatic Shut-Off Valve, Electric	EC2a033	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Low-Flow Showerhead, Electric	EC2a034	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Open Drip	EC2a035	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Motors, Totally Enclosed Fan Cooled	EC2a036	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Novelty Cooler Shutoff	EC2a037	5	5	5	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%	4.5	4.5	4.5	45.0	45.0	45.0	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Heating, Electric	EC2a038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Hot Water, Electric	EC2a039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Pre Rinse Spray Valve, Electric	EC2a040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Programmable Thermostat, Electric	EC2a041	3	3	3	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%	0.5	0.5	0.5	6.8	6.8	6.8	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Steam Trap, Electric	EC2a042	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive	EC2a043	3	3	3	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%	11.4	11.4	11.4	170.3	170.3	170.3	0.7	0.7	0.7	0.6	0.6	0.6	-	-	-	-	-	-
C2a - SCI Retrofit	Variable Frequency Drive with Motor	EC2a044	3	3	3	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%	9.6	9.6	9.6	144.7	144.7	144.7	-	-	-	-	-	-	-	-	-	-	-	-
C2a - SCI Retrofit	Vending Miser	EC2a045	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Zero Loss Condensate Drain	EC2a046	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Small Retrocommissioning	EC2a049	-	-	-	3	3	3	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2a - SCI Retrofit	Induction Cooktop Displacing Electric Resistance	EC2a050	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Compressed Air New	EC2b001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Hot Water New	EC2b002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small HVAC New	EC2b003	3	3	3	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	9.2	9.2	9.2	137.7	137.7	137.7	0.6	0.6	0.6	1.6	1.6	1.6	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Lighting New - Interior	EC2b004	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Lighting New - Exterior	EC2b054	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Lighting New - Controls	EC2b055	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Motors New	EC2b005	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Process New	EC2b006	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Refrigeration New	EC2b007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Other New	EC2b008	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	0.0	0.0	0.0	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Comprehensive Design	EC2b056	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2b - SCI New Equipment	Daylight Dimming	EC2b009	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Exterior w/ Controls	EC2b010	1	1	1	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%	4.8	4.8	4.8	72.4	72.4	72.4	0.9	0.9	0.9	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Exterior w/o Controls	EC2b011	20	20	20	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%	15.4	15.4	15.4	231.7	231.7	231.7	3.0	3.0	3.0	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Performance Lighting - Interior w/ Controls	EC2b012	1	1	1	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%	20.0	20.0	20.0	300.6	300.6	300.6	1.5	1.5	1.5	2.2	2.2	2.2	(3.1)	(3.1)	(3.1)	(45.8)	(45.8)	(45.8)
C2b - SCI New Equipment	Performance Lighting - Interior w/o Controls	EC2b013	400	400	400	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%	120.2	120.2	120.2	1,803.7	1,803.7	1,803.7	8.8	8.8	8.8	12.9	12.9	12.9	(18.3)	(18.3)	(18.3)	(274.6)	(274.6)	(274.6)
C2b - SCI New Equipment	Lighting Occupancy Sensors	EC2b014	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Advanced Power Strip	EC2b015	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Air Compressor	EC2b016	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%	17.5	17.5	17.5	262.5	262.5	262.5	1.7	1.7	1.7	2.0	2.0	2.0	-	-	-	-	-	-
C2b - SCI New Equipment	Air Nozzle	EC2b017	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Circulator Pump	EC2b018	1	1	1	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%	0.9	0.9	0.9	18.5	18.5	18.5	-	-	-	-	-	-	-	-	-	-	-	-
C2b - SCI New Equipment	Combination Oven, Electric	EC2b019	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Compressor Storage	EC2b020	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Convection Oven, Electric	EC2b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Door Type	EC2b022	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Multi Tank Conveyor	EC2b023	1	1	1	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%	27.4	27.4	27.4	548.2	548.2	548.2	3.8	3.8	3.8	3.8	3.8	3.8	-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Pot, Pan, Utensil	EC2b024	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Single Tank Conveyor	EC2b025	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - High Temp Under Counter	EC2b026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Door Type	EC2b027	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Multi Tank Conveyor	EC2b028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Single Tank Conveyor	EC2b029	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Dishwasher - Low Temp Under Counter	EC2b030	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Faucet Aerator, Electric	EC2b031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Fryer Large Vat, Electric	EC2b032	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Fryer Standard Vat, Electric	EC2b033	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Griddle, Electric	EC2b034	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Ground Source Heat Pump	EC2b035	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet 3/4 Size	EC2b036	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet Full Size	EC2b037	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Hot Food Holding Cabinet Half Size	EC2b038	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Ice Making Head	EC2b039	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-

Subprogram	Measure	Measure ID	Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
			2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2b - SCI New Equipment	Ice Machine - Remote Cond./Split Unit - Batch	EC2b040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Remote Cond./Split Unit - Continuous	EC2b041	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Ice Machine - Self Contained	EC2b042	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Low Pressure Drop Filter	EC2b043	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Thermostatic Shut-Off Valve, Electric	EC2b044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Low-Flow Showerhead, Electric	EC2b045	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Pre Rinse Spray Valve, Electric	EC2b046	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Refrigerated Air Dryer	EC2b047	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Steam Cooker, Electric	EC2b048	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Unitary Air Conditioner	EC2b049	20	20	20	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%	15.0	15.0	15.0	180.0	180.0	180.0	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-
C2b - SCI New Equipment	Water Source Heat Pump	EC2b050	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Zero Loss Condensate Drain	EC2b051	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	High Efficiency Chiller - FL	EC2b052	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C2b - SCI New Equipment	High Efficiency Chiller - IPLV	EC2b053	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C2b - SCI New Equipment	C&I Small New Construction Code Compliance	EC2b057	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	36%	36%	36%													-	-	-	-	-	-
C2b - SCI New Equipment	Induction Cooktop Displacing Electric Resistance	EC2b058	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2b - SCI New Equipment	Compressed Air Leak Detection	EC2b059	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Circulator Pump	EC2c001	1	1	1	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.9	0.9	0.9	17.2	17.2	17.2	0.0	0.0	0.0	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Demand Control Ventilation	EC2c002	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream DMSHP Systems	EC2c003	1	1	1	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.6	0.6	0.6	7.5	7.5	7.5	-	-	-	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dual Enthalpy Economizer Controls	EC2c004	1	1	1	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%	1.7	1.7	1.7	17.2	17.2	17.2	-	-	-	0.6	0.6	0.6	-	-	-	-	-	-
C2c - SCI Midstream	Midstream ECM Fan Motors	EC2c005	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Systems	EC2c006	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Unitary Air Conditioners	EC2c007	5	5	5	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	15.1	15.1	15.1	180.6	180.6	180.6	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-
C2c - SCI Midstream	Midstream VRF	EC2c008	3	3	3	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	19.4	19.4	19.4	232.2	232.2	232.2	-	-	-	1.3	1.3	1.3	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Water Source Heat Pump Systems	EC2c009	1	1	1	25	25	25	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.8	0.8	0.8	21.0	21.0	21.0	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED Downlight	EC2c010	1,500	1,500	1,500	1	1	1	84%	84%	84%	86%	86%	86%	127%	127%	127%	164.6	164.6	164.6	164.6	164.6	164.6	12.7	12.7	12.7	18.2	18.2	18.2	(42.7)	(42.7)	(42.7)	(42.7)	(42.7)	(42.7)
C2c - SCI Midstream	Midstream LED Exterior	EC2c011	350	350	350	5	5	5	84%	84%	84%	96%	96%	96%	99%	99%	99%	145.8	145.8	145.8	728.9	728.9	728.9	29.5	29.5	29.5	-	-	-	-	-	-	-	-	-
C2c - SCI Midstream	Midstream LED High Bay/Low Bay	EC2c012	1,560	1,560	1,560	7	7	7	84%	84%	84%	100%	100%	100%	75%	75%	75%	975.0	975.0	975.0	6,824.7	6,824.7	6,824.7	169.7	169.7	169.7	216.7	216.7	216.7	(211.4)	(211.4)	(211.4)	(1,480.0)	(1,480.0)	(1,480.0)
C2c - SCI Midstream	Midstream LED Linear Fixture	EC2c013	800	800	800	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%	92.6	92.6	92.6	555.5	555.5	555.5	10.6	10.6	10.6	13.5	13.5	13.5	(13.2)	(13.2)	(13.2)	(79.3)	(79.3)	(79.3)
C2c - SCI Midstream	Midstream LED Linear Fixture with Controls	EC2c014	7	7	7	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%	1.0	1.0	1.0	5.8	5.8	5.8	0.1	0.1	0.1	0.1	0.1	0.1	(0.1)	(0.1)	(0.1)	(0.8)	(0.8)	(0.8)
C2c - SCI Midstream	Midstream LED Linear Lamp	EC2c015	75	75	75	6	6	6	84%	84%	84%	97%	97%	97%	114%	114%	114%	5.2	5.2	5.2	31.2	31.2	31.2	0.6	0.6	0.6	0.8	0.8	0.8	(0.7)	(0.7)	(0.7)	(4.5)	(4.5)	(4.5)
C2c - SCI Midstream	Midstream LED Screw In	EC2c016	3,000	3,000	3,000	1	1	1	73%	73%	73%	71%	71%	71%	171%	171%	171%	200.8	200.8	200.8	200.8	200.8	200.8	11.5	11.5	11.5	16.4	16.4	16.4	(38.6)	(38.6)	(38.6)	(38.6)	(38.6)	(38.6)
C2c - SCI Midstream	Midstream LED Stairwell Kit	EC2c017	10	10	10	5	5	5	84%	84%	84%	96%	96%	96%	99%	99%	99%	1.2	1.2	1.2	6.0	6.0	6.0	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Combination Oven, Electric	EC2c018	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Convection Oven, Electric	EC2c019	2	2	2	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	3.4	3.4	3.4	41.3	41.3	41.3	0.7	0.7	0.7	0.7	0.7	0.7	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Conveyor Broiler	EC2c047	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Deck Oven, Electric	EC2c050	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Door Type	EC2c020	1	1	1	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%	10.2	10.2	10.2	153.0	153.0	153.0	1.4	1.4	1.4	1.4	1.4	1.4	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Multi Tank Convey	EC2c021	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Pot, Pan, Utensil	EC2c022	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Single Tank Conve	EC2c023	1	1	1	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%	7.9	7.9	7.9	158.4	158.4	158.4	1.1	1.1	1.1	1.1	1.1	1.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - High Temp Under Counter	EC2c024	1	1	1	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%	2.7	2.7	2.7	27.3	27.3	27.3	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Door Type	EC2c025	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Multi Tank Convey	EC2c026	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Single Tank Conve	EC2c027	-	-	-	20	20	20	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Dishwasher - Low Temp Under Counter	EC2c028	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Solid Door	EC2c029	3	3	3	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.5	0.5	0.5	6.6	6.6	6.6	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Freezer - Glass Door	EC2c030	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Large Vat, Electric	EC2c031	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer Standard Vat, Electric	EC2c032	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Griddle, Electric	EC2c033	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hand-Wrap Machine	EC2c051	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream High Efficiency Condensing Unit	EC2c052	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet 3/4 Size	EC2c034	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Full Size	EC2c035	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Hot Food Holding Cabinet Half Size	EC2c036	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Ice Making Head	EC2c037	1	1	1	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%	1.0	1.0	1.0	7.7	7.7	7.7	0.2	0.2	0.2	0.2	0.2	0.2	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Batch	EC2c038	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Remote Cond/Split Unit Contin	EC2c039	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ice Machine Self Contained	EC2c040	2	2	2	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%	1.4	1.4	1.4	11.1	11.1	11.1	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerated Chef Base	EC2c053	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Glass Door	EC2c041	1	1	1	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.2	0.2	0.2	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Refrigerator - Solid Door	EC2c042	2	2	2	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	0.3	0.3	0.3	3.5	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Steam Cooker, Electric	EC2c043	1	1	1	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%	5.6	5.6	5.6	67.6	67.6	67.6	1.8	1.8	1.8	1.8	1.8	1.8	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Ultra Low-Temp Freezer	EC2c048	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 120 gallons	EC2c044	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 50 gallons	EC2c045	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Heat Pump Water Heater, 80 gallons	EC2c046	-	-	-	13	13	13	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Room Air Purifier	EC2c054	-	-	-	3	3	3	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 1	EC2c055	-	-	-	5	5	5	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Smart Strip, Tier 2	EC2c056	-	-	-	5	5	5	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead, Electric	EC2c057	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, E	EC2c058	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Thermostatic Shut-off Valve, Electric	EC2c059	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Faucet Aerator, Electric	EC2c060	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pipe Wrap, Electric	EC2c061	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pre-Rinse Spray Valve, Electric	EC2c062	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	OMP ES Dehumidifier	EC2c063	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Induction Cooktop Displacing Electric Resist	EC2c064	-	-	-	12	12	12	86%	86%	86%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Compressed Air Direct Install	EC2d001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Hot Water Direct Install	EC2d002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small HVAC Direct Install	EC2d003	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Interior	EC2d004	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Exterior	EC2d005	-	-	-	-			94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Lighting Direct Install - Controls	EC2d006	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Motors Direct Install	EC2d007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Process Direct Install	EC2d008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Custom Small Refrigeration Direct Install	EC2d009	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2d - SCI Direct Install	Custom Small Other Direct Install	EC2d010	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C2d - SCI Direct Install	Daylight Dimming	EC2d011	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/ Controls	EC2d012	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Exterior w/o Controls	EC2d013	-	-	-	5	5	5	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Interior w/ Controls	EC2d014	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Fixture - Interior w/o Controls	EC2d015	-	-	-	5	5	5	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C2d - SCI Direct Install	Lighting Occupancy Sensors	EC2d016	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Case Motor Replacement	EC2d018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Cooler Night Cover	EC2d019	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Demand Control Ventilation	EC2d020	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Door Heater Controls	EC2d021	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC2d022	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Duct Sealing, Electric	EC2d023	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Ductless Mini Split Heat Pump	EC2d024	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC2d025	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Electronic Defrost Control	EC2d026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Management System, Electric	EC2d027	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Energy Star Wifi Thermostat, Electric	EC2d028	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Evaporator Fan Control	EC2d029	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Faucet Aerator, Electric	EC2d030	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Hotel Occupancy Sensor	EC2d031	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Low Pressure Drop Filter	EC2d032	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Thermostatic Shut-Off Valve, Electric	EC2d033	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Low-Flow Showerhead, Electric	EC2d034	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Open Drip	EC2d035	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Motors, Totally Enclosed Fan Cooled	EC2d036	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Novelty Cooler Shutoff	EC2d037	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Heating, Electric	EC2d038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Pipe Wrap - Hot Water, Electric	EC2d039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Pre Rinse Spray Valve, Electric	EC2d040	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Programmable Thermostat, Electric	EC2d041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Steam Trap, Electric	EC2d042	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive	EC2d043	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C2d - SCI Direct Install	Variable Frequency Drive with Motor	EC2d044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C2d - SCI Direct Install	Vending Miser	EC2d045	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Zero Loss Condensate Drain	EC2d046	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C2d - SCI Direct Install	Induction Cooktop Displacing Electric Resistance	EC2d047	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
	Small Business Energy Solutions Subtotal																	**3,587.0**	**3,587.0**	**3,587.0**	**22,001.2**	**22,001.2**	**22,001.1**	**410.5**	**410.5**	**410.5**	**451.4**	**451.4**	**451.4**	**(1,284.8)**	**(1,284.8)**	**(1,284.8)**	**(6,938.5)**	**(6,938.5)**	**(6,938.5)**

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026
C3a - Muni Retrofit	Custom Muni Compressed Air Retro	EC3a001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni Hot Water Retro	EC3a002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni HVAC Retro	EC3a003	4	4	4	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni Lighting Retro - Interior	EC3a004	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%
C3a - Muni Retrofit	Custom Muni Lighting Retro - Exterior	EC3a091	-	-	-	-			94%	94%	94%	100%	100%	100%	103%	103%	103%
C3a - Muni Retrofit	Custom Muni Lighting Retro - Controls	EC3a092	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Custom Muni Motors Retro	EC3a005	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni Process Retro	EC3a006	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni Refrigeration Retro	EC3a007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Custom Muni Other Retro	EC3a008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%
C3a - Muni Retrofit	Daylight Dimming	EC3a009	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Lighting Fixture - Exterior w/ Controls	EC3a010	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	103%	103%	103%
C3a - Muni Retrofit	Lighting Fixture - Exterior w/o Controls	EC3a011	100	100	100	5	5	5	94%	94%	94%	100%	100%	100%	103%	103%	103%
C3a - Muni Retrofit	Lighting Fixture - Interior w/ Controls	EC3a012	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	107%	107%	107%
C3a - Muni Retrofit	Lighting Fixture - Interior w/o Controls	EC3a013	1,000	1,000	1,000	5	5	5	94%	94%	94%	100%	100%	100%	107%	107%	107%
C3a - Muni Retrofit	Lighting Occupancy Sensors	EC3a014	25	25	25	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Air Sealing, Electric	EC3a015	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Air Sealing, Gas	EC3a016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Air Sealing, Oil	EC3a017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Air Sealing, Propane	EC3a018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Boiler Reset Controls, Gas	EC3a019	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Boiler Reset Controls, Oil	EC3a020	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Boiler Reset Controls, Propane	EC3a021	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Case Motor Replacement	EC3a022	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Cooler Night Cover	EC3a023	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Demand Control Ventilation	EC3a024	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Door Heater Controls	EC3a025	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Dual Enthalpy Economizer Controls (DEEC)	EC3a026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Insulation, Electric	EC3a027	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Insulation, Gas	EC3a028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Insulation, Oil	EC3a029	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Insulation, Propane	EC3a030	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Sealing, Electric	EC3a031	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Sealing, Gas	EC3a032	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Sealing, Oil	EC3a033	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Duct Sealing, Propane	EC3a034	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Ductless Mini Split Heat Pump	EC3a035	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	ECM Evaporator Fan Motors for Walk-in Cooler/Freeze	EC3a036	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Electronic Defrost Control	EC3a037	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Energy Management System, Electric	EC3a038	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Electric	EC3a039	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Gas	EC3a040	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Oil	EC3a041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Energy Star Wifi Thermostat, Propane	EC3a042	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Evaporator Fan Control	EC3a043	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Faucet Aerator, Electric	EC3a044	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Faucet Aerator, Gas	EC3a045	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Faucet Aerator, Oil	EC3a046	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Faucet Aerator, Propane	EC3a047	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Hotel Occupancy Sensor	EC3a050	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Insulation, Electric	EC3a051	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Insulation, Gas	EC3a052	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Insulation, Oil	EC3a053	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Insulation, Propane	EC3a054	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Low Pressure Drop Filter	EC3a055	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Electric	EC3a056	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Gas	EC3a057	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Oil	EC3a058	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Thermostatic Shut-Off Valve, Propane	EC3a059	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Low-Flow Showerhead, Electric	EC3a060	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Low-Flow Showerhead, Gas	EC3a061	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Low-Flow Showerhead, Oil	EC3a062	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Low-Flow Showerhead, Propane	EC3a063	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Motors, Open Drip	EC3a064	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Motors, Totally Enclosed Fan Cooled	EC3a065	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Novelty Cooler Shutoff	EC3a066	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Heating, Electric	EC3a067	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Heating, Gas	EC3a068	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Heating, Oil	EC3a069	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Heating, Propane	EC3a070	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Electric	EC3a071	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Gas	EC3a072	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Oil	EC3a073	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Propane	EC3a074	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pre Rinse Spray Valve, Electric	EC3a075	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pre Rinse Spray Valve, Gas	EC3a076	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pre Rinse Spray Valve, Oil	EC3a077	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Pre Rinse Spray Valve, Propane	EC3a078	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Programmable Thermostat, Electric	EC3a079	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Programmable Thermostat, Gas	EC3a080	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Programmable Thermostat, Oil	EC3a081	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Programmable Thermostat, Propane	EC3a082	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Steam Trap, Electric	EC3a083	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Steam Trap, Gas	EC3a084	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Steam Trap, Oil	EC3a085	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Steam Trap, Propane	EC3a086	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%
C3a - Muni Retrofit	Variable Frequency Drive	EC3a087	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%
C3a - Muni Retrofit	Variable Frequency Drive with Motor	EC3a088	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%
C3a - Muni Retrofit	Vending Miser	EC3a089	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%

Measure ID	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
EC3a001													-	-	-	-	-	-
EC3a002													-	-	-	-	-	-
EC3a003	39.6	39.6	39.6	594.0	594.0	594.0	3.7	3.7	3.7	3.1	3.1	3.1	-	-	-	-	-	-
EC3a004													-	-	-	-	-	-
EC3a091													-	-	-	-	-	-
EC3a092													-	-	-	-	-	-
EC3a005													-	-	-	-	-	-
EC3a006													-	-	-	-	-	-
EC3a007													-	-	-	-	-	-
EC3a008													-	-	-	-	-	-
EC3a009													-	-	-	-	-	-
EC3a010													-	-	-	-	-	-
EC3a011	38.6	38.6	38.6	193.1	193.1	193.1	7.5	7.5	7.5	-	-	-	-	-	-	-	-	-
EC3a012													-	-	-	-	-	-
EC3a013	95.2	95.2	95.2	476.0	476.0	476.0	6.9	6.9	6.9	10.2	10.2	10.2	(61.7)	(61.7)	(61.7)	(308.5)	(308.5)	(308.5)
EC3a014	4.7	4.7	4.7	42.3	42.3	42.3	0.1	0.1	0.1	0.1	0.1	0.1	(19.2)	(19.2)	(19.2)	(172.6)	(172.6)	(172.6)
EC3a015													-	-	-	-	-	-
EC3a016													-	-	-	-	-	-
EC3a017													-	-	-	-	-	-
EC3a018													-	-	-	-	-	-
EC3a019													-	-	-	-	-	-
EC3a020													-	-	-	-	-	-
EC3a021													-	-	-	-	-	-
EC3a022													-	-	-	-	-	-
EC3a023													-	-	-	-	-	-
EC3a024													-	-	-	-	-	-
EC3a025													-	-	-	-	-	-
EC3a026													-	-	-	-	-	-
EC3a027													-	-	-	-	-	-
EC3a028													-	-	-	-	-	-
EC3a029													-	-	-	-	-	-
EC3a030													-	-	-	-	-	-
EC3a031													-	-	-	-	-	-
EC3a032													-	-	-	-	-	-
EC3a033													-	-	-	-	-	-
EC3a034													-	-	-	-	-	-
EC3a035													-	-	-	-	-	-
EC3a036													-	-	-	-	-	-
EC3a037													-	-	-	-	-	-
EC3a038													-	-	-	-	-	-
EC3a039													-	-	-	-	-	-
EC3a040													-	-	-	-	-	-
EC3a041													-	-	-	-	-	-
EC3a042													-	-	-	-	-	-
EC3a043													-	-	-	-	-	-
EC3a044													-	-	-	-	-	-
EC3a045													-	-	-	-	-	-
EC3a046													-	-	-	-	-	-
EC3a047													-	-	-	-	-	-
EC3a050													-	-	-	-	-	-
EC3a051													-	-	-	-	-	-
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EC3a081													-	-	-	-	-	-
EC3a082													-	-	-	-	-	-
EC3a083													-	-	-	-	-	-
EC3a084													-	-	-	-	-	-
EC3a085													-	-	-	-	-	-
EC3a086													-	-	-	-	-	-
EC3a087													-	-	-	-	-	-
EC3a088													-	-	-	-	-	-
EC3a089													-	-	-	-	-	-

Subprogram	Measure	Measure ID	Quantity 2024	Quantity 2025	Quantity 2026	Measure Life 2024	Measure Life 2025	Measure Life 2026	Net to Gross 2024	Net to Gross 2025	Net to Gross 2026	In Service Rate 2024	In Service Rate 2025	In Service Rate 2026	kWh Realization Rate 2024	kWh Realization Rate 2025	kWh Realization Rate 2026	Net Annual MWh Savings 2024	Net Annual MWh Savings 2025	Net Annual MWh Savings 2026	Net Lifetime MWh Savings 2024	Net Lifetime MWh Savings 2025	Net Lifetime MWh Savings 2026	Annual Net Winter kW 2024	Annual Net Winter kW 2025	Annual Net Winter kW 2026	Annual Net Summer kW 2024	Annual Net Summer kW 2025	Annual Net Summer kW 2026	Total Net Annual MMBTU 2024	Total Net Annual MMBTU 2025	Total Net Annual MMBTU 2026	Total Net Lifetime MMBTU 2024	Total Net Lifetime MMBTU 2025	Total Net Lifetime MMBTU 2026
C3a - Muni Retrofit	Zero Loss Condensate Drain	EC3a090	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3a - Muni Retrofit	Induction Cooktop Displacing Electric Resistance	EC3a093	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Compressed Air New	EC3b001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Hot Water New	EC3b002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni HVAC New	EC3b003	1	1	1	15	15	15	100%	100%	100%	100%	100%	100%	90%	90%	90%	67.5	67.5	67.5	1,012.5	1,012.5	1,012.5	2.9	2.9	2.9	7.5	7.5	7.5	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Lighting New - Interior	EC3b004	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Lighting New - Exterior	EC3b085	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Lighting New - Controls	EC3b086	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Motors New	EC3b005	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Process New	EC3b006	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Refrigeration New	EC3b007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Other New	EC3b008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Muni Comprehensive Design	EC3b087	-	-	-				100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3b - Muni New Equipmen	Daylight Dimming	EC3b009	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Exterior w/ Controls	EC3b010	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Exterior w/o Controls	EC3b011	1	1	1	15	15	15	94%	94%	94%	100%	100%	100%	103%	103%	103%	1.4	1.4	1.4	21.7	21.7	21.7	0.3	0.3	0.3	-	-	-	-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Interior w/ Controls	EC3b012	-	-	-	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C3b - Muni New Equipmen	Performance Lighting - Interior w/o Controls	EC3b013	1	1	1	15	15	15	94%	94%	94%	100%	100%	100%	107%	107%	107%	25.1	25.1	25.1	375.8	375.8	375.8	1.8	1.8	1.8	2.7	2.7	2.7	(3.8)	(3.8)	(3.8)	(57.2)	(57.2)	(57.2)
C3b - Muni New Equipment	Lighting Occupancy Sensors	EC3b014	-	-	-	10	10	10	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Advanced Power Strip	EC3b015	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Air Compressor	EC3b016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Air Nozzle	EC3b017	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 1000 to 1700 MBH 90 AFUE, Oil	EC3b018	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 1000 to 1700 MBH 90 AFUE, Propane	EC3b019	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 1701 to 2000 MBH 85 AFUE, Oil	EC3b020	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 1701 to 2000 MBH 90 AFUE, Propane	EC3b021	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 301 to 499 MBH 85 AFUE, Oil	EC3b022	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 301 to 499 MBH 90 AFUE, Propane	EC3b023	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 500 to 999 MBH 85 AFUE, Oil	EC3b024	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler 500 to 999 MBH 90 AFUE, Propane	EC3b025	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler to 300 MBH 85 AFUE, Oil	EC3b026	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler to 300 MBH 87 AFUE, Oil	EC3b027	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler to 300 MBH 90 AFUE, Propane	EC3b028	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Boiler to 300 MBH 95 AFUE, Propane	EC3b029	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Circulator Pump	EC3b030	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Combination Oven, Electric	EC3b031	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Compressor Storage	EC3b032	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Condensing Unit Heater up to 300 MBH, Oil	EC3b033	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Condensing Unit Heater up to 300 MBH, Propane	EC3b034	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Convection Oven, Electric	EC3b035	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - High Temp Door Type	EC3b036	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - High Temp Multi Tank Conveyor	EC3b037	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - High Temp Pot, Pan, Utensil	EC3b038	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - High Temp Single Tank Conveyor	EC3b039	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - High Temp Under Counter	EC3b040	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - Low Temp Door Type	EC3b041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - Low Temp Multi Tank Conveyor	EC3b042	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - Low Temp Single Tank Conveyor	EC3b043	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Dishwasher - Low Temp Under Counter	EC3b044	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Faucet Aerator, Electric	EC3b045	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Faucet Aerator, Gas	EC3b046	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Faucet Aerator, Oil	EC3b047	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Faucet Aerator, Propane	EC3b048	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Fryer Large Vat, Electric	EC3b049	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Fryer Standard Vat, Electric	EC3b050	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Furnace w/ ECM 85 AFUE up to 150 MBH, Oil	EC3b051	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Furnace w/ ECM 87 AFUE up to 150 MBH, Oil	EC3b052	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Furnace w/ ECM 95 AFUE up to 150 MBH, Propane	EC3b053	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Furnace w/ ECM 97 AFUE up to 150 MBH, Propane	EC3b054	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Griddle, Electric	EC3b055	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Ground Source Heat Pump	EC3b056	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Hot Food Holding Cabinet 3/4 Size	EC3b057	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Hot Food Holding Cabinet Full Size	EC3b058	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Hot Food Holding Cabinet Half Size	EC3b059	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Ice Machine - Ice Making Head	EC3b060	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Ice Machine - Remote Cond./Split Unit - Batch	EC3b061	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Ice Machine - Remote Cond./Split Unit - Continuous	EC3b062	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Ice Machine - Self Contained	EC3b063	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Infrared Heater	EC3b064	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Low Pressure Drop Filter	EC3b065	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Thermostatic Shut-Off Valve, Electric	EC3b066	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Thermostatic Shut-Off Valve, Gas	EC3b067	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Thermostatic Shut-Off Valve, Oil	EC3b068	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Thermostatic Shut-Off Valve, Propane	EC3b069	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Low-Flow Showerhead, Electric	EC3b070	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Low-Flow Showerhead, Gas	EC3b071	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Low-Flow Showerhead, Oil	EC3b072	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Low-Flow Showerhead, Propane	EC3b073	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Pre Rinse Spray Valve, Electric	EC3b074	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Pre Rinse Spray Valve, Gas	EC3b075	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Pre Rinse Spray Valve, Oil	EC3b076	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Pre Rinse Spray Valve, Propane	EC3b077	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Refrigerated Air Dryer	EC3b078	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Steam Cooker, Electric	EC3b079	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Unitary Air Conditioner	EC3b080	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Water Source Heat Pump	EC3b081	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Zero Loss Condensate Drain	EC3b082	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	High Efficiency Chiller - FL	EC3b083	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C3b - Muni New Equipment	High Efficiency Chiller - IPLV	EC3b084	-	-	-	23	23	23	100%	100%	100%	100%	100%	100%	120%	120%	120%													-	-	-	-	-	-
C3b - Muni New Equipment	Induction Cooktop Displacing Electric Resistance	EC3b088	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3b - Muni New Equipment	Compressed Air Leak Detection	EC3b089	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Compressed Air Direct Install	EC3d001	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Hot Water Direct Install	EC3d002	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni HVAC Direct Install	EC3d003	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Interior	EC3d004	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Exterior	EC3d005	-	-	-	-			94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Lighting Direct Install - Controls	EC3d006	-	-	-	-			94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Motors Direct Install	EC3d007	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Process Direct Install	EC3d008	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Refrigeration Direct Install	EC3d009	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Custom Muni Other Direct Install	EC3d010	-	-	-	-			100%	100%	100%	100%	100%	100%	90%	90%	90%													-	-	-	-	-	-
C3d - Muni Direct Install	Daylight Dimming	EC3d011	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/ Controls	EC3d012	-	-	-	-			94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Exterior w/o Controls	EC3d013	-	-	-	-			94%	94%	94%	100%	100%	100%	103%	103%	103%													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/ Controls	EC3d014	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Fixture - Interior w/o Controls	EC3d015	-	-	-	-			94%	94%	94%	100%	100%	100%	107%	107%	107%													-	-	-	-	-	-
C3d - Muni Direct Install	Lighting Occupancy Sensors	EC3d016	-	-	-	9	9	9	94%	94%	94%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Electric	EC3d017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Gas	EC3d018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Oil	EC3d019	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Air Sealing, Propane	EC3d020	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Gas	EC3d021	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Oil	EC3d022	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Boiler Reset Controls, Propane	EC3d023	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Case Motor Replacement	EC3d024	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Cooler Night Cover	EC3d025	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Demand Control Ventilation	EC3d026	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Door Heater Controls	EC3d027	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Dual Enthalpy Economizer Controls (DEEC)	EC3d028	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Electric	EC3d029	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Gas	EC3d030	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Oil	EC3d031	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Insulation, Propane	EC3d032	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Electric	EC3d033	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Gas	EC3d034	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Oil	EC3d035	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Duct Sealing, Propane	EC3d036	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Ductless Mini Split Heat Pump	EC3d037	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	EC3d038	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Electronic Defrost Control	EC3d039	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Management System, Electric	EC3d040	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Electric	EC3d041	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Gas	EC3d042	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Oil	EC3d043	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Energy Star Wifi Thermostat, Propane	EC3d044	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Evaporator Fan Control	EC3d045	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Electric	EC3d046	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Gas	EC3d047	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Oil	EC3d048	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Faucet Aerator, Propane	EC3d049	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Hotel Occupancy Sensor	EC3d050	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Electric	EC3d051	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Gas	EC3d052	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Oil	EC3d053	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Insulation, Propane	EC3d054	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Low Pressure Drop Filter	EC3d055	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Electric	EC3d056	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Gas	EC3d057	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Oil	EC3d058	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Thermostatic Shut-Off Valve, Propane	EC3d059	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Electric	EC3d060	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Gas	EC3d061	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Oil	EC3d062	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Low-Flow Showerhead, Propane	EC3d063	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Open Drip	EC3d064	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Motors, Totally Enclosed Fan Cooled	EC3d065	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Novelty Cooler Shutoff	EC3d066	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Electric	EC3d067	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Gas	EC3d068	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Oil	EC3d069	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Heating, Propane	EC3d070	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Electric	EC3d071	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Gas	EC3d072	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Oil	EC3d073	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pipe Wrap - Hot Water, Propane	EC3d074	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Electric	EC3d075	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Gas	EC3d076	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Oil	EC3d077	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Pre Rinse Spray Valve, Propane	EC3d078	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Electric	EC3d079	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Gas	EC3d080	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Oil	EC3d081	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Programmable Thermostat, Propane	EC3d082	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Electric	EC3d083	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Gas	EC3d084	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Oil	EC3d085	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Steam Trap, Propane	EC3d086	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive	EC3d087	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C3d - Muni Direct Install	Variable Frequency Drive with Motor	EC3d088	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	95%	95%	95%													-	-	-	-	-	-
C3d - Muni Direct Install	Vending Miser	EC3d089	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Zero Loss Condensate Drain	EC3d090	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
C3d - Muni Direct Install	Induction Cooktop Displacing Electric Resistance	EC3d091	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	100%	100%	100%													-	-	-	-	-	-
	Municipal Energy Solutions Subtotal																	**272.1**	**272.1**	**272.1**	**2,715.3**	**2,715.3**	**2,715.3**	**23.3**	**23.3**	**23.3**	**23.6**	**23.6**	**23.6**	**(84.7)**	**(84.7)**	**(84.7)**	**(538.3)**	**(538.3)**	**(538.3)**

			Quantity			Measure Life			Net to Gross			In Service Rate			kWh Realization Rate		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A4a - Residential Behavior	Home Energy Reports	EA4a001	26,800	26,800	26,800	1	1	1	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Residential Behavior Subtotal					**-**						**-**			**-**		

			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A4a - Residential Behavior	Home Energy Reports	EA4a001	2,904.5	2,904.5	2,904.5	2,904.5	2,904.5	2,904.5	627.0	627.0	627.0	404.5	404.5	404.5	-	-	-	-	-	-
	Residential Behavior Subtotal		**2,904.5**	**2,904.5**	**2,904.5**	**2,904.5**	**2,904.5**	**2,904.5**	**627.0**	**627.0**	**627.0**	**404.5**	**404.5**	**404.5**	**-**	**-**	**-**	**-**	**-**	**-**

Unitil Energy System, Inc.
System Benefits Charge ("SBC") Calculation

Year	**Current** SBC Rate EE Portion ($/kWh)	Inflation Factor (%)	**Estimated** SBC Rate EE Portion ($/kWh)	SBC Rate EAP Portion ($/kWh)	Total SBC Rate ($/kWh)
Col. A	Col. B	Col. C	Col D	Col. E	Col. F
2024	$0.00550	4.860%	$0.00577	$0.00150	$0.00727
2025	$0.00577	4.510%	$0.00603	$0.00150	$0.00753
2026	$0.00603	2.670%	$0.00619	$0.00150	$0.00769

Col. A: Rate Effective years, January - December 2024, 2025 & 2026
Col. B: Current EE portion of SBC
Col. C: Estimated inflation factor based on CPI
Col. D: Current EE increased by infation factor
Col. E: EAP portion of SBC Rate
Col. F: Total SBC propposed for effect January 1, 2024, 2025 & 2026.

Unitil Energy System, Inc.
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2022 to December 31, 2022

		Jan-22 Actual	Feb-22 Actual	Mar-22 Actual	Apr-22 Actual	May-22 Actual	Jun-22 Actual	Jul-22 Actual	Aug-22 Actual	Sep-22 Actual	Oct-22 Actual	Nov-22 Actual	Dec-22 Actual	Total
1	Beginning Balance -- (Over)/Under Recovery	$ 253,416	$ (198,154)	$ (517,641)	$ (766,051)	$ (928,283)	$ (1,116,053)	$ (1,199,897)	$ (1,612,718)	$ (1,903,667)	$ (2,021,076)	$ (1,920,724)	$ (1,946,051)	
2	**Total Costs**	144,072	128,041	305,591	399,007	309,791	473,887	277,151	423,427	482,187	644,901	448,464	1,821,036	$ 5,857,556
	Revenues													
3	Class Sales (Residential inc. LI) -- kWh	51,683,735	47,617,490	43,276,594	35,040,709	33,992,121	38,566,936	48,304,885	59,834,960	44,576,312	32,241,631	32,373,113	40,648,151	508,156,637
4	Class Sales (C&I inc. OL) -- kWh	56,107,347	55,159,275	54,526,942	49,413,819	51,094,503	55,503,489	60,302,167	67,257,935	59,820,400	49,316,003	49,013,786	50,638,741	658,154,407
5	Total Sales - kWh	107,791,082	102,776,765	97,803,536	84,454,528	85,086,624	94,070,425	108,607,052	127,092,895	104,396,712	81,557,634	81,386,899	91,286,892	1,166,311,044
6	Charge -- $/kWh	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	$ 0.00373	
7	Energy Efficiency Revenues	$ 481,434	$ 403,629	$ 509,225	$ 447,173	$ 450,560	$ 498,002	$ 574,907	$ 672,767	$ 552,947	$ 432,195	$ 431,324	$ 483,199	$ 5,937,362
8	Forward Capacity Market Revenue	$ 43,006	$ 43,006	$ 43,006	$ 43,006	$ 44,183	$ 61,335	$ 41,051	$ 35,647	$ 40,209	$ 33,927	$ 33,747	$ 35,676	$ 497,800
9	RGGI Funding	$ 71,278	$ -	$ -	$ 69,243	$ -	$ -	$ 69,243	$ -	$ -	$ 69,243	$ -	$ 69,243	$ 348,250
10	Other Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11	**Total Revenues**	$ 595,719	$ 446,636	$ 552,232	$ 559,423	$ 494,743	$ 559,337	$ 685,201	$ 708,413	$ 593,155	$ 535,365	$ 465,071	$ 588,117	$ 6,783,412
12	(Over)/Under Recovery (excluding interest)	$ (198,231)	$ (516,750)	$ (764,281)	$ (926,466)	$ (1,113,235)	$ (1,201,502)	$ (1,607,948)	$ (1,897,704)	$ (2,014,635)	$ (1,911,539)	$ (1,937,331)	$ (713,132)	
	Interest Calculation													
13	Average Monthly Balance	$ 27,593	$ (357,452)	$ (640,961)	$ (846,258)	$ (1,020,759)	$ (1,158,777)	$ (1,403,923)	$ (1,755,211)	$ (1,959,151)	$ (1,966,308)	$ (1,929,028)	$ (1,329,592)	
14	Interest Rate	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%	4.00%	4.00%	4.00%	5.50%	5.50%	5.50%	
15	Days per Month	31	28	31	30	31	30	31	31	30	31	30	31	365
16	Computed Interest	$ 76	$ (891)	$ (1,769)	$ (1,816)	$ (2,818)	$ 1,605	$ (4,769)	$ (5,963)	$ (6,441)	$ (9,185)	$ (8,720)	$ (6,211)	$ (46,903)
17	**Ending Balance**	$ (198,154)	$ (517,641)	$ (766,051)	$ (928,283)	$ (1,116,053)	$ (1,199,897)	$ (1,612,718)	$ (1,903,667)	$ (2,021,076)	$ (1,920,724)	$ (1,946,051)	$ (719,343)	

Line 1: Prior period ending balance
Line 2: Actual costs, includes prior period PI true-up.
Lines 3 & 4: Actual sales.
Line 5: Line 3 + Line 4
Line 6: Rates in effect.
Line 7: Actual revenue.
Line 8: Actual data
Line 9: Actual data.
Line 10:
Line 11: Sum Lines 7-10
Line 12: Line 1 + Line 2 - Line 11
Line 13: (Line 1 + Line 12)/2
Line 14: Prime Rate
Line 16: Line 13 * ((Line 14/# days per year) * Line 15)), includes adjustments for PI true-up.
Line 17: Line 12 + Line 16

Unitil Energy System, Inc.
Energy Efficiency Expense & SBC Revenue Reconciliation
January 1, 2023 to December 31, 2023

	Jan-23 Actual	Feb-23 Actual	Mar-23 Actual	Apr-23 Actual	May-23 Actual	Jun-23 Estimate	Jul-23 Estimate	Aug-23 Estimate	Sep-23 Estimate	Oct-23 Estimate	Nov-23 Estimate	Dec-23 Estimate	Total
1 Beginning Balance -- (Over)/Under Recovery	$ (719,343)	$ (1,062,970)	$ (1,452,339)	$ (1,595,370)	$ (1,791,106)	$ (1,687,105)	$ (1,545,045)	$ (1,453,027)	$ (1,415,352)	$ (1,329,633)	$ (1,125,674)	$ (974,066)	
2 **Total Costs**	254,175	199,633	433,236	380,534	610,714	725,176	701,588	701,588	701,588	701,588	701,588	701,588	$ 6,812,997
Revenues													
3 Class Sales (Residential inc. LI) -- kWh	47,340,110	44,442,288	41,592,277	34,180,063	33,883,259	34,983,598	45,774,142	52,434,993	40,089,151	34,517,073	35,277,212	43,017,575	487,531,742
4 Class Sales (C&I inc. OL) -- kWh	54,954,238	55,141,079	53,690,273	49,218,174	54,750,597	52,681,840	59,402,106	62,703,872	53,710,788	50,650,791	46,939,211	51,692,296	645,535,265
5 Total Sales - kWh	102,294,348	99,583,367	95,282,550	83,398,237	88,633,855	87,665,438	105,176,249	115,138,866	93,799,939	85,167,864	82,216,423	94,709,870	1,133,067,007
6 Charge -- $/kWh	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	$ 0.00550	
7 Energy Efficiency Revenues	$ 552,085	$ 549,340	$ 526,222	$ 461,161	$ 457,901	$ 482,160	$ 578,469	$ 633,264	$ 515,900	$ 468,423	$ 452,190	$ 520,904	$ 6,198,019
8 Forward Capacity Market Revenue	$ 40,435	$ 32,926	$ 41,013	$ 34,589	$ 37,403	$ 20,635	$ 20,635	$ 20,635	$ 20,635	$ 20,635	$ 20,635	$ 20,635	$ 330,807
9 RGGI Funding	$ -	$ -	$ -	$ 69,769	$ -	$ 70,060	$ -	$ -	$ 70,060	$ -	$ 70,060	$ -	$ 279,948
10 Other Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11 **Total Revenues**	$ 592,520	$ 582,266	$ 567,234	$ 565,518	$ 495,304	$ 572,854	$ 599,104	$ 653,898	$ 606,594	$ 489,058	$ 542,885	$ 541,539	$ 6,808,774
12 (Over)/Under Recovery (excluding interest)	$ (1,057,688)	$ (1,445,603)	$ (1,586,337)	$ (1,780,355)	$ (1,675,695)	$ (1,534,783)	$ (1,442,561)	$ (1,405,338)	$ (1,320,357)	$ (1,117,102)	$ (966,971)	$ (814,016)	
Interest Calculation													
13 Average Monthly Balance	$ (888,516)	$ (1,254,287)	$ (1,519,338)	$ (1,687,862)	$ (1,733,401)	$ (1,610,944)	$ (1,493,803)	$ (1,429,183)	$ (1,367,855)	$ (1,223,367)	$ (1,046,322)	$ (894,041)	
14 Interest Rate	7.00%	7.00%	7.00%	7.75%	7.75%	7.75%	8.25%	8.25%	8.25%	8.25%	8.25%	8.25%	
15 Days per Month	31	28	31	30	31	30	31	31	30	31	30	31	365
16 Computed Interest	$ (5,282)	$ (6,735)	$ (9,033)	$ (10,751)	$ (11,410)	$ (10,261)	$ (10,467)	$ (10,014)	$ (9,275)	$ (8,572)	$ (7,095)	$ (6,264)	$ (105,160)
17 **Ending Balance**	$ (1,062,970)	$ (1,452,339)	$ (1,595,370)	$ (1,791,106)	$ (1,687,105)	$ (1,545,045)	$ (1,453,027)	$ (1,415,352)	$ (1,329,633)	$ (1,125,674)	$ (974,066)	$ (820,281)	

Line 1: Prior period ending balance
Line 2: Actual costs. June 2023 includes 2022 PI true-up.
Lines 3 & 4: Actual through May, remainder company forecast
Line 5: Line 3 + Line 4
Line 6: Rates in effect.
Line 7: Actual revenue. Line 3 * Line 4 in forecast months.
Line 8: Actual through May , forecast through December.
Line 9: Actual through May, forecast through December.
Line 10:
Line 11: Sum Lines 7-10
Line 12: Line 1 + Line 2 - Line 11
Line 13: (Line 1 + Line 12)/2
Line 14: Prime Rate
Line 16: Line 13 * ((Line 14/# days per year) * Line 15)), includes adjustments for PI true-up.
Line 17: Line 12 + Line 16

Unitil Energy System, Inc.
System Benefits Charge Bill Impacts

	January 1, 2023	January 1, 2024	January 1, 2025	January 1, 2026
System Benefits Charge ($/kWh) Residential	$ 0.00700	$ 0.00727	0.00753	0.00769
System Benefits Charge ($/kWh) C&I	$ 0.00700	$ 0.00727	0.00753	0.00769
Bill per month, including UES Default Service Charge				
Residential Rate R (625 kWh/month)	$ 226.55	$ 226.71	$ 226.87	$ 226.98
General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)	$ 3,364.69	$ 3,367.36	$ 3,369.96	$ 3,371.57
Change from previous rate level - $ per month				
Residential Rate R (625 kWh/month)		$ 0.17	$ 0.16	$ 0.10
General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		$ 2.67	$ 2.60	$ 1.61
Change from previous rate level - %				
Residential Rate R (625 kWh/month)		0.07%	0.07%	0.04%
General Service Rate G, three-phase service (40 kW, 10,000 kWh/month)		0.08%	0.08%	0.05%

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.02	*2.02*	3,725.1	*3,725.1*	1,846.3	-	16.0	332.4	2.9	3.5	190	10,429.7	221,938.8
B2a - IE Education	-	-	-	-	39.7	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	99.3	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.88**	***1.88***	**3,725.1**	***3,725.1***	**1,985.3**	**-**	**16.0**	**332.4**	**2.9**	**3.5**	**190**	**10,429.7**	**221,938.8**
Residential Programs													
A1 - Energy Star Homes	1.43	*1.33*	1,126.8	*1,391.1*	789.2	260.1	-	-	-	-	236	5,849.6	137,973.8
A2 - Home Performance	1.09	*1.10*	1,586.1	*1,955.9*	1,450.0	328.3	12.9	207.4	2.3	2.8	178	8,874.4	181,476.7
A3 - Energy Star Products	2.84	*1.60*	3,803.2	*4,697.1*	1,340.8	1,589.1	30.8	507.9	10.3	0.1	3,840	26,570.8	432,782.9
A4 - Residential Behavior	1.15	*1.42*	212.7	*263.5*	185.0	-	-	-	-	-	22,043	20,044.4	20,044.4
A6a - Res Education	-	-	-	-	73.0	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	202.0	-	-	-	-	-		-	-
Sub-Total Residential	**1.67**	***1.34***	**6,728.8**	***8,307.6***	**4,040.0**	**2,177.5**	**43.7**	**715.3**	**12.6**	**2.9**	**26,297**	**61,339.1**	**772,277.7**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.01	*1.45*	3,405.5	*3,723.7*	1,694.0	877.2	-	-	-	-	310	33,167.7	377,706.8
C2 - Small Business Energy Solutions	1.45	*1.13*	2,309.8	*2,467.2*	1,591.2	597.0	4.9	87.7	1.4	-	1,410	14,521.1	217,325.3
C3 - Municipal Energy Solutions	1.66	*1.31*	615.7	*668.1*	370.0	138.3	0.5	9.1	0.1	-	256	4,794.5	71,798.4
C6a - C&I Education	-	-	-	-	51.0	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	195.1	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.62**	***1.24***	**6,331.0**	***6,859.0***	**3,901.2**	**1,612.5**	**5.4**	**96.8**	**1.6**	**-**	**1,975**	**52,483.3**	**666,830.5**
Total	**1.69**	***1.38***	**16,784.9**	***18,891.7***	**9,926.6**	**3,790.0**	**65.1**	**1,144.5**	**17.1**	**6.4**	**28,463**	**124,252.1**	**1,661,047.0**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.

Annual Net Savings as a % of 2022 Sales	0.79%

Spending per Customer	Low-Income	$	369.29
	Residential	$	45.40
	C&I	$	266.88

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	$ 3,725	*$ 3,725*	$ 1	$ -	$ 6	$ 6	$ -	$ 6	$ 7	$ 3	$ 3	$ 1	$ 33	$ 1,779	$ 23	$ 1,835	$ 113	$ 1,777	$ 1,890	$ 10
B2a - IE Education	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
B2b - IE Evaluation, Measurement and Verification	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Income Eligible	**$ 3,725**	*$ 3,725*	**$ 1**	**$ -**	**$ 6**	**$ 6**	**$ -**	**$ 6**	**$ 7**	**$ 3**	**$ 3**	**$ 1**	**$ 33**	**$ 1,779**	**$ 23**	**$ 1,835**	**$ 113**	**$ 1,777**	**$ 1,890**	**$ 10**
Residential Programs																				
A1 - Energy Star Homes	$ 1,127	*$ 1,391*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,057	$ -	$ 1,057	$ 70	$ 264	$ 334	$ -
A2 - Home Performance	$ 1,586	*$ 1,956*	$ 1	$ -	$ 3	$ 4	$ -	$ 4	$ 5	$ 2	$ 2	$ 1	$ 21	$ 1,458	$ 14	$ 1,494	$ 93	$ 370	$ 462	$ 8
A3 - Energy Star Products	$ 3,803	*$ 4,697*	$ 0	$ -	$ 0	$ 0	$ -	$ 15	$ 20	$ (1)	$ (0)	$ 2	$ 36	$ 3,540	$ -	$ 3,576	$ 228	$ 894	$ 1,122	$ 18
A4 - Residential Behavior	$ 213	*$ 264*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 203	$ -	$ 203	$ 9	$ 51	$ 60	$ -
A6a - Res Education	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A6b - Res Evaluation, Measurement and Verification	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Residential	**$ 6,729**	*$ 8,308*	**$ 1**	**$ -**	**$ 3**	**$ 4**	**$ -**	**$ 19**	**$ 24**	**$ 1**	**$ 1**	**$ 3**	**$ 57**	**$ 6,258**	**$ 14**	**$ 6,330**	**$ 399**	**$ 1,579**	**$ 1,978**	**$ 25**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	$ 3,405	*$ 3,724*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,182	$ 27	$ 3,209	$ 196	$ 318	$ 514	$ -
C2 - Small Business Energy Solutions	$ 2,310	*$ 2,467*	$ -	$ -	$ -	$ -	$ -	$ 3	$ 3	$ -	$ -	$ 0	$ 6	$ 1,568	$ 624	$ 2,198	$ 112	$ 157	$ 270	$ 3
C3 - Municipal Energy Solutions	$ 616	*$ 668*	$ -	$ -	$ -	$ -	$ -	$ 0	$ 0	$ -	$ -	$ 0	$ 1	$ 523	$ 55	$ 579	$ 37	$ 52	$ 89	$ 0
C6a - C&I Education	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
C6b - C&I Evaluation, Measurement and Verification	$ -	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-Total Commercial & Industrial	**$ 6,331**	*$ 6,859*	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3**	**$ 3**	**$ -**	**$ -**	**$ 0**	**$ 7**	**$ 5,273**	**$ 706**	**$ 5,986**	**$ 345**	**$ 528**	**$ 873**	**$ 3**
Total	**$ 16,785**	*$ 18,892*	**$ 2**	**$ -**	**$ 9**	**$ 11**	**$ -**	**$ 27**	**$ 35**	**$ 4**	**$ 4**	**$ 5**	**$ 97**	**$ 13,310**	**$ 743**	**$ 14,150**	**$ 857**	**$ 3,884**	**$ 4,742**	**$ 38**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024									
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime MMBtu Savings	1,661,047,031	*1,245,785,273*		-	2.475%	-	$ 245,683	*$ 307,104*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	124,252,109	*93,189,082*		-	1.100%	-	$ 109,192	*$ 136,491*	$ -	Planned and Actual from Cost Eff Tab
3	Total Resource Benefits	$ 14,150,155			-						Planned and Actual from Benefits Tab
4	Total Utility Costs[1,3]	$ 9,926,588			-						Planned and Actual from Cost Eff Tab
5	Net Benefits	$ 4,223,567	*$ 3,167,675*		-	1.925%	-	$ 191,087	*$ 238,859*	$ -	Line 3 minus line 4
6	Total					5.500%	-	$ 545,962	*$ 682,453*	**$ -**	

		Granite State Test		
		Planned	Actual	Source
7	Total Benefits	$ 16,784,894		Planned and Actual from Cost Eff Tab
8	Performance Incentive	$ 545,962	$ -	from row 6 above
9	Total Utility Costs	$ 9,926,588	$ -	from row 4 above
10	**Portfolio GST BCR**	**1.60**	**-**	row 7 divided by rows 8+9

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2025 Plan

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.27	*2.27*	3,952.1	*3,952.1*	1,742.4	-	16.2	337.7	2.9	3.6	197	10,721.5	228,509.6
B2a - IE Education	-	-	-	-	37.5	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	93.7	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.11**	***2.11***	**3,952.1**	***3,952.1***	**1,873.5**	**-**	**16.2**	**337.7**	**2.9**	**3.6**	**197**	**10,721.5**	**228,509.6**
Residential Programs													
A1 - Energy Star Homes	1.58	*1.47*	1,084.2	*1,338.2*	688.2	223.5	-	-	-	-	220	5,456.8	128,725.2
A2 - Home Performance	1.20	*1.21*	1,504.7	*1,855.0*	1,249.4	284.5	11.5	185.5	2.1	2.5	167	8,091.1	167,096.5
A3 - Energy Star Products	3.17	*1.81*	3,689.1	*4,554.9*	1,164.0	1,350.2	27.7	455.3	9.4	0.1	3,627	24,980.0	406,002.6
A4 - Residential Behavior	1.25	*1.55*	219.6	*272.1*	175.5	-	-	-	-	-	22,043	20,044.4	20,044.4
A6a - Res Education	-	-	-	-	64.7	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	175.9	-	-	-	-	-		-	-
Sub-Total Residential	**1.85**	***1.49***	**6,497.6**	***8,020.2***	**3,517.7**	**1,858.1**	**39.2**	**640.8**	**11.5**	**2.5**	**26,057**	**58,572.3**	**721,868.6**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.30	*1.65*	4,031.2	*4,406.9*	1,753.5	918.8	-	-	-	-	330	37,439.0	433,111.2
C2 - Small Business Energy Solutions	1.57	*1.21*	2,550.4	*2,727.8*	1,621.3	632.7	5.0	90.7	1.5	-	1,448	15,795.2	238,596.7
C3 - Municipal Energy Solutions	1.80	*1.44*	631.0	*684.6*	351.0	125.7	0.5	9.1	0.1	-	256	4,746.4	71,055.0
C6a - C&I Education	-	-	-	-	51.7	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	198.8	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.81**	***1.38***	**7,212.7**	***7,819.3***	**3,976.4**	**1,677.2**	**5.5**	**99.8**	**1.6**	**-**	**2,034**	**57,980.7**	**742,762.9**
Total	**1.89**	***1.53***	**17,662.4**	***19,791.6***	**9,367.6**	**3,535.4**	**60.9**	**1,078.2**	**16.0**	**6.1**	**28,287**	**127,274.4**	**1,693,141.1**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

Annual Net Savings as a % of 2022 Sales	0.81%

Spending per Customer	Low-Income	$	348.50
	Residential	$	39.53
	C&I	$	272.02

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 3,952**	*$ 3,952*	$ 1	$ -	$ 6	$ 7	$ -	$ 6	$ 7	$ 3	$ 3	$ 1	**$ 34**	$ 1,886	$ 24	**$ 1,945**	$ 122	$ 1,885	**$ 2,007**	**$ 10**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 3,952**	*$ 3,952*	**$ 1**	**$ -**	**$ 6**	**$ 7**	**$ -**	**$ 6**	**$ 7**	**$ 3**	**$ 3**	**$ 1**	**$ 34**	**$ 1,886**	**$ 24**	**$ 1,945**	**$ 122**	**$ 1,885**	**$ 2,007**	**$ 10**
Residential Programs																				
A1 - Energy Star Homes	**$ 1,084**	*$ 1,338*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 1,016	$ -	**$ 1,016**	$ 68	$ 254	**$ 322**	**$ -**
A2 - Home Performance	**$ 1,505**	*$ 1,855*	$ 1	$ -	$ 3	$ 4	$ -	$ 4	$ 4	$ 2	$ 1	$ 1	**$ 20**	$ 1,382	$ 14	**$ 1,415**	$ 90	$ 350	**$ 440**	**$ 6**
A3 - Energy Star Products	**$ 3,689**	*$ 4,555*	$ 0	$ -	$ (0)	$ (0)	$ -	$ 14	$ 18	$ (1)	$ (1)	$ 2	**$ 33**	$ 3,430	$ -	**$ 3,463**	$ 226	$ 866	**$ 1,092**	**$ 15**
A4 - Residential Behavior	**$ 220**	*$ 272*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 210	$ -	**$ 210**	$ 10	$ 52	**$ 62**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 6,498**	*$ 8,020*	**$ 1**	**$ -**	**$ 3**	**$ 4**	**$ -**	**$ 17**	**$ 23**	**$ 1**	**$ 1**	**$ 3**	**$ 53**	**$ 6,038**	**$ 14**	**$ 6,104**	**$ 394**	**$ 1,523**	**$ 1,916**	**$ 22**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 4,031**	*$ 4,407*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 3,757	$ 34	**$ 3,791**	$ 240	$ 376	**$ 616**	**$ -**
C2 - Small Business Energy Solutions	**$ 2,550**	*$ 2,728*	$ -	$ -	$ -	$ -	$ -	$ 3	$ 3	$ -	$ -	$ 0	**$ 6**	$ 1,768	$ 646	**$ 2,420**	$ 131	$ 177	**$ 308**	**$ 3**
C3 - Municipal Energy Solutions	**$ 631**	*$ 685*	$ -	$ -	$ -	$ -	$ -	$ 0	$ 0	$ -	$ -	$ 0	**$ 1**	$ 535	$ 57	**$ 592**	$ 39	$ 54	**$ 92**	**$ 0**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 7,213**	*$ 7,819*	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3**	**$ 4**	**$ -**	**$ -**	**$ 0**	**$ 7**	**$ 6,059**	**$ 737**	**$ 6,803**	**$ 409**	**$ 607**	**$ 1,016**	**$ 3**
Total	**$ 17,662**	*$ 19,792*	**$ 2**	**$ -**	**$ 9**	**$ 10**	**$ -**	**$ 26**	**$ 33**	**$ 4**	**$ 4**	**$ 4**	**$ 94**	**$ 13,983**	**$ 775**	**$ 14,852**	**$ 925**	**$ 4,014**	**$ 4,940**	**$ 34**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2025										
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime MMBtu Savings	1,693,141,058	*1,269,855,793*		-	2.475%	-	$ 250,975	*$ 313,719*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	127,274,431	*95,455,823*		-	1.100%	-	$ 111,545	*$ 139,431*	$ -	Planned and Actual from Cost Eff Tab
3	Total Resource Benefits	$ 14,852,032			-						Planned and Actual from Benefits Tab
4	Total Utility Costs[1,3]	$ 10,140,417			-						Planned and Actual from Cost Eff Tab
5	Net Benefits	$ 4,711,615	*$ 3,533,711*	$ -	-	1.925%	-	$ 195,203	*$ 244,004*	$ -	Line 3 minus line 4
6	Total					5.500%	-	$ 557,723	*$ 697,154*	$ -	

		Granite State Test		
		Planned	Actual	Source
7	Total Benefits	$ 17,662,381		Planned and Actual from Cost Eff Tab
8	Performance Incentive	$ 557,723	$ -	from row 6 above
9	Total Utility Costs	$ 10,140,417	$ -	from row 4 above
10	**Portfolio GST BCR**	**1.65**	**-**	row 7 divided by rows 8+9

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2026 Plan

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.48	*2.48*	4,109.9	*4,109.9*	1,659.6	-	16.6	344.7	3.0	3.6	199	10,873.7	231,590.9
B2a - IE Education	-	-	-	-	37.5	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	89.3	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.30**	***2.30***	**4,109.9**	***4,109.9***	**1,786.5**	**-**	**16.6**	**344.7**	**3.0**	**3.6**	**199**	**10,873.7**	**231,590.9**
Residential Programs													
A1 - Energy Star Homes	1.75	*1.63*	1,148.9	*1,417.8*	658.0	212.0	-	-	-	-	226	5,607.9	132,295.3
A2 - Home Performance	1.34	*1.34*	1,593.5	*1,964.1*	1,192.2	270.7	11.5	185.5	2.1	2.5	172	8,307.3	171,712.3
A3 - Energy Star Products	3.57	*2.02*	3,968.8	*4,898.8*	1,112.0	1,310.1	29.2	479.4	9.8	0.1	3,782	26,031.3	423,304.4
A4 - Residential Behavior	1.37	*1.69*	227.8	*282.1*	166.4	-	-	-	-	-	22,043	20,044.4	20,044.4
A6a - Res Education	-	-	-	-	63.2	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	168.0	-	-	-	-	-		-	-
Sub-Total Residential	**2.07**	***1.66***	**6,939.0**	***8,562.8***	**3,359.8**	**1,792.8**	**40.7**	**664.8**	**11.9**	**2.5**	**26,222**	**59,990.9**	**747,356.3**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.48	*1.80*	4,101.9	*4,484.2*	1,655.6	839.1	-	-	-	-	318	36,909.1	426,266.9
C2 - Small Business Energy Solutions	1.74	*1.36*	2,716.4	*2,907.3*	1,558.0	580.4	4.9	87.7	1.4	-	1,440	16,353.8	247,713.5
C3 - Municipal Energy Solutions	1.94	*1.57*	645.7	*700.5*	332.8	114.7	0.7	12.1	0.2	-	258	4,667.8	70,111.1
C6a - C&I Education	-	-	-	-	50.3	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	189.3	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.97**	***1.52***	**7,464.1**	***8,091.9***	**3,786.1**	**1,534.2**	**5.5**	**99.8**	**1.6**	**-**	**2,016**	**57,930.8**	**744,091.4**
Total	**2.07**	***1.69***	**18,513.0**	***20,764.6***	**8,932.3**	**3,327.0**	**62.8**	**1,109.4**	**16.5**	**6.1**	**28,436**	**128,795.3**	**1,723,038.6**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied to total benefits

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

Annual Net Savings as a % of 2022 Sales	0.82%

Spending per Customer	Low-Income	$	332.30
	Residential	$	37.75
	C&I	$	259.00

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environ-mental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 4,110**	*$ 4,110*	$ 1	$ -	$ 6	$ 7	$ -	$ 6	$ 8	$ 3	$ 3	$ 1	**$ 36**	$ 1,969	$ 25	**$ 2,030**	$ 130	$ 1,950	**$ 2,080**	**$ 9**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 4,110**	*$ 4,110*	**$ 1**	**$ -**	**$ 6**	**$ 7**	**$ -**	**$ 6**	**$ 8**	**$ 3**	**$ 3**	**$ 1**	**$ 36**	**$ 1,969**	**$ 25**	**$ 2,030**	**$ 130**	**$ 1,950**	**$ 2,080**	**$ 9**
Residential Programs																				
A1 - Energy Star Homes	**$ 1,149**	*$ 1,418*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 1,076	$ -	**$ 1,076**	$ 73	$ 269	**$ 342**	**$ -**
A2 - Home Performance	**$ 1,594**	*$ 1,964*	$ 1	$ -	$ 3	$ 4	$ -	$ 4	$ 4	$ 2	$ 2	$ 1	**$ 20**	$ 1,462	$ 14	**$ 1,497**	$ 97	$ 371	**$ 467**	**$ 6**
A3 - Energy Star Products	**$ 3,969**	*$ 4,899*	$ 0	$ -	$ 0	$ 0	$ -	$ 15	$ 20	$ (1)	$ (1)	$ 2	**$ 36**	$ 3,684	$ -	**$ 3,720**	$ 249	$ 930	**$ 1,179**	**$ 15**
A4 - Residential Behavior	**$ 228**	*$ 282*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 217	$ -	**$ 217**	$ 11	$ 54	**$ 65**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 6,939**	*$ 8,563*	**$ 1**	**$ -**	**$ 3**	**$ 4**	**$ -**	**$ 19**	**$ 24**	**$ 1**	**$ 1**	**$ 3**	**$ 56**	**$ 6,439**	**$ 14**	**$ 6,510**	**$ 429**	**$ 1,624**	**$ 2,053**	**$ 21**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 4,102**	*$ 4,484*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 3,822	$ 28	**$ 3,851**	$ 251	$ 382	**$ 634**	**$ -**
C2 - Small Business Energy Solutions	**$ 2,716**	*$ 2,907*	$ -	$ -	$ -	$ -	$ -	$ 3	$ 3	$ -	$ -	$ 0	**$ 6**	$ 1,902	$ 665	**$ 2,573**	$ 143	$ 191	**$ 334**	**$ 3**
C3 - Municipal Energy Solutions	**$ 646**	*$ 700*	$ -	$ -	$ -	$ -	$ -	$ 0	$ 0	$ -	$ -	$ 0	**$ 1**	$ 546	$ 58	**$ 605**	$ 40	$ 55	**$ 95**	**$ 0**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 7,464**	*$ 8,092*	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3**	**$ 4**	**$ -**	**$ -**	**$ 0**	**$ 7**	**$ 6,271**	**$ 751**	**$ 7,029**	**$ 435**	**$ 628**	**$ 1,063**	**$ 3**
Total	**$ 18,513**	*$ 20,765*	**$ 2**	**$ -**	**$ 9**	**$ 11**	**$ -**	**$ 28**	**$ 36**	**$ 5**	**$ 4**	**$ 5**	**$ 99**	**$ 14,679**	**$ 791**	**$ 15,569**	**$ 994**	**$ 4,201**	**$ 5,195**	**$ 34**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2026										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime MMBtu Savings	1,723,038,601	*1,292,278,950*		-	2.475%	-	$ 259,057	*$ 323,822*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	128,795,302	*96,596,477*		-	1.100%	-	$ 115,137	*$ 143,921*	$ -	Planned and Actual from Cost Eff Tab
3	Total Resource Benefits	$ 15,569,413			-						Planned and Actual from Benefits Tab
4	Total Utility Costs[1,3]	$ 10,466,964			-						Planned and Actual from Cost Eff Tab
5	Net Benefits	$ 5,102,449	*$ 3,826,837*	$ -	-	1.925%	-	$ 201,489	*$ 251,861*	$ -	Line 3 minus line 4
6	Total					5.500%	-	$ 575,683	*$ 719,604*	$ -	

		Granite State Test		
		Planned	**Actual**	**Source**
7	Total Benefits	$ 18,512,979		Planned and Actual from Cost Eff Tab
8	Performance Incentive	$ 575,683	$ -	from row 6 above
9	Total Utility Costs	$ 10,466,964	$ -	from row 4 above
10	**Portfolio GST BCR**	**1.68**	**-**	row 7 divided by rows 8+9

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	Granite State Test	*Total Resource Cost Test*	Utility Costs ($000 - 2024$)[2]	Customer Costs ($000 - 2024$)[2]	Annual Net MWh Savings	Lifetime Net MWh Savings	Winter kW Savings	Summer kW Savings	Number of Customers Served	Annual Net MMBtu Savings	Lifetime Net MMBtu Savings
Income Eligible Programs													
B1 - Home Energy Assistance	2.25	*2.25*	11,787.1	*11,787.1*	5,248.3	-	48.8	1,014.9	8.8	10.7	585	32,024.8	682,039.3
B2a - IE Education	-	-	-	-	114.7	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	282.3	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**2.09**	***2.09***	**11,787.1**	***11,787.1***	**5,645.3**	**-**	**48.8**	**1,014.9**	**8.8**	**10.7**	**585**	**32,024.8**	**682,039.3**
Residential Programs													
A1 - Energy Star Homes	1.57	*1.46*	3,359.9	*4,147.1*	2,135.4	695.6	-	-	-	-	682	16,914.4	398,994.2
A2 - Home Performance	1.20	*1.21*	4,684.2	*5,775.0*	3,891.6	883.5	35.9	578.3	6.5	7.7	516	25,272.7	520,285.4
A3 - Energy Star Products	3.17	*1.80*	11,461.1	*14,150.9*	3,616.9	4,249.4	87.7	1,442.6	29.5	0.2	11,249	77,582.1	1,262,089.9
A4 - Residential Behavior	1.25	*1.55*	660.1	*817.6*	526.9	-	-	-	-	-	66,129	60,133.1	60,133.1
A6a - Res Education	-	-	-	-	200.8	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	545.9	-	-	-	-	-	-	-	-
Sub-Total Residential	**1.85**	***1.49***	**20,165.4**	***24,890.7***	**10,917.5**	**5,828.4**	**123.6**	**2,020.9**	**36.0**	**7.9**	**78,576**	**179,902.3**	**2,241,502.5**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.26	*1.63*	11,538.6	*12,614.8*	5,103.1	2,635.2	-	-	-	-	958	107,515.9	1,237,084.9
C2 - Small Business Energy Solutions	1.59	*1.23*	7,576.6	*8,102.2*	4,770.5	1,810.1	14.8	266.1	4.3	-	4,297	46,670.1	703,635.5
C3 - Municipal Energy Solutions	1.80	*1.43*	1,892.5	*2,053.2*	1,053.9	378.7	1.7	30.2	0.5	-	770	14,208.7	212,964.5
C6a - C&I Education	-	-	-	-	153.1	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	583.2	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**1.80**	***1.38***	**21,007.8**	***22,770.2***	**11,663.7**	**4,823.9**	**16.5**	**296.4**	**4.8**	**-**	**6,025**	**168,394.8**	**2,153,684.8**
Total	**1.88**	***1.53***	**52,960.3**	***59,448.0***	**28,226.5**	**10,652.4**	**188.8**	**3,332.1**	**49.6**	**18.6**	**85,186**	**380,321.8**	**5,077,226.7**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

Annual Net Savings as a % of 2022 Sales	2.41%

Spending per Customer			
	Low-Income	$	1,050.09
	Residential	$	122.67
	C&I	$	797.90

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)														Non-Resource Benefits ($000)			Environmental Benefits ($000)[3]
			Electric											Non-Electric						
			CAPACITY					ENERGY												
	Granite State Test	*Total Resource Cost Test*	Summer Generation	Winter Generation	Transmission	Distribution	Reliability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Total Electric Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	
Income Eligible Programs																				
B1 - Home Energy Assistance	**$ 11,787**	*$ 11,787*	$ 4	$ -	$ 17	$ 20	$ -	$ 18	$ 21	$ 10	$ 9	$ 3	**$ 103**	$ 5,634	$ 73	**$ 5,810**	$ 365	$ 5,612	**$ 5,977**	**$ 29**
B2a - IE Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 11,787**	*$ 11,787*	**$ 4**	**$ -**	**$ 17**	**$ 20**	**$ -**	**$ 18**	**$ 21**	**$ 10**	**$ 9**	**$ 3**	**$ 103**	**$ 5,634**	**$ 73**	**$ 5,810**	**$ 365**	**$ 5,612**	**$ 5,977**	**$ 29**
Residential Programs																				
A1 - Energy Star Homes	**$ 3,360**	*$ 4,147*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 3,149	$ -	**$ 3,149**	$ 211	$ 787	**$ 998**	**$ -**
A2 - Home Performance	**$ 4,684**	*$ 5,775*	$ 3	$ -	$ 10	$ 12	$ -	$ 12	$ 14	$ 5	$ 5	$ 2	**$ 61**	$ 4,302	$ 42	**$ 4,405**	$ 279	$ 1,091	**$ 1,370**	**$ 20**
A3 - Energy Star Products	**$ 11,461**	*$ 14,151*	$ 0	$ -	$ 0	$ 0	$ -	$ 43	$ 58	$ (2)	$ (2)	$ 7	**$ 105**	$ 10,654	$ -	**$ 10,759**	$ 702	$ 2,690	**$ 3,392**	**$ 48**
A4 - Residential Behavior	**$ 660**	*$ 818*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 630	$ -	**$ 630**	$ 30	$ 157	**$ 188**	**$ -**
A5 - Residential Active Demand Response	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 20,165**	*$ 24,891*	**$ 3**	**$ -**	**$ 10**	**$ 12**	**$ -**	**$ 55**	**$ 71**	**$ 3**	**$ 3**	**$ 9**	**$ 166**	**$ 18,735**	**$ 42**	**$ 18,943**	**$ 1,222**	**$ 4,725**	**$ 5,947**	**$ 68**
Commercial/Industrial Programs																				
C1 - Large Business Energy Solutions	**$ 11,539**	*$ 12,615*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ 10,762	$ 89	**$ 10,851**	$ 688	$ 1,076	**$ 1,764**	**$ -**
C2 - Small Business Energy Solutions	**$ 7,577**	*$ 8,102*	$ -	$ -	$ -	$ -	$ -	$ 8	$ 10	$ -	$ -	$ 1	**$ 19**	$ 5,238	$ 1,935	**$ 7,191**	$ 386	$ 526	**$ 911**	**$ 8**
C3 - Municipal Energy Solutions	**$ 1,893**	*$ 2,053*	$ -	$ -	$ -	$ -	$ -	$ 1	$ 1	$ -	$ -	$ 0	**$ 2**	$ 1,604	$ 170	**$ 1,777**	$ 116	$ 161	**$ 277**	**$ 1**
C5 - C&I Active Demand Response	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 21,008**	*$ 22,770*	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 9**	**$ 11**	**$ -**	**$ -**	**$ 1**	**$ 21**	**$ 17,603**	**$ 2,194**	**$ 19,818**	**$ 1,190**	**$ 1,762**	**$ 2,952**	**$ 9**
C6d - Smart Start	**$ -**	*$ -*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 52,960**	*$ 59,448*	**$ 6**	**$ -**	**$ 27**	**$ 32**	**$ -**	**$ 82**	**$ 103**	**$ 13**	**$ 12**	**$ 14**	**$ 290**	**$ 41,973**	**$ 2,309**	**$ 44,572**	**$ 2,776**	**$ 12,100**	**$ 14,876**	**$ 107**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024-2026										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime MMBtu Savings	5,077,226,689	*3,807,920,017*		-	2.475%	-	$ 755,716	*$ 944,645*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	380,321,843	*285,241,382*		-	1.100%	-	$ 335,874	*$ 419,842*	$ -	Planned and Actual from Cost Eff Tab
3	Total Resource Benefits	$ 44,571,600			-						Planned and Actual from Benefits Tab
4	Total Utility Costs[1,3]	$ 30,533,969			-						Planned and Actual from Cost Eff Tab
5	Net Benefits	$ 14,037,630	*$ 10,528,223*	$ -	-	1.925%	-	$ 587,779	*$ 734,724*	$ -	Line 3 minus line 4
6	Total					5.500%	-	$ 1,679,368	*$ 2,099,210*	$ -	

		Granite State Test		
		Planned	**Actual**	**Source**
7	Total Benefits	$ 52,960,254		Planned and Actual from Cost Eff Tab
8	Performance Incentive	$ 1,679,368	$ -	from row 6 above
9	Total Utility Costs	$ 30,533,969	$ -	from row 4 above
10	**Portfolio GST BCR**	**1.64**	**-**	row 7 divided by rows 8+9

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherization)	Air Sealing, Gas	GB1a001	190	197	199	-	-	-	-	-	-	-	-	-	-	-	-	2,249.2	2,327.8	2,349.3	33,738.7	34,917.7	35,240.0
B1a - HEA (Weatherization)	Faucet Aerator, Gas	GB1a002	190	197	199	-	-	-	-	-	-	-	-	-	-	-	-	27.0	27.9	28.2	188.9	195.5	197.3
B1a - HEA (Weatherization)	Hand Held Showerhead, Gas	GB1a003	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulation, Gas	GB1a004	190	197	199	8.7	9.0	9.0	216.3	223.8	225.9	1.4	1.4	1.4	2.3	2.4	2.4	6,488.2	6,714.9	6,776.9	162,205.4	167,873.5	169,423.1
B1a - HEA (Weatherization)	LED Bulb, General Service Lamps	GB1a005	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Linear	GB1a006	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Other Specialty	GB1a007	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Bulb, Reflector	GB1a008	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	LED Fixture	GB1a009	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Low Flow Showerhead, Gas	GB1a010	190	197	199	-	-	-	-	-	-	-	-	-	-	-	-	109.5	113.3	114.4	766.6	793.4	800.8
B1a - HEA (Weatherization)	Pipe Insulation - Hot Water, Gas	GB1a011	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Visual Audit	GB1a012	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Baseload Audit - SF	GB1a013	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Baseload Audit - MF	GB1a014	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Insulated Door, Gas	GB1a015	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Replacement, Gas	GB1a016	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Window Insert, Gas	GB1a017	40	40	40	-	-	-	-	-	-	-	-	-	-	-	-	40.1	40.0	40.0	160.4	160.2	160.2
B1a - HEA (Weatherization)	Duct Insulation, Gas	GB1a018	-	-	-													-	-	-	-	-	-
B1a - HEA (Weatherization)	Hot Water Setback	GB1a019	30	30	30	-	-	-	-	-	-	-	-	-	-	-	-	37.4	37.4	37.4	74.8	74.8	74.8
B1a - HEA (Weatherization)	Duct Sealing, Gas	GB1a020	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Boiler Replacement, Gas	GB1b001	20	20	21	-	-	-	-	-	-	-	-	-	-	-	-	582.4	582.4	611.5	11,065.6	11,065.6	11,618.9
B1b - HEA (HVAC Systems)	Furnace Replacement, Gas	GB1b002	20	19	21	2.7	2.6	2.9	46.4	44.1	48.7	0.8	0.8	0.8	-	-	-	364.0	345.8	382.2	6,188.0	5,878.6	6,497.4
B1b - HEA (HVAC Systems)	Programmable Thermostat, Gas	GB1b003	70	70	71	1.7	1.7	1.7	25.8	25.8	26.2	0.3	0.3	0.3	0.5	0.5	0.5	131.9	131.9	133.7	1,977.9	1,977.9	2,006.1
B1b - HEA (HVAC Systems)	Wifi Thermostat, Gas	GB1b004	70	70	70	2.9	2.9	2.9	44.0	44.0	44.0	0.5	0.5	0.5	0.8	0.8	0.8	369.5	369.5	369.5	5,541.9	5,541.9	5,541.9
B1b - HEA (HVAC Systems)	HVAC Repair: Boiler - Condensing, Water	GB1b005	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	HVAC Repair: Boiler - Steam	GB1b006	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	HVAC Repair: Boiler -Water	GB1b007	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	19.5	19.5	19.5	19.5	19.5	19.5
B1b - HEA (HVAC Systems)	HVAC Repair: Furnace - Condensing, Ducted	GB1b008	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	HVAC Repair: Furnace - Ducted	GB1b009	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	10.9	10.9	10.9	10.9	10.9	10.9
B1b - HEA (HVAC Systems)	Stand Alone Storage Water Heater, Gas	GB1b010	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Indirect Water Heater, Gas	GB1b011	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82), Gas	GB1b012	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Water Heater - Integrated with Condensing Boiler >= 90% AFUE, Gas	GB1b013	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Water Heater - Integrated with Condensing Boiler >= 95% AFUE, Gas	GB1b014	-	-	-													-	-	-	-	-	-
B1b - HEA (HVAC Systems)	Water Heater - Tankless, OnDemand UEF >=.87, Gas	GB1b015	-	-	-													-	-	-	-	-	-
	Home Energy Assistance Subtota		**-**	**-**	**-**	**16.0**	**16.2**	**16.6**	**332.4**	**337.7**	**344.7**	**2.9**	**2.9**	**3.0**	**3.5**	**3.6**	**3.6**	**10,429.7**	**10,721.5**	**10,873.7**	**221,938.8**	**228,509.6**	**231,590.9**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	GA1a001	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, SF	GA1a002	148	140	144	-	-	-	-	-	-	-	-	-	-	-	-	3,482.9	3,287.3	3,392.6	87,072.8	82,181.3	84,816.0
A1a - ES Homes	Hot Water, Gas, SF	GA1a003	148	140	144	-	-	-	-	-	-	-	-	-	-	-	-	518.7	489.6	505.3	7,781.0	7,343.9	7,579.3
A1a - ES Homes	Cooling, Electric, MF	GA1a002	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, MF	GA1a005	88	80	81	-	-	-	-	-	-	-	-	-	-	-	-	1,540.0	1,400.0	1,425.0	38,500.0	35,000.0	35,625.0
A1a - ES Homes	Hot Water, Gas, MF	GA1a006	88	80	81	-	-	-	-	-	-	-	-	-	-	-	-	308.0	280.0	285.0	4,620.0	4,200.0	4,275.0
A1a - ES Homes	LED Bulb	GA1a007	-	-	-													-	-	-	-	-	-
A1a - ES Homes	LED Fixture	GA1a008	-	-	-													-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	GA1a009	-	-	-													-	-	-	-	-	-
		ES Homes Subtotal	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,849.6**	**5,456.8**	**5,607.9**	**137,973.8**	**128,725.2**	**132,295.3**

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A2a - Home Performance (Weatherization)	Air Sealing, Gas	GA2a001	178	167	172	-	-	-	-	-	-	-	-	-	-	-	-	2,378.9	2,233.6	2,300.7	35,683.0	33,504.2	34,510.6
A2a - Home Performance (Weatherization)	Faucet Aerator, Gas	GA2a002	62	58	60	-	-	-	-	-	-	-	-	-	-	-	-	10.0	9.4	9.7	69.9	65.7	67.6
A2a - Home Performance (Weatherization)	Hand Held Showerhead, Gas	GA2a003	62	58	60	-	-	-	-	-	-	-	-	-	-	-	-	39.0	36.6	37.7	273.0	256.3	264.0
A2a - Home Performance (Weatherization)	Insulation, Gas	GA2a004	178	167	172	-	-	-	-	-	-	-	-	-	-	-	-	4,940.7	4,639.0	4,778.4	123,518.2	115,976.2	119,459.9
A2a - Home Performance (Weatherization)	LED Bulb, General Service Lamps	GA2a005	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Linear	GA2a006	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Other Specialty	GA2a007	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Bulb, Reflector	GA2a008	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	LED Fixture	GA2a009	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Low Flow Showerhead, Gas	GA2a010	62	58	60	-	-	-	-	-	-	-	-	-	-	-	-	39.0	36.6	37.7	272.9	256.2	263.9
A2a - Home Performance (Weatherization)	Pipe Insulation - Hot Water, Gas	GA2a011	71	58	60	-	-	-	-	-	-	-	-	-	-	-	-	292.8	240.5	247.8	4,391.8	3,608.1	3,716.5
A2a - Home Performance (Weatherization)	Baseload Audit - Electric Savings	GA2a012	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Baseload Audit - Thermal Savings	GA2a013	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Visual Audit	GA2a014	-	-	-													-	-	-	-	-	-
A2a - Home Performance (Weatherization)	Duct Insulation, Gas	GA2a018	36	33	34	-	-	-	-	-	-	-	-	-	-	-	-	144.9	-	-	2,173.9	-	-
A2a - Home Performance (Weatherization)	Hot Water Setback	GA2a019	62	58	60	-	-	-	-	-	-	-	-	-	-	-	-	26.3	-	-	52.6	-	-
A2b - Home Performance (HVAC Systems)	Boiler Replacement, Gas	GA2b001	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Furnace Replacement, Gas	GA2b002	-	-	-													-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Programmable Thermostat, Gas	GA2b003	46	38	38	1.2	1.0	1.0	18.4	15.2	15.2	0.2	0.2	0.2	0.3	0.3	0.3	98.0	81.0	81.0	1,469.3	1,214.8	1,214.8
A2b - Home Performance (HVAC Systems)	Wifi Thermostat, Gas	GA2b004	150	135	135	6.9	6.2	6.2	103.5	93.2	93.2	1.1	1.0	1.0	1.8	1.6	1.6	904.8	814.3	814.3	13,572.0	12,214.8	12,214.8
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Boiler Circulator Pump	GA2b008	20	17	17	0.2	0.2	0.2	3.4	2.9	2.9	0.1	0.0	0.0	-	-	-	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Furnace	GA2b009	40	36	36	3.4	3.1	3.1	61.9	55.7	55.7	1.0	0.9	0.9	-	-	-	-	-	-	-	-	-
A2b - Home Performance (HVAC Systems)	Ancillary Savings – Central AC	GA2b010	35	32	32	1.1	1.0	1.0	20.2	18.4	18.4	-	-	-	0.6	0.6	0.6	-	-	-	-	-	-
	Home Performance Subtotal		**1,004**	**919**	**939**	**12.9**	**11.5**	**11.5**	**207.4**	**185.5**	**185.5**	**2.3**	**2.1**	**2.1**	**2.8**	**2.5**	**2.5**	**8,874.4**	**8,091.1**	**8,307.3**	**181,476.7**	**167,096.5**	**171,712.3**

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A3b - ES Appliances and Products	Early Replacement Boiler, FHW - EE 90 AFUE (80%-90%)	GA3b001	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Early Replacement Boiler, FHW - Retirement: 90 AFUE (65%-90%)	GA3b002	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Early Replacement Boiler, Steam - EE: 82%+ AFUE	GA3b003	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Early Replacement Boiler, Steam - Retirement: 82%+ AFUE	GA3b004	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Boiler Reset Controls	GA3b005	5	4	5	-	-	-	-	-	-	-	-	-	-	-	-	25.5	20.4	25.5	382.5	306.0	382.5
A3b - ES Appliances and Products	Condensing Boiler >= 90% AFUE (Up to 300 MBH)	GA3b006	36	33	35	-	-	-	-	-	-	-	-	-	-	-	-	435.6	399.3	423.5	8,276.4	7,586.7	8,046.5
A3b - ES Appliances and Products	Condensing Boiler >= 95% AFUE (Up to 300 MBH)	GA3b007	140	130	135	-	-	-	-	-	-	-	-	-	-	-	-	2,075.8	1,924.0	1,998.0	39,440.1	36,556.0	37,962.0
A3b - ES Appliances and Products	Furnace 95+ AFUE (<150) w/ECM Motor	GA3b008	265	250	256	27.6	26.1	26.6	469.4	442.9	452.6	8.0	7.6	7.8	-	-	-	2,597.0	2,450.0	2,504.1	44,149.0	41,650.0	42,570.2
A3b - ES Appliances and Products	Furnace 97+ AFUE (<150) w/ECM Motor	GA3b009	90	75	85	9.4	7.8	8.9	159.4	132.9	150.6	2.7	2.3	2.6	-	-	-	927.0	772.5	875.5	15,759.0	13,132.5	14,883.5
A3b - ES Appliances and Products	Heat Recovery Ventilator (-133 kWh penalty)	GA3b010	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Programmable Thermostat	GA3b011	75	65	70	2.0	1.8	1.9	30.4	26.3	28.4	0.3	0.3	0.3	0.5	0.5	0.5	155.3	134.6	144.9	2,328.8	2,018.3	2,173.5
A3b - ES Appliances and Products	Indirect Water Heater (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82)	GA3b012	55	45	55	-	-	-	-	-	-	-	-	-	-	-	-	220.0	180.0	220.0	4,400.0	3,600.0	4,400.0
A3b - ES Appliances and Products	Integrated Water Heater w/Condensing Boiler >= 90% AFUE	GA3b013	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Integrated Water Heater w/Condensing Boiler >= 95% AFUE	GA3b014	215	191	200	-	-	-	-	-	-	-	-	-	-	-	-	2,752.0	2,446.2	2,560.0	52,288.0	46,478.1	48,640.0
A3b - ES Appliances and Products	Condensing Water Heater (EF 0.95)	GA3b015	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Stand Alone Storage Tank Water Heater (EF 0.67)	GA3b016	15	14	15	(0.6)	(0.6)	(0.6)	(8.4)	(7.8)	(8.4)	(0.1)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	45.0	42.0	45.0	585.0	546.0	585.0
A3b - ES Appliances and Products	Tankless On-Demand Water Heater, >= .82	GA3b017	-	-	-													-	-	-	-	-	-
A3b - ES Appliances and Products	Tankless On-Demand Water Heater, >= .94	GA3b018	175	170	176	(7.5)	(7.3)	(7.6)	(143.0)	(138.9)	(143.8)	(0.7)	(0.7)	(0.7)	(0.4)	(0.4)	(0.4)	1,277.5	1,241.0	1,284.8	24,272.5	23,579.0	24,411.2
A3b - ES Appliances and Products	WiFi Thermostat (Heating Only)	GA3b019	2,769	2,650	2,750	-	-	-	-	-	-	-	-	-	-	-	-	16,060.1	15,370.0	15,950.0	240,901.6	230,550.0	239,250.0
A3b - ES Appliances and Products	WiFi Thermostat (Heating & Cooling)	GA3b020	-	-	-													-	-	-	-	-	-
	ES Products Subtotal		**-**	**-**	**-**	**30.8**	**27.7**	**29.2**	**507.9**	**455.3**	**479.4**	**10.3**	**9.4**	**9.8**	**0.1**	**0.1**	**0.1**	**26,570.8**	**24,980.0**	**26,031.3**	**432,782.9**	**406,002.6**	**423,304.4**

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
A4a - Residential Behavior	Home Energy Reports	GA4a001	22,043	22,043	22,043	-	-	-	-	-	-	-	-	-	-	-	-	20,044.4	20,044.4	20,044.4	20,044.4	20,044.4	20,044.4
	Residential Behavior Subtota		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**20,044.4**	**20,044.4**	**20,044.4**	**20,044.4**	**20,044.4**	**20,044.4**

			Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Hot Water Retro	GC1a001	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large HVAC Retro	GC1a002	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Other Retro	GC1a003	21	23	23	-	-	-	-	-	-	-	-	-	-	-	-	14,562.4	16,060.6	16,008.0	189,311.8	208,787.7	208,104.0
C1a - LCI Retrofit	Custom Large Process Retro	GC1a004	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Faucet Aerator, Gas	GC1a005	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC1a006	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Low Flow Showerhead, Gas	GC1a007	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Hot Water, Gas	GC1a008	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pre Rinse Spray Valve, Gas	GC1a009	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Boiler Reset Controls, Gas	GC1a010	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Boiler Tune-Ups	GC1a011	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Energy Management System, Gas	GC1a012	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Insulation - Heating, Gas	GC1a013	4	5	5	-	-	-	-	-	-	-	-	-	-	-	-	620.0	775.0	775.0	9,300.0	11,625.0	11,625.0
C1a - LCI Retrofit	Steam Trap, Gas	GC1a014	250	260	255	-	-	-	-	-	-	-	-	-	-	-	-	9,000.0	9,360.0	9,170.9	54,000.0	56,160.0	55,025.3
C1a - LCI Retrofit	Programmable Thermostat, Gas	GC1a015	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	WiFi Thermostat (Heating & Cooling)	GC1a016	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Air Sealing, Gas	GC1a017	-	-	-													-	-	-	-	-	-
C1a - LCI Retrofit	Insulation, Gas	GC1a018	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Hot Water New	GC1b001	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large HVAC New	GC1b002	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Custom Large Other New	GC1b003	4	5	5	-	-	-	-	-	-	-	-	-	-	-	-	7,656.0	9,570.0	9,570.0	99,528.0	124,410.0	124,410.0
C1b - LCI New Equipment and Construction	Custom Large Process New	GC1b004	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC1b005	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC1b006	3	4	4	-	-	-	-	-	-	-	-	-	-	-	-	283.5	378.0	378.0	7,087.5	9,450.0	9,450.0
C1b - LCI New Equipment and Construction	Boiler 500 to 999 MBH 90 AFUE, Gas	GC1b007	4	5	4	-	-	-	-	-	-	-	-	-	-	-	-	205.6	257.0	205.6	5,140.0	6,425.0	5,140.0
C1b - LCI New Equipment and Construction	Boiler 301 to 499 MBH 90 AFUE, Gas	GC1b008	4	4	3	-	-	-	-	-	-	-	-	-	-	-	-	112.0	112.0	84.0	2,800.0	2,800.0	2,100.0
C1b - LCI New Equipment and Construction	Boiler to 300 MBH 90 AFUE, Gas	GC1b009	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Boiler to 300 MBH 95 AFUE, Gas	GC1b010	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Combo Condensing Boiler / Water Heater, Gas	GC1b011	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Combo Furnace / Water Heater, Gas	GC1b012	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Condensing Unit Heater, Gas	GC1b013	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Furnace w/ ECM 95 AFUE, Gas	GC1b014	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Furnace w/ ECM 97 AFUE, Gas	GC1b015	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Infrared Heater, Gas	GC1b016	6	7	6	-	-	-	-	-	-	-	-	-	-	-	-	72.0	84.0	72.0	1,224.0	1,428.0	1,224.0
C1b - LCI New Equipment and Construction	Faucet Aerator, Gas	GC1b017	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Low Flow Showerhead With Thermostatic Valve, Gas	GC1b018	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Low Flow Showerhead, Gas	GC1b019	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Pre Rinse Spray Valve, Gas	GC1b020	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Combination Oven, Gas	GC1b021	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Convection Oven, Gas	GC1b022	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Conveyor Oven, Gas	GC1b023	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Fryer, Gas	GC1b024	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Griddle, Gas	GC1b025	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Rack Oven, Gas	GC1b026	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Steam Cooker, Gas	GC1b027	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Indirect Water Heater, Gas	GC1b028	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	On Demand Tankless Water Heater, Gas	GC1b029	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Volume Water Heater, Gas	GC1b030	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Condensing Gas Water Heater	GC1b031	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Clothes Washer, High Speed, Gas	GC1b032	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	Pasta Cooker, Gas	GC1b033	-	-	-													-	-	-	-	-	-
C1b - LCI New Equipment and Construction	C&I Large New Construction Code Compliance	GC1b028	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Combination Oven, Gas	GC1c001	4	5	4	-	-	-	-	-	-	-	-	-	-	-	-	112.0	139.9	112.0	1,343.5	1,679.3	1,343.5
C1c - LCI Midstream	Midstream Convection Oven, Gas	GC1c002	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	21.2	21.2	10.6	253.9	253.9	126.9
C1c - LCI Midstream	Midstream Conveyor Oven, Gas	GC1c003	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Fryer, Gas	GC1c004	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	42.6	42.6	42.6	511.8	511.8	511.8
C1c - LCI Midstream	Midstream Griddle, Gas	GC1c005	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Pre-Rinse Spray Valve, Gas	GC1c006	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Rack Oven, Gas	GC1c007	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Steam Cooker, Gas	GC1c008	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Indirect Water Heater, Gas	GC1c009	4	5	4	-	-	-	-	-	-	-	-	-	-	-	-	22.5	28.1	22.5	336.9	421.1	336.9
C1c - LCI Midstream	Midstream On Demand Tankless Water Heater, Gas	GC1c010	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Midstream Volume Water Heater, Gas	GC1c011	3	4	3	-	-	-	-	-	-	-	-	-	-	-	-	458.0	610.6	458.0	6,869.5	9,159.3	6,869.5
C1c - LCI Midstream	Midstream Condensing Gas Water Heater	GC1c012	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Thermostatic Shut-off Valve, Gas	GC1c013	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead, Gas	GC1c014	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, Gas	GC1c015	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Faucet Aerator, Gas	GC1c016	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pipe Wrap, Gas	GC1c017	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Pre-Rinse Spray Valve, Gas	GC1c018	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Programmable Thermostat, Gas	GC1c019	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	OMP Wi-Fi Thermostat	GC1c020	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Underfired Broiler	GC1c021	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Clothes Washer, High Speed, Gas	GC1c022	-	-	-													-	-	-	-	-	-
C1c - LCI Midstream	Pasta Cooker, Gas	GC1c023	-	-	-													-	-	-	-	-	-
	Large Business Energy Solutions Subtota		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**33,167.7**	**37,439.0**	**36,909.1**	**377,706.8**	**433,111.2**	**426,266.9**

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Custom Small Hot Water Retro	GC2a001	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small HVAC Retro	GC2a002	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Other Retro	GC2a003	39	50	48	-	-	-	-	-	-	-	-	-	-	-	-	3,367.8	4,350.0	4,164.3	50,517.6	65,250.0	62,463.8
C2a - SCI Retrofit	Custom Small Process Retro	GC2a004	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Faucet Aerator, Gas	GC2a005	475	485	480	-	-	-	-	-	-	-	-	-	-	-	-	807.5	824.5	816.0	5,652.5	5,771.5	5,712.0
C2a - SCI Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC2a006	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Low Flow Showerhead, Gas	GC2a007	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Wrap - Hot Water, Gas	GC2a008	130	130	130	-	-	-	-	-	-	-	-	-	-	-	-	27.3	27.3	27.3	191.1	191.1	191.1
C2a - SCI Retrofit	Pre Rinse Spray Valve, Gas	GC2a009	20	22	21	-	-	-	-	-	-	-	-	-	-	-	-	228.0	250.8	239.4	1,824.0	2,006.4	1,915.2
C2a - SCI Retrofit	Boiler Reset Controls, Gas	GC2a010	2	2	4	-	-	-	-	-	-	-	-	-	-	-	-	71.0	71.0	142.0	1,065.0	1,065.0	2,130.0
C2a - SCI Retrofit	Boiler Tune-Ups	GC2a011	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Energy Management System, Gas	GC2a012	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Insulation - Heating, Gas	GC2a013	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Steam Trap, Gas	GC2a014	5	7	6	-	-	-	-	-	-	-	-	-	-	-	-	80.0	112.0	96.0	480.0	672.0	576.0
C2a - SCI Retrofit	Programmable Thermostat, Gas	GC2a015	125	126	126	-	-	-	-	-	-	-	-	-	-	-	-	437.5	441.0	441.0	6,562.5	6,615.0	6,615.0
C2a - SCI Retrofit	Air Sealing, Gas	GC2a017	-	-	-													-	-	-	-	-	-
C2a - SCI Retrofit	Insulation, Gas	GC2a018	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Hot Water New	GC2b001	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small HVAC New	GC2b002	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Custom Small Other New	GC2b003	30	32	34	-	-	-	-	-	-	-	-	-	-	-	-	3,257.0	3,451.6	3,698.9	42,341.2	44,870.4	48,086.2
C2b - SCI New Equipment and Construction	Custom Small Process New	GC2b004	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC2b005	4	4	5	-	-	-	-	-	-	-	-	-	-	-	-	661.2	661.2	826.5	16,530.0	16,530.0	20,662.5
C2b - SCI New Equipment and Construction	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC2b006	2	3	4	-	-	-	-	-	-	-	-	-	-	-	-	189.0	283.5	378.0	4,725.0	7,087.5	9,450.0
C2b - SCI New Equipment and Construction	Boiler 500 to 999 MBH 90 AFUE, Gas	GC2b007	19	20	19	-	-	-	-	-	-	-	-	-	-	-	-	976.6	1,028.0	976.6	24,415.0	25,700.0	24,415.0
C2b - SCI New Equipment and Construction	Boiler 301 to 499 MBH 90 AFUE, Gas	GC2b008	15	16	17	-	-	-	-	-	-	-	-	-	-	-	-	420.0	448.0	476.0	10,500.0	11,200.0	11,900.0
C2b - SCI New Equipment and Construction	Boiler to 300 MBH 90 AFUE, Gas	GC2b009	-	-	1			-			-			-			-	-	-	14.7	-	-	367.5
C2b - SCI New Equipment and Construction	Boiler to 300 MBH 95 AFUE, Gas	GC2b010	30	30	30	-	-	-	-	-	-	-	-	-	-	-	-	531.0	531.0	531.0	13,275.0	13,275.0	13,275.0
C2b - SCI New Equipment and Construction	Combo Condensing Boiler / Water Heater, Gas	GC2b011	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Combo Furnace / Water Heater, Gas	GC2b012	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Condensing Unit Heater, Gas	GC2b013	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Furnace w/ ECM 95 AFUE, Gas	GC2b014	25	25	25	4.2	4.2	4.2	75.6	75.6	75.6	1.2	1.2	1.2	-	-	-	142.5	142.5	142.5	2,565.0	2,565.0	2,565.0
C2b - SCI New Equipment and Construction	Furnace w/ ECM 97 AFUE, Gas	GC2b015	4	5	4	0.7	0.8	0.7	12.1	15.1	12.1	0.2	0.2	0.2	-	-	-	26.8	33.5	26.8	482.4	603.0	482.4
C2b - SCI New Equipment and Construction	Infrared Heater, Gas	GC2b016	21	22	21	-	-	-	-	-	-	-	-	-	-	-	-	252.0	264.0	252.0	4,284.0	4,488.0	4,284.0
C2b - SCI New Equipment and Construction	Faucet Aerator, Gas	GC2b017	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Low Flow Showerhead With Thermostatic Valve, Gas	GC2b018	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Low Flow Showerhead, Gas	GC2b019	400	400	400	-	-	-	-	-	-	-	-	-	-	-	-	1,060.0	1,060.0	1,060.0	7,420.0	7,420.0	7,420.0
C2b - SCI New Equipment and Construction	Pre Rinse Spray Valve, Gas	GC2b020	18	20	18	-	-	-	-	-	-	-	-	-	-	-	-	205.2	-	205.2	1,641.6	-	1,641.6
C2b - SCI New Equipment and Construction	Combination Oven, Gas	GC2b021	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Convection Oven, Gas	GC2b022	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Conveyor Oven, Gas	GC2b023	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Fryer, Gas	GC2b024	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Griddle, Gas	GC2b025	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Rack Oven, Gas	GC2b026	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Steam Cooker, Gas	GC2b027	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Indirect Water Heater, Gas	GC2b028	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	On Demand Tankless Water Heater, Gas	GC2b029	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Volume Water Heater, Gas	GC2b030	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Condensing Gas Water Heater	GC2b031	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Clothes Washer, High Speed, Gas	GC2b032	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	Pasta Cooker, Gas	GC2b033	-	-	-													-	-	-	-	-	-
C2b - SCI New Equipment and Construction	C&I Small New Construction Code Compliance	GC2b028	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Combination Oven, Gas	GC2c001	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	56.0	56.0	84.0	671.7	671.7	1,007.6
C2c - SCI Midstream	Midstream Convection Oven, Gas	GC2c002	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	21.2	31.7	21.2	253.9	380.8	253.9
C2c - SCI Midstream	Midstream Conveyor Oven, Gas	GC2c003	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	147.3	147.3	220.9	1,767.3	1,767.3	2,650.9
C2c - SCI Midstream	Midstream Fryer, Gas	GC2c004	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	127.9	127.9	85.3	1,535.4	1,535.4	1,023.6
C2c - SCI Midstream	Midstream Griddle, Gas	GC2c005	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	18.4	36.8	18.4	220.9	441.8	220.9
C2c - SCI Midstream	Midstream Pre-Rinse Spray Valve, Gas	GC2c006	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Rack Oven, Gas	GC2c007	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	Midstream Steam Cooker, Gas	GC2c008	16	16	16	-	-	-	-	-	-	-	-	-	-	-	-	950.3	950.3	950.3	11,403.4	11,403.4	11,403.4
C2c - SCI Midstream	Midstream Indirect Water Heater, Gas	GC2c009	8	9	8	-	-	-	-	-	-	-	-	-	-	-	-	45.6	51.3	45.6	684.0	769.5	684.0
C2c - SCI Midstream	Midstream On Demand Tankless Water Heater, Gas	GC2c010	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	21.4	21.4	21.4	427.2	427.2	427.2
C2c - SCI Midstream	Midstream Volume Water Heater, Gas	GC2c011	8	8	8	-	-	-	-	-	-	-	-	-	-	-	-	392.6	392.6	392.6	5,889.6	5,889.6	5,889.6
C2c - SCI Midstream	Midstream Water Heater, Condensing Gas	GC2c012	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Thermostatic Shut-off Valve, Gas	GC2c013	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead, Gas	GC2c014	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve, Gas	GC2c015	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Faucet Aerator, Gas	GC2c016	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pipe Wrap, Gas	GC2c017	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Pre-Rinse Spray Valve, Gas	GC2c018	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Programmable Thermostat, Gas	GC2c019	-	-	-													-	-	-	-	-	-
C2c - SCI Midstream	OMP Wi-Fi Thermostat	GC2c020	-	-	-													-	-	-	-	-	-
	Small Business Energy Solutions Subtota					**4.9**	**5.0**	**4.9**	**87.7**	**90.7**	**87.7**	**1.4**	**1.5**	**1.4**	**-**	**-**	**-**	**14,521.1**	**15,795.2**	**16,353.8**	**217,325.3**	**238,596.7**	**247,713.5**

		-	Quantity			Net Annual MWh Savings			Net Lifetime MWh Savings			Annual Net Winter kW			Annual Net Summer kW			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Custom Small Hot Water Retro	GC3a001	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Small HVAC Retro	GC3a002	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Custom Small Other Retro	GC3a003	10	10	9	-	-	-	-	-	-	-	-	-	-	-	-	1,566.0	1,515.5	1,405.1	23,490.0	22,731.9	21,076.6
C3a - Muni Retrofit	Custom Small Process Retro	GC3a004	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Gas	GC3a005	50	50	50	-	-	-	-	-	-	-	-	-	-	-	-	85.0	85.0	85.0	595.0	595.0	595.0
C3a - Muni Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC3a006	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Low Flow Showerhead, Gas	GC3a007	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Gas	GC3a008	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	2.5	2.5	2.5	17.6	17.6	17.6
C3a - Muni Retrofit	Pre Rinse Spray Valve, Gas	GC3a009	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	11.4	11.4	11.4	91.2	91.2	91.2
C3a - Muni Retrofit	Boiler Reset Controls, Gas	GC3a010	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Tune-Ups	GC3a011	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Energy Management System, Gas	GC3a012	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	136.0	136.0	136.0	1,360.0	1,360.0	1,360.0
C3a - Muni Retrofit	Pipe Insulation - Heating, Gas	GC3a013	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Gas	GC3a014	40	40	40	-	-	-	-	-	-	-	-	-	-	-	-	637.6	640.0	640.0	3,825.4	3,840.0	3,840.0
C3a - Muni Retrofit	Programmable Thermostat, Gas	GC3a015	50	50	50	-	-	-	-	-	-	-	-	-	-	-	-	175.0	175.0	175.0	2,625.0	2,625.0	2,625.0
C3a - Muni Retrofit	Air Sealing, Gas	GC3a017	-	-	-													-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Gas	GC3a018	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Small Hot Water New	GC3b001	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Small HVAC New	GC3b002	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Custom Small Other New	GC3b003	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	913.5	913.5	913.5	11,875.3	11,875.3	11,875.5
C3b - Muni New Equipment and Construction	Custom Small Process New	GC3b004	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC3b005	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	330.6	330.6	330.6	8,265.0	8,265.0	8,265.0
C3b - Muni New Equipment and Construction	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC3b006	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler 500 to 999 MBH 90 AFUE, Gas	GC3b007	8	8	8	-	-	-	-	-	-	-	-	-	-	-	-	411.2	411.2	411.2	10,280.0	10,280.0	10,280.0
C3b - Muni New Equipment and Construction	Boiler 301 to 499 MBH 90 AFUE, Gas	GC3b008	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	56.0	56.0	56.0	1,400.0	1,400.0	1,400.0
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 90 AFUE, Gas	GC3b009	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Boiler to 300 MBH 95 AFUE, Gas	GC3b010	12	12	13	-	-	-	-	-	-	-	-	-	-	-	-	212.4	212.4	230.1	5,310.0	5,310.0	5,752.5
C3b - Muni New Equipment and Construction	Combo Condensing Boiler / Water Heater, Gas	GC3b011	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Combo Furnace / Water Heater, Gas	GC3b012	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Condensing Unit Heater, Gas	GC3b013	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 95 AFUE, Gas	GC3b014	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Furnace w/ ECM 97 AFUE, Gas	GC3b015	3	3	4	0.5	0.5	0.7	9.1	9.1	12.1	0.1	0.1	0.2	-	-	-	20.1	20.1	26.8	361.8	361.8	482.4
C3b - Muni New Equipment and Construction	Infrared Heater, Gas	GC3b016	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Faucet Aerator, Gas	GC3b017	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low Flow Showerhead With Thermostatic Valve, Gas	GC3b018	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Low Flow Showerhead, Gas	GC3b019	61	61	61	-	-	-	-	-	-	-	-	-	-	-	-	161.7	161.7	161.7	1,131.8	1,131.8	1,131.6
C3b - Muni New Equipment and Construction	Pre Rinse Spray Valve, Gas	GC3b020	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Combination Oven, Gas	GC3b021	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Convection Oven, Gas	GC3b022	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Conveyor Oven, Gas	GC3b023	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Fryer, Gas	GC3b024	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Griddle, Gas	GC3b025	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Rack Oven, Gas	GC3b026	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Steam Cooker, Gas	GC3b027	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Indirect Water Heater, Gas	GC3b028	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	On Demand Tankless Water Heater, Gas	GC3b029	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	7.4	7.4	14.8	148.3	148.3	296.5
C3b - Muni New Equipment and Construction	Volume Water Heater, Gas	GC3b030	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	68.1	68.1	68.1	1,022.1	1,022.1	1,022.1
C3b - Muni New Equipment and Construction	Condensing Gas Water Heater	GC3b031	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Clothes Washer, High Speed, Gas	GC3b032	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	Pasta Cooker, Gas	GC3b033	-	-	-													-	-	-	-	-	-
C3b - Muni New Equipment and Construction	C&I Small New Construction Code Compliance	GC3b028	-	-	-													-	-	-	-	-	-
	Municipal Energy Solutions Subtota					**0.5**	**0.5**	**0.7**	**9.1**	**9.1**	**12.1**	**0.1**	**0.1**	**0.2**	**-**	**-**	**-**	**4,794.5**	**4,746.4**	**4,667.8**	**71,798.4**	**71,055.0**	**70,111.1**

Program Cost-Effectiveness - 2024 PLAN

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	1.82	*1.82*	861.0	*861.0*	472.5	-	4.1	82.6	0.7	1.0	45	2,342.8	50,351.4
B2a - IE Education	-	-	-	-	8.8	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	24.4	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.70**	***1.70***	**861.0**	***861.0***	**505.7**	**-**	**4.1**	**82.6**	**0.7**	**1.0**	**45**	**2,342.8**	**50,351.4**
Residential Programs													
A1 - Energy Star Homes	1.40	*1.26*	302.9	*373.9*	217.0	80.0	-	-	-	-	65	1,575.0	37,100.0
A2 - Home Performance	1.23	*1.26*	379.6	*468.7*	309.6	61.6	4.5	80.2	0.7	1.2	35	2,057.4	43,355.0
A3 - Energy Star Products	2.21	*1.34*	391.7	*483.8*	177.3	185.1	7.2	114.1	1.7	1.0	250	2,639.7	44,433.8
A4 - Residential Behavior	1.50	*1.86*	125.2	*155.1*	83.6	-	-	-	-	-	11,200	11,800.0	11,800.0
A6a - Res Education	-	-	-	-	14.5	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	35.7	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.43**	***1.27***	**1,199.4**	***1,481.5***	**837.6**	**326.7**	**11.7**	**194.3**	**2.4**	**2.2**	**11,550**	**18,072.1**	**136,688.8**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.44	*2.19*	1,239.6	*1,355.1*	507.2	112.4	-	-	-	-	11	9,990.5	161,960.8
C2 - Small Business Energy Solutions	1.88	*1.55*	918.4	*977.8*	487.6	142.7	2.5	45.4	0.7	-	75	6,048.4	81,979.3
C3 - Municipal Energy Solutions	1.68	*1.62*	180.6	*197.6*	107.2	15.0	-	-	-	-	5	1,459.9	20,438.0
C6a - C&I Education	-	-	-	-	33.8	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	49.4	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.97**	***1.74***	**2,338.6**	***2,530.5***	**1,185.2**	**270.0**	**2.5**	**45.4**	**0.7**	**-**	**91**	**17,498.8**	**264,378.1**
Total	**1.74**	***1.56***	**4,399.1**	***4,873.0***	**2,528.6**	**596.8**	**18.4**	**322.3**	**3.8**	**3.2**	**11,686**	**37,913.6**	**451,418.4**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2024.

Annual Net Savings as a % of 2022 Sales	0.44%

Spending per Customer	Low-Income	$	803.99
	Residential	$	29.27
	C&I	$	196.85

Present Value Benefits - 2024 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)							Non-Resource Benefits ($000)			
	Granite State Test	*Total Resource Cost Test*	Total Electric Benefit	Natural Gas Benefit	Natural Gas DRIPE	Total Natural Gas Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	Environ-mental Benefits ($000)[3]
Income Eligible Programs													
B1 - Home Energy Assistance	**$ 861**	*$ 861*	**$ 8**	$ 395	$ 7	$ 402	$ 402	$ 5	**$ 416**	$ 26	$ 419	**$ 445**	**$ 3**
B2a - IE Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 861**	*$ 861*	**$ 8**	**$ 395**	**$ 7**	**$ 402**	**$ 402**	**$ 5**	**$ 416**	**$ 26**	**$ 419**	**$ 445**	**$ 3**
Residential Programs													
A1 - Energy Star Homes	**$ 303**	*$ 374*	**$ -**	$ 279	$ 5	$ 284	$ 284	$ -	**$ 284**	$ 19	$ 71	**$ 90**	**$ -**
A2 - Home Performance	**$ 380**	*$ 469*	**$ 9**	$ 341	$ 7	$ 348	$ 348	$ 1	**$ 358**	$ 22	$ 89	**$ 111**	**$ 3**
A3 - Energy Star Products	**$ 392**	*$ 484*	**$ 10**	$ 350	$ 8	$ 358	$ 358	$ -	**$ 368**	$ 23	$ 92	**$ 115**	**$ 4**
A4 - Residential Behavior	**$ 125**	*$ 155*	**$ -**	$ 116	$ 4	$ 120	$ 120	$ -	**$ 120**	$ 5	$ 30	**$ 35**	**$ -**
A5 - Residential Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 1,199**	*$ 1,482*	**$ 19**	**$ 1,086**	**$ 23**	**$ 1,109**	**$ 1,109**	**$ 1**	**$ 1,130**	**$ 70**	**$ 282**	**$ 352**	**$ 7**
Commercial/Industrial Programs													
C1 - Large Business Energy Solutions	**$ 1,240**	*$ 1,355*	**$ -**	$ 1,131	$ 24	$ 1,155	$ 1,155	$ -	**$ 1,155**	$ 84	$ 116	**$ 200**	**$ -**
C2 - Small Business Energy Solutions	**$ 918**	*$ 978*	**$ 3**	$ 576	$ 14	$ 590	$ 590	$ 283	**$ 876**	$ 42	$ 59	**$ 102**	**$ 1**
C3 - Municipal Energy Solutions	**$ 181**	*$ 198*	**$ -**	$ 165	$ 5	$ 170	$ 170	$ -	**$ 170**	$ 11	$ 17	**$ 28**	**$ -**
C5 - C&I Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 2,339**	*$ 2,530*	**$ 3**	**$ 1,873**	**$ 43**	**$ 1,915**	**$ 1,915**	**$ 283**	**$ 2,201**	**$ 137**	**$ 192**	**$ 329**	**$ 1**
C6d - Smart Start	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 4,399**	*$ 4,873*	**$ 31**	**$ 3,354**	**$ 73**	**$ 3,427**	**$ 3,427**	**$ 290**	**$ 3,747**	**$ 233**	**$ 893**	**$ 1,126**	**$ 11**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings

(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.

(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024										
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**	***125% of Planned PI***	**Actual PI**	**Source**
1	Lifetime MMBtu Savings	451,418	*338,564*		-	2.475%	-	$ 62,582	*$ 78,227*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	37,914	*28,435*		-	1.100%	-	$ 27,814	*$ 34,768*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 3,747,169			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,3]	$ 2,528,551			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 1,218,618	*$ 913,964*		-	1.925%	-	$ 48,675	*$ 60,843*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 139,070	*$ 173,838*	**$ -**	

		Granite State Test		
		Planned	**Actual**	**Source**
10	Total Benefits	$ 4,399,065		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 139,070	$ -	from row 9 above
12	Total Utility Costs	$ 2,528,551	$ -	from row 7 above
13	**Portfolio GST BCR**	**1.65**	**-**	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2025 Plan

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)²**	**Customer Costs ($000 - 2024$)²**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.03	*2.03*	998.1	*998.1*	491.6	-	4.4	89.4	0.7	1.1	51	2,622.8	56,565.0
B2a - IE Education	-	-	-	-	9.1	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	22.5	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**1.91**	***1.91***	**998.1**	***998.1***	**523.2**	**-**	**4.4**	**89.4**	**0.7**	**1.1**	**51**	**2,622.8**	**56,565.0**
Residential Programs													
A1 - Energy Star Homes	1.42	*1.31*	312.4	*385.5*	219.5	73.9	-	-	-	-	65	1,575.0	37,100.0
A2 - Home Performance	1.34	*1.38*	441.7	*545.2*	329.9	65.0	4.7	86.4	0.7	1.3	40	2,310.5	49,009.4
A3 - Energy Star Products	2.22	*1.41*	404.4	*499.3*	182.5	171.0	7.2	114.1	1.7	1.0	250	2,639.7	44,433.8
A4 - Residential Behavior	1.83	*2.27*	129.3	*160.2*	70.5	-	-	-	-	-	11,200	11,800.0	11,800.0
A6a - Res Education	-	-	-	-	14.6	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	31.2	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.52**	***1.37***	**1,287.7**	***1,590.2***	**848.2**	**309.9**	**12.0**	**200.5**	**2.4**	**2.3**	**11,555**	**18,325.2**	**142,343.2**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.46	*2.24*	1,281.9	*1,401.2*	521.3	103.8	-	-	-	-	11	9,990.5	161,960.8
C2 - Small Business Energy Solutions	1.84	*1.55*	925.3	*984.6*	502.7	131.8	2.5	45.4	0.7	-	75	5,792.8	78,912.1
C3 - Municipal Energy Solutions	1.44	*1.37*	166.9	*182.5*	115.5	17.3	-	-	-	-	5	1,305.0	18,270.0
C6a - C&I Education	-	-	-	-	42.8	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	62.2	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**1.91**	***1.72***	**2,374.1**	***2,568.3***	**1,244.6**	**252.9**	**2.5**	**45.4**	**0.7**	**-**	**91**	**17,088.3**	**259,142.9**
Total	**1.78**	***1.62***	**4,660.0**	***5,156.6***	**2,616.0**	**562.9**	**18.9**	**335.3**	**3.9**	**3.3**	**11,697**	**38,036.4**	**458,051.1**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2025.

Annual Net Savings as a % of 2022 Sales	0.45%

Spending per Customer	Low-Income	$	831.80
	Residential	$	29.64
	C&I	$	206.71

Present Value Benefits - 2025 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)								Non-Resource Benefits ($000)			
	Granite State Test	*Total Resource Cost Test*	Total Electric Benefit	Natural Gas Benefit	Natural Gas DRIPE	Total Natural Gas Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	Environmental Benefits ($000)[3]
Income Eligible Programs													
B1 - Home Energy Assistance	**$ 998**	*$ 998*	**$ 9**	$ 457	$ 9	$ 465	$ 465	$ 6	**$ 481**	$ 30	$ 487	**$ 517**	**$ 3**
B2a - IE Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 998**	*$ 998*	**$ 9**	**$ 457**	**$ 9**	**$ 465**	**$ 465**	**$ 6**	**$ 481**	**$ 30**	**$ 487**	**$ 517**	**$ 3**
Residential Programs													
A1 - Energy Star Homes	**$ 312**	*$ 386*	**$ -**	$ 288	$ 5	$ 293	$ 293	$ -	**$ 293**	$ 20	$ 73	**$ 93**	**$ -**
A2 - Home Performance	**$ 442**	*$ 545*	**$ 9**	$ 397	$ 8	$ 405	$ 405	$ 1	**$ 415**	$ 26	$ 104	**$ 130**	**$ 3**
A3 - Energy Star Products	**$ 404**	*$ 499*	**$ 11**	$ 361	$ 8	$ 369	$ 369	$ -	**$ 380**	$ 25	$ 95	**$ 120**	**$ 4**
A4 - Residential Behavior	**$ 129**	*$ 160*	**$ -**	$ 119	$ 4	$ 123	$ 123	$ -	**$ 123**	$ 6	$ 31	**$ 37**	**$ -**
A5 - Residential Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 1,288**	*$ 1,590*	**$ 20**	**$ 1,165**	**$ 25**	**$ 1,190**	**$ 1,190**	**$ 1**	**$ 1,211**	**$ 76**	**$ 302**	**$ 379**	**$ 7**
Commercial/Industrial Programs													
C1 - Large Business Energy Solutions	**$ 1,282**	*$ 1,401*	**$ -**	$ 1,168	$ 25	$ 1,192	$ 1,192	$ -	**$ 1,192**	$ 89	$ 119	**$ 209**	**$ -**
C2 - Small Business Energy Solutions	**$ 925**	*$ 985*	**$ 3**	$ 575	$ 14	$ 589	$ 589	$ 290	**$ 882**	$ 43	$ 59	**$ 102**	**$ 1**
C3 - Municipal Energy Solutions	**$ 167**	*$ 183*	**$ -**	$ 152	$ 4	$ 157	$ 157	$ -	**$ 157**	$ 10	$ 16	**$ 26**	**$ -**
C5 - C&I Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 2,374**	*$ 2,568*	**$ 3**	**$ 1,896**	**$ 43**	**$ 1,938**	**$ 1,938**	**$ 290**	**$ 2,231**	**$ 143**	**$ 194**	**$ 337**	**$ 1**
C6d - Smart Start	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 4,660**	*$ 5,157*	**$ 33**	**$ 3,517**	**$ 76**	**$ 3,593**	**$ 3,593**	**$ 297**	**$ 3,924**	**$ 249**	**$ 984**	**$ 1,233**	**$ 11**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2025										
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime MMBtu Savings	458,051	*343,538*		-	2.475%	-	$ 70,088	*$ 87,610*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	38,036	*28,527*		-	1.100%	-	$ 31,150	*$ 38,938*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 3,923,650			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,3]	$ 2,831,833			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 1,091,817	*$ 818,863*	$ -	-	1.925%	-	$ 54,513	*$ 68,141*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 155,751	*$ 194,689*	$ -	

		Granite State Test		
		Planned	Actual	Source
10	Total Benefits	$ 4,659,956		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 155,751	$ -	from row 9 above
12	Total Utility Costs	$ 2,831,833	$ -	from row 7 above
13	**Portfolio GST BCR**	**1.56**	**-**	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2026 Plan

	Benefit/Cost Ratios		Benefits ($000)										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.31	*2.31*	1,103.4	*1,103.4*	477.2	-	4.6	94.0	0.8	1.1	55	2,809.5	60,707.4
B2a - IE Education	-	-	-	-	8.7	-	-	-	-	-		-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	16.6	-	-	-	-	-		-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Income Eligible	**2.20**	***2.20***	**1,103.4**	***1,103.4***	**502.5**	**-**	**4.6**	**94.0**	**0.8**	**1.1**	**55**	**2,809.5**	**60,707.4**
Residential Programs													
A1 - Energy Star Homes	1.49	*1.40*	322.1	*397.4*	216.2	68.3	-	-	-	-	65	1,575.0	37,100.0
A2 - Home Performance	1.39	*1.45*	455.4	*562.0*	327.3	60.1	4.7	86.4	0.7	1.3	40	2,310.5	49,009.4
A3 - Energy Star Products	2.41	*1.56*	417.4	*515.3*	173.0	158.0	7.2	114.1	1.7	1.0	250	2,639.7	44,433.8
A4 - Residential Behavior	1.93	*2.39*	134.1	*166.0*	69.4	-	-	-	-	-	11,200	11,800.0	11,800.0
A6a - Res Education	-	-	-	-	14.1	-	-	-	-	-		-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	21.9	-	-	-	-	-		-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Residential	**1.62**	***1.48***	**1,329.0**	***1,640.8***	**821.8**	**286.3**	**12.0**	**200.5**	**2.4**	**2.3**	**11,555**	**18,325.2**	**142,343.2**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.71	*2.47*	1,325.2	*1,448.3*	489.4	95.9	-	-	-	-	11	9,990.5	161,960.8
C2 - Small Business Energy Solutions	2.07	*1.87*	977.6	*1,040.9*	472.5	85.1	2.5	45.4	0.7	-	75	6,048.4	81,979.3
C3 - Municipal Energy Solutions	1.70	*1.62*	201.1	*219.9*	118.3	17.6	-	-	-	-	5	1,522.5	21,315.0
C6a - C&I Education	-	-	-	-	48.5	-	-	-	-	-		-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	59.4	-	-	-	-	-		-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-		-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-		-	-
Sub-Total Commercial & Industrial	**2.11**	***1.95***	**2,503.9**	***2,709.1***	**1,188.1**	**198.6**	**2.5**	**45.4**	**0.7**	**-**	**91**	**17,561.4**	**265,255.1**
Total	**1.96**	***1.82***	**4,936.3**	***5,453.3***	**2,512.4**	**484.9**	**19.1**	**339.8**	**3.9**	**3.4**	**11,701**	**38,696.2**	**468,305.7**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization project in the Home Energy Assistance program. For the illustrative Total Resource Cost Test, NEI adders of 25% for Residential and 10% for C&I are applied

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023 for program year 2026.

Annual Net Savings as a % of 2022 Sales	0.45%

Spending per Customer	Low-Income	$	798.86
	Residential	$	28.71
	C&I	$	197.33

Present Value Benefits - 2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)							Non-Resource Benefits ($000)			
	Granite State Test	*Total Resource Cost Test*	Total Electric Benefit	Natural Gas Benefit	Natural Gas DRIPE	Total Natural Gas Benefit	Other Fuels	Water Benefit	Total Resource Benefits	Fossil Emissions	Other Non-Resource Benefits[2]	Total Non-Resource Benefits	Environmental Benefits ($000)[3]
Income Eligible Programs													
B1 - Home Energy Assistance	**$ 1,103**	*$ 1,103*	**$ 10**	$ 505	$ 9	$ 514	$ 514	$ 7	**$ 531**	$ 34	$ 538	**$ 572**	**$ 3**
B2a - IE Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 1,103**	*$ 1,103*	**$ 10**	**$ 505**	**$ 9**	**$ 514**	**$ 514**	**$ 7**	**$ 531**	**$ 34**	**$ 538**	**$ 572**	**$ 3**
Residential Programs													
A1 - Energy Star Homes	**$ 322**	*$ 397*	**$ -**	$ 297	$ 5	$ 302	$ 302	$ -	**$ 302**	$ 21	$ 75	**$ 96**	**$ -**
A2 - Home Performance	**$ 455**	*$ 562*	**$ 10**	$ 409	$ 8	$ 417	$ 417	$ 1	**$ 428**	$ 27	$ 107	**$ 134**	**$ 2**
A3 - Energy Star Products	**$ 417**	*$ 515*	**$ 11**	$ 372	$ 8	$ 380	$ 380	$ -	**$ 391**	$ 26	$ 98	**$ 124**	**$ 4**
A4 - Residential Behavior	**$ 134**	*$ 166*	**$ -**	$ 123	$ 4	$ 128	$ 128	$ -	**$ 128**	$ 6	$ 32	**$ 38**	**$ -**
A5 - Residential Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 1,329**	*$ 1,641*	**$ 21**	**$ 1,201**	**$ 25**	**$ 1,226**	**$ 1,226**	**$ 1**	**$ 1,249**	**$ 80**	**$ 312**	**$ 392**	**$ 6**
Commercial/Industrial Programs													
C1 - Large Business Energy Solutions	**$ 1,325**	*$ 1,448*	**$ -**	$ 1,206	$ 25	$ 1,231	$ 1,231	$ -	**$ 1,231**	$ 94	$ 123	**$ 217**	**$ -**
C2 - Small Business Energy Solutions	**$ 978**	*$ 1,041*	**$ 3**	$ 615	$ 15	$ 630	$ 630	$ 297	**$ 930**	$ 48	$ 63	**$ 111**	**$ 1**
C3 - Municipal Energy Solutions	**$ 201**	*$ 220*	**$ -**	$ 183	$ 5	$ 188	$ 188	$ -	**$ 188**	$ 13	$ 19	**$ 32**	**$ -**
C5 - C&I Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 2,504**	*$ 2,709*	**$ 3**	**$ 2,004**	**$ 45**	**$ 2,049**	**$ 2,049**	**$ 297**	**$ 2,349**	**$ 155**	**$ 205**	**$ 360**	**$ 1**
C6d - Smart Start	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 4,936**	*$ 5,453*	**$ 34**	**$ 3,710**	**$ 80**	**$ 3,790**	**$ 3,790**	**$ 305**	**$ 4,129**	**$ 269**	**$ 1,055**	**$ 1,324**	**$ 10**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.
(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.
(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2026										
	Portfolio	Planned	Threshold	Actual	% of Plan	Design Coefficient	Actual Coefficient	Planned PI[3]	*125% of Planned PI*	Actual PI	Source
1	Lifetime MMBtu Savings	468,306	*351,229*		-	2.475%	-	$ 72,865	*$ 91,082*	$ -	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	38,696	*29,022*		-	1.100%	-	$ 32,385	*$ 40,481*	$ -	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 4,129,210			-						Planned and Actual from Benefits Tab
7	Total Utility Costs[1,3]	$ 2,944,052			-						Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 1,185,158	*$ 888,868*	$ -	-	1.925%	-	$ 56,673	*$ 70,841*	$ -	Line 5 minus line 6
9	Total					5.500%	-	$ 161,923	*$ 202,404*	$ -	

		Granite State Test		
		Planned	Actual	Source
10	Total Benefits	$ 4,936,285		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 161,923	$ -	from row 9 above
12	Total Utility Costs	$ 2,944,052	$ -	from row 7 above
13	**Portfolio GST BCR**	**1.59**	-	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

Program Cost-Effectiveness - 2024-2026 PLAN

	Benefit/Cost Ratios		**Benefits ($000)**										
	Granite State Test	*Total Resource Cost Test*	**Granite State Test**	*Total Resource Cost Test*	**Utility Costs ($000 - 2024$)[2]**	**Customer Costs ($000 - 2024$)[2]**	**Annual Net MWh Savings**	**Lifetime Net MWh Savings**	**Winter kW Savings**	**Summer kW Savings**	**Number of Customers Served**	**Annual Net MMBtu Savings**	**Lifetime Net MMBtu Savings**
Income Eligible Programs													
B1 - Home Energy Assistance	2.06	*2.06*	2,962.5	*2,962.5*	1,441.4	-	13.0	266.1	2.2	3.2	151	7,775.1	167,623.9
B2a - IE Education	-	-	-	-	26.5	-	-	-	-	-	-	-	-
B2b - IE Evaluation, Measurement and Verification	-	-	-	-	63.5	-	-	-	-	-	-	-	-
B3 - IE TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Income Eligible	**1.93**	***1.93***	**2,962.5**	***2,962.5***	**1,531.4**	**-**	**13.0**	**266.1**	**2.2**	**3.2**	**151**	**7,775.1**	**167,623.9**
Residential Programs													
A1 - Energy Star Homes	1.44	*1.32*	937.3	*1,156.9*	652.7	222.2	-	-	-	-	195	4,725.0	111,300.0
A2 - Home Performance	1.32	*1.37*	1,276.7	*1,575.8*	966.8	186.7	14.0	253.0	2.1	3.8	115	6,678.4	141,373.8
A3 - Energy Star Products	2.28	*1.43*	1,213.6	*1,498.4*	532.8	514.0	21.7	342.3	5.2	2.9	750	7,919.1	133,301.4
A4 - Residential Behavior	1.74	*2.15*	388.6	*481.3*	223.4	-	-	-	-	-	33,600	35,400.0	35,400.0
A6a - Res Education	-	-	-	-	43.2	-	-	-	-	-	-	-	-
A6b - Res Evaluation, Measurement and Verification	-	-	-	-	88.7	-	-	-	-	-	-	-	-
A7 - Res TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Residential	**1.52**	***1.37***	**3,816.2**	***4,712.5***	**2,507.6**	**923.0**	**35.7**	**595.3**	**7.3**	**6.7**	**34,660**	**54,722.5**	**421,375.2**
Commercial, Industrial & Municipal													
C1 - Large Business Energy Solutions	2.53	*2.30*	3,846.7	*4,204.5*	1,517.8	312.1	-	-	-	-	33	29,971.5	485,882.4
C2 - Small Business Energy Solutions	1.93	*1.65*	2,821.3	*3,003.3*	1,462.9	359.5	7.6	136.1	2.2	-	225	17,889.7	242,870.6
C3 - Municipal Energy Solutions	1.61	*1.53*	548.6	*600.1*	341.0	49.9	-	-	-	-	15	4,287.4	60,023.0
C6a - C&I Education	-	-	-	-	125.1	-	-	-	-	-	-	-	-
C6b - C&I Evaluation, Measurement and Verification	-	-	-	-	171.0	-	-	-	-	-	-	-	-
C6c - C&I Customer Partnerships	-	-	-	-	-	-	-	-	-	-	-	-	-
C7 - C&I TBD Pilots/Demonstrations	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Commercial & Industrial	**1.99**	***1.80***	**7,216.6**	***7,807.9***	**3,617.9**	**721.5**	**7.6**	**136.1**	**2.2**	**-**	**273**	**52,148.6**	**788,776.1**
Total	**1.83**	***1.66***	**13,995.3**	***15,482.9***	**7,657.0**	**1,644.5**	**56.3**	**997.4**	**11.6**	**10.0**	**35,084**	**114,646.2**	**1,377,775.1**

Notes:

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322, and includes an annual NEI adder of $405.71 per weatherization

(2) Utility and Customer Costs and Benefits are expressed in 2024 Dollars.

(3) Per past precedent, discount and inflation rates have been updated for the year in which measures will be installed, and were updated as of June 1, 2023.

Annual Net Savings as a % of 2022 Sales	1.35%

Spending per Customer			
	Low-Income	$	2,434.65
	Residential	$	87.62
	C&I	$	600.89

Present Value Benefits - 2024-2026 PLAN

	Total Benefits ($000)[1]		Resource Benefits ($000)							Non-Resource Benefits ($000)			
	Granite State Test	*Total Resource Cost Test*	**Total Electric Benefit**	**Natural Gas Benefit**	**Natural Gas DRIPE**	**Total Natural Gas Benefit**	**Other Fuels**	**Water Benefit**	**Total Resource Benefits**	**Fossil Emissions**	**Other Non-Resource Benefits[2]**	**Total Non-Resource Benefits**	**Environmental Benefits ($000)[3]**
Income Eligible Programs													
B1 - Home Energy Assistance	**$ 2,963**	*$ 2,963*	**$ 28**	$ 1,356	$ 25	$ 1,382	$ 1,382	$ 19	**$ 1,429**	$ 90	$ 1,444	**$ 1,534**	**$ 8**
B2a - IE Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B2b - IE Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
B3 - IE TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Income Eligible	**$ 2,963**	*$ 2,963*	**$ 28**	**$ 1,356**	**$ 25**	**$ 1,382**	**$ 1,382**	**$ 19**	**$ 1,429**	**$ 90**	**$ 1,444**	**$ 1,534**	**$ 8**
Residential Programs													
A1 - Energy Star Homes	**$ 937**	*$ 1,157*	**$ -**	$ 864	$ 15	$ 878	$ 878	$ -	**$ 878**	$ 59	$ 220	**$ 278**	**$ -**
A2 - Home Performance	**$ 1,277**	*$ 1,576*	**$ 28**	$ 1,147	$ 22	$ 1,169	$ 1,169	$ 4	**$ 1,201**	$ 76	$ 299	**$ 375**	**$ 8**
A3 - Energy Star Products	**$ 1,214**	*$ 1,498*	**$ 32**	$ 1,084	$ 24	$ 1,108	$ 1,108	$ -	**$ 1,140**	$ 74	$ 285	**$ 359**	**$ 12**
A4 - Residential Behavior	**$ 389**	*$ 481*	**$ -**	$ 358	$ 13	$ 371	$ 371	$ -	**$ 371**	$ 18	$ 93	**$ 110**	**$ -**
A5 - Residential Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6a - Res Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A6b - Res Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
A7 - Res TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Residential	**$ 3,816**	*$ 4,713*	**$ 60**	**$ 3,453**	**$ 73**	**$ 3,526**	**$ 3,526**	**$ 4**	**$ 3,590**	**$ 226**	**$ 896**	**$ 1,123**	**$ 20**
Commercial/Industrial Programs													
C1 - Large Business Energy Solutions	**$ 3,847**	*$ 4,205*	**$ -**	$ 3,504	$ 74	$ 3,578	$ 3,578	$ -	**$ 3,578**	$ 268	$ 358	**$ 626**	**$ -**
C2 - Small Business Energy Solutions	**$ 2,821**	*$ 3,003*	**$ 10**	$ 1,767	$ 43	$ 1,810	$ 1,810	$ 869	**$ 2,688**	$ 133	$ 182	**$ 315**	**$ 4**
C3 - Municipal Energy Solutions	**$ 549**	*$ 600*	**$ -**	$ 501	$ 14	$ 515	$ 515	$ -	**$ 515**	$ 34	$ 51	**$ 85**	**$ -**
C5 - C&I Active Demand Response	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6a - C&I Education	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6b - C&I Evaluation, Measurement and Verification	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C6c - C&I Customer Partnerships	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
C7 - C&I TBD Pilots/Demonstrations	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Sub-Total Commercial & Industrial	**$ 7,217**	*$ 7,808*	**$ 10**	**$ 5,772**	**$ 131**	**$ 5,903**	**$ 5,903**	**$ 869**	**$ 6,782**	**$ 435**	**$ 591**	**$ 1,026**	**$ 4**
C6d - Smart Start	**$ -**	*$ -*	**$ -**	$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	$ -	**$ -**	**$ -**
Total	**$ 13,995**	*$ 15,483*	**$ 97**	**$ 10,581**	**$ 229**	**$ 10,810**	**$ 10,810**	**$ 892**	**$ 11,800**	**$ 751**	**$ 2,932**	**$ 3,683**	**$ 32**

(1) The Granite State Test is used as the primary cost test, as approved in Order No. 36,322. Benefits are calculated based on net savings.

(2) Non-resource benefits include NEIs, which are only applied to the Home Energy Asssitance program in the GST primary cost test.

(3) Non-embedded environmental benefits are not included in the GST primary cost test.

	Portfolio Planned Versus Actual Performance - 2024-2026													
	Portfolio	**Planned**	**Threshold**	**Actual**	**% of Plan**	**Design Coefficient**	**Actual Coefficient**	**Planned PI[3]**		***125% of Planned PI***		**Actual PI**		**Source**
1	Lifetime MMBtu Savings	1,377,775	*1,033,331*		-	2.475%	-	$	205,535	*$*	*256,919*	$	-	Planned and Actual from Cost Eff Tab
2	Annual MMBtu Savings	114,646	*85,985*		-	1.100%	-	$	91,349	*$*	*114,186*	$	-	Planned and Actual from Cost Eff Tab
6	Total Resource Benefits	$ 11,800,030			-									Planned and Actual from Benefits Tab
7	Total Utility Costs[1,3]	$ 8,304,437			-									Planned and Actual from Cost Eff Tab
8	Net Benefits	$ 3,495,593	*$ 2,621,695*	$ -	-	1.925%	-	$	159,860	*$*	*199,826*	$	-	Line 5 minus line 6
9	Total					5.500%	-	$	456,744	*$*	*570,930*	$	-	

		Granite State Test		
		Planned	**Actual**	**Source**
10	Total Benefits	$ 13,995,306		Planned and Actual from Cost Eff Tab
11	Performance Incentive	$ 456,744	$ -	from row 9 above
12	Total Utility Costs	$ 8,304,437	$ -	from row 7 above
13	**Portfolio GST BCR**	**1.60**	-	row 10 divided by rows 11+12

[1] Note that in order to avoid a circular reference in the calculation of performance incentive, "Total Utility Costs" does not include the value of PI.

[3] Costs and PI expressed in nominal dollars.

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
B1a - HEA (Weatherizatior	Air Sealing, Gas	GB1a001	45	51	55	15	15	15	100%	100%	100%	100%	100%	100%	532.4	603.3	650.7	7,985.3	9,050.0	9,759.8
B1a - HEA (Weatherizatior	Faucet Aerator, Gas	GB1a002	45	51	55	7	7	7	100%	100%	100%	100%	100%	100%	6.4	7.2	7.8	44.7	50.7	54.7
B1a - HEA (Weatherizatior	Hand Held Showerhead, Gas	GB1a003	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Insulation, Gas	GB1a004	45	51	55	25	25	25	100%	100%	100%	100%	100%	100%	1,535.6	1,740.4	1,876.9	38,390.6	43,509.4	46,921.9
B1a - HEA (Weatherizatior	LED Bulb, General Service Lamps	GB1a005	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	LED Bulb, Linear	GB1a006	-	-	-	10	10	10	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	LED Bulb, Other Specialty	GB1a007	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	LED Bulb, Reflector	GB1a008	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	LED Fixture	GB1a009	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Low Flow Showerhead, Gas	GB1a010	45	51	55	7	7	7	100%	100%	100%	100%	100%	100%	25.9	29.4	31.7	181.4	205.6	221.8
B1a - HEA (Weatherizatior	Pipe Insulation - Hot Water, Gas	GB1a011	5	5	5	15	15	15	100%	100%	100%	100%	100%	100%	15.9	15.9	15.9	238.9	238.9	238.9
B1a - HEA (Weatherizatior	Visual Audit	GB1a012	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Baseload Audit - SF	GB1a013	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Baseload Audit - MF	GB1a014	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Insulated Door, Gas	GB1a015	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Window Replacement, Gas	GB1a016	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Window Insert, Gas	GB1a017	-	-	-	4	4	4	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Duct Insulation, Gas	GB1a018	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1a - HEA (Weatherizatior	Hot Water Setback	GB1a019	20	20	20	2	2	2	100%	100%	100%	100%	100%	100%	7.5	7.5	7.5	15.0	15.0	15.0
B1a - HEA (Weatherizatior	Duct Sealing, Gas	GB1a020	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Boiler Replacement, Gas	GB1b001	3	3	3	19	19	19	100%	100%	100%	100%	100%	100%	43.7	43.7	43.7	829.9	829.9	829.9
B1b - HEA (HVAC System	Furnace Replacement, Gas	GB1b002	2	2	2	17	17	17	100%	100%	100%	100%	100%	100%	36.4	36.4	36.4	618.8	618.8	618.8
B1b - HEA (HVAC System	Programmable Thermostat, Gas	GB1b003	25	25	25	15	15	15	100%	100%	100%	100%	100%	100%	47.1	47.1	47.1	706.4	706.4	706.4
B1b - HEA (HVAC System	Wifi Thermostat, Gas	GB1b004	28	28	28	15	15	15	100%	100%	100%	100%	100%	100%	89.2	89.2	89.2	1,337.7	1,337.7	1,337.7
B1b - HEA (HVAC System	HVAC Repair: Boiler - Condensing, Water	GB1b005	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	HVAC Repair: Boiler - Steam	GB1b006	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	HVAC Repair: Boiler -Water	GB1b007	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	HVAC Repair: Furnace - Condensing, Ducted	GB1b008	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	HVAC Repair: Furnace - Ducted	GB1b009	1	1	1	1	1	1	100%	100%	100%	100%	100%	100%	2.7	2.7	2.7	2.7	2.7	2.7
B1b - HEA (HVAC System	Stand Alone Storage Water Heater, Gas	GB1b010	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Indirect Water Heater, Gas	GB1b011	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Water Heater - Indirect (attached to ES FHW Boiler; Cc	GB1b012	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Water Heater - Integrated with Condensing Boiler >= 9	GB1b013	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Water Heater - Integrated with Condensing Boiler >= 9	GB1b014	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
B1b - HEA (HVAC System	Water Heater - Tankless, OnDemand UEF >=.87, Gas	GB1b015	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
	Home Energy Assistance Subtotal														**2,342.8**	**2,622.8**	**2,809.5**	**50,351.4**	**56,565.0**	**60,707.4**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
A1a - ES Homes	Cooling, Electric, SF	GA1a001	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, SF	GA1a002	35	35	35	25	25	25	100%	100%	100%	100%	100%	100%	822.5	822.5	822.5	20,562.5	20,562.5	20,562.5
A1a - ES Homes	Hot Water, Gas, SF	GA1a003	35	35	35	15	15	15	100%	100%	100%	100%	100%	100%	122.5	122.5	122.5	1,837.5	1,837.5	1,837.5
A1a - ES Homes	Cooling, Electric, MF	GA1a002	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A1a - ES Homes	Heating, Gas, MF	GA1a005	30	30	30	25	25	25	100%	100%	100%	100%	100%	100%	525.0	525.0	525.0	13,125.0	13,125.0	13,125.0
A1a - ES Homes	Hot Water, Gas, MF	GA1a006	30	30	30	15	15	15	100%	100%	100%	100%	100%	100%	105.0	105.0	105.0	1,575.0	1,575.0	1,575.0
A1a - ES Homes	LED Bulb	GA1a007	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A1a - ES Homes	LED Fixture	GA1a008	-	-	-	5	5	5	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A1a - ES Homes	Clothes Washer	GA1a009	-	-	-	11	11	11	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A1a - ES Homes	Residential New Construction Code Compliance	GA1a010	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
	ES Homes Subtotal														**1,575.0**	**1,575.0**	**1,575.0**	**37,100.0**	**37,100.0**	**37,100.0**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
A2a - Home Performance (	Air Sealing, Gas	GA2a001	35	40	40	15	15	15	100%	100%	100%	99%	99%	99%	540.5	617.8	617.8	8,108.1	9,266.4	9,266.4
A2a - Home Performance (	Faucet Aerator, Gas	GA2a002	10	10	10	7	7	7	100%	100%	100%	99%	99%	99%	1.6	1.6	1.6	11.2	11.2	11.2
A2a - Home Performance (	Hand Held Showerhead, Gas	GA2a003	10	10	10	7	7	7	100%	100%	100%	99%	99%	99%	6.3	6.3	6.3	43.9	43.9	43.9
A2a - Home Performance (	Insulation, Gas	GA2a004	35	40	40	25	25	25	100%	100%	100%	99%	99%	99%	1,261.3	1,441.4	1,441.4	31,531.5	36,036.0	36,036.0
A2a - Home Performance (	LED Bulb, General Service Lamps	GA2a005	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Linear	GA2a006	1	1	1	10	10	10	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Other Specialty	GA2a007	5	5	5	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
A2a - Home Performance (	LED Bulb, Reflector	GA2a008	5	5	5	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
A2a - Home Performance (	LED Fixture	GA2a009	-	-	-	2	2	2	100%	100%	100%	98%	98%	98%	-	-	-	-	-	-
A2a - Home Performance (	Low Flow Showerhead, Gas	GA2a010	-	-	-	7	7	7	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2a - Home Performance (	Pipe Insulation - Hot Water, Gas	GA2a011	10	10	10	15	15	15	100%	100%	100%	99%	99%	99%	41.2	41.2	41.2	617.8	617.8	617.8
A2a - Home Performance (	Baseload Audit - Electric Savings	GA2a012	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2a - Home Performance (	Baseload Audit - Thermal Savings	GA2a013	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2a - Home Performance (	Visual Audit	GA2a014	-	-	-	1	1	1	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2a - Home Performance (	Duct Insulation, Gas	GA2a018	-	-	-	15	15	15	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2a - Home Performance (	Hot Water Setback	GA2a019	10	10	10	2	2	2	100%	100%	100%	99%	99%	99%	4.2	-	-	8.5	-	-
A2b - Home Performance (	Boiler Replacement, Gas	GA2b001	-	-	-	19	19	19	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2b - Home Performance (	Furnace Replacement, Gas	GA2b002	-	-	-	17	17	17	100%	100%	100%	99%	99%	99%	-	-	-	-	-	-
A2b - Home Performance (	Programmable Thermostat, Gas	GA2b003	10	10	10	15	15	15	100%	100%	100%	99%	99%	99%	21.3	21.3	21.3	319.7	319.7	319.7
A2b - Home Performance (	Wifi Thermostat, Gas	GA2b004	30	30	30	15	15	15	100%	100%	100%	100%	100%	100%	181.0	181.0	181.0	2,714.4	2,714.4	2,714.4
A2b - Home Performance (	Ancillary Savings – Boiler Circulator Pump	GA2b008	15	15	15	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Furnace	GA2b009	1	1	1	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A2b - Home Performance (	Ancillary Savings – Central AC	GA2b010	12	12	12	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
	Home Performance Subtotal														**2,057.4**	**2,310.5**	**2,310.5**	**43,355.0**	**49,009.4**	**49,009.4**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
A3b - ES Appliances and F	Early Replacement Boiler, FHW - EE 90 AFUE (80%-9	GA3b001	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Early Replacement Boiler, FHW - Retirement: 90 AFUE	GA3b002	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Early Replacement Boiler, Steam - EE: 82%+ AFUE	GA3b003	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Early Replacement Boiler, Steam - Retirement: 82%+ A	GA3b004	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Boiler Reset Controls	GA3b005	2	2	2	15	15	15	100%	100%	100%	100%	100%	100%	10.2	10.2	10.2	153.0	153.0	153.0
A3b - ES Appliances and F	Condensing Boiler >= 90% AFUE (Up to 300 MBH)	GA3b006	5	5	5	19	19	19	100%	100%	100%	100%	100%	100%	60.5	60.5	60.5	1,149.5	1,149.5	1,149.5
A3b - ES Appliances and F	Condensing Boiler >= 95% AFUE (Up to 300 MBH)	GA3b007	30	30	30	19	19	19	100%	100%	100%	100%	100%	100%	444.0	444.0	444.0	8,436.0	8,436.0	8,436.0
A3b - ES Appliances and F	Furnace 95+ AFUE (<150) w/ECM Motor	GA3b008	30	30	30	17	17	17	100%	100%	100%	100%	100%	100%	294.0	294.0	294.0	4,998.0	4,998.0	4,998.0
A3b - ES Appliances and F	Furnace 97+ AFUE (<150) w/ECM Motor	GA3b009	9	9	9	17	17	17	100%	100%	100%	100%	100%	100%	92.7	92.7	92.7	1,575.9	1,575.9	1,575.9
A3b - ES Appliances and F	Heat Recovery Ventilator (-133 kWh penalty)	GA3b010	1	1	1	20	20	20	100%	100%	100%	100%	100%	100%	7.7	7.7	7.7	154.0	154.0	154.0
A3b - ES Appliances and F	Programmable Thermostat	GA3b011	100	100	100	15	15	15	100%	100%	100%	100%	100%	100%	207.0	207.0	207.0	3,105.0	3,105.0	3,105.0
A3b - ES Appliances and F	Indirect Water Heater (attached to ES FHW Boiler; Cor	GA3b012	7	7	7	20	20	20	100%	100%	100%	100%	100%	100%	28.0	28.0	28.0	560.0	560.0	560.0
A3b - ES Appliances and F	Integrated Water Heater w/Condensing Boiler >= 90%	GA3b013	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Integrated Water Heater w/Condensing Boiler >= 95%	GA3b014	30	30	30	19	19	19	100%	100%	100%	100%	100%	100%	384.0	384.0	384.0	7,296.0	7,296.0	7,296.0
A3b - ES Appliances and F	Condensing Water Heater (EF 0.95)	GA3b015	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Stand Alone Storage Tank Water Heater (EF 0.67)	GA3b016	3	3	3	13	13	13	100%	100%	100%	100%	100%	100%	9.0	9.0	9.0	117.0	117.0	117.0
A3b - ES Appliances and F	Tankless On-Demand Water Heater, >= .82	GA3b017	-	-	-	19	19	19	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
A3b - ES Appliances and F	Tankless On-Demand Water Heater, >= .94	GA3b018	12	12	12	19	19	19	100%	100%	100%	100%	100%	100%	87.6	87.6	87.6	1,664.4	1,664.4	1,664.4
A3b - ES Appliances and F	WiFi Thermostat (Heating Only)	GA3b019	125	125	125	15	15	15	100%	100%	100%	100%	100%	100%	725.0	725.0	725.0	10,875.0	10,875.0	10,875.0
A3b - ES Appliances and F	WiFi Thermostat (Heating & Cooling)	GA3b020	50	50	50	15	15	15	100%	100%	100%	100%	100%	100%	290.0	290.0	290.0	4,350.0	4,350.0	4,350.0
	ES Products Subtotal														**2,639.7**	**2,639.7**	**2,639.7**	**44,433.8**	**44,433.8**	**44,433.8**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
A4a - Residential Behavior	Home Energy Reports	GA4a001	11,200	11,200	11,200	1	1	1	100%	100%	100%	100%	100%	100%	11,800.0	11,800.0	11,800.0	11,800.0	11,800.0	11,800.0
	Residential Behavior Subtotal														**11,800.0**	**11,800.0**	**11,800.0**	**11,800.0**	**11,800.0**	**11,800.0**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C1a - LCI Retrofit	Custom Large Hot Water Retro	GC1a001	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large HVAC Retro	GC1a002	3	3	3	20	20	20	100%	100%	100%	100%	100%	100%	4,176.0	4,176.0	4,176.0	83,520.0	83,520.0	83,520.0
C1a - LCI Retrofit	Custom Large Other Retro	GC1a003	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Custom Large Process Retro	GC1a004	2	2	2	13	13	13	100%	100%	100%	100%	100%	100%	3,480.0	3,480.0	3,480.0	45,240.0	45,240.0	45,240.0
C1a - LCI Retrofit	Faucet Aerator, Gas	GC1a005	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC1a006	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Low Flow Showerhead, Gas	GC1a007	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Wrap - Hot Water, Gas	GC1a008	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Pre Rinse Spray Valve, Gas	GC1a009	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Boiler Reset Controls, Gas	GC1a010	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Boiler Tune-Ups	GC1a011	-	-	-	1	1	1	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Energy Management System, Gas	GC1a012	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Pipe Insulation - Heating, Gas	GC1a013	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Steam Trap, Gas	GC1a014	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Programmable Thermostat, Gas	GC1a015	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	WiFi Thermostat (Heating & Cooling)	GC1a016	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Air Sealing, Gas	GC1a017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1a - LCI Retrofit	Insulation, Gas	GC1a018	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Hot Water New	GC1b001	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large HVAC New	GC1b002	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Other New	GC1b003	-	-	-	13	13	13	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Custom Large Process New	GC1b004	2	2	2	13	13	13	100%	100%	100%	100%	100%	100%	2,088.0	2,088.0	2,088.0	27,144.0	27,144.0	27,144.0
C1b - LCI New Equipment	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC1b005	1	1	1	25	25	25	100%	100%	100%	100%	100%	100%	165.3	165.3	165.3	4,132.5	4,132.5	4,132.5
C1b - LCI New Equipment	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC1b006	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Boiler 500 to 999 MBH 90 AFUE, Gas	GC1b007	1	1	1	25	25	25	100%	100%	100%	100%	100%	100%	51.4	51.4	51.4	1,285.0	1,285.0	1,285.0
C1b - LCI New Equipment	Boiler 301 to 499 MBH 90 AFUE, Gas	GC1b008	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Boiler to 300 MBH 90 AFUE, Gas	GC1b009	1	1	1	25	25	25	100%	100%	100%	100%	100%	100%	14.7	14.7	14.7	367.5	367.5	367.5
C1b - LCI New Equipment	Boiler to 300 MBH 95 AFUE, Gas	GC1b010	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Combo Condensing Boiler / Water Heater, Gas	GC1b011	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Combo Furnace / Water Heater, Gas	GC1b012	1	1	1	18	18	18	100%	100%	100%	100%	100%	100%	15.1	15.1	15.1	271.8	271.8	271.8
C1b - LCI New Equipment	Condensing Unit Heater, Gas	GC1b013	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Furnace w/ ECM 95 AFUE, Gas	GC1b014	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Furnace w/ ECM 97 AFUE, Gas	GC1b015	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Infrared Heater, Gas	GC1b016	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Faucet Aerator, Gas	GC1b017	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Low Flow Showerhead With Thermostatic Valve, Gas	GC1b018	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Low Flow Showerhead, Gas	GC1b019	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Pre Rinse Spray Valve, Gas	GC1b020	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Combination Oven, Gas	GC1b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Convection Oven, Gas	GC1b022	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Conveyor Oven, Gas	GC1b023	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C1b - LCI New Equipment	Fryer, Gas	GC1b024	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Griddle, Gas	GC1b025	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Rack Oven, Gas	GC1b026	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Steam Cooker, Gas	GC1b027	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Indirect Water Heater, Gas	GC1b028	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	On Demand Tankless Water Heater, Gas	GC1b029	-	-	-	20	20	20	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Volume Water Heater, Gas	GC1b030	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Condensing Gas Water Heater	GC1b031	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Clothes Washer, High Speed, Gas	GC1b032	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	Pasta Cooker, Gas	GC1b033	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1b - LCI New Equipment	C&I Large New Construction Code Compliance	GC1b028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Combination Oven, Gas	GC1c001	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Griddle, Gas	GC1c005	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Pre-Rinse Spray Valve, Gas	GC1c006	-	-	-	8	8	8	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Rack Oven, Gas	GC1c007	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Steam Cooker, Gas	GC1c008	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Indirect Water Heater, Gas	GC1c009	-	-	-	15	15	15	30%	30%	30%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream On Demand Tankless Water Heater, Gas	GC1c010	-	-	-	20	20	20	60%	60%	60%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Volume Water Heater, Gas	GC1c011	-	-	-	15	15	15	60%	60%	60%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Midstream Condensing Gas Water Heater	GC1c012	-	-	-	15	15	15	30%	30%	30%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Thermostatic Shut-off Valve, Gas	GC1c013	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead, Gas	GC1c014	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve,	GC1c015	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Faucet Aerator, Gas	GC1c016	-	-	-	10	10	10	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Pipe Wrap, Gas	GC1c017	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Pre-Rinse Spray Valve, Gas	GC1c018	-	-	-	8	8	8	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Programmable Thermostat, Gas	GC1c019	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	OMP Wi-Fi Thermostat	GC1c020	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
C1c - LCI Midstream	Underfired Broiler	GC1c021	-	-	-	15	15	15	86%	86%	86%	100%	100%	100%	-	-	-	-	-	-
		LCI Subtotal													**9,990.5**	**9,990.5**	**9,990.5**	**161,960.8**	**161,960.8**	**161,960.8**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C2a - SCI Retrofit	Custom Small Hot Water Retro	GC2a001	5	5	5	10	10	10	100%	100%	100%	100%	100%	100%	413.3	413.3	413.3	4,132.5	4,132.5	4,132.5
C2a - SCI Retrofit	Custom Small HVAC Retro	GC2a002	5	5	5	14	14	14	100%	100%	100%	100%	100%	100%	217.5	217.5	217.5	3,045.0	3,045.0	3,045.0
C2a - SCI Retrofit	Custom Small Other Retro	GC2a003	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Custom Small Process Retro	GC2a004	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Faucet Aerator, Gas	GC2a005	300	300	300	7	7	7	100%	100%	100%	100%	100%	100%	510.0	510.0	510.0	3,570.0	3,570.0	3,570.0
C2a - SCI Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC2a006	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Low Flow Showerhead, Gas	GC2a007	175	175	175	7	7	7	100%	100%	100%	100%	100%	100%	463.8	463.8	463.8	3,246.3	3,246.3	3,246.3
C2a - SCI Retrofit	Pipe Wrap - Hot Water, Gas	GC2a008	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Pre Rinse Spray Valve, Gas	GC2a009	2	2	2	8	8	8	100%	100%	100%	100%	100%	100%	22.8	22.8	22.8	182.4	182.4	182.4
C2a - SCI Retrofit	Boiler Reset Controls, Gas	GC2a010	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Boiler Tune-Ups	GC2a011	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Energy Management System, Gas	GC2a012	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Pipe Insulation - Heating, Gas	GC2a013	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Steam Trap, Gas	GC2a014	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Programmable Thermostat, Gas	GC2a015	125	125	125	15	15	15	100%	100%	100%	100%	100%	100%	437.5	437.5	437.5	6,562.5	6,562.5	6,562.5
C2a - SCI Retrofit	Air Sealing, Gas	GC2a017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2a - SCI Retrofit	Insulation, Gas	GC2a018	2	2	2	25	25	25	100%	100%	100%	100%	100%	100%	100.0	100.0	100.0	2,500.0	2,500.0	2,500.0
C2b - SCI New Equipment	Custom Small Hot Water New	GC2b001	10	10	10	12	12	12	100%	100%	100%	100%	100%	100%	652.5	652.5	652.5	7,830.0	7,830.0	7,830.0
C2b - SCI New Equipment	Custom Small HVAC New	GC2b002	6	6	6	14	14	14	100%	100%	100%	100%	100%	100%	783.0	783.0	783.0	10,962.0	10,962.0	10,962.0
C2b - SCI New Equipment	Custom Small Other New	GC2b003	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Custom Small Process New	GC2b004	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC2b005	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC2b006	3	3	3	25	25	25	100%	100%	100%	100%	100%	100%	283.5	283.5	283.5	7,087.5	7,087.5	7,087.5
C2b - SCI New Equipment	Boiler 500 to 999 MBH 90 AFUE, Gas	GC2b007	3	3	3	25	25	25	100%	100%	100%	100%	100%	100%	154.2	154.2	154.2	3,855.0	3,855.0	3,855.0
C2b - SCI New Equipment	Boiler 301 to 499 MBH 90 AFUE, Gas	GC2b008	5	5	5	25	25	25	100%	100%	100%	100%	100%	100%	140.0	140.0	140.0	3,500.0	3,500.0	3,500.0
C2b - SCI New Equipment	Boiler to 300 MBH 90 AFUE, Gas	GC2b009	5	5	5	25	25	25	100%	100%	100%	100%	100%	100%	73.5	73.5	73.5	1,837.5	1,837.5	1,837.5
C2b - SCI New Equipment	Boiler to 300 MBH 95 AFUE, Gas	GC2b010	5	5	5	25	25	25	100%	100%	100%	100%	100%	100%	88.5	88.5	88.5	2,212.5	2,212.5	2,212.5
C2b - SCI New Equipment	Combo Condensing Boiler / Water Heater, Gas	GC2b011	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Combo Furnace / Water Heater, Gas	GC2b012	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Condensing Unit Heater, Gas	GC2b013	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Furnace w/ ECM 95 AFUE, Gas	GC2b014	15	15	15	18	18	18	100%	100%	100%	100%	100%	100%	85.5	85.5	85.5	1,539.0	1,539.0	1,539.0
C2b - SCI New Equipment	Furnace w/ ECM 97 AFUE, Gas	GC2b015	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Infrared Heater, Gas	GC2b016	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Faucet Aerator, Gas	GC2b017	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Low Flow Showerhead With Thermostatic Valve, Gas	GC2b018	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Low Flow Showerhead, Gas	GC2b019	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Pre Rinse Spray Valve, Gas	GC2b020	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C2b - SCI New Equipment	Combination Oven, Gas	GC2b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Convection Oven, Gas	GC2b022	4	4	4	12	12	12	100%	100%	100%	100%	100%	100%	50.8	-	50.8	609.6	-	609.6
C2b - SCI New Equipment	Conveyor Oven, Gas	GC2b023	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Fryer, Gas	GC2b024	4	4	4	12	12	12	100%	100%	100%	100%	100%	100%	204.8	-	204.8	2,457.6	-	2,457.6
C2b - SCI New Equipment	Griddle, Gas	GC2b025	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Rack Oven, Gas	GC2b026	4	4	4	12	12	12	100%	100%	100%	100%	100%	100%	491.6	491.6	491.6	5,899.2	5,899.2	5,899.2
C2b - SCI New Equipment	Steam Cooker, Gas	GC2b027	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Indirect Water Heater, Gas	GC2b028	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	On Demand Tankless Water Heater, Gas	GC2b029	-	-	-	20	20	20	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Volume Water Heater, Gas	GC2b030	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Condensing Gas Water Heater	GC2b031	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Clothes Washer, High Speed, Gas	GC2b032	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	Pasta Cooker, Gas	GC2b033	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2b - SCI New Equipment	C&I Small New Construction Code Compliance	GC2b028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Combination Oven, Gas	GC2c001	5	5	5	12	12	12	83%	83%	83%	100%	100%	100%	139.9	139.9	139.9	1,679.3	1,679.3	1,679.3
C2c - SCI Midstream	Midstream Convection Oven, Gas	GC2c002	6	6	6	12	12	12	83%	83%	83%	100%	100%	100%	63.5	63.5	63.5	761.7	761.7	761.7
C2c - SCI Midstream	Midstream Conveyor Oven, Gas	GC2c003	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Fryer, Gas	GC2c004	6	6	6	12	12	12	83%	83%	83%	100%	100%	100%	255.9	255.9	255.9	3,070.8	3,070.8	3,070.8
C2c - SCI Midstream	Midstream Griddle, Gas	GC2c005	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Pre-Rinse Spray Valve, Gas	GC2c006	10	10	10	8	8	8	83%	83%	83%	100%	100%	100%	95.0	95.0	95.0	759.7	759.7	759.7
C2c - SCI Midstream	Midstream Rack Oven, Gas	GC2c007	-	-	-	12	12	12	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	Midstream Steam Cooker, Gas	GC2c008	2	2	2	12	12	12	83%	83%	83%	100%	100%	100%	118.8	118.8	118.8	1,425.4	1,425.4	1,425.4
C2c - SCI Midstream	Midstream Indirect Water Heater, Gas	GC2c009	4	4	4	15	15	15	30%	30%	30%	100%	100%	100%	22.8	22.8	22.8	342.0	342.0	342.0
C2c - SCI Midstream	Midstream On Demand Tankless Water Heater, Gas	GC2c010	8	8	8	20	20	20	60%	60%	60%	100%	100%	100%	42.7	42.7	42.7	854.4	854.4	854.4
C2c - SCI Midstream	Midstream Volume Water Heater, Gas	GC2c011	2	2	2	15	15	15	60%	60%	60%	100%	100%	100%	98.2	98.2	98.2	1,472.4	1,472.4	1,472.4
C2c - SCI Midstream	Midstream Water Heater, Condensing Gas	GC2c012	5	5	5	15	15	15	30%	30%	30%	100%	100%	100%	39.0	39.0	39.0	585.0	585.0	585.0
C2c - SCI Midstream	OMP Thermostatic Shut-off Valve, Gas	GC2c013	-	-	-	15	15	15	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead, Gas	GC2c014	-	-	-	10	10	10	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Low-Flow Showerhead with Thermostatic Valve,	GC2c015	-	-	-	10	10	10	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Faucet Aerator, Gas	GC2c016	-	-	-	10	10	10	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Pipe Wrap, Gas	GC2c017	-	-	-	15	15	15	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Pre-Rinse Spray Valve, Gas	GC2c018	-	-	-	8	8	8	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Programmable Thermostat, Gas	GC2c019	-	-	-	15	15	15	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C2c - SCI Midstream	OMP Wi-Fi Thermostat	GC2c020	-	-	-	15	15	15	86%	100%	100%	100%	100%	100%	-	-	-	-	-	-
		SCI Subtotal													**6,048.4**	**5,792.8**	**6,048.4**	**81,979.3**	**78,912.1**	**81,979.3**

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C3a - Muni Retrofit	Custom Small Hot Water Retro	GC3a001	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Custom Small HVAC Retro	GC3a002	2	3	4	14	14	14	100%	100%	100%	100%	100%	100%	870.0	1,305.0	1,522.5	12,180.0	18,270.0	21,315.0
C3a - Muni Retrofit	Custom Small Other Retro	GC3a003	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Custom Small Process Retro	GC3a004	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Faucet Aerator, Gas	GC3a005	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Low Flow Showerhead With Thermostatic Valve, Gas	GC3a006	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Low Flow Showerhead, Gas	GC3a007	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Wrap - Hot Water, Gas	GC3a008	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Pre Rinse Spray Valve, Gas	GC3a009	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Reset Controls, Gas	GC3a010	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Boiler Tune-Ups	GC3a011	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Energy Management System, Gas	GC3a012	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Pipe Insulation - Heating, Gas	GC3a013	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Steam Trap, Gas	GC3a014	-	-	-	6	6	6	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Programmable Thermostat, Gas	GC3a015	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Air Sealing, Gas	GC3a017	-	-	-	15	15	15	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3a - Muni Retrofit	Insulation, Gas	GC3a018	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Small Hot Water New	GC3b001	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Small HVAC New	GC3b002	3	3	3	14	14	14	100%	100%	100%	100%	100%	100%	589.9	-	-	8,258.0	-	-
C3b - Muni New Equipmen	Custom Small Other New	GC3b003	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Custom Small Process New	GC3b004	-	-	-	-	-	-	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1701 to 2000 MBH 90 AFUE, Gas	GC3b005	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 1000 to 1700 MBH 90 AFUE, Gas	GC3b006	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 500 to 999 MBH 90 AFUE, Gas	GC3b007	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler 301 to 499 MBH 90 AFUE, Gas	GC3b008	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 90 AFUE, Gas	GC3b009	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Boiler to 300 MBH 95 AFUE, Gas	GC3b010	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Combo Condensing Boiler / Water Heater, Gas	GC3b011	-	-	-	25	25	25	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Combo Furnace / Water Heater, Gas	GC3b012	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Condensing Unit Heater, Gas	GC3b013	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-

			Quantity			Measure Life			Net to Gross			In Service Rate			Total Net Annual MMBTU			Total Net Lifetime MMBTU		
Subprogram	Measure	Measure ID	2024	2025	2026	2021	2022	2023	2021	2022	2023	2021	2022	2023	2024	2025	2026	2024	2025	2026
C3b - Muni New Equipmen	Furnace w/ ECM 95 AFUE, Gas	GC3b014	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Furnace w/ ECM 97 AFUE, Gas	GC3b015	-	-	-	18	18	18	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Infrared Heater, Gas	GC3b016	-	-	-	17	17	17	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Faucet Aerator, Gas	GC3b017	-	-	-	10	10	10	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Low Flow Showerhead With Thermostatic Valve, Gas	GC3b018	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Low Flow Showerhead, Gas	GC3b019	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Pre Rinse Spray Valve, Gas	GC3b020	-	-	-	8	8	8	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Combination Oven, Gas	GC3b021	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Convection Oven, Gas	GC3b022	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Conveyor Oven, Gas	GC3b023	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Fryer, Gas	GC3b024	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Griddle, Gas	GC3b025	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Rack Oven, Gas	GC3b026	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Steam Cooker, Gas	GC3b027	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Indirect Water Heater, Gas	GC3b028	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	On Demand Tankless Water Heater, Gas	GC3b029	-	-	-	20	20	20	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Volume Water Heater, Gas	GC3b030	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Condensing Gas Water Heater	GC3b031	-	-	-	15	15	15	83%	83%	83%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Clothes Washer, High Speed, Gas	GC3b032	-	-	-	7	7	7	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	Pasta Cooker, Gas	GC3b033	-	-	-	12	12	12	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
C3b - Muni New Equipmen	C&I Small New Construction Code Compliance	GC3b028	-	-	-	20	20	20	100%	100%	100%	100%	100%	100%	-	-	-	-	-	-
		SCI Subtotal													**1,459.9**	**1,305.0**	**1,522.5**	**20,438.0**	**18,270.0**	**21,315.0**

Northern Utilities, Inc.
EEC Charge Factor Calculation

EEC Charge Factors for Residential Customers	**Effective** January 1, 2024	**Effective** January 1, 2025	**Effective** January 1, 2026
EEC effective January 1, 2023 ($/therm)	$0.0520	$0.0545	$0.0570
Estimated Inflation Factor	4.860%	4.510%	2.670%
Proposed EEC effective January 1, 2024 ($/therm)	$0.0545	$0.0570	$0.0585
Energy Efficiency Charge Factor for Residential Customers	**$0.0545**	**$0.0570**	**$0.0585**

EEC Charge Factors for Commercial and Industrial Customers (C&I)			
EEC effective January 1, 2023 ($/therm)	$0.0257	$0.0269	$0.0282
Estimated Inflation Factor	4.860%	4.510%	2.670%
Proposed EEC effective January 1, 2024 ($/therm)	$0.0269	$0.0282	$0.0289
Energy Efficiency Charge Factor for C&I Customers	**$0.0269**	**$0.0282**	**$0.0289**

(1) Estimated Inflation Factor based on most recently available 3-yr average CPI.

Northern Utilities, Inc.

Energy Efficiency Charge, a Component of the Local Distribution Adjustment Charge

Reconciliation of Costs and Revenues January 1 2022 through December 31, 2023

Residential Customers

		Beginning Balance (Over)/Under	EEC Rate per Therm	EEC Collections	EEC Costs	DSM PI	Allocated Low Income Costs	Allocated Low Income PI	Ending Balance (Over)/Under	Average Balance (Over)/Under	Interest Prime Rate	Interest @ Prime Rate	Ending Balance plus Interest (Over)/Under	Therm Sales	# of Days
January-22	Actual	($7,889)	$0.0476	$155,767	$16,661	$0	$2,307	$0	($144,688)	($76,288)	3.25%	($211)	($144,898)	3,369,745	31
February-22	Actual	($144,898)	$0.0476	$171,599	$35,078	$0	$2,571	$0	($278,848)	($211,873)	3.25%	($528)	($279,376)	3,604,902	28
March-22	Actual	($279,376)	$0.0499	$143,459	$127,262	$0	$3,299	$0	($292,273)	($285,825)	3.25%	($789)	($293,062)	2,938,474	31
April-22	Actual	($293,062)	$0.0499	$87,884	$49,497	$15,673	$2,741	$2,704	($310,331)	($301,697)	3.25%	($448)	($310,778)	1,761,356	30
May-22	Actual	($310,778)	$0.0499	$54,152	$42,801	$3,918	$2,258	$591	($315,361)	($313,070)	3.25%	($864)	($316,225)	1,085,211	31
June-22	Actual	($316,225)	$0.0499	$24,314	$53,507	$17,071 (1)	$1,993	$966 (1)	($267,003)	($291,614)	3.25%	($162)(1)	($267,165)	487,419	30
July-22	Actual	($267,165)	$0.0499	$17,980	$19,751	$3,918	$33,548	$364	($227,565)	($247,365)	4.00%	($840)	($228,405)	360,397	31
August-22	Actual	($228,405)	$0.0499	$15,855	$45,349	$3,918	$3,649	$311	($191,033)	($209,719)	4.00%	($712)	($191,746)	318,137	31
September-22	Actual	($191,746)	$0.0499	$17,600	$17,830	$3,918	$1,335	$322	($185,940)	($188,843)	4.00%	($621)	($186,561)	352,672	30
October-22	Actual	($186,561)	$0.0499	$30,708	$59,438	$3,918	$5,568	$422	($147,923)	($167,242)	5.50%	($781)	($148,704)	615,455	31
November-22	Actual	($148,704)	$0.0499	$48,363	$79,074	$3,918	$31,332	$499	($82,244)	($115,474)	5.50%	($522)	($82,766)	969,156	30
December-22	Actual	($82,766)	$0.0499	$109,029	$193,698	$3,918	$33,362	$687	$39,870	($21,448)	5.50%	($100)	$39,770	2,184,906	31
January-23	Actual	$39,770	$0.0520	$154,999	$48,837	$2,768	$2,707	$432	($60,485)	($10,357)	7.00%	($62)	($60,546)	3,049,368	31
February-23	Actual	($60,546)	$0.0520	$159,973	$26,760	$2,768	$6,066	$433	($184,492)	($122,519)	7.00%	($658)	($185,150)	3,076,441	28
March-23	Actual	($185,150)	$0.0520	$145,482	$84,827	$2,768	$7,946	$428	($234,663)	($209,907)	7.00%	($1,248)	($235,911)	2,797,702	31
April-23	Actual	($235,911)	$0.0520	$91,427	$48,117	$2,768	$2,375	$395	($273,682)	($254,797)	7.75%	($1,623)	($275,305)	1,758,160	30
May-23	Actual	($275,305)	$0.0520	$51,096	$82,685	$2,768	$13,750	$318	($226,880)	($251,093)	7.75%	($1,653)	($228,533)	982,595	31
June-23 (2)	Forecast	($228,533)	$0.0520	$32,860	$91,131	($2,551)	$11,156	$1,873	($159,785)	($194,159)	7.75%	($1,237)	($161,022)	631,919	30
July-23	Forecast	($101,022)	$0.0520	$21,625	$91,131	$2,768	$11,156	$316	($17,277)	($59,149)	8.25%	($414)	($17,691)	415,872	31
August-23	Forecast	$57,309	$0.0520	$18,824	$91,131	$2,768	$11,156	$316	$143,855	$100,582	8.25%	$705	$144,560	361,994	31
September-23	Forecast	$144,560	$0.0520	$19,674	$91,131	$2,768	$11,156	$316	$230,256	$187,408	8.25%	$1,271	$231,526	378,354	30
October-23	Forecast	$231,526	$0.0520	$35,012	$91,131	$2,768	$11,156	$316	$301,884	$266,705	8.25%	$1,869	$303,753	673,311	31
November-23	Forecast	$303,753	$0.0520	$76,662	$91,131	$2,768	$11,156	$316	$332,461	$318,107	8.25%	$2,157	$334,618	1,474,271	30
December-23	Forecast	$334,618	$0.0520	$148,592	$91,131	$2,768	$11,156	$316	$291,396	$313,007	8.25%	$2,193	$293,589	2,857,544	31
Jan 22 thru Dec 23 Totals				$1,832,936	$1,669,089	$88,070	$234,899	$12,636						36,505,362	

Actual Performance Incentives includes reconciliations from prior year(s).
(1) Includes interest related to prior period PI reconciliation.
(2) Includes 2022 PI true-up.

Northern Utilities, Inc.

Energy Efficiency Charge, a Component of the Local Distribution Adjustment Charge

Reconciliation of Costs and Revenues January 1 2022 through December 31, 2023

General Service Customers

		Beginning Balance (Over)/Under	EEC Rate per Therm	EEC Collections	EEC Costs	DSM PI	Allocated Low Income Costs	Allocated Low Income PI	Ending Balance (Over)/Under	Average Balance (Over)/Under	Interest Prime Rate	Interest @ Prime Rate	Ending Balance plus Interest (Over)/Under	Therm Sales	# of Days
January-22	Actual	($325,069)	$0.0326	$238,296	$18,716	$0	$5,494	$0	($539,155)	($432,112)	3.25%	($1,193)	($540,348)	8,026,522	31
February-22	Actual	($540,348)	$0.0326	$259,736	$30,806	$0	$5,697	$0	($763,581)	($651,964)	3.25%	($1,625)	($765,207)	7,986,044	28
March-22	Actual	($765,207)	$0.0247	$187,679	$19,249	$0	$7,744	$0	($925,891)	($845,549)	3.25%	($2,334)	($928,225)	6,897,763	31
April-22	Actual	($928,225)	$0.0247	$120,785	$24,070	$25,163	$7,605	$7,505	($984,667)	($956,446)	3.25%	($2,708)(1)	($987,375)	4,887,758	30
May-22	Actual	($987,375)	$0.0247	$89,019	$16,214	$6,291	$7,503	$1,962	($1,044,425)	($1,015,900)	3.25%	($2,804)	($1,047,229)	3,605,029	31
June-22	Actual	($1,047,229)	$0.0247	$61,201	$38,512	$8,056 (1)	$10,129	$4,911 (1)	($1,046,822)	($1,047,025)	3.25%	($2,836)(1)	($1,049,658)	2,477,313	30
July-22	Actual	($1,049,658)	$0.0247	$53,594	$15,457	$6,291	$202,001	$2,189	($877,315)	($963,486)	4.00%	($3,273)	($880,588)	2,170,039	31
August-22	Actual	($880,588)	$0.0247	$56,700	$31,808	$6,291	$26,326	$2,242	($870,622)	($875,605)	4.00%	($2,975)	($873,596)	2,295,293	31
September-22	Actual	($873,596)	$0.0247	$60,267	$113,504	$6,291	$9,237	$2,230	($802,602)	($838,099)	4.00%	($2,755)	($805,357)	2,439,921	30
October-22	Actual	($805,357)	$0.0247	$76,740	$91,856	$6,291	$28,105	$2,130	($753,715)	($779,536)	5.50%	($3,641)	($757,357)	3,106,839	31
November-22	Actual	($757,357)	$0.0247	$98,561	$136,901	$6,291	$129,004	$2,054	($581,668)	($669,512)	5.50%	($3,027)	($584,695)	3,990,311	30
December-22	Actual	($584,695)	$0.0247	$146,629	$760,461	$6,291	$90,599	$1,865	$127,893	($228,401)	5.50%	($1,067)	$126,826	5,933,403	31
January-23	Actual	$126,826	$0.0257	$186,368	$21,642	$3,129	$6,529	$1,042	($27,200)	$49,813	7.00%	$296.15	($26,903)	7,355,197	31
February-23	Actual	($26,903)	$0.0257	$190,429	$33,104	$3,129	$14,611	$1,042	($165,446)	($96,175)	7.00%	($516.45)	($165,962)	7,409,936	28
March-23	Actual	($165,962)	$0.0257	$176,036	$163,509	$3,129	$19,455	$1,047	($154,859)	($160,411)	7.00%	($953.68)	($155,812)	6,849,674	31
April-23	Actual	($155,812)	$0.0257	$123,446	$75,978	$3,129	$6,490	$1,079	($192,581)	($174,197)	7.75%	($1,109.61)	($193,691)	4,803,317	30
May-23	Actual	($193,691)	$0.0257	$91,952	$45,143	$3,129	$50,092	$1,157	($186,122)	($189,906)	7.75%	($1,250.00)	($187,372)	3,579,527	31
June-23 (2)	Forecast	($187,372)	$0.0257	$69,392	$101,582	$764	$40,969	$5,798	($107,651)	($147,511)	7.75%	($939.62)	($108,591)	2,700,077	30
July-23	Forecast	($2,591)	$0.0257	$65,156	$101,582	$3,129	$40,969	$1,159	$79,093	$38,251	8.25%	$268.02	$79,361	2,535,253	31
August-23	Forecast	$229,361	$0.0257	$64,339	$101,582	$3,129	$40,969	$1,159	$311,862	$270,611	8.25%	$1,896.13	$313,758	2,503,467	31
September-23	Forecast	$313,758	$0.0257	$65,399	$101,582	$3,129	$40,969	$1,159	$395,199	$354,478	8.25%	$2,403.65	$397,603	2,544,691	30
October-23	Forecast	$397,603	$0.0257	$85,158	$101,582	$3,129	$40,969	$1,159	$459,285	$428,444	8.25%	$3,002.04	$462,287	3,313,533	31
November-23	Forecast	$462,287	$0.0257	$120,572	$101,582	$3,129	$40,969	$1,159	$488,554	$475,421	8.25%	$3,223.75	$491,778	4,691,520	30
December-23	Forecast	$491,778	$0.0257	$171,151	$101,582	$3,129	$40,969	$1,159	$467,467	$479,623	8.25%	$3,360.65	$470,828	6,659,570	31
Jan 22 thru Dec 23 Totals				$2,858,604	$2,348,005	$112,443	$913,407	$45,205						108,761,997	

Actual Performance Incentives includes reconciliations from prior year(s).
(1) Includes interest related to prior period PI reconciliation.
(2) Includes 2022 PI true-up.

NORTHERN UTILITIES, INC.
Summary of EEC Typical Bill Analysis

Energy Efficiency Charge/Lost Revenue Rate ($/therm)	2023	2024	2025	2026
Residential	$0.0520	$0.0545	$0.0570	$0.0585
Commercial & Industrial	$0.0257	$0.0269	$0.0282	$0.0289

Bill per period	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Residential Heat - R-5	$1,366.37	$316.84	$1,367.84	$317.15	$1,369.27	$317.46	$1,370.16	$317.65
Residential Non-Heat - R-6	$474.05	$222.67	$474.38	$222.82	$474.70	$222.97	$474.90	$223.06
G-40 Commercial & Industrial	$2,877.64	$687.82	$2,879.90	$688.18	$2,882.11	$688.53	$2,883.47	$688.74
G-41 Commercial & Industrial	$26,180.38	$4,220.72	$26,203.23	$4,225.46	$26,225.47	$4,230.08	$26,239.23	$4,232.93
G-51 Commercial & Industrial	$14,708.31	$5,410.84	$14,722.81	$5,420.25	$14,736.91	$5,429.40	$14,745.64	$5,435.06
Change from prior period - $ per period								
Residential Heat - R-5			$1.47	$0.31	$1.43	$0.30	$0.89	$0.19
Residential Non-Heat - R-6			$4.77	$0.15	$0.32	$0.15	$0.20	$0.09
G-40 Commercial & Industrial			$17.89	$0.36	$2.20	$0.35	$1.36	$0.22
G-41 Commercial & Industrial			$169.66	$4.74	$22.24	$4.61	$13.76	$2.86
G-51 Commercial & Industrial			$101.47	$9.41	$14.11	$9.15	$8.73	$5.66
Change from prior period - %								
Residential Heat - R-5			0.11%	0.10%	0.10%	0.10%	0.06%	0.06%
Residential Non-Heat - R-6			1.01%	0.07%	0.07%	0.07%	0.04%	0.04%
G-40 Commercial & Industrial			0.62%	0.05%	0.08%	0.05%	0.05%	0.03%
G-41 Commercial & Industrial			0.65%	0.11%	0.08%	0.11%	0.05%	0.07%
G-51 Commercial & Industrial			0.69%	0.17%	0.10%	0.17%	0.06%	0.10%

STATE OF NEW HAMPSHIRE

BEFORE THE PUBLIC UTILITIES COMMISSION

DIRECT TESTIMONY OF MARISA B. PARUTA

PETITION OF PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
d/b/a EVERSOURCE ENERGY
ESTIMATED 2024-2026 SYSTEM BENEFITS CHARGE RATE CHANGE

June 30, 2023

Docket No. DE 23-XXX

I. INTRODUCTION

Q. Please state your name, by whom you are employed and in what capacity.

A. My name is Marisa B. Paruta. My business address is 107 Selden Street, Berlin, Connecticut. I am employed by Eversource Energy Service Company as the Director of Revenue Requirements and in that position, I support Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH", "Eversource" or the "Company") regarding revenue and rate-related matters.

Q. Please provide your educational and professional background.

A. I received a Bachelor of Science degree in accounting from the University of Connecticut School of Business. I started my career at Arthur Andersen in the client audit and assurance practice, continuing at Deloitte in the same practice. I joined Northeast Utilities, Eversource's predecessor, and worked in the accounting organization through multiple positions leading to the Director of Corporate Accounting and Financial Reporting in 2015.

I moved to the Regulatory and Revenue Requirements team in my current position in June 2021. I have been with Eversource Energy for over 20 years.

Q. What are your principal responsibilities in your current position?

A. I am currently responsible for the coordination and implementation of revenue requirements calculations and regulatory filings for the New Hampshire and Connecticut electric and natural gas subsidiaries of Eversource Energy, as well as the filings associated with PSNH's default Energy Service ("ES"), Stranded Cost Recovery Charge ("SCRC"), Transmission Cost Adjustment Mechanism ("TCAM"), System Benefits Charge ("SBC"), Regulatory Reconciliation Adjustment ("RRA") mechanism, and Base Distribution Rates.

Q. Have you previously testified before the New Hampshire Public Utilities Commission (the "Commission")?

A. Yes, I provided testimony before the Commission in the RRA filings submitted in Docket Nos. DE 21-029, DE 22-010 and DE 23-021; the Step 3 Adjustment filing in Docket No. DE 22-030; TCAM Rate filing in Docket No. DE 22-034; Recovery of Storm Expense filings in Docket Nos. DE 22-031 and DE 23-051; Default Energy Service rate filings in Docket Nos. DE 22-021 and DE 23-043; and SCRC rate filings in Docket No. DE 22-039. I also testified before the Commission in Docket No. DE 20-092 pertaining to the 2022-2023 Energy Efficiency Plan and Docket No. DE 21-078 pertaining to the EV Make Ready/Demand Charge Alternatives.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is: (1) to present and support the estimated calculation of the Energy Efficiency ("EE") component of the System Benefits Charge ("SBC") used to develop the Energy Efficiency budgets for 2024, 2025, and 2026; and (2) to present and support the estimated calculation of the lost base revenue ("LBR") component of the SBC for effect in 2024, 2025 and 2026. My testimony explains what is contained in Attachment E3, which provides the estimated calculations of the EE and LBR rate components of the SBC for Eversource. The testimony provides an explanation of the changes made to the LBR rate component to account for the directives of HB 549, which amended RSA 374-F:3, VI-a ("HB 549").

II. EE COMPONENT OF THE SBC

Q. What is the estimated EE component of the SBC?

A. The most recent actual statewide EE rates in effect in 2022 and 2023, and the estimated statewide EE rates for effect on January 1st in each of the years beginning January 1, 2024, 2025, and 2026 (the "three-year plan") are shown in the table below:

Energy Efficiency (EE) portion of SBC Rate ($ per kWh)		
Effective Date	Estimated Rate	Actual Rate
January 1, 2022		$ 0.00373
March 1, 2022		$ 0.00528
January 1, 2023		$ 0.00550
January 1, 2024	$ 0.00577	
January 1, 2025	$ 0.00603	
January 1, 2026	$ 0.00619	

In accordance with SB113, which has passed both the House and Senate and is awaiting the Governor's signature, the EE portion of the SBC rates in the three-year plan is "calculated using the most recently available 3-year average of the consumer price index as published by the Bureau of Labor Statistics of the United States Department of Labor, all as calculated by the Department of Energy ."[1] The estimated rates for effect on January 1st for each year of the three-year plan will be updated on December 1st of each preceding year, in accordance with RSA 374-F:3 VI-a.

Q. How was the EE rate calculated?

A. For the estimated rate effective January 1, 2024, the EE portion of the SBC rate was calculated using the 2023 EE charge totaling $0.00550 per kilowatt-hour ("kWh"), which was approved on December 14, 2022 in DE 22-081 (Order No. 26,745), increased by a consumer price index ("CPI-W") factor (4.855 percent), as described above. For the estimated rates effective January 1, 2025 and 2026, the EE portion of the SBC rates was calculated using the prior year estimated rate, increased by a forecasted CPI-W factor (4.510 percent and 2.671 percent, respectively).[2] Attachment E3 provides the actual and forecasted revenues and expense reconciliations for plan years 2022 and 2023, and

[1] House Bill 549, *An Act Relative to the System Benefits Charge and the Energy Efficiency and Sustainable Energy Board,* signed into law by the Governor on February 24, 2022.

[2] Currently RSA 374-F:3, VI-a(d)(2), also allows for an increase of .25% on top of the CPI-W increase, but this will be eliminated once SB 113 is signed by the Governor. SB 113 passed both houses of the Legislature on June 1, 2023, and is awaiting the Governor's signature to be signed into law, therefore the estimated SBC rates for 2024-2026 do not include the .25% adder.

preliminary reconciliations of the EE component of the SBC rate for each of the years in the three-year plan as shown in the table below:

Energy Efficiency (EE) Rate Reconciliation (Attachment E3)		
Page Reference	Plan Year	Description
2	2022	Actual
3	2023	Estimate
4	2024	Preliminary
5	2025	Preliminary
6	2026	Preliminary

III. LBR COMPONENT OF THE SBC

Q. What is the estimated LBR component of the SBC and how was it calculated?

A. HB 549 states, "the joint utility energy efficiency plan and programming framework and components, including utility performance incentive payments, lost base revenue calculations, and Evaluation, Measurement, and Verification process that were in effect on January 1, 2021, shall remain in effect until changed by an order or operation of law as authorized in subparagraphs (3) and (5)." Consistent with this legislative directive, Eversource "trued-up," or reconciled, the most recent actual LBR rates and also calculated estimated LBR rates for effect on January 1st for each of the years in the three-year plan, as shown in the table below:

Lost Base Revenue (LBR) portion of SBC Rate ($ per kWh)		
Effective Date	Estimated Rate	Actual Rate
January 1, 2022		$ 0.00065
May 1, 2022		$ 0.00185
January 1, 2023		$ 0.00205
January 1, 2024	$ 0.00178	
January 1, 2025	$ 0.00217	
January 1, 2026	$ 0.00246	

For the estimated rate effective January 1, 2024, the LBR portion of the SBC rate was calculated using the sum of the preliminary 2023 LBR over recovery amount carried into 2024 (totaling $625,000[3]), the forecasted LBR revenue, further described below, and the estimated current year carried interest charge on any over or under recovery amount, the total of which is then divided by the forecasted sales. The over or under collection of revenue occurs as a result of differences between the actual revenue collected from the LBR rate, and the preliminary calculated LBR. Over or under collections typically result from variances between: 1) actual sales volumes and forecasted sales volumes, and 2) actual measure savings and forecasted measure savings. In both instances, the forecasted numbers were used to calculate the estimated LBR portion of the SBC rate.

Q. Please explain the contents of Attachment E3.

A. The LBR rate calculations and supporting documentation are provided on pages 7 through 21 of Attachment E3.

[3] Attachment E3, Page 15, Line 4, Col. B

- Page 7 provides a summary of the LBR portion of the SBC rate for each of the years in the three-year plan, which includes the sum of the forecasted LBR in each plan year, the prior plan year over or under recovery balance (with interest), and the interest from the subject plan year to calculate the total estimated LBR revenue for each plan year in the three-year plan. The total LBR revenue is then divided by the forecasted sales to arrive at the estimated LBR component of the SBC rate proposed in this filing.
- Pages 8 to 12 provide the supporting calculations for LBR for calendar years 2022 through 2026 using actual (2022), estimated/forecasted (2023), and forecasted (2024 – 2026) kWh savings and rates. Measures installed after 2018 have LBR calculated by adding two “separate” calculations: (1) the kWh savings are multiplied by the sector’s kWh LBR Average Distribution Rate (“ADR”); and (2) the kW savings are multiplied by the sector’s kW LBR ADR. The sum of these two calculations results in the total LBR for measures installed. For all measures installed on or after January 1, 2019, this method is used to calculate LBR for the life of the measure.
- Pages 13 to 17 provide the (i) reconciliation of LBR for 2022 using actual monthly revenues collected against actual LBR to determine the over or under recovery, plus interest, that is carried over into the 2023 plan year; and (ii) preliminary reconciliations of actual (collected thus far) and forecasted monthly revenues against estimated (2023) and forecasted (2024 – 2026) LBR for the calendar years 2023 through 2026.

- Page 18 provides average sector distribution rates from calendar year 2022 for use in the calculation of the LBR.
- Page 19 provides the total SBC rate bill impacts for 2024, 2025 and 2026, as compared to rates effective February 1, 2023.
- Pages 20 and 21 provide additional details supporting the calendar year 2022 average distribution rate calculation for each customer class.

Q. Are there changes in the way that LBR is calculated for the upcoming three-year plan, compared to the current plan period of 2022 and 2023?

A. No. LBR for the three-year plan was calculated consistent with the mandate of HB 549, which states that LBR must be calculated and implemented in the same manner as it was on January 1, 2021, therefore there is no difference in the LBR calculation methodology between the current period of 2022 and 2023 and the upcoming three-year plan of 2024-2026.

Q. Please describe how kWh savings are derived for the first month of a new measure's installation.

A. Consistent with sections III and IV and Appendix A and B of the EERS Working Group Report on LBR[4], which is how LBR was calculated on January 1, 2021 and therefore how LBR should be calculated according to HB 549, when calculating forecasted

[4] For the EERS Working Group Report, please see - https://www.puc.nh.gov/EESE%20Board/EERS_Working_Groups.html

savings, a 50 percent factor is applied to reflect that installations occur across any given month rather than all occurring on the first of the month. When calculating actual savings in the calendar year reconciliation, 100 percent of savings are claimed beginning in the month that includes the paid date – which is on average two months after measures are installed and generating savings.

Q. Please describe how Eversource has accounted for 2018 test year savings from the most recently approved rate case in Docket No. DE 19-057, within the calculation of LBR.

A. Consistent with the Settlement Agreement approved by the Commission in Docket No. DE 19-057 in Order No. 26,433 (December 15, 2020), measures installed prior to the 2018 test year were incorporated into the cost of service and revenue requirement and therefore are not included in the calculation of LBR savings. For measures installed during the 2018 test year, those annualized savings were not fully recognized in 2018 and therefore, the residual savings that were not recognized in the test year were not incorporated into the revenue requirement that resulted from the Settlement Agreement. Those residual savings not fully recognized in 2018 were what comprised the 2018 savings and LBR calculations included in the cumulative kWh savings in this filing.

Q. Please describe the derivation of the Average Distribution Rates used in the calculation of LBR.

A. Consistent with section V of the EERS Working Group Report[5], the ADR used in the LBR preliminary reconciliation calculation for 2023 and in the forecasted LBR calculation for each year in the three-year plan utilizes the distribution rates in effect during the 2022 period using billing determinants for the 12-month period ending December 31, 2022.

Q. Please describe how Eversource has accounted for retirements in the calculation of LBR.

A. Consistent with sections III.F and IV.F. of the EERS Working Group Report[6], any savings associated with measures that are retiring within the calendar year are removed from the LBR calculation. A separate line showing retired measures, if applicable, is provided in the schedules supporting the LBR calculation and as measures retire will reflect the savings being removed from the calculation.

Q. Please explain why the 2023 LBR reconciliation is considered a preliminary calculation.

A. The 2023 LBR reconciliation is a preliminary calculation because the 2023 LBR savings are an estimate and have not been finalized at the time of this filing. The final 2023 LBR and any resulting over or under recoveries will be calculated in the 2023 annual performance filing made on June 1, 2024. Any over or under recoveries will be carried

[5] *Id*.
[6] *Id*.

forward into the 2024 LBR rate, which will be filed on December 1, 2024. In addition, a carrying charge is applied to the cumulative over or under recovery balance on a monthly basis using the Prime Rate and is carried forward into the next plan year.

IV. EAP COMPONENT OF THE SBC

Q. What is the proposed EAP Component of the SBC?

A. As part of this SBC rate filing, the Company includes the statutory EAP rate of $0.00150 per kWh. Consistent with current statutory authority, this rate remains unchanged from prior plan filings.

V. TOTAL SBC AND BILL IMPACTS

Q. What is the total estimated SBC rate?

A. Page 1 of Attachment E3 provides a summary of the calculation of the SBC rate, consisting of the EE, LBR and EAP rate components discussed above. The recent actual and total estimated SBC rates for 2022, 2023, and each of the years in the three-year plan are summarized and shown in the table below:

Total System Benefit Charge (SBC) Rate ($ per kWh)				
Effective Date	EE Rate	EAP Rate	LBR Rate	Total SBC
January 1, 2022	$0.00373	$0.00150	$0.00065	$ 0.00588
May 1, 2022	$0.00528	$0.00150	$0.00185	$ 0.00863
January 1, 2023	$0.00550	$0.00150	$0.00205	$ 0.00905
January 1, 2024	$0.00577	$0.00150	$0.00178	$ 0.00905
January 1, 2025	$0.00603	$0.00150	$0.00217	$ 0.00970
January 1, 2026	$0.00619	$0.00150	$0.00246	$ 0.01015

Q. Have you provided bill impacts associated with the proposed SBC?

A. Yes. The bill impacts for a typical residential and C&I customer are provided on Page 19 of Attachment E3. The bill impacts in each of the years in the three-year plan are measured against the rates in effect as of February 1, 2023.

Q. Does the Company require Commission approval of the SBC billed to customers by a specific date?

A. Yes, according to RSA 374-F:3 VI-a, the Commission must issue a decision on the proposed three-year plan by November 30, 2023, otherwise the plan will be deemed automatically approved. While RSA 374-F:3 VI-a still requires a Commission order for adjustments to LBR and has no automatic approval provision, the Company respectfully requests that the Commission approve the proposed LBR rates in the same order approving the proposed plan, no later than November 30, 2023 so that a complete updated SBC rate can be implemented on January 1, 2024.

VI. CONCLUSION

Q. Does this conclude your testimony?

A. Yes, it does.

STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISSION

Docket No. DE 23-xxx

Electric and Gas Utilities
2024–2026 Triennial Energy Efficiency Plan
System Benefits Charge

DIRECT TESTIMONY

OF

TYLER CULBERTSON

ATTACHMENT K

June 30, 2023

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I. INTRODUCTION AND BACKGROUND

Q. Please state your full name, business address, and position.

A. My name is Tyler J Culbertson, and my business address is 15 Buttrick Road, Londonderry, New Hampshire. I am the Director of Rates and Regulatory Affairs for Liberty Utilities Service Corp. ("LUSC") and am responsible for providing rate-related services for Liberty Utilities (EnergyNorth Natural Gas) Corp. ("EnergyNorth") and Liberty Utilities (Granite State Electric) Corp. ("Granite State") ("collectively Liberty" or "the Company").

Q. On whose behalf are you appearing?

A. I am appearing on behalf of Granite State and EnergyNorth.

Q. Please describe your educational background and training.

A. I graduated from the University of Iowa in 2009 with a Bachelor of Science degree in Accounting, and I have held an active Certified Public Accountant ("CPA") license since 2012.

Q. Please describe your professional background.

A. I joined LUSC in May 2023. Prior to my employment at LUSC, I was employed by DCP Midstream as the Senior Manager of Regulatory Affairs from 2015 to 2023. My responsibility at DCP Midstream was to ensure company-wide compliance with the economic regulations of the Federal Energy Regulatory Commission and various state regulatory agencies. From 2014 to 2015, I was a Senior Rate Analyst for Tallgrass

Energy, and from 2010 to 2014 I was a Rate Analyst for SourceGas (now Black Hills Energy).

Q. Have you previously testified before the Commission?

A. Yes, I have testified before the Commission.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to present and support the calculation of the annual rates for the Energy Efficiency ("EE") component of the System Benefits Charge ("SBC") for Granite State and the EE component of the Local Distribution Adjustment Charge ("LDAC") for EnergyNorth. I also explain how each rate was derived and provide additional, related information regarding bill impacts of energy efficiency program revenues and costs, and a forecast of 2024 through 2026 energy efficiency revenue and costs.

III. BACKGROUND

Q. Why are the Companies providing supporting documentation for the SBC rates at this time?

A. On September 1, 2020, the Companies, along with the New Hampshire Electric Cooperative, Inc., Public Service Company of New Hampshire d/b/a Eversource Energy, Unitil Energy Systems, Inc., and Northern Utilities (collectively, the "Joint Utilities") filed a triennial EE plan for approval by the Commission that included, among other things, updated SBC rates designed to fund New Hampshire's EE programs for the period

2021 through 2023. In Order No. 26,553 (Nov. 12, 2021) the Commission rejected the plan, proposed rates, and set SBC rates at historical levels.[1] On February 24, 2022, the Governor signed House Bill 549, which established a new method for setting SBC rates, which has been codified at RSA 374-F:3, VI-a(d)(2) (referred to here as "HB 549"). The supporting documentation for the rates is consistent with the requirements of HB 549.

Q. Please summarize the requirements established by HB 549.

A. The new legislation set funding for EE based on 2020 levels with subsequent adjustments beginning January 1, 2023, based on the inflationary data of the most recently available 3-year average of the consumer price index for wage earners (CPI-W[2]) as published by the United States Department of Labor, Bureau of Labor Statistics, all as calculated by the New Hampshire Department of Energy. HB 549 also establishes a mechanism to reconcile over- and under-collections that requires the New Hampshire utilities to submit a filing to the Commission each December in which they summarize their variances and propose rate changes to reconcile the differences. The Joint Utilities will submit tariff amendments altering solely the electric utilities' SBC rate and the gas utilities' local delivery adjustment charge ("LDAC") reconciled for over- and under-collections already occurred, for effect each December 1 for the following year.

1 "[T]he Commission authorizes energy efficiency program spending at an overall level consistent with the 2018–20 Plan." Order No. 26,553 at 36.

2 https://www.bls.gov/opub/btn/volume-3/why-does-bls-provide-both-the-cpi-w-and-cpi-u.htm#_edn1

IV. Systems Benefits Charge ("SBC")

Q. Please provide the calculated SBC rates for 2024 – 2026.

A. The calculated SBC is 0.00727 cents per kWh. This rate includes the EE portion and the Electric Assistance Program ("EAP") portion of the rate. The EAP portion is 1.5 mils or $0.0015 and does not vary per RSA 374-F:4.VIII(c). The table below provides the projected rates to be effective from 2024 – 2026. Attachment E3 provides the breakdown of the revenues and expenses associated with these rates.

Table 1. SBC Rate Forecast

Effective Date (A)	SBC Rate EE Portion (B)	SBC Rate EAP Portion (C)	Total SBC Rate (D)	Rate Change (E)	Percent Change (F)
January 1, 2023	$0.00550	$0.0015	$0.00700		
January 1, 2024	$0.00577	$0.0015	$0.00727	$0.00027	3.9%
January 1, 2025	$0.00603	$0.0015	$0.00753	$0.00026	3.6%
January 1, 2026	$0.00619	$0.0015	$0.00769	$0.00016	2.1%

V. LOCAL DISTRIBUTION ADJUSTMENT CHARGE ("LDAC")

Q. Please provide the calculated LDAC rates for 2024 – 2026.

A. The table below provides the calculated rates to be effective from 2024 – 2026.

Table 2. Residential LDAC Rate Forecast

Effective Date (A)	EE Portion (B)	Rate Change (C)	Percent Change (D)
January 1, 2023	$0.0667		
January 1, 2024	$0.0699	$0.0032	4.9%
January 1, 2025	$0.0731	$0.0032	4.6%
January 1, 2026	$0.0750	$0.0019	2.6%

Table 3. C&I LDAC Rate Forecast

Effective Date (A)	EE Portion (B)	Rate Change (C)	Percent Change (D)
January 1, 2023	$0.04440		
January 1, 2024	$0.04660	$0.0022	4.9%
January 1, 2025	$0.04870	$0.0021	4.5%
January 1, 2026	$0.05000	$0.0013	2.7%

Q. Please explain when the rate change for the LDAC occurs.

A. The LDAC rate is included in the Company's annual Cost of Gas proceeding, filed in September of each year. In that filing, the Company provides the reconciliation of the energy efficiency portion of the LDAC rate. In December 2023, the Company will present a new LDAC rate in accordance with HB 549.

Q. How were the EE rates calculated?

A. The EE rates for electric and gas customers were calculated using the most recently available 3-year average of the consumer price index ("CPI-W") as published by the Bureau of Labor Statistics of the United States Department of Labor [to account for inflation] all as calculated by the DOE both in accordance with HB 549. The estimated rates for effect January 1, 2024, will be updated by December 1, 2023, to account for any over or under collections and to incorporate the inflation calculation in accordance with HB 549.

Q. What other information is provided in Attachment E3?

A. The following information is provided in Attachment E3:

- Page 1 provides a summary of the energy efficiency budget and rates for 2024 - 2026;
- Page 2 provides the actual expenses and revenues for 2022;
- Page 3 provides the actual expenses and reconciliations through May 2023 with a forecast of the remainder of the year's funding;
- Page 4 provides a forecast of 2024 energy efficiency funding;
- Page 5 provides a forecast of 2025 energy efficiency funding;
- Page 6 provides a forecast of 2026 energy efficiency funding;
- Page 7 provides bill impacts to residential and commercial customers.

VI. BILL IMPACTS

Q. What is the bill impact to a residential customer?

A. An average Granite State Electric residential customer using 650 kWh per month would see a bill increase of $0.18 or 0.08% per month under the 2024 projected rate.

VII. CONCLUSION

Q. Does that conclude your testimony?

A. Yes, it does.

UNITIL ENERGY SYSTEMS, INC.

AND

NORTHERN UTILITIES, INC.

DIRECT TESTIMONY OF

S. ELENA DEMERIS

ATTACHMENT K

NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION

DOCKET NO. DE 23-XXX

JUNE 30, 2023

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is S. Elena Demeris, and my business address is 6 Liberty Lane West, Hampton, New Hampshire 03842.

Q. Ms. Demeris, what is your position and what are your responsibilities?

A. I am Senior Regulatory Analyst, for Unitil Service Corp. ("Unitil Service"), a subsidiary of Unitil Corporation that provides managerial, financial, regulatory and engineering services to Unitil Corporation's utility subsidiaries including Unitil Energy Systems, Inc., ("UES") and Northern Utilities ("Northern"). In this capacity I am responsible for preparing regulatory filings, pricing research, regulatory analysis, tariff administration, revenue requirements calculations, customer research, and other analytical services.

Q. **Please describe your business and educational background.**

A. In 1996, I graduated from the University of Massachusetts - Lowell with a Bachelor's of Science Degree in Civil Engineering. In 2005, I earned a Master's Degree in Business Administration and in 2006 a Master's Degree in Finance from Southern New Hampshire University. I joined Unitil in July 1998 in the regulatory/rate department.

Q. Have you previously testified before the Commission or other regulatory agencies?

A. Yes.

Q. What is the purpose of your testimony?

A. For UES, the purpose of my testimony is to present the estimated Energy Efficiency ("EE") component of the System Benefits Charge ("SBC") used to develop the Energy Efficiency budgets for 2024, 2025, and 2026. Additionally, for informational purposes, my testimony provides a detailed explanation of Attachment H3, which provides a preliminary reconciliation of the EE component of the SBC for 2022 and 2023 and bill impacts for the January 1, 2024, January 1, 2025, and January 1, 2026 estimated rates. As discussed in the 2022 Annual Report, filed June 1, 2023 in Docket No, IR22-042, the LBR component of the SBC ceased in 2022.

For Northern, the purpose of my testimony is to present the estimated residential and C&O Energy Efficiency Charge's ("EEC") used to develop the 2024, 2025, and 2026 EEC budgets. Additionally, for informational purposes, my testimony provides a detailed explanation of Attachment H3 which provides a preliminary reconciliation of the EE component of the SBC for 2022 and 2023 and bill impacts for the January 1, 2024, January 1, 2025 and January 1, 2026 estimated rates. As discussed in the 2022 Annual Report, filed June 1, 2023 in Docket No, IR22-042, the LBR component of the SBC ceased in 2022.

Actual rates for effect January 1, 2024, including reconciliation of prior period over/under recoveries and inflation factors provided by the DOE, will be filed in December 2023.

II. EE COMPONENT OF THE SBC

Q. What is the estimated EE component of the SBC?

A. The estimated statewide EE rate for effect January 1st during the 2024-2026 three-year term is shown on Attachment H3, Page 1 of 4.

In accordance with SB113, which has passed both the House and Senate and is expected to become law, the EE portion of the SBC is calculated based on the 3-year average of the consumer price index ("CPI-W") as published by the Bureau of Labor Statistics of the United States Department of Labor, all as calculated by the Department of Energy ("DOE").[1] The estimated rates for effect on January 1st during the three-year term will be updated on December 1st each year, in accordance with RSA 374-F:3 VI-a.

Q. How was the EE rate calculated?

A. The current EE portion of the SBC rate effective January 1, 2023 was adjusted as discussed above for the 2024-2026 three-year term.

Q. What is the currently effective EE rate for UES?

A. The EE rate for UES that has been in effect since January 1, 2023 is $0.00550 per kWh.

III. TOTAL SBC AND BILL IMPACTS (UES)

Q. What is the total estimated SBC rate?

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[1] House Bill 549, *An Act Relative to the System Benefits Charge and the Energy Efficiency and Sustainable Energy Board,* signed into law by the Governor on February 24, 2022.

A. For UES, the total SBC rates effective January 1st for each year of the three-year term are shown on Attachment H3, Page 1 of 4. The estimated residential EE portion of the SBC for effect January 1, 2024 is $0.0577 per kWh and estimated to be $0.0603 and $0.0619 per kWh for January 1, 2025 and January 1, 2026 respectively. The total SBC is comprised of the EE component, the fixed low income component of $0.00150 per kWh and the LBR component, which is zero.

Q. Have you provided bill impacts associated with the estimated three-year term?

A. Yes, Attachment H3, Page 4 of 4, contains the bill impacts for an average residential customer and for a small general service customer assuming 40 kW and 10,000 kWh of usage per month. As shown, the January 1, 2024 estimated monthly bill impact for a typical residential customer using 625 kWh per month is $0.17.

IV. EEC FOR NORTHERN

Q. What is the estimated EEC?

A. The estimated residential EEC for effect January 1, 2024 is $0.0545 per therm and estimated to be $0.0570 and $0.0585 per therm for January 1, 2025 and January 1, 2026 respectively.

The estimated C&I EEC for effect January 1, 2024 is $0.0269 per therm and estimated to be $0.0282 and $0.0289 per therm for effect on January 1, 2025 and January 1, 2026 respectively.

Q. How were the estimated January 1, EECs for the three-year term calculated?

A. In accordance with SB113, which has passed both the House and Senate and is expected to become law, the EE portion of the SBC is calculated based on the 3-year average of the consumer price index ("CPI-W") as published by the Bureau of Labor Statistics of the United States Department of Labor, all as calculated by the Department of Energy ("DOE").[2] The estimated rates for effect on January 1st during the three-year term will be updated on December 1st each year, in accordance with RSA 374-F:3 VI-a.

V. BILL IMPACTS (NORTHERN)

Q. What is the bill impact for an average residential heating customer?

A. Bill impacts are shown on Attachment J3, Page 4 of 4. The estimated January 1, 2024 rate results in an increase of $1.78 to a residential heating customer using 706 therms annually.

VI. CONCLUSION

Q. Does this conclude your testimony?

A. Yes.

[2] House Bill 549, *An Act Relative to the System Benefits Charge and the Energy Efficiency and Sustainable Energy Board,* signed into law by the Governor on February 24, 2022.

THE STATE OF NEW HAMPSHIRE

BEFORE THE PUBLIC UTILITIES COMMISSION

PREPARED TESTIMONY OF

CAROL M. WOODS

PROPOSED 2024-2026 SYSTEM BENEFITS CHARGE RATE CHANGE

Docket No. DE 23-xxx

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, by whom you are employed and in what capacity.

A. My name is Carol M. Woods. I am employed by New Hampshire Electric Cooperative as Energy Solutions Executive. My responsibilities include management of planning and regulatory support for the company's energy efficiency programs.

Q. Have you previously testified before the Commission?

A. Yes, I have.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to present and support the calculation of the Energy Efficiency ("EE") component of the System Benefits Charge ("SBC") used to develop the Energy Efficiency budgets for 2024, 2025, and 2026. My testimony explains what is contained in Attachment G3, which provides the calculation of the EE rate components of the SBC for New Hampshire Electric Cooperative.

II. EE COMPONENT OF THE SBC

Q. What is the estimated EE Component of the SBC?

A. The statewide EE rate for effect on January 1, 2024, is $0.00577 per kWh, $0.00603 per kWh for effect on January 1, 2025, and $0.00619 for effect on January 1, 2026. The EE portion of the SBC is "calculated using the most recently available 3-year average of the consumer price index ("CPI-W") as published by the Bureau of Labor Statistics of the United States Department of Labor, all as calculated by the Department of Energy (DOE)."[1] The estimated rate for effect on January 1st during the three-year term will be updated on December 1st each year, in accordance with RSA 374-F:3 VI-a.

Q. How was the EE rate calculated?

A. The EE portion of the SBC rate was set explicitly for 2023, and then using the 2023 rate and adjusting it as discussed above for the three-year term 2024-2026. Attachment G3 provides the forecasted revenues and expenses and a preliminary reconciliation of the EE component of the SBC rate for 2024 to 2026.

III. EAP COMPONENT OF THE SBC

Q. What is the proposed EAP Component of the SBC?

[1] House Bill 549, *An Act Relative to the System Benefits Charge and the Energy Efficiency and Sustainable Energy Board,* signed into law by the Governor on February 24, 2022.

A. As part of this SBC rate filing, the Company includes the statutory EAP rate of $0.00150 per kWh. Due to no statutory change, this rate remains unchanged from prior plan filings.

III. TOTAL SBC AND BILL IMPACTS

Q. What is the total estimated SBC rate?

A. As shown on Page 1 of Attachments G3, which provides a summary of the calculation of the SBC rate, consisting of the EE and EAP rate components discussed above. The total estimated SBC rates for the three-year plan period 2024 to 2026 are:

- 2024 - $0.00727
- 2025 - $0.00753
- 2026 - $0.00769

Q. Have you provided bill impacts associated with the proposed SBC?

A. Yes. The bill impact for a typical residential and C&I member is provided on Page 5 of Attachment G3.

Q. Do the utilities require Commission approval of the SBC billed to members by a specific date?

A. Yes, according to RSA 374-F:3 VI-a, the Commission must issue a decision on the estimated/proposed three-year plan 2024-2026 in time for programs and rates to be effective January 1, 2024, otherwise the plan will be deemed automatically approved.

V. CONCLUSION

Q. Does this conclude your testimony?

A. Yes, it does.

MEMORANDUM

TO	NHSaves Workforce Development Team
FROM	GDS Associates Team
DATE	June 8, 2023
RE	NHSaves Workforce Development Study Key Findings and Recommendations

The GDS Associates Workforce Development Study Team, comprised of team members Foster Sustainable Energy, LLC (FSE), BW Research (BW), Resilient Buildings Group (RBG), and Emerald Cities Collaborative (ECC), has concluded the study phase of energy efficiency workforce needs and developed actionable recommendations for the NHSaves utilities to consider in the 2024-2026 plan. This memorandum is a summary of our research activities, key findings, and recommendations.

EXECUTIVE SUMMARY

Access to a trained and flexible workforce is critical to the success of the NHSaves programs. 100% of NHSaves program managers surveyed indicated that workforce development is important for the programs to achieve their targets in the 2024-2026 plan with 75% of those surveyed responding it is "very important". Over 92% of energy employers in New Hampshire who hired in the past year reported difficulty hiring qualified workers with over half saying it was "very difficult".[1]

Lack of qualified new entrants to the energy workforce was widely cited as a primary challenge facing the trade allies who work to support the NHSaves programs. Our research found that there is a general lack of awareness among high school students and job seekers regarding energy careers and few well-defined career paths available to follow. There is, however, a strong network of non-profits, educational institutions, businesses, organizations, and government agencies in New Hampshire with a willingness to work together to support the development of energy workers (NH Energy Ecosystem). NHSaves has a unique opportunity in the 2024-2026 plan to lend technical expertise and work with the NH Energy Ecosystem to foster the development of clear pathways to energy efficiency careers.

Training of incumbent workers in technical and business services is another key priority area for New Hampshire energy efficiency contractors. Incumbent workforce in this context refers both to upskilling and supporting the growth of trade allies who currently work with the NHSaves program and vendors who work in New Hampshire but are not currently engaged with the NHSaves programs. The latter group is a recommended focus for NHSaves workforce development efforts in the 2024-2026 plan.

As the NHSaves utilities develop the 2024-2026 plan, our team recommends an incremental approach to supporting workforce development. The need is large, and challenges are significant. Without a clearly articulated and focused plan, the NHSaves utilities risk being drawn into trying to solve a broader workforce issue in New Hampshire that they have neither the resources nor responsibility to solve alone. As such, our team recommends a targeted strategy built around three principal areas of focus as shown in Table 1 below.

[1] Energy Employment by State, USEER, U.S. Department of Energy. https://www.energy.gov/sites/default/files/2022-06/USEER%202022%20-%20New%20Hampshire.pdf

Table 1: Recommended Focus Areas for NHSaves 2024-2026 Workforce Development Plan

Focus Area	Description
Education	Leverage existing K-12 programming and enhance focus on grades 9-12. Build awareness of energy efficiency careers and entry pathways. Focus on three key occupations: weatherization installer, energy auditor, and energy engineer. Serve as a hub of information for job seekers and employers on energy efficiency careers.
Recruitment	Serve as a repository for information on EE jobs and career pathways. Work through NH Energy Ecosystem partners to disseminate information. Lend industry expertise to program advisory boards to help shape EE programming within existing networks. Link with national programs that highlight EE careers, such as the U.S. Department of Energy's Green Buildings Career Map.
Training	Target gaps in skills between current workforce and 2024-2026 plan objectives. Engage vendors that already work in NH but not the NHSaves programs to promote participation. Develop a formal training plan that includes objective criteria for providing NHSaves funding to trainings and participants, based on needed skills and measurable outcomes. Support the EE knowledge growth of facility managers.

Detailed micro-recommendations in each focus area are presented later in this memorandum. Given budgetary constraints, some prioritization of activities will be necessary. Working through existing NH Energy Ecosystem partners will help the NHSaves utilities achieve the greatest impact to their program success with least cost to ratepayers.

SUMMARY OF RESEARCH TEAM ACTIVITIES

Our team's conclusions and recommendations are based on a series of activities undertaken in Q1 and Q2 2023 and supplemented by decades of experience in energy efficiency and workforce development in New Hampshire. This section provides a brief overview of our team's key activities.

Table 2: Summary of Research Activities

Activity	Description
NH Energy Ecosystem Partner Engagement	The research team interviewed over twenty (20) different ecosystem partners to better understand their workforce needs, how they could potentially contribute to a more coordinated EE workforce development effort, or how they could benefit from such an effort. A list of partners contacted as part of this research is included in Appendix A.
Analysis of Existing NH Data on Energy Jobs	Led by BW Research Partnership, the team analyzed existing data from the U.S. Energy Employment Report and Occupational Compendium for New Hampshire (a proprietary dataset owned by BW). The data included information on wages,

	certifications, education and experience requirements, and hiring difficulty (and reasons). Reference to the summary presentation in Appendix B.
Map EE Occupations to Standard Labor Classifications	The team reviewed energy efficiency measures offered by the NHSaves program and the specific occupations involved with the identification and implementation of each measure. The purpose of this analysis was to identify the specific occupations of greatest importance to the NHSaves programs. Refer to the EE occupation mapping in Appendix C.
Inventory of Existing Trainings and Programs in NH	Led by FSE, the team created an excel-based inventory of the existing energy efficiency related trainings currently offered in New Hampshire. This included online trainings, Career and Technical Education (CTE) programs, community college programs, utility sponsored trainings, and others. Refer to the training inventory included in Appendix D.
Program Administrator (PA) Surveys	The team conducted a web-based survey of NHSaves program staff who are responsible for implementing programs to understand their perceptions about the needs and importance of workforce development, and potential target areas. Refer to the summary results in Appendix E.
Trade Ally (TA) Surveys	Led by RBG, the team conducted an online survey of New Hampshire trade allies focused on better understanding their hiring and training needs and challenges. The survey also sought to understand barriers to their participation in the NHSaves programs and how their engagement with the programs could be increased. Refer to the summary results in Appendix F.
Research and Synthesize Regional Best Practices	Led by BW Research Partnership and leveraging similar work they have recently conducted in the northeast region, the team reviewed EE workforce development best practices, including similar work for MassSave, MassCEC, the Maine Governor's Office of Energy, Connecticut Utility Program Administrators, and NYSERDA.
Federal Energy Efficiency Training and Workforce Development Grant Opportunities	Led by FSE, the team has researched funding sources available through the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA; also called the Bipartisan Infrastructure Law – BIL) for opportunities of synergies which would assist in the development and sustainability of workforce development. Please see Appendix G.

KEY FINDINGS

A number of key findings were identified during the course of the study that influenced our team's recommendations for the NHSaves utilities workforce development strategy in the 2024-2026 plan. These key findings are briefly summarized below.

- There is likely to be a significant increase in federal spending on energy efficiency during the plan period. The Inflation Reduction Act (IRA) alone is projected to create an additional 850+ full-time clean energy and energy efficiency installation and maintenance jobs in the next 10 years. New Hampshire is projected to see over $2.6 billion in federal climate investment over this period.[2] This investment will create more demand for energy projects and strain an already thin energy efficiency workforce in New Hampshire.

- Each state surrounding New Hampshire has committed substantial funding and attention to energy efficiency and energy workforce development targets over the next decade. This investment and stable energy policy has fostered growth of these industries and drawn some New Hampshire based contractors into work in other states, creating further competition for resources. This investment by surrounding states in energy workforce, coupled with federal funding streams, creates huge demand for energy workers.

- Contacts with the NH Department of Education, Community College System, and the University System all echoed the same general theme – that they want to offer educational programming that is aligned with where the jobs will be. Each sees energy as a significant industry of new jobs over the next 10 years. Engagement from industry partners, such as NHSaves or private business, is a critical component of effectively launching these energy-oriented programs. Having sufficient demand for the programs generated by building awareness of energy careers is also required before educators will invest to build out programming.

- There is a general lack of awareness about energy efficiency careers and how to enter this field despite many students being passionate about energy and climate and seeking career opportunities that provide a sense of purpose beyond collecting a paycheck. Better defining clear pathways to enter the energy efficiency field and promoting these occupations and pathways to job seekers is a needed step to increase recruitment pipeline and demand for energy oriented educational programming.

- There is already a robust array of workforce development resources available to NHSaves trade ally employers and job seekers. These resources include the WorkInvestNH Job Training Fund, WorkNowNH and WIOA training grants to eligible job seekers, WIOA on-the-job training funding, ApprenticeshipNH technical and financial assistance, high school CTE work-based learning programs, and other resources. Many NHSaves contractors are not aware of these resources and would benefit from advice on how to access and leverage these existing sources of workforce assistance.

- Registered Apprenticeship is an important pathway to an energy efficiency career. Currently, there are few Registered Apprenticeship programs in New Hampshire and those that exist are largely in the Southeastern region and focused on electricians.

- Beyond just energy efficiency, New Hampshire is facing a major deficit in the trades overall. Older generations of trade workers and engineers are retiring at an accelerating pace and there is an inadequate pipeline of new entrants to the energy field. New Hampshire is also experiencing historically low unemployment and lower than average labor market participation. These issues are not unique to New Hampshire. NHSaves does not have the obligation or resources to solve

[2] https://www.nature.org/en-us/newsroom/nh-climate-report/

these broader issues but must be aware that they complicate the overall energy workforce development picture in New Hampshire.

- Through SB152[3], the New Hampshire State legislature has committed to supporting the development of energy workforce targeted at the budding offshore wind industry in the Gulf of Maine. This bill would establish a new workforce development and innovation fund and create new dedicated programming at a regional career technology center. The objectives of this bill are in harmony with the objectives of energy efficiency workforce development in the state and present opportunities for collaboration. However, as noted above, the offshore wind industry will compete with energy efficiency employers for many job roles in the construction trades.
- The New Hampshire Department of Energy (NH DOE) has significant funding available through the Weatherization Assistance Program (WAP) and strong training and technical assistance (T&TA) resources. They are facing shortages of weatherization installers and energy audits to accomplish their program objectives. This constraint overlaps with the needs of NHSaves and presents opportunity for collaboration to build and nurture career pathways for weatherization installers and energy auditors.
- NH DOE is in a position to pursue competitive federal grant funding related to energy efficiency workforce development. Outcomes from this study could be used to identify gaps in energy efficiency workforce development not addressed by the NHSaves programs that could be supported through DOE administered grants. Identifying, pursuing, and administrating these grants is time intensive. Further investigation is needed to better define these opportunities and the optimal approach for New Hampshire to pursue these funds.
- NHSaves' technical training program in the 2021-2023 plan period has been heavily concentrated on the residential sector and on building codes. Opportunity exists to expand technical training in the commercial and industrial sector to focus on more "beyond-lighting" offerings. Opportunity also exists to promote and cost-share participation in existing training programs offered through other providers. Recruitment of incumbent workers to attend these training courses is a challenge. NHSaves would benefit from a more targeted training program in the 2024-2026 plan period that is organized in advance, posted on a shared training calendar, and consistently promoted to vendor partners. Existing training is largely absent from lower income and more rural communities.
- Opportunity exists for NHSaves to increase the engagement of vendor partners with the programs, including New Hampshire based contractors who live and work in the state but currently do not work extensively with the programs. Resources available to contractors on the NHSaves website could be improved. The education and engagement of these incumbent trade allies should be an important target for the NHSaves programs in the 2024-2026 plan.
- Representatives from the Business and Industry Association (BIA) reported that many mid-sized manufacturers and businesses in the state do not have full-time energy managers on staff, as many large businesses do, and this can challenge their ability to identify and execute cost effective energy efficiency projects. Opportunity exists for NHSaves to more directly engage this cohort in

[3] https://legiscan.com/NH/bill/SB152/2023. Bill awaiting Governor Sununu's signature as of 6/7/23

the 2024-2026 plan to increase their technical acumen with energy efficiency and simultaneous serve as a lead generator of projects for the commercial programs.

RECOMMENDATIONS

The research team has identified a series of specific recommendations for the NHSaves utilities to consider as part of their workforce development efforts in the 2024-2026 plan period. These recommendations are organized by the three focus areas (education, recruitment, training) and include an assessment of the relative effort to implement.

Table 3: Research Team Recommendations

Reference	Recommendation	Level of Effort to Implement
Education and Awareness Building		
1A	Work with the K-12 vendor to build out the “Career Pathways” program by defining clear pathways for the three priority occupations (Wx installer; energy auditor; energy engineer). Promote this program in grades 6-12 as a priority.	Medium
1B	Enhance the contractor resources page of the NHSaves website to support contractors who work in the programs, or who desire to work in the programs. The site could include program resources, information on trainings, FAQ’s, and information on upcoming program offerings.	Low
1C	Develop a one-stop shop NHSaves EE Workforce Development Hub hosted on the NHSaves site. This hub would be a clearinghouse of information for job seekers. Marketing materials would highlight the link to this site where NHSaves would control and regularly update the content. Focus on the three EE occupations or initial focus; Wx installer, energy auditor, and energy engineer. Link to existing federal resources such as U.S. DOE’s Green Buildings Career Map.	High
1D	If SB152 is signed into law by the Governor, engage with the *Offshore Wind Industry Workforce Training Center Committee* to coordinate efforts to reach students and job seekers and educate them on career path opportunities. As constituted, the committee is required to include “Two representatives of public utilities, selected by the utilities”.	Low
1E	Work with the NH Career and Technical Education (NH CTE) program to develop programs targeting Wx installers and energy auditors. This requires support from industry experts to design and administer the programs. Consider piloting one or more programs in CTE locations	High

	with the greatest need and targeting underserved populations. Once established, the programs could be replicated in other CTE locations.	
1F	Commit representation to serve on the advisory board for the Chemical Engineering department at the University of New Hampshire. This department currently possesses a concentration on Energy Systems which, with support and insight from the NH utilities themselves, could produce highly educated, focused graduates with a solid foundation of knowledge curated specifically by and for the utilities. NHSaves has been invited to participate as part of this advisory board.	Low
Recruitment		
2A	Promote the target EE occupations and career pathways through the workforce development arms of existing partners such as the Community Action Agencies, the NH Office of Workforce Opportunity, the University and Community College Systems, and related organizations. Direct interested parties to the NHSaves EE Workforce Development Hub established in recommendation 1C above.	Low
2B	Support the development and execution of a weatherization installer apprenticeship program through ApprenticeshipNH and share best practices with other interested parties who could adopt similar apprenticeship programs. There is at least one Community Action Agency that is ready to undertake this process.	Medium
2C	Further study the best practices of other New England states regarding recruitment of Opportunity Youth[4] and other disadvantaged populations. Identify specific organizations in New Hampshire that could be partnered with to support reaching these potential labor pools.	Medium
2D	Collaborate with the NH Department of Energy to identify potential funding streams through the Inflation Reduction Act (IRA) or the Bipartisan Infrastructure Investment and Jobs Act (IIJA) that could be braided with NHSaves funding to expand outreach and recruitment efforts.	Low
2E	Work with the NH Office of Workforce Opportunity to get key EE careers listed as high-demand (bright outlook) occupations. Ensure relevant training programs are included on WIOA Eligible Training Provider Lists (ETPLs) to increase participation and unlock funding sources.	Low

[4] https://www.dol.gov/agencies/eta/youth

2F	Consider workforce incentive programs to encourage contractors to participate in the NHSaves programs. Other states have enacted programs used to entice participation from contractors that could be used as a model.	Medium
2G	Maintain current information on wages and benefits associated with energy efficiency occupations. These jobs often offer less flexibility (remote/hybrid or non-traditional work hours) and can have challenging work conditions. Providing competitive wages is critically important to recruiting potential workers and the data is important to understand these complex dynamics.	High
Training		
3A	Develop a formal training plan for the residential/income-eligible population that includes objective criteria for providing NHSaves funding to trainings and participants, based on needed skills and measurable outcomes such as industry-recognized credentials. Address tuition costs and cost-share needs. Promote trainings on the NHSaves enhanced website, through social media, and through direct communications with trade allies.	Medium
3B	Develop a formal annual training plan for the commercial sector that includes objective criteria for providing NHSaves training funding to trainings and participants, based on needed skills and measurable outcomes such as industry-recognized credentials. Organize and market these trainings through distributors as a means to promote more energy efficient products and to reach vendors who may not have historically participated in the NHSaves programs.	High
3C	Work through the NH Business and Industry Association (BIA) to increase support for medium sized commercial and industrial users focused on expanding the energy management acumen of facility managers and facilitating their participation in the NHSaves programs.	High
3D	Collaborate with the NH Department of Energy Weatherization Assistance Program (WAP) to harmonize training efforts of energy auditors and weatherization installers. Establish regular communication with the WAP administrators, set goals and monitor progress. Focus on micro-credentials that can be a first step for job seekers to gain relevant experience and boost attractiveness to employers.	Low
3E	Engage proven partners that provide direct experiential learning to disadvantaged youth. Youth Build International just opened a Manchester location and could be one such organization to partner	Medium

	with to reach locations in northern New Hampshire and to incorporate NHSaves credentialing requirements into its program.	
3F	When developing the formal training plans, specifically consider increasing the amount of online training and building web resources to ensure that lower income areas and areas in Northern New Hampshire can participate.	Medium

Appendix A

NH Energy Ecosystem Contacts

The following New Hampshire based organizations, businesses, and government agencies were interviewed to gain a greater understanding of their WFD needs, challenges, and potential areas of collaboration with NHSaves in the 2024-2026 plan. This is not intended to represent a complete list of potential NH Energy Ecosystem partners.

- ✓ ApprenticeshipNH
- ✓ Bring Back the Trades
- ✓ Business and Industry Association (BIA)
- ✓ Belknap-Merrimack County CAP
- ✓ Clean Energy NH (CENH)
- ✓ Energy Circle
- ✓ Girls at Work
- ✓ Lakes Region Community College
- ✓ NH Department of Business and Economic Affairs
- ✓ NH Department of Environmental Services
- ✓ NH Department of Education, Career and technical Education (CTE)
- ✓ NH Department of Energy
- ✓ NH Department of Energy, Weatherization Assistance Program
- ✓ NH Energy Education Program & Vermont Energy Education Program
- ✓ NH Home Builders Association
- ✓ NH Office of Workforce Opportunity
- ✓ Northeast Clean Energy Council
- ✓ Northeast Energy Efficiency Partnership
- ✓ Peterborough Renewable Energy Planning
- ✓ Southern NH Services
- ✓ Stay Work Play NH

Appendix B

Analysis of Existing NH Data on Energy Jobs

Memo #1:
Key Occupations for New Hampshire

Based on 2021-2023 New Hampshire Statewide Energy Efficiency Plan

March 2023

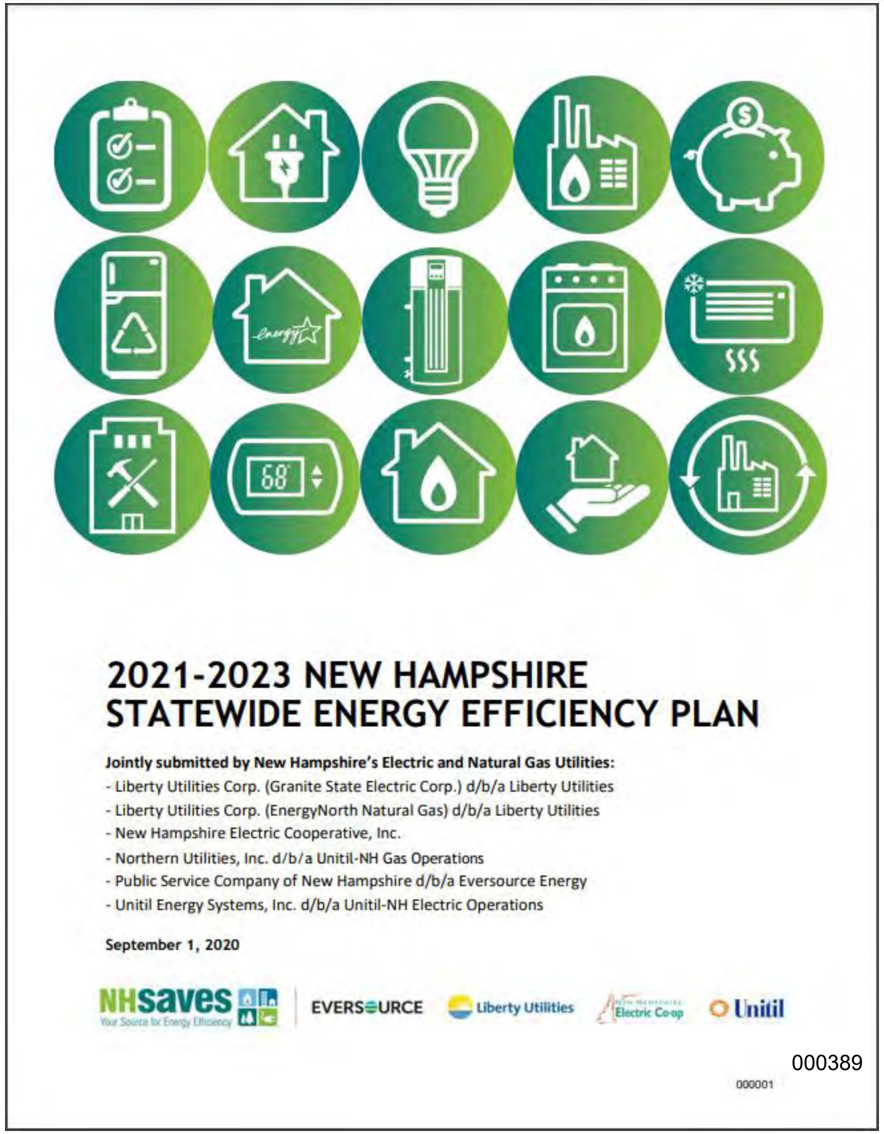
[bw] RESEARCH PARTNERSHIP

GDS Associates, Inc. ENGINEERS & CONSULTANTS

NHsaves® Your Source for Energy Efficiency

2021-2023 New Hampshire Statewide Energy Efficiency Plan

- The BW team has used the 2021-2023 Energy Efficiency Plan to identify the state's priority activities and then crosswalk those with labor market classifications to identify key occupations for the state of New Hampshire
- The 2021-2023 Energy Efficiency Plan includes residential-, commercial-, industrial-, and municipal-tailored programs
- Includes incentives and rebates to increase energy efficiency measures across New Hampshire
- Approved by the state's Public Utilities Commission and various utility companies



2021-2023 NEW HAMPSHIRE
STATEWIDE ENERGY EFFICIENCY PLAN

Jointly submitted by New Hampshire's Electric and Natural Gas Utilities:
- Liberty Utilities Corp. (Granite State Electric Corp.) d/b/a Liberty Utilities
- Liberty Utilities Corp. (EnergyNorth Natural Gas) d/b/a Liberty Utilities
- New Hampshire Electric Cooperative, Inc.
- Northern Utilities, Inc. d/b/a Unitil-NH Gas Operations
- Public Service Company of New Hampshire d/b/a Eversource Energy
- Unitil Energy Systems, Inc. d/b/a Unitil-NH Electric Operations

September 1, 2020

NHSaves Your Source for Energy Efficiency | EVERSOURCE | Liberty Utilities | Electric Co-op | Unitil

000389

000001

Methodology

Energy Efficiency Master Plan

"HEA contractors will direct-install a number of cost-effective energy efficiency measures, such as: Air Sealing"

*Home Energy Assistance (HEA)

"The NH Utilities partner with numerous retailers, distributors, and manufacturers ("Retail Partnerships") to promote LED light bulbs and fixtures."

Key Activities

Install air sealing measures

Promote LED light bulbs and fixtures

Key Occupations

Weatherization Tech/Insulator

Retailers, distributors, and manufacturers of LED light bulbs and fixtures

Summary list of occupations identified

Activity	Key Occupation	Secondary Occupation
Air source or ductless heat pumps	HVAC technician	Electrician
HVAC Optimization	HVAC technician	
Smart home energy management systems	Electrician	Energy Auditor
Air sealing	Weatherization Tech/Insulator	
Building shell insulation	Weatherization Tech/Insulator	
Duct sealing (and insulation)	Weatherization Tech/Insulator	HVAC
High-efficiency lighting	Electrician	
Hot water pipe insulation and hot water temperature setback	HVAC technician	Insulators
Refrigerator replacements	Laborer	Plumber
Water-saving devices (low-flow showerheads and faucet aerators)	Plumber	
Wi-Fi thermostats	HVAC technician	Electrician
Health and safety measures that serve as barriers to energy efficiency	HERS Raters	
Evaluate the efficiency of the home's appliances (clothes dryers, clothes washers, dehumidifiers, refrigerators, room air purifiers, and other measures.)	HERS Raters	
Energy assessment of current home state	HERS Raters	
Energy audit for post-work inspections	HERS Raters	
Freezer replacements	Laborer	Plumber
Hot water-saving devices (hot water temperature setback, faucet aerators, low-flow showerheads, and water pipe insulation)	Plumber	
HVAC system cleaning	HVAC technician	
Window and door replacements	Carpenter	
HVAC equipment replacement	HVAC technician	
Community Action Agencies and qualified contractor trainings	Training instructors	
Promote LED light bulbs and fixtures	Retailers, distributors, and manufacturers of LED light bulbs and	
Pick up old refrigerators or freezers from customer homes	Laborer	
Thermal enclosure (i.e., high-performance windows, properly installed insulation, and air sealing)	Weatherization Tech/Insulator	Carpenter
Air compressors and chiller optimization for manufacturers	Building operator	
Energy efficiency measure: commercial kitchen equipment	Building operator	
Heat pump water heaters	Plumber	Electrician
Energy efficiency measure: programmable Wi-Fi thermostats	HVAC technician	Electrician
Energy efficiency measure: VFDs	Building operator	HVAC
Energy management systems	Building operator	

Key Occupations related to commercial and industrial-related projects

		Helpers--Electricians
		Helpers--Carpenters
		Helpers--Installation, Maintenance, and Repair Workers
		Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters
Commercial and Industrial Activities	Engineers	
Commercial and Industrial Activities	Architects	
Commercial and Industrial Activities	Building operator	

Key Occupations (14)

- Architects
- Building Operators
- Carpenters
- Electricians
- Energy Auditors
- Engineers
- Home Energy Rating System (HERS) Raters
- Heating, Ventilation, and Air Conditioning (HVAC) Technicians
- Insulators
- Laborers
- Plumbers
- Retailers, Distributors, and Manufacturers of LED Light Bulbs and Fixtures
- Training Instructors
- Weatherization Technicians

Engineers, architects, and building operators are included for commercial and industrial activities

"Helper" positions are subsumed by the general categories since they are part of the career pathway and apprentice-related positions

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Occupational Profiles for New Hampshire

Memo #2

April 2023

[bw] RESEARCH PARTNERSHIP

GDS Associates, Inc. ENGINEERS & CONSULTANTS

NHsaves® Your Source for Energy Efficiency

Key Occupations (14)

- Architects
- Building Operators
- Carpenters
- Electricians
- Energy Auditors
- Engineers
- Home Energy Rating System (HERS) Raters
- Heating, Ventilation, and Air Conditioning (HVAC) Technicians
- Insulators
- Laborers
- Plumbers
- Retailers, Distributors, and Manufacturers of LED Light Bulbs and Fixtures
- Training Instructors
- Weatherization Technicians

Engineers, architects, and building operators are included for commercial and industrial activities

"Helper" positions are subsumed by the general categories since they are part of the career pathway and apprentice-related positions

Methodology

1. Gathered available USEER data on New Hampshire energy jobs and hiring difficulty
2. Using the list of key occupations developed for memo #1, translated these occupations into Bureau of Labor Statistics occupational profile groups using the Standard Occupational Classification (SOC) codes
3. Obtained wage, certification, skill, educational and work experience requirements data for each BLS occupational group from JobsEQ

Wage, educational, number of workers, and work experience requirements sourced from JobsEQ, 2022 Q3 data
Currently preferred certifications and skills sourced from JobsEQ Real Time Intelligence, 4/03/2022 to 4/03/2023 job postings

Map of Energy Efficiency Occupations to Standard labor Classifications

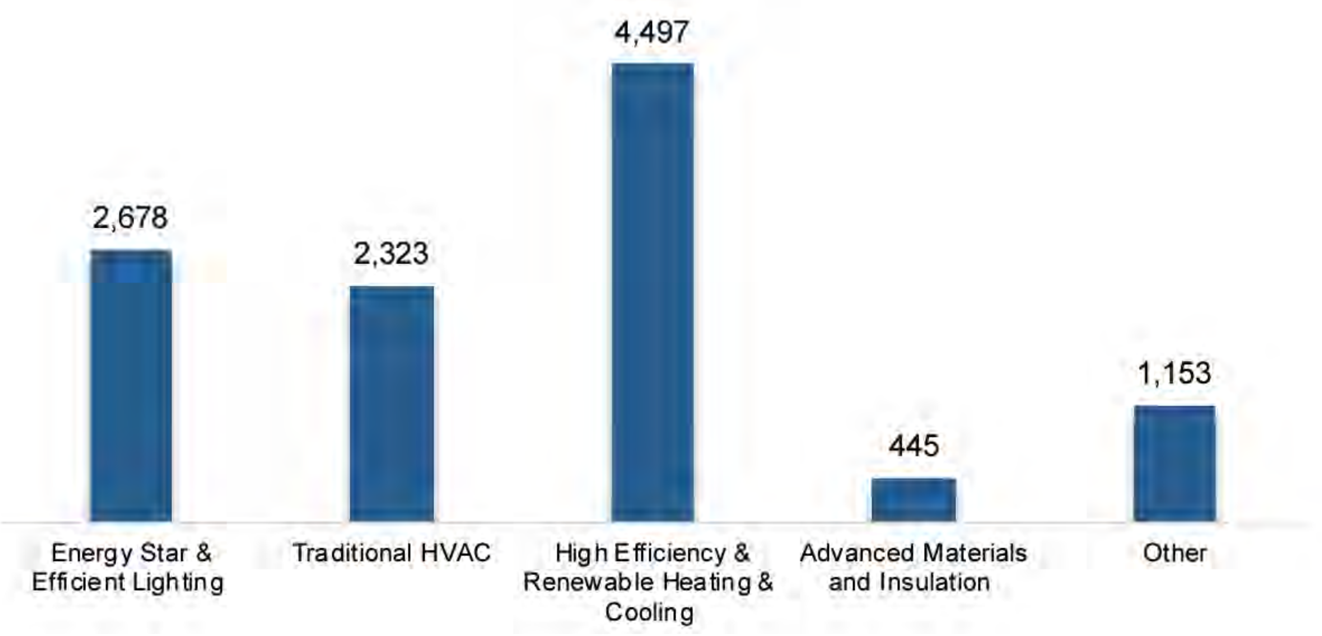
Memo #1 List	SOC Code	SOC Code Title	Reasoning
Architects	17-1011	Architects, Except Landscape and Naval	
Building Operators	49-9071	Maintenance and Repair Workers, General	Building operators are responsible for the day-to-day operation of a building, including ensuring that all mechanical systems are functioning properly, conducting routine maintenance and repairs, and responding to emergencies
Carpenters	47-2031	Carpenter	
Electricians	47-2111	Electrician	
Energy Auditors, HERS Raters	47-4011	Construction and Building Inspectors	ONET classification is 47-4011.01, a subset of Construction and Building Inspectors
Engineers	17-2141, 17-2071, 17-2051	Mechanical Engineers, Electrical Engineers, Civil Engineers	
HVAC technicians	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	
Insulators	47-2131	Insulation Workers, Floor, Ceiling, and Wall	
Laborers	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	While there are a few types of laborers, material moving workers seemed to fit the best here as they will be moving refrigerators and freezers in and out of buildings
Plumbers	47-2152	Plumbers, Pipefitters, and Steamfitters	
Retailers, distributors, and manufacturers of LED light bulbs and fixtures	41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	
Training instructors	13-1151	Training and Development Specialists	
Weatherization Techs/Insulators	47-4099	Miscellaneous Construction and Related Workers	ONET classification is 47-4099.03, a subset of miscellaneous construction-related workers

Energy Efficiency Jobs Overview

- In 2021, there were 29,508 energy workers in New Hampshire
- Among these energy workers, 11,096 were employed in energy efficiency, representing 0.5% of energy efficiency workers nationwide
- Energy efficiency jobs in New Hampshire are mainly concentrated in the construction industry
- Between 2020 and 2021, total energy efficiency jobs rose by 258

- Within energy efficiency, jobs can be categorized by specific sub-technologies:

Energy Efficiency Employment by Detailed Technology Application in New Hampshire



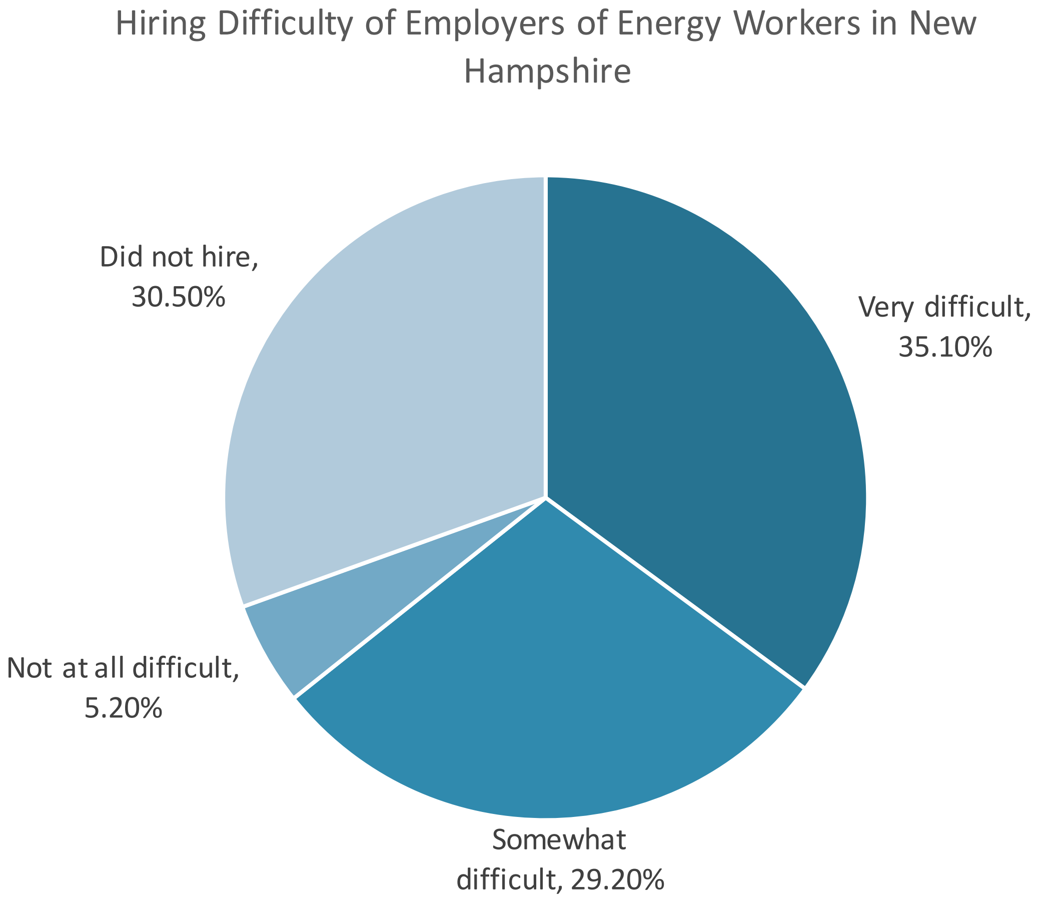
Energy Employment by State 2022, USEER, U.S. Department of Energy, June 2022

Hiring Difficulty

USEER Survey Question:

Thinking of the [response to previous question] energy workers that you have hired at your location over the last 12 months, please indicate your level of difficulty finding qualified applicants to fill the positions.

- Significantly, 64.3% of employers with energy workers in New Hampshire reported at least some difficulty with hiring energy workers



Architects, Except Landscape and Naval

Architects

Typical Entry-Level Education Requirement

Bachelor's degree

Previous Work Experience

None

Typical On-The-Job Training

Internship/residency

Common Certifications/ Licensing

- Licensed Professional Engineer
- Secret Clearance
- NCIDQ Certification
- NCARB Certification (NCARB)

Frequently Required Skills

- Autodesk Revit
- Autodesk AutoCAD
- Adobe Photoshop
- Google Sketchup
- Computer Programming/Coding
- Microsoft Office
- Autodesk Navisworks
- Computer Aided Design Software (CAD Software)
- Interior Design
- Microsoft Excel

Current number of workers in NH: 445

Wages (Hourly)

Entry-Level: $26.69

Median: $41.44

Experienced: $58.21

Maintenance and Repair Workers, General

Building Operators

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Moderate-term on-the-job training

Common Certifications/ Licensing

- Driver's License
- Commercial Driver's License (CDL)
- EPA Section 608 Certification (EPA 608)
- Secret Clearance
- DOT Medical Card
- Certification in Cardiopulmonary Resuscitation (CPR)
- Cisco Certified Network Associate (CCNA)
- HAZMAT
- OSHA 10
- Class B Commercial Driver's License (CDL-B)

Frequently Required Skills

- Plumbing
- HVAC Systems
- Mechanical
- Ability to Lift 41-50 lbs.
- Ability to Lift 51-100 lbs.
- Manufacturing
- Microsoft Excel
- Maintenance
- Microsoft Office
- Boilers

Current number of workers in NH: 5,667

Wages (Hourly)

- Entry-Level: $16.26
- Median: $22.28
- Experienced: $26.88

Carpenters

Pathways

Helpers--Carpenters

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Apprenticeship (paid, hands-on experience)

Common Certifications/ Licensing

- Driver's License
- OSHA 10
- Certified Door Consultants (CDC)
- Commercial Driver's License (CDL)
- OSHA 30

Frequently Required Skills

- Plumbing
- Power Tools
- Hand Tools
- Ability to Lift 41-50 lbs.
- Welding
- Commercial Construction
- Blueprint Reading
- Tape Measures
- Nail Guns
- Cabinet Installation

Current number of workers in NH: 4,636

Wages (Hourly)

- Entry-Level: $20.21
- Median: $25.79
- Experienced: $30.81

Electricians

Pathways

Helpers--Electricians

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Apprenticeship (paid, hands-on experience)

Common Certifications/ Licensing

- Driver's License
- OSHA 10
- Certification in Cardiopulmonary Resuscitation (CPR)
- NABCEP Certification
- Commercial Driver's License (CDL)
- DOT Medical Card
- Secret Clearance
- Certified Tree Worker
- Certified Welder
- OSHA 30

Frequently Required Skills

- HVAC Systems
- Ability to Lift 41-50 lbs.
- Power Tools
- Mechanical
- Hand Tools
- Using Ladders
- Blueprint Reading
- Maintenance
- Plumbing
- Reading Schematics

Current number of workers in NH: 3,314

Wages (Hourly)

Entry-Level: $20.14

Median: $29.29

Experienced: $36.63

Construction and Building Inspectors

Energy Auditors, HERS Raters

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

5 years or more

Typical On-The-Job Training

Moderate-term on-the-job training

Common Certifications/ Licensing

- Driver's License
- Certified Energy Auditor (CEA)
- ASNT Central Certification Program Level II - Liquid Penetrant Testing (ACCP-PT)
- Certified Welder
- Certified Welding Inspector (CWI)
- Concrete Strength Testing Technician (CSTT)
- NICET Level 1
- OSHA 10
- Society for Protective Coatings Certification (SSPC)
- Certified Fire Protection Specialist (CFPS)

Frequently Required Skills

- Microsoft Excel
- Plumbing
- Microsoft Office
- Microsoft Outlook
- Personal Computers (PC)
- Microsoft Word
- HVAC Systems
- iOS
- Insurance
- Microsoft SharePoint

Current number of workers in NH: 569

Wages (Hourly)

- Entry-Level: $20.02
- Median: $29.97
- Experienced: $35.82

Mechanical Engineers

Typical Entry-Level Education Requirement

Bachelor's degree

Previous Work Experience

None

Typical On-The-Job Training

None

Common Certifications/ Licensing

- Engineer in Training (EIT)
- Licensed Professional Engineer
- Driver's License
- Certified Maintenance & Reliability Professional (CMRP)
- Certified Reliability Engineer (CRE)
- Certified SOLIDWORKS Associate (CSWA)
- Certified SOLIDWORKS Professional (CSWP)
- Commercial Building Inspector (CBI)
- Professional Engineering Manager (PEM)
- Secret Clearance

Frequently Required Skills

- Computer Aided Design Software (CAD Software)
- Dassault Systemes SolidWorks Software
- Mechanical Design
- Autodesk AutoCAD
- Finite Element Analysis Software (FEA Software)
- Microsoft Office
- Manufacturing
- Microsoft Excel
- Mechanical Engineering
- Microsoft PowerPoint

Current number of workers in NH: 1,993

Wages (Hourly)

Entry-Level: $35.06

Median: $47.57

Experienced: $56.19

Electrical Engineers

Typical Entry-Level Education Requirement

Bachelor’s degree

Previous Work Experience

None

Typical On-The-Job Training

None

Common Certifications/ Licensing

- Licensed Professional Engineer
- Engineer in Training (EIT)
- Driver's License
- Secret Clearance
- Project Management Professional (PMP)
- Certified Associate in Project Management (CAPM)
- Certified Information Systems Security Professional (CISSP)
- Commercial Building Inspector (CBI)
- Six Sigma Green Belt Certification (SSGB)

Frequently Required Skills

- Computer Aided Design Software (CAD Software)
- Autodesk AutoCAD
- Computer Programming/Coding
- Microsoft Office
- Microsoft Excel
- Circuits
- Radio Frequency (RF)
- Python
- Field Programmable Gate Array (FPGA)
- MATLAB

Current number of workers in NH: 1,926

Wages (Hourly)

- Entry-Level: $36.20
- Median: $52.90
- Experienced: $62.92

Civil Engineers

Typical Entry-Level Education Requirement

Bachelor's degree

Previous Work Experience

None

Typical On-The-Job Training

None

Common Certifications/ Licensing

- Engineer in Training (EIT)
- Licensed Professional Engineer
- Driver's License
- LEED Accredited Professional (not specified)
- Geographic Information Systems Professional (GISP)
- Professional Traffic Operations Engineer (PTOE)

Frequently Required Skills

- Autodesk AutoCAD
- Microsoft Office
- Computer Aided Design Software (CAD Software)
- HydroCAD
- Microsoft Excel
- Autodesk Revit
- Report Writing/Report Preparation
- Mathsoft Mathcad
- Technical Writing
- Computer Aided Design and Drafting Software (CADD)

Current number of workers in NH: 1,605

Wages (Hourly)

- Entry-Level: $30.54
- Median: $42.60
- Experienced: $52.96

Heating, Air Conditioning, & Refrigeration Mechanics & Installers

HVAC Technicians

Pathways

Helpers—Installation, Maintenance, and Repair Workers

Typical Entry-Level Education Requirement

Postsecondary non-degree award

Previous Work Experience

None

Typical On-The-Job Training

Long-term on-the-job training

Common Certifications/ Licensing

- EPA Universal Certification
- Driver's License
- EPA Section 608 Certification (EPA 608)
- Light Commercial Refrigeration Certification (NATE Certified)
- OSHA 10
- Commercial Driver's License (CDL)
- HAZMAT
- Secret Clearance
- DOT Medical Card
- Certified Welder

Frequently Required Skills

- HVAC Systems
- Boilers
- Plumbing
- Ability to Lift 41-50 lbs.
- Mechanical
- Refrigeration Systems
- Ability to Lift 51-100 lbs.
- Using Ladders
- Gauges
- Microsoft Office

Current number of workers in NH: 2,127

Wages (Hourly)

- Entry-Level: $20.96
- Median: $29.80
- Experienced: $34.46

Insulation Workers, Floor, Ceiling, and Wall

Insulators

Typical Entry-Level Education Requirement

None

Previous Work Experience

None

Typical On-The-Job Training

Short-term on-the-job training

Common Certifications/ Licensing

- Driver's License

Frequently Required Skills

- Ability to Lift 41-50 lbs.
- Using Ladders
- Ability to Lift 51-100 lbs.
- Painting
- Extension Ladders
- Mechanical

Current number of workers in NH: 196

Wages (Hourly)

- Entry-Level: $17.24
- Median: $20.61
- Experienced: $23.19

Laborers and Freight, Stock, and Material Movers, Hand

Laborers

Typical Entry-Level Education Requirement

None

Previous Work Experience

None

Typical On-The-Job Training

Short-term on-the-job training

Common Certifications/ Licensing

- Driver's License
- Forklift Certified
- Commercial Driver's License (CDL)
- Class B Commercial Driver's License (CDL-B)
- HAZMAT
- Certified Supply Chain Professional (CSCP)
- Certified in Production and Inventory Management (CPIM)
- Class A Commercial Driver's License (CDL-A)
- DOT Medical Card
- IPC-A-610 Acceptability of Electronic Assemblies (IPC-A-610)

Frequently Required Skills

- Forklifts
- Ability to Lift 41-50 lbs.
- Ability to Lift 51-100 lbs.
- Pallet Jacks
- Hand Trucks
- Stand-up ForkLifts
- Manufacturing
- Microsoft Excel
- Inventory Control
- Microsoft Office

Current number of workers in NH: 6,746

Wages (Hourly)

Entry-Level: $14.30

Median: $17.76

Experienced: $20.33

Plumbers, Pipefitters, and Steamfitters

Plumbers

Pathways

Helpers--Plumbers

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Apprenticeship (paid, hands-on experience)

Common Certifications/ Licensing

- Driver's License
- OSHA 10
- Certified Welder
- DOT Medical Card

Frequently Required Skills

- Plumbing
- HVAC Systems
- Power Tools
- Ability to Lift 51-100 lbs.
- Boilers
- Mathematics
- Drainage Systems
- Gauges
- Ability to Lift 41-50 lbs.
- Mechanical

Current number of workers in NH: 2,170

Wages (Hourly)

Entry-Level: $22.39

Median: $29.13

Experienced: $37.34

Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products

Retailers, Distributors, and Manufacturers of LED Light Bulbs and Fixtures

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Moderate-term on-the-job training

Common Certifications/ Licensing

- None

Frequently Required Skills

- Sales
- Hospitality
- Personal Computers (PC)
- Restaurant Management
- Marketing
- Outside Sales
- Microsoft Outlook
- Keyboarding/Typing
- Culinary Arts
- Microsoft Office

Current number of workers in NH: 7,674

Wages (Hourly)

Entry-Level: $20.64

Median: $34.06

Experienced: $47.26

Training and Development Specialists

Training Instructors

Typical Entry-Level Education Requirement

Bachelor's degree

Previous Work Experience

Less than 5 years

Typical On-The-Job Training

None

Common Certifications/ Licensing

- Associate Certified Coach (ACC)
- Certified ScrumMaster (CSM)
- Secret Clearance
- Certified Scrum Product Owner (CSPO)
- Licensed Practical Nurse (LPN)
- Certification in Cardiopulmonary Resuscitation (CPR)
- Certified Scrum Professional (CSP)
- Certified Six Sigma Yellow Belt
- Professional Scrum Product Owner (PSPO)
- Project Management Professional (PMP)

Frequently Required Skills

- Microsoft Office
- Microsoft Excel
- Microsoft PowerPoint
- Instructional Design
- Presentation
- Teaching/Training, Job
- Agile
- Microsoft Outlook
- Microsoft Word
- Change Management

Current number of workers in NH: 1,682

Wages (Hourly)

Entry-Level: $19.93

Median: $31.95

Experienced: $41.36

Miscellaneous Construction and Related Workers

Weatherization Technicians

Typical Entry-Level Education Requirement

High school diploma or equivalent

Previous Work Experience

None

Typical On-The-Job Training

Moderate-term on-the-job training

Common Certifications/ Licensing

- None

Frequently Required Skills

- Global Distribution System (GDS)
- HVAC Systems
- Mathematics
- Power Tools

Current number of workers in NH: 130

Wages (Hourly)

- Entry-Level: $15.31
- Median: $19.84
- Experienced: $26.37

[bw]
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<u>Appendix C</u>

Map of Energy Efficiency Occupations to Standard labor Classifications

Map of Energy Efficiency Occupations to Standard labor Classifications

Memo #1 List	SOC Code	SOC Code Title	Reasoning
Architects	17-1011	Architects, Except Landscape and Naval	
Building Operators	49-9071	Maintenance and Repair Workers, General	Building operators are responsible for the day-to-day operation of a building, including ensuring that all mechanical systems are functioning properly, conducting routine maintenance and repairs, and responding to emergencies
Carpenters	47-2031	Carpenter	
Electricians	47-2111	Electrician	
Energy Auditors, HERS Raters	47-4011	Construction and Building Inspectors	ONET classification is 47-4011.01, a subset of Construction and Building Inspectors
Engineers	17-2141, 17-2071, 17-2051	Mechanical Engineers, Electrical Engineers, Civil Engineers	
HVAC technicians	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	
Insulators	47-2131	Insulation Workers, Floor, Ceiling, and Wall	
Laborers	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	While there are a few types of laborers, material moving workers seemed to fit the best here as they will be moving refrigerators and freezers in and out of buildings
Plumbers	47-2152	Plumbers, Pipefitters, and Steamfitters	
Retailers, distributors, and manufacturers of LED light bulbs and fixtures	41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	
Training instructors	13-1151	Training and Development Specialists	
Weatherization Techs/Insulators	47-4099	Miscellaneous Construction and Related Workers	ONET classification is 47-4099.03, a subset of miscellaneous construction-related workers

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NEW HAMPSHIRE ENERGY EFFICIENCY WORKFORCE DEVELOPMENT

Occupational Analysis and Development Paths

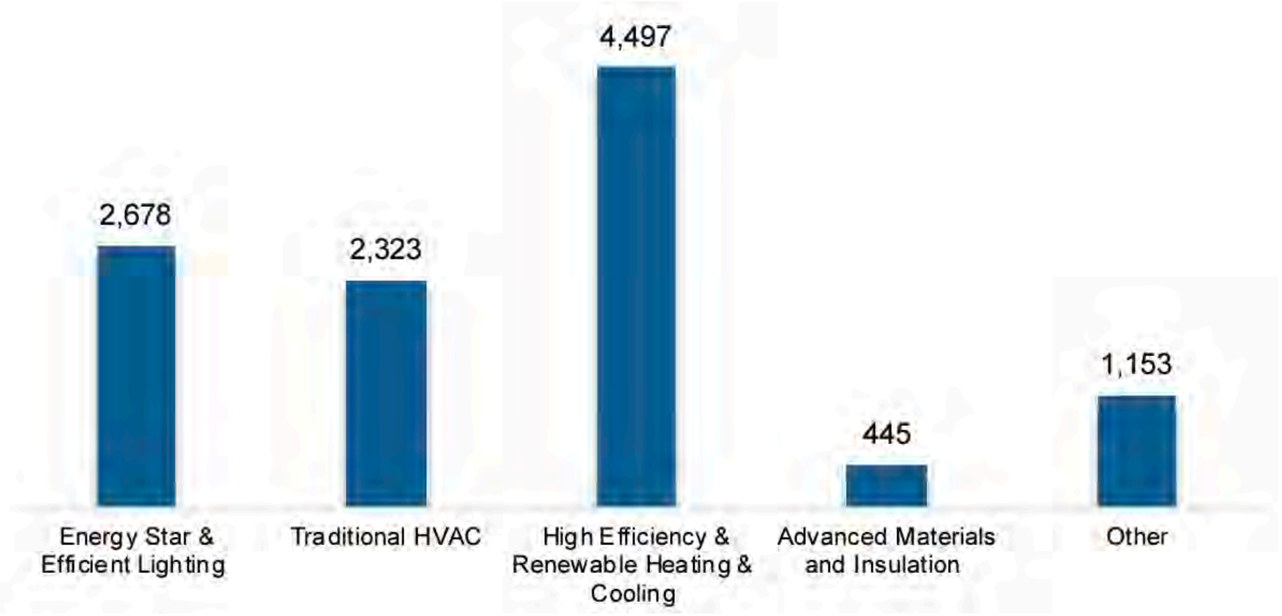
June 5, 2023

ENERGY EFFICIENCY JOBS OVERVIEW

- In 2021, there were 29,508 energy workers in New Hampshire
- Among these energy workers, 11,096 were employed in energy efficiency, representing 0.5% of energy efficiency workers nationwide
- Energy efficiency jobs in New Hampshire are mainly concentrated in the construction industry
- Between 2020 and 2021, total energy efficiency jobs rose by 258

Within energy efficiency, jobs can be categorized by specific sub-technologies:

Energy Efficiency Employment by Detailed Technology Application in New Hampshire



Energy Employment by State 2022, USEER, U.S. Department of Energy, June 2022

IDENTIFIED CHALLENGES

- Supply of new labor is very low
- A "firehose of money" for clean energy, particularly from the IRA, is worsening the imbalance in the demand and supply of labor
- A gap of 700-800 new NH jobs in energy efficiency just from the IRA over the next 10 years (Nature Conservancy Study)
- Labor data doesn't allow specific gap analysis by energy efficiency occupation
- USEER Survey reports that 92% of NH employers that have hired energy workers over the last 12 months indicated at least some difficulty in hiring

IDENTIFIED GAPS

Key Findings:

- There are few pre-apprenticeship programs in New Hampshire, but several Career and Technical Education Centers, to help prepare individuals for apprenticeships
- There are not many apprenticeships, however, reflecting a difficulty for individuals to enter these key occupations
- There are fewer trainings for Weatherization Installers & Technicians than there are for HVAC Technicians or Energy Auditors
- College/University programs are solely for Engineers rather than any of the other Key Occupations
- Most (9 out of 11) of the apprenticeships and apprenticeship courses are for electricians
- Locations:
  - Training programs are primarily clustered around major cities: Portsmouth, Concord, Manchester, Nashua, and Claremont.
  - The three counties where trainings are most prevalent are the three highest income counties.
  - Access to training for the 5 key occupations listed is restricted for low-income communities

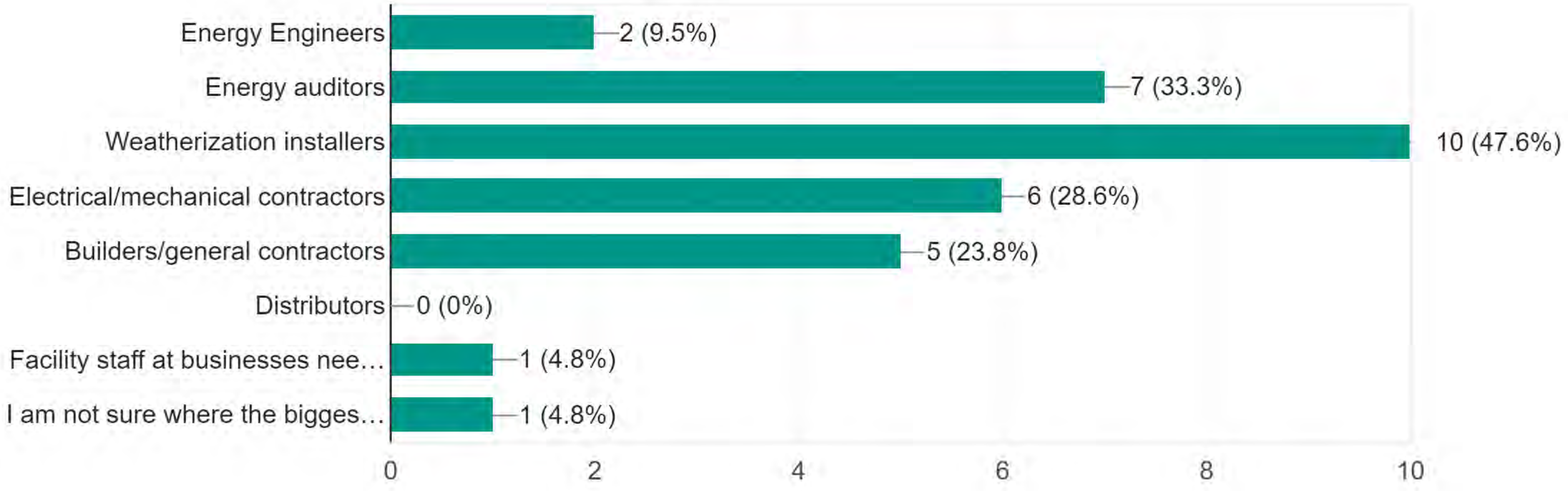
KEY OCCUPATIONS (14)

- Architects
- Building Operators
- Carpenters
- Electricians
- Energy Auditors
- Engineers
- Home Energy Rating System (HERS) Raters
- Heating, Ventilation, and Air Conditioning (HVAC) Technicians
- Insulators
- Laborers
- Plumbers
- Retailers, Distributors, and Manufacturers of LED Light Bulbs and Fixtures
- Training Instructors
- Weatherization Technicians

Engineers, architects, and building operators are included for commercial and industrial activities

"Helper" positions are subsumed by the general categories since they are part of the career pathway and apprentice-related positions

WHAT IS THE MOST IMPORTANT WORKFORCE SEGMENT TO FOCUS ON?



TARGETED ENERGY EFFICIENCY OCCUPATIONS

NHSaves Occupation	*Specific SOC*	*General Occupation(s)*	*General SOC(s)*
Weatherization Installers	47.4099.03	Miscellaneous Construction and Related Workers	47-4099
Energy Auditors	47-4011.01	Construction and Building Inspectors	47-4011
Energy Engineers	17-2199.03	Engineers, All Other	17-2199

Career Path – Weatherization Installer

Great for hands-on problem solvers

1 Student	2 Installer	3 Crew Lead	4 Operations Manager or Business Owner

Preparatory
- High School CTE program
- Pre-Apprenticeship

Entry Level
- Apprentice – OJT mentoring and experience
- Wx Installer trainings & Credentials

Mid Level
- Management training & job skills
- Customer service

Advanced Level
- Additional trainings and certifications
- Associate's or Bachelor's degree

Weatherization Installers and Technicians

Typical Entry-Level Education Requirement

None

Previous Work Experience

None

Typical On-The-Job Training

Short-term on-the-job training

Common Certifications/ Licensing

Driver's License
OSHA-10
Lead Paint RRP (US EPA)
Building Science principles (BPI)
Air Leakage Control installer (BPI)
BPI HEP Retrofit Installer Technician (BPI)
Installer Badges (US DOE, NREL)

Frequently Required Skills

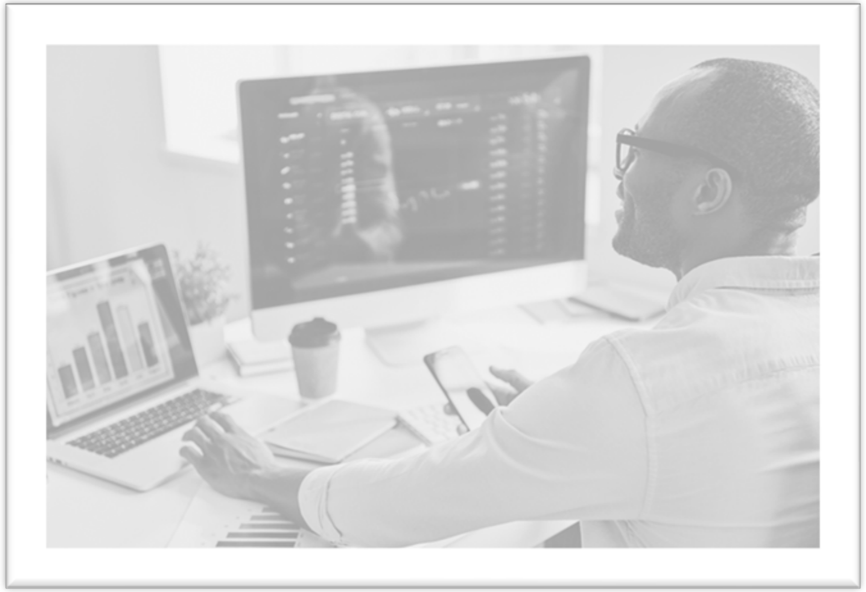
- ***Ability to Lift 41-50 lbs.***
- ***Using Ladders***
- ***Ability to Lift 51-100 lbs.***
- ***Painting***
- ***Extension Ladders***
- ***Mechanical***

Wages (Hourly)

Entry-Level: $15.02

Median: $22.89

Experienced: $32.54



Career Path – Energy Auditor

Great for analytical thinkers

1 Student

2 Energy Auditor Technician

3 Professional Energy Auditor

4 Specialized Energy Auditor or Manager

Preparatory
- High School science or CTE program
- Internship

Entry Level
- BPI BA-T certification
- Experience and mentoring

Mid Level
- Project management and energy modeling
- Additional experience and credentials

Advanced Level
- Additional trainings and certifications
- Bachelor’s degree

Energy Auditor

Typical Entry-Level Education Requirement

High School Diploma/GED

Previous Work Experience

Less than 5 years

Typical On-The-Job Training

- *Energy load profile analysis*
- *Energy benchmarking tools*

Common Certifications/ Licensing

- *Two-year degree in engineering or a related field*
- *Certified Energy Auditor (AEE)*
- *Certified Energy Manager (CEM)*
- *Building Science Principles (BPI)*
- *Building Analyst Technician/Professional (BPI)*
- *HEP Energy Auditor (BPI)*
- *Certified Home Energy Rater (RESNET)*
- *Building Energy Assessment Professional (ASHRAE)*

Frequently Required Skills

- *Microsoft Office*
- *Experience in conducting energy audits and project feasibility studies*
- *Experience with energy modeling software*
- *Knowledge of green building design, green construction, and energy efficiency techniques and technology*
- *Strong understanding of the construction and/or building operations industry*

Wages (Hourly)

- Entry-Level: $21.36
- Median: $29.80
- Experienced: $42.90

Career Path – Energy Engineer

Great for the math whiz

1	2	3	4
Student	Building Scientist	Professional Energy Engineer	Senior Energy Engineer or Manager

Preparatory
- High School science program
- Bachelor's engineering college program (2+2)

Entry Level
- BPI BA-T certification
- Gain experience and get mentored

Mid Level
- Complex problem solving
- Earn PE license

Advanced Level
- People Management
- Additional trainings and certifications

Energy Engineer

Typical Entry-Level Education Requirement

Bachelor's degree in Engineering

Previous Work Experience

Less than 5 years

Typical On-The-Job Training

None

Common Certifications/ Licensing

- *Certified Energy Manager (CEM)*
- *Certified Measurement and Verification Professional (CMPV)*
- *Certified Energy Auditor (CEA)*
- *LEED AP*
- *Professional Engineer License (State of NH)*
- *Building Energy Assessment Professional (BPI)*
- *Certified Commissioning Professional (BCxA)*

Frequently Required Skills

- *Knowledge of boiler and chiller operations and maintenance*
- *HVAC controls*
- *computerized building automation and energy management systems*
- *variable air volume (VAV) distribution systems*
- *steam and chilled water system optimization methods*
- *Knowledge of green building design, green construction, and energy efficiency techniques and technology*

Wages (Hourly)

Entry-Level: $30.50

Median: $61.78

Experienced: $66.64

Appendix D
Training Inventory

This list includes trainings offered for key energy efficiency occupations, and is representative rather than comprehensive. In some cases, multiple trainings are summarized in one line. The number of hours is approximate, and may include student study time.

Training Organization	Training Program Name	Length (Hours)	Format
ASHRAE (national)	Commissioning Process in New & Existing Buildings	6	Virtual
ASHRAE (national)	HVAC Design Training: High Performance Building Design	18	Virtual
ASHRAE (national)	Multiple short instructor-led virtual courses	3 - 6+	Virtual
ASHRAE Granite State Chapter	Webinars, Field Trips and Events	1 - 3	Varies
Associated Building Contractors	Business Law (Series)	~15	Virtual
Association of Energy Engineers	Certified Energy Manager (CEM)- Premier Training	33	In-Person
Association of Energy Engineers	Multiple C&I trainings- DSM, commissioning, etc.	10+	Varies
Building Performance Institute (BPI)	Healthy Housing Principles Certificate	12	Online
Building Performance Institute (BPI)	Site Supervisor Certificate	10	Online
Dover School of Technology	Electrical Apprenticeship Program	150	In-Person
Energy Smart Academy (SFCC)	Air and Duct Sealing	14	In-Person
Energy Smart Academy (SFCC)	Cold Climate Heat Pumps	12	Online
Everblue	BPI [Building Analyst] Certification	10-40	Hybrid
Everblue	Building Science Principles course and BPI exam	16	Online
Everblue	LEED Certification	114	Hybrid
Everblue	RESNET HERS Rater	2-20	Hybrid
Eversource	Eversource Zero Energy Buildings Conference, 2022	6	Virtual
GDS Associates	Electric Codes	4	In-person
GDS Associates	Energy Codes	6	In-person
Granite State Trade School	Electrical Continuing Education	15	In-Person
Granite State Trade School	HVAC Certificate	~300	Hybrid
Green Jobs Academy	BPI Energy Auditor Field Test Refresher	5	In-Person
Green Jobs Academy	Weatherization Career Ladder	40	In-person
Green Training USA	BPI Building Science Principles (course & exam)	12	Online
GreenHomes America	Air Sealing I, II, III	3	Online
GreenHomes America	Home Diagnostics and Testing	3	Online
GreenHomes America	Home Performance Efficiency I, II	3	Online
GreenHomes America	Indoor Air Quality	3	Online
IBEW Local 490	Electrician Joint Apprenticeship & Training	~675	In-Person
International Ground Source Heat Pump Assn.	Ground-Source Heat Pump Installer Training- Accredited	27	Hybrid
International Ground Source Heat Pump Association	Certified GeoExchange Designer	15	Hybrid
Jules Junker	Weatherization Trainings- Job Site	3+	In-Person
Keene State College	Architecture	~360	In-Person
Laconia Adult Education	Electrical & Plumbing Apprenticeship Program	~624	In-Person
Lakes Region Community College (LRCC)	Building Analyst Course & Certification	56	In-Person
Lakes Region Community College (LRCC)	Building Operator Certificate, Level I	82	In-Person
Lakes Region Community College (LRCC)	Building Operator Certificate, Level II	73	In-Person
Lakes Region Community College (LRCC)	Building Science Principles	20	Virtual

Training Organization	Training Program Name	Length (Hours)	Format
Lakes Region Community College (LRCC)	Electrical Control Technologies Degree	~204	In-Person
Lakes Region Community College (LRCC)	Infiltration and Duct Leakage Technician BPI Certfcn.	6	In-person
Lakes Region Community College (LRCC)	Weatherization Installer: 3 modules	21	In-person
Lead-Edu	Lead Renovator Initial RRP	8	In-Person
Leadsmart Training Solutions, Inc	Lead Paint Renovation, Repair and Painting (RRP)	8	In-Person
Manchester Community College	Air Conditioning & Refrigeration Certificate	~78	In-Person
Manchester Community College	Electrical Lineworker Certificate	72	In-Person
Manchester Community College	Electrical Technology Certificate	~117	In-Person
Manchester Community College	Electrical Technology Degree	~201	In-Person
Manchester Community College	Heating Services Certificate	~90	In-Person
Manchester Community College	HVAC Certificate	~144	In-Person
Manchester Community College	HVAC Certificate- Advanced	~60	In-Person
Manchester Community College	HVAC Degree	~201	In-Person
Manchester Community College	HVACR Technican - Online Program	~488	Online
Manchester Community College	National Electrical Code Update	15	In-Person
Manchester Community College	National Gas Fuel Code	3	In-Person
Mitsubishi Electric Trane	Heat Pump training (commercial and residential)	varies	Varies
Nashua Community College	Mechanical Engineering Technology	~222	Hybrid
National Association of Home Builders	Advanced High Performance Practices: Best Practices	6	Virtual
National Comfort Institute	Duct System Optimization Live Certification Program	18	Hybrid
NH Career Pathway (through NHTI)	Mechanical Engineering Technology (at NHTI)	~216	In-Person
NH Energy Education Program (NHEEP)	Conservation Kids	1.5	In-person
NH Energy Education Program (NHEEP)	Electricity and the Environment	1.5	In-person
NH Energy Education Program (NHEEP)	Green Energy Careers: Efficiency	1.5	In-person
NH Energy Education Program (NHEEP)	Home Heat Transfer	1.5	In-person
NH Energy Education Program (NHEEP)	Other programs for K-12 teachers and students	1 - 16	In-person
NH Home Builders Association	Business 101 (Business Bootcamp)	5.5	In-person
NH Home Builders Association	Cost Estimating with Energy Efficiency	3	In-person
NH Home Builders Association	Home Performance with ENERGY STAR	3	In-person
NH Home Builders Association	Low Income Weatherization	3	In-person
NH Home Builders Association	Products Program / NH Energy Star	3	In-person
NH Home Builders Association	Residential Building Code	5.5	In-person
NH School of Mechanical Trades	Electrical Courses- 101 and Apprenticeship	~608	In-Person
NH School of Mechanical Trades	Gas Licensing Code Courses	~140	In-Person
NH School of Mechanical Trades	HVAC Courses	120	In-Person
NHTI Concord	Architectural Engineering Technology	~207	In-Person
NHTI Concord	Mechanical Engineering Technology	~216	In-Person
Northeast Home Energy Rating Systems Alliance	RESNET HERS Rating System Training	81	Hybrid

Training Organization	Training Program Name	Length (Hours)	Format
Northwest Energy Efficiency Council - BOC	Fundamentals of Energy Efficient Building Operations	18	Virtual
Pacific Northwest National Laboratory	Re-tuning Online Training	6	Online
Performance Electrical Training	Electrician Apprenticeship Training	150	Online
Performance Electrical Training	Electrician Apprenticeship Training	~240	Hybrid
Performance Systems Development (PSD)	Energy Modeling Training- TREAT, Surveyor, etc.	Varies	Hybrid
Residential Energy Performance Assn. of NH	REPA Member Trainings	2 - 3	Hybrid
Snell Group	Infrared for Weatherization and Energy Auditors	14	Hybrid
Spray Foam Distributors of New England	Spray Foam Insulation Applicator Training	20	In-Person
Trane	Trane HVAC Education and Training (multiple offerings)	1 - ~30	Hybrid*
U.S. Green Building Council	LEED AP Building Design and Construction- Prep & Exam	~12	Online
University of NH, Manchester	Mechanical Engineering Technology B.S.	~264	In-Person
Weatherization Assistance Program (US DOE)	Weatherization Trainings and Resources (multiple)	varies	Hybrid

Notes on Workforce Development Resources

Date June 2, 2023

By Andy Duncan, FSELLC,

OVERVIEW OF WORKFORCE DEVELOPMENT RESOURCES FOR ENERGY EFFICIENCY

There is a robust infrastructure of workforce development (WFD) resources available to NH employers, employees, unemployed individuals, those on assistance, and other targeted groups. Many of these resources can be utilized by the energy efficiency community. These resources include:

WorkInvestNH

https://www.nhes.nh.gov/services/employers/work-invest-nh.htm

Through the Unemployment Trust Fund, the State of NH WorkInvestNH program provides up to 50% cost-share grants for eligible NH employee trainings that increase job skills. Most employers are eligible to apply, on behalf of their NH-based employees. A wide variety of trainings are eligible, from classroom trainings to custom on-site trainings. The trainings can focus on a specific technical skill, or cover broad business and marketing skills. There are some administrative challenges with the application process, with at least a 60 day window needed for the application prior to the training, and the training grant going through a NH Secretary of State contract process.

WorkNowNH

https://www.nhes.nh.gov/services/job-seekers/work-now-nh.htm

WorkNowNH provides up to $6,500 in tuition payments for short-term job reading trainings, such as a weatherization installer boot camp, to eligible participants. The program provides additional services and funding, such as up to $500 for books and supplies, and child care assistance. Eligible participants need to be enrolled in Medicaid or receiving similar assistance.

WIOA Training and Other Adult Programs

https://www.snhs.org/services/wioa

https://www.nhes.nh.gov/services/job-seekers/wioa-adult-worker.htm

The federal Workforce Innovation and Opportunity Act (WIOA) provides a federal source of funding similar to WorkNowNH, and targeted similar individuals such as those receiving public assistance, are low-income, unemployed, veterans, or skills-deficient. WIOA can provide up to $6,500 in tuition assistance and $1,500 in support services along with career counseling. The funding can potentially be used for on-the-job training. Eligible trainings must be listed in the NH Employment Security's NSCITE system. The community action agency Southern NH Services (SNHS) is the primary NH WIOA contractor.

High School Career and Technical Education Centers

https://www.education.nh.gov/who-we-are/division-of-learner-support/bureau-of-career-development

https://nh-cte.org/

The 28 regional Career and Technical Education (CTE) centers are associated with NH's public high schools, and are located around the state. At these CTE centers, there are approximately 20 construction trades training programs, and ~15 engineering, 6 HVAC, 3 plumbing, and 3 electrical programs. High school graduates from these CTE programs may go directly into the trades as an apprentice, or continue their training at a community college, technical school or four-year college. The

NH Community Colleges Workforce Development Offices

https://ccsnhtraining.org/

https://www.ccsnh.edu/

The seven NH community colleges are responsive to employer workforce training needs, and can develop both ongoing and customized short-term, non-credit trainings in energy, business, technology, and other topics. Workforce development programs at each community college have both unique programs as well as program common to all colleges. One such common program is the free "WorkReadyNH" general workplace skills program. For two-year associate degree programs, and one-year certificate programs, the CCSNH system has many options including HVACR and energy engineering.

ApprenticeshipNH

https://apprenticeshipnh.com/

ApprenticeshipNH is a grant-funded program of the Community College System of NH (CCSNH). It helps employers and employee/apprentices create a pipeline of trained workers with both on-the-job learning as well as related instruction. The program is tied to the U.S. Dept. of Labor's "registered apprentice" system. For potential apprentices, the value proposition is "earn as you learn," and having a clear career advancement pathway. For employers, apprenticeships can be an excellent recruiting and retention tool, particularly with the technical and financial assistance provided by ApprenticeshipNH.

Training and Technical Assistance Funding, NH Weatherization Assistance Program

https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/weatherization-assistance-program

(See separate memo) While not technically a WFD resource, the "T&TA" set-aside funding within the federally-funded NH Weatherization Assistance Program (NH WAP) allows both community action agency staff as well as contractors associated with NH WAP to receive relevant training paid for by NH WAP. Contractors may also be able to receive a stipend for time spent in training.

Adult and Community Education Programs

https://www.nhadulted.org/

Adult education programs that are available at some high school CTEs or at standalone centers are primarily for adults to gain a high school level education through HISET (formerly GED) diplommas or similar. These programs are free or low-cost, and overseen and funded in part by the NH Dept. of Education. Some adult/community education programs are more extensive, including electrician training programs in Dover, Hudson, Keene, Laconia, and Manchester.

There are also approximately 10 non-profit “makerspaces” around NH that focus on community-based hands-on skills, with some such as the MAXT Center in Peterborough interested in pursuing energy efficiency skills trainings.

NH Employment Security – Other Resources for Employers and Job Seekers

https://www.nhes.nh.gov/services/employers/recruit.htm

https://www.nhes.nh.gov/services/job-seekers/index.htm

NHES coordinates a variety of services and resources through its “NH Works” offices. It also hosts virtual and in-person career fairs, including a spring 2023 Energy Career and Resource Fair, co-hosted with Clean Energy NH. There are resources both for employers and job seekers, with key resources described elsewhere in this memo.

At-Risk Youth Programs- My Turn, NH JAG and NH Job Corps

The federally-funded “NH Job Corps Center,” is a residential training program for at-risk youth. NH Job Corps offers Electrical and Facilities Maintenance training programs. WIOA also provides funding for at-risk youth programs, such as “My Turn” which focuses on high school dropouts in areas with high rates of poverty. WIOA also funds the NH JAG program for at-risk youth who are still in high school, with a focus primarily on the healthcare sector.

OVERCOMING CHALLENGES WITH ACCESSING WFD RESOURCES

There are several challenges with accessing these WFD resources, including:

- Employers, job seekers or employees not being aware the resources exist, and/or not knowing how to access them.
- Administrative challenges (red tape) that make it more difficult to apply or qualify for the resources.
- Potential applicants not having the time and/or fortitude to wade through the bureaucratic qualifying process.
- Narrow qualifying criteria that may exclude individuals or entities that may otherwise benefit from these resources.
- Stigma against accepting “assistance,” or working with a “bloated” government program.

A knowledgeable advisor can help energy efficiency employers and professionals with the process, and can quickly determine which WFD resources may be applicable for the situation.

Appendix E

Program Adminstrator Survey Results

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

PRESENTED BY GDS ASSOCIATES, INC.

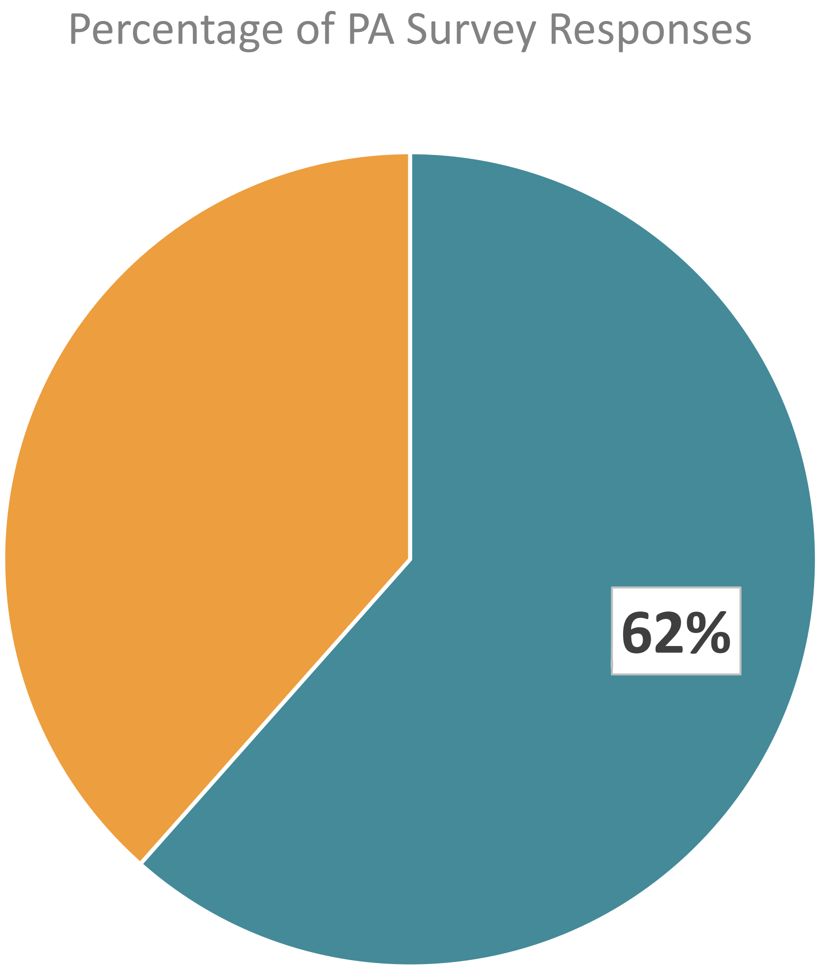
NEW HAMPSHIRE ENERGY EFFICIENCY WORKFORCE DEVELOPMENT

Program Administor Survey Results Summary

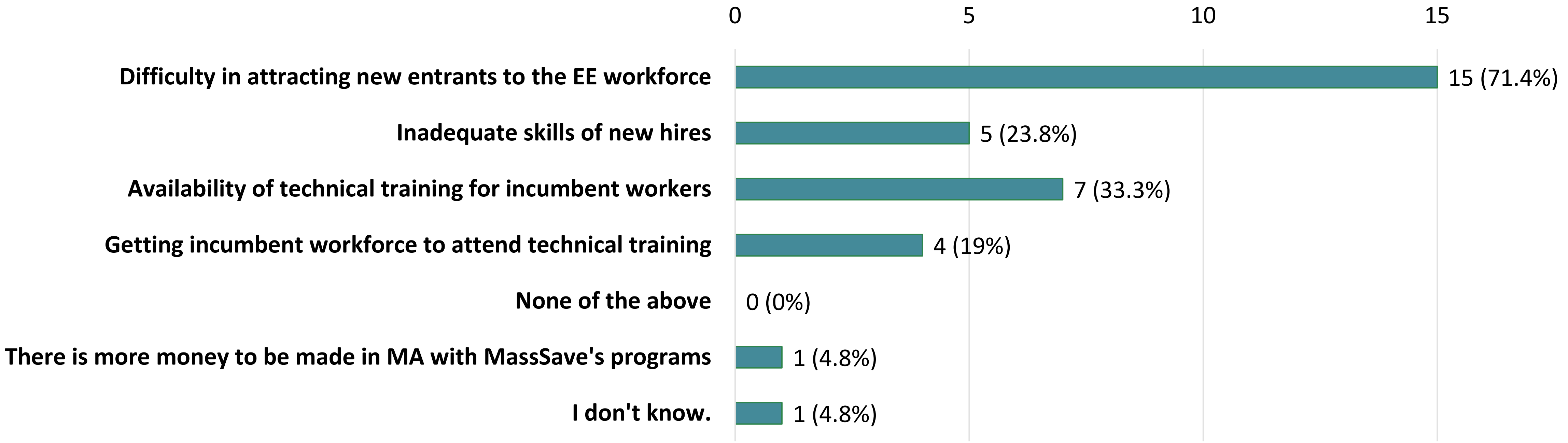
June 6, 2023

PA SURVEY DIRECT INVITATION RESPONSE RATE

Number of Respondents: 22



WHAT IS THE BIGGEST BARRIER WITH RESPECT TO WORKFORCE DEVELOPMENT?



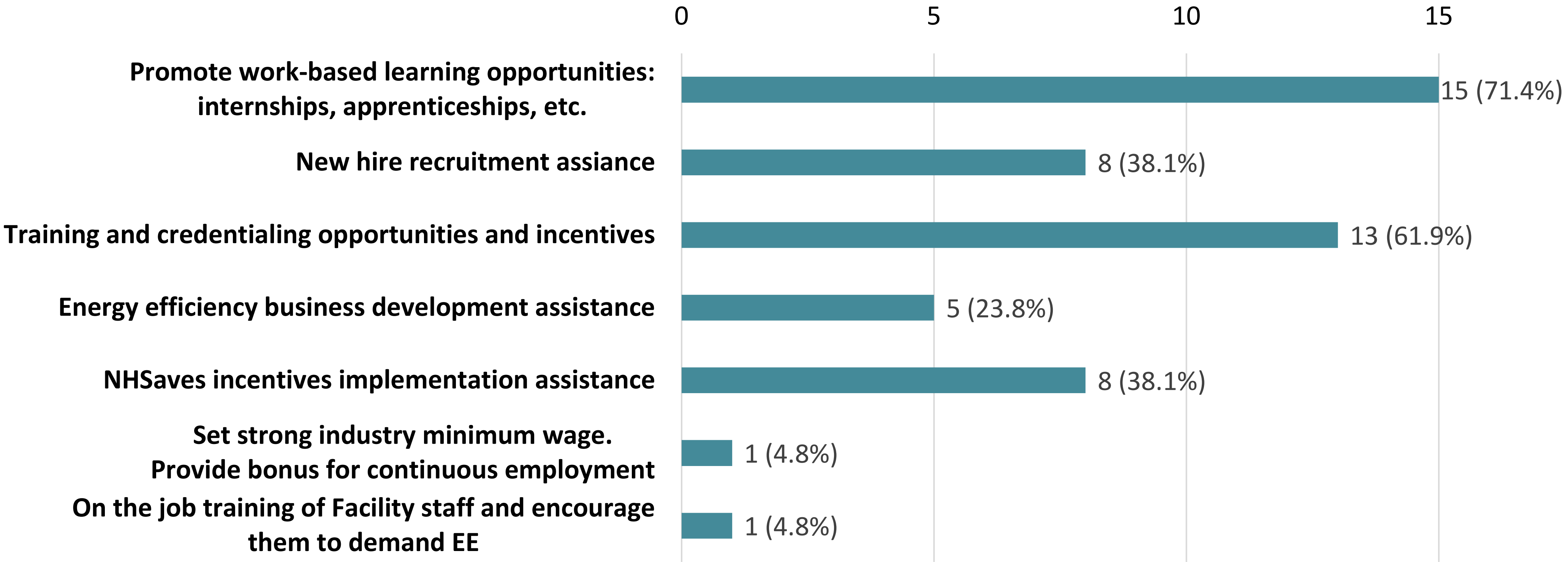
TOP 3 BARRIERS TO WORKFORCE DEVELOPMENT

Difficulties attracting new entrants (71.4%)

Availability of technical training for incumbent workers (33.3%)

Inadequate Skills of New hires (23.8%)

WHAT WORKFORCE DEVELOPMENT STRATEGIES DO YOU THINK NHSAVES SHOULD PRIORITIZE IN THE 2024-2026 PLAN?



TOP 4 IDENTIFIED STRATEGIES

- Promote Work-based Learning Opportunities – internships, apprenticeships, etc. (71.4%)
- Training and Credentialing Opportunities and Incentives (61.9%)
- New Hire Recruitment Assistance (38.1%)
- Energy Efficiency Business Development Assistance (38.1%)

HOW DOES THIS TIE TO GDS RECOMMENDATIONS?

- Expand and coordinate training for incumbent workforce
- Targeted actions to support recruitment into key occupations
- Support work-based learning opportunities for energy efficiency employees
- Create a foundation of energy WFD coordination in the state

Appendix F

Trade Ally Survey Results

Trade Ally Survey Results

NHSaves Work Force Development Research Group

Facilitated by Resilient Buildings Group

Agenda

Survey Development

Distribution Strategy

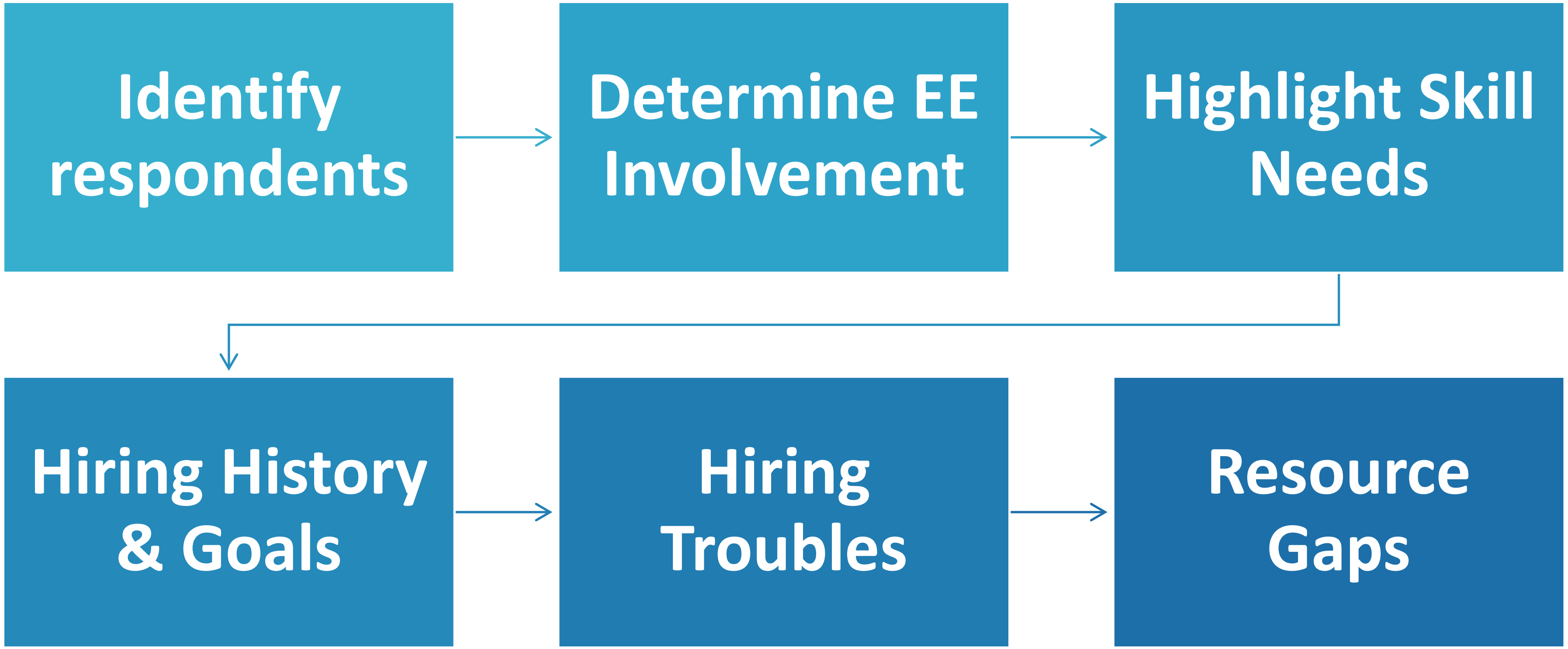
Survey Responses

Key Takeaways

Survey Goals

- **Identify Responders**
- **Highlight Resource gaps**
- **Understand Hiring Goals & History**
- **Propose solutions**

Survey Goals



Survey Distribution

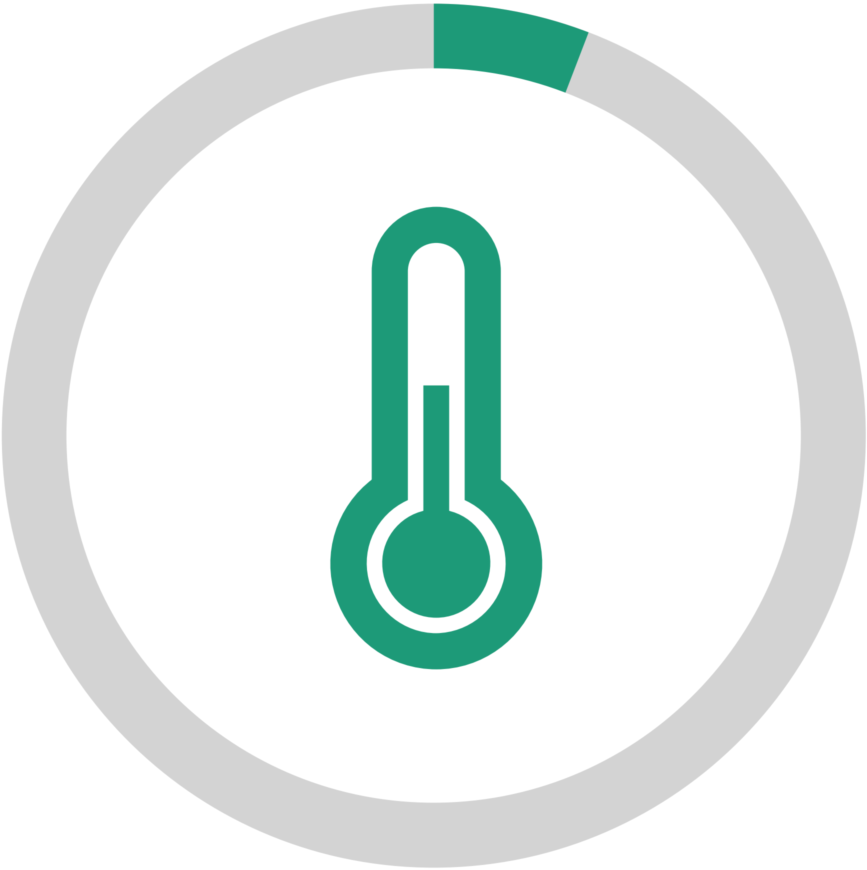
- **Leverage RBG's existing contractor database (Over 1,700 Leads)**
- **Get contractor lists from Community Action Programs**
- **Ensure all Energy Efficiency market sectors are included in distribution**

Distribution Methods

1,700 CONTRACTORS ACROSS THE STATE

CONSTANT CONTACT

CHANCE TO WIN GIFT CARD



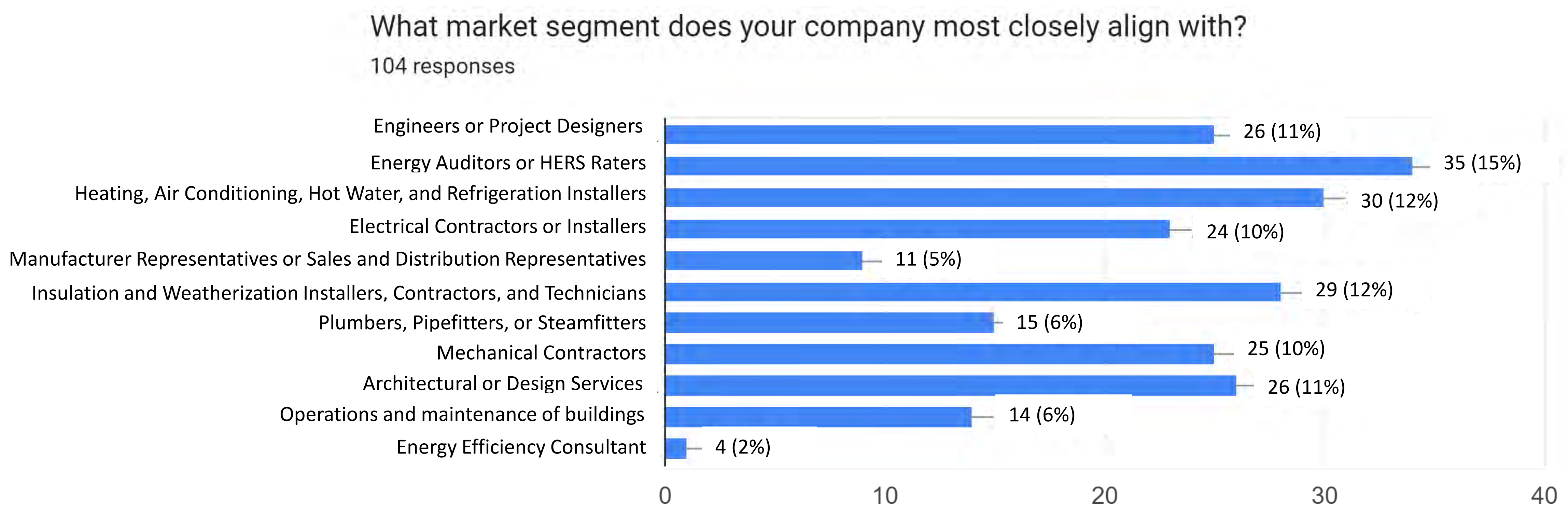
104 Survey Responses

- **Representative of NHSaves contractors**
- **Low 6 % Response rate**
  - Large database (1,700 contractors)
  - Busy Contractors unable to make time
  - Lack of personal stake in WFD or NHSaves Program

Identify Responders

- **Market Sector**
  - Wide range of market sectors represented (Question 1)
- **Involvement in Energy Efficiency Work**
  - 80% of responders have worked with NHSaves in the past 12 months (Question 2)
- **Company Size**
  - Most respondents work for small companies that are between 1-20 employees (Questions 6 & 7)
- **Territory**
  - Spread throughout the state but weighted towards the southeastern and central portion regions (Question 5)

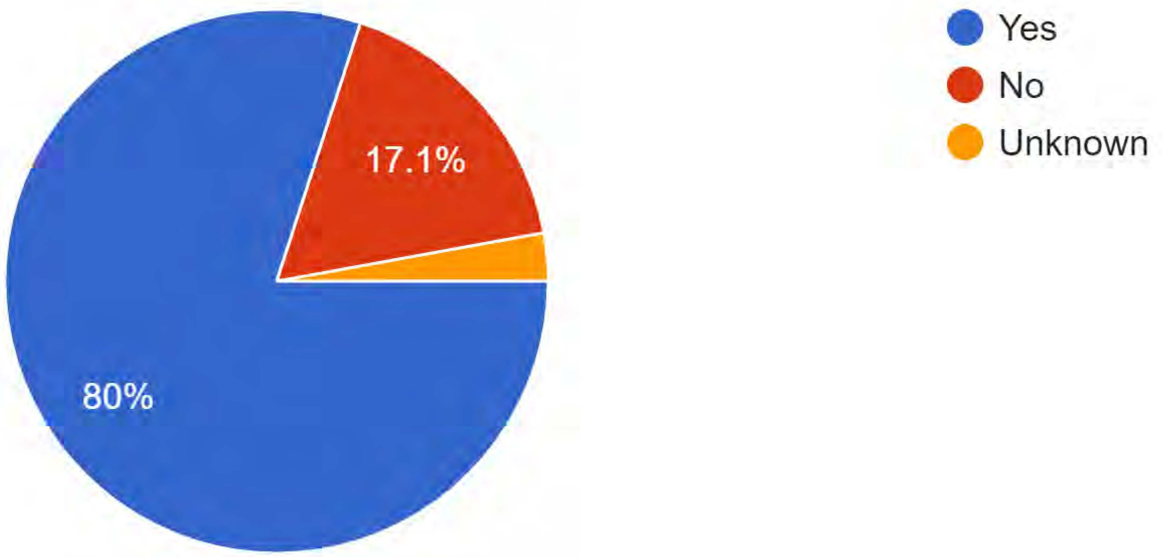
Question #1


What market segment does your company most closely align with?
104 responses
Engineers or Project Designers
Energy Auditors or HERS Raters
Heating, Air Conditioning, Hot Water, and Refrigeration Installers
Electrical Contractors or Installers
Manufacturer Representatives or Sales and Distribution Representatives
Insulation and Weatherization Installers, Contractors, and Technicians
Plumbers, Pipefitters, or Steamfitters
Mechanical Contractors
Architectural or Design Services
Operations and maintenance of buildings
Energy Efficiency Consultant
26 (11%)
35 (15%)
30 (12%)
24 (10%)
11 (5%)
29 (12%)
15 (6%)
25 (10%)
26 (11%)
14 (6%)
4 (2%)
0
10
20
30
40

Question #2

Have you or your company worked with NHSaves energy efficiency programs in the past 12 months?

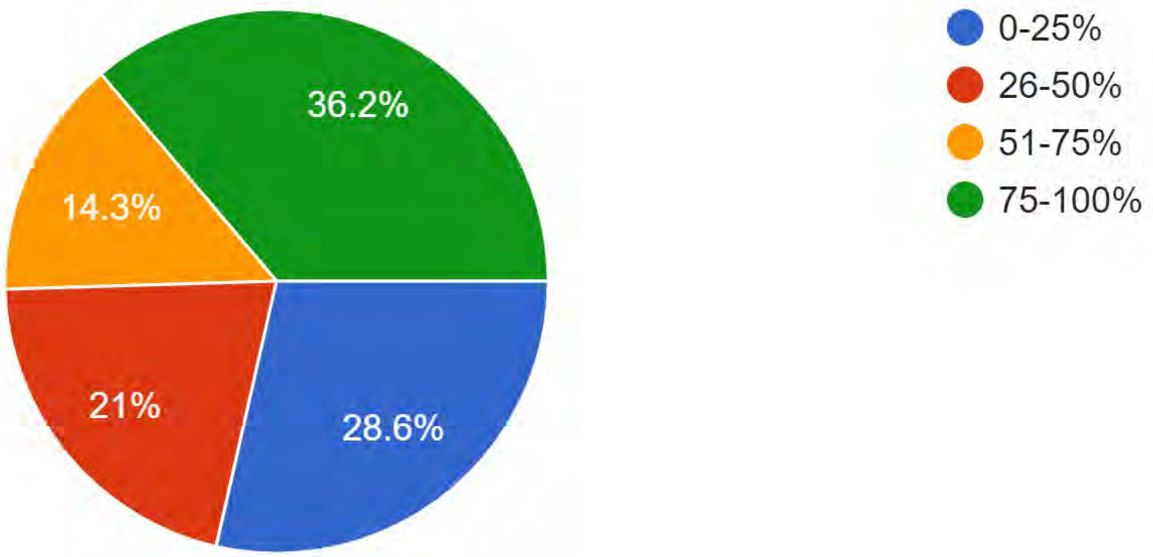
105 responses



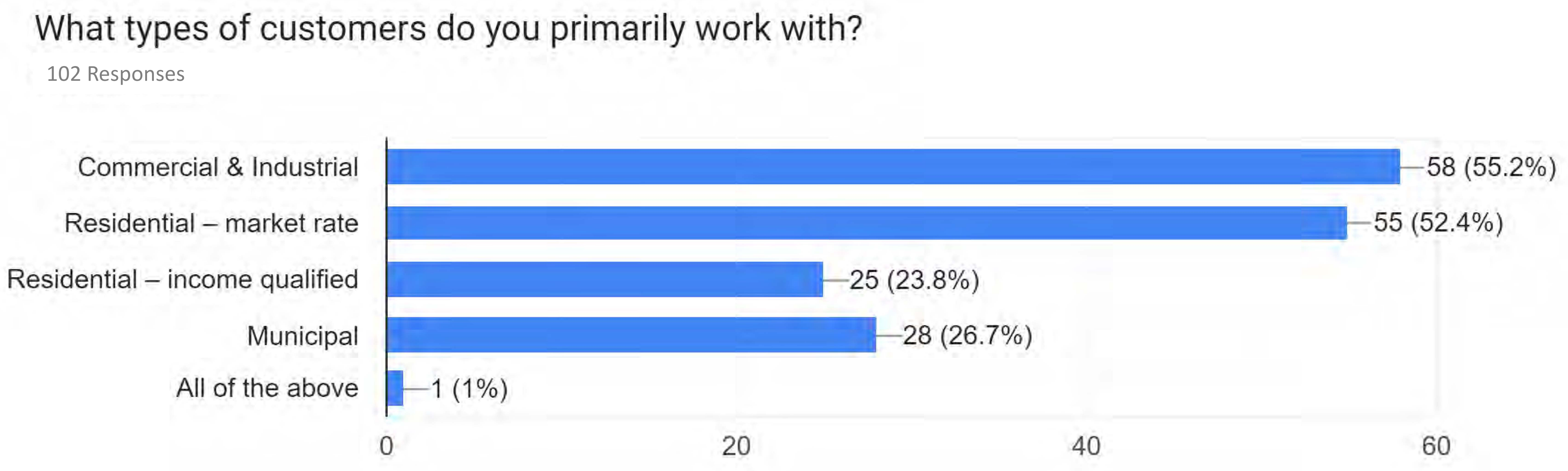
Question #3

Approximately what percentage of your company's overall work involves energy efficiency projects?

105 responses



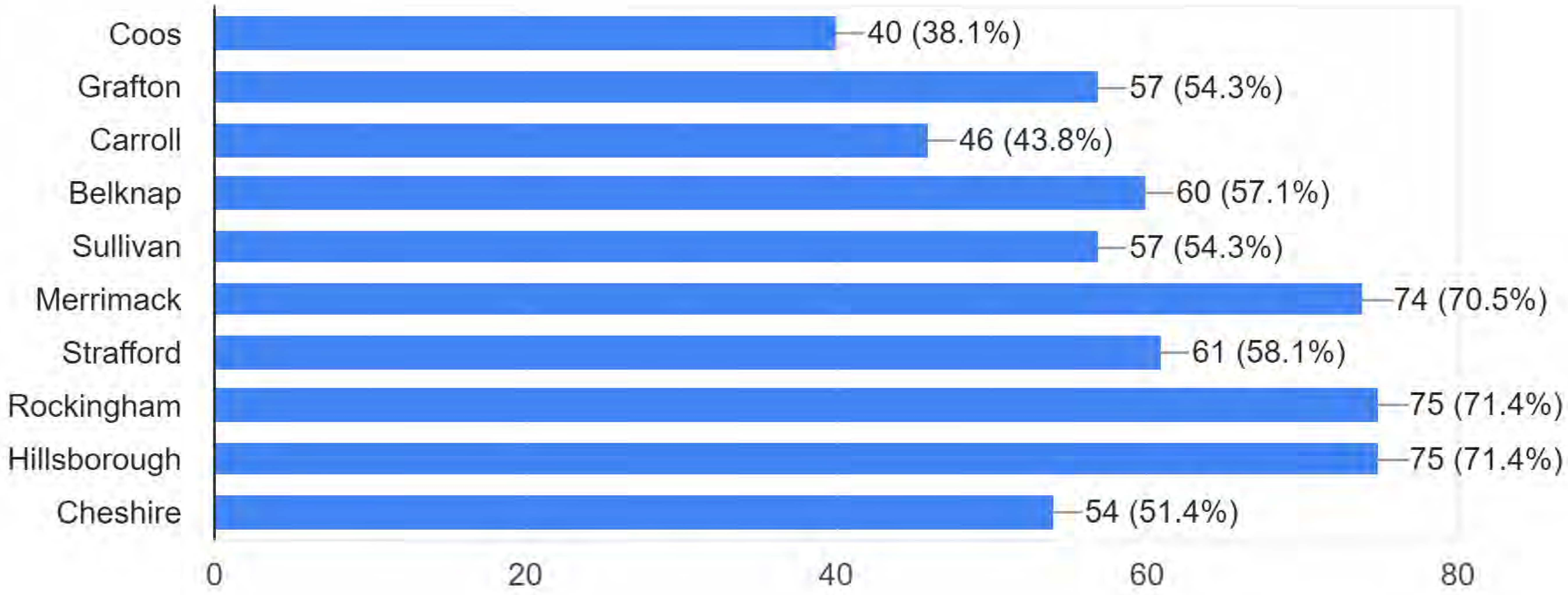
Question #4


What types of customers do you primarily work with?
102 Responses
Commercial & Industrial
58 (55.2%)
Residential – market rate
55 (52.4%)
Residential – income qualified
25 (23.8%)
Municipal
28 (26.7%)
All of the above
1 (1%)
0
20
40
60

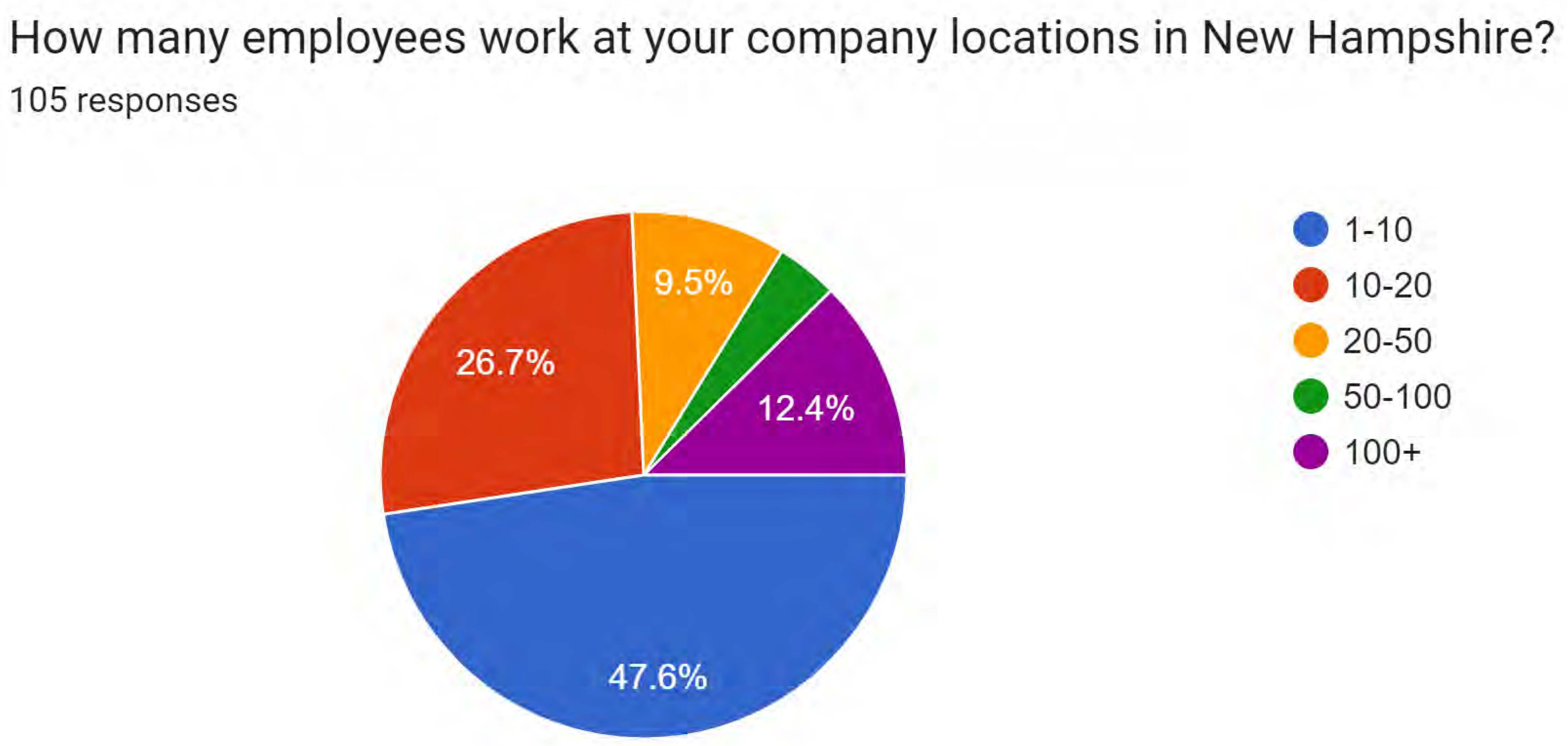
Question #5

What Counties of the state do you work in?

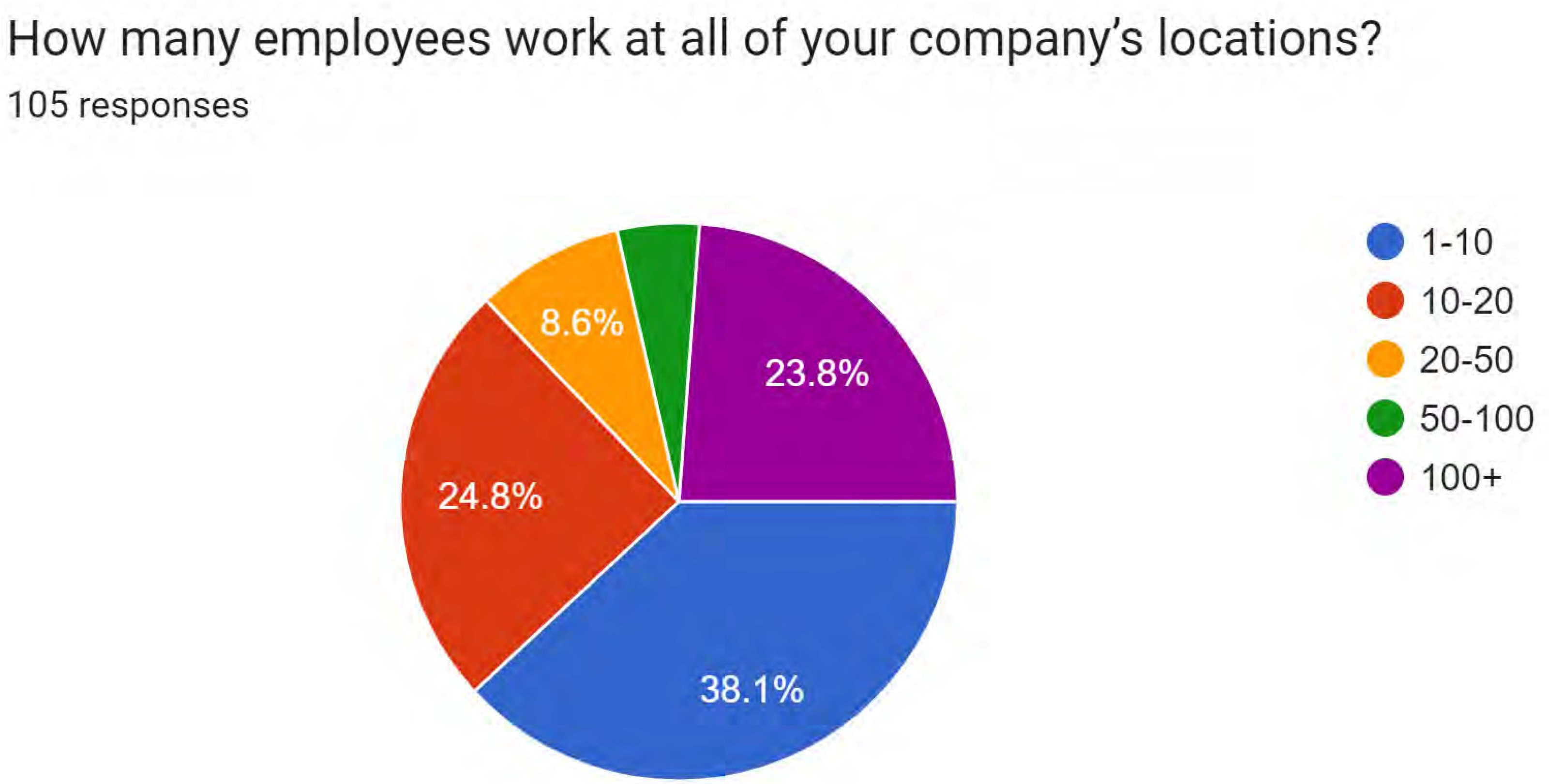
105 responses



Question #6


How many employees work at your company locations in New Hampshire?
105 responses
9.5%
26.7%
12.4%
47.6%
1-10
10-20
20-50
50-100
100+

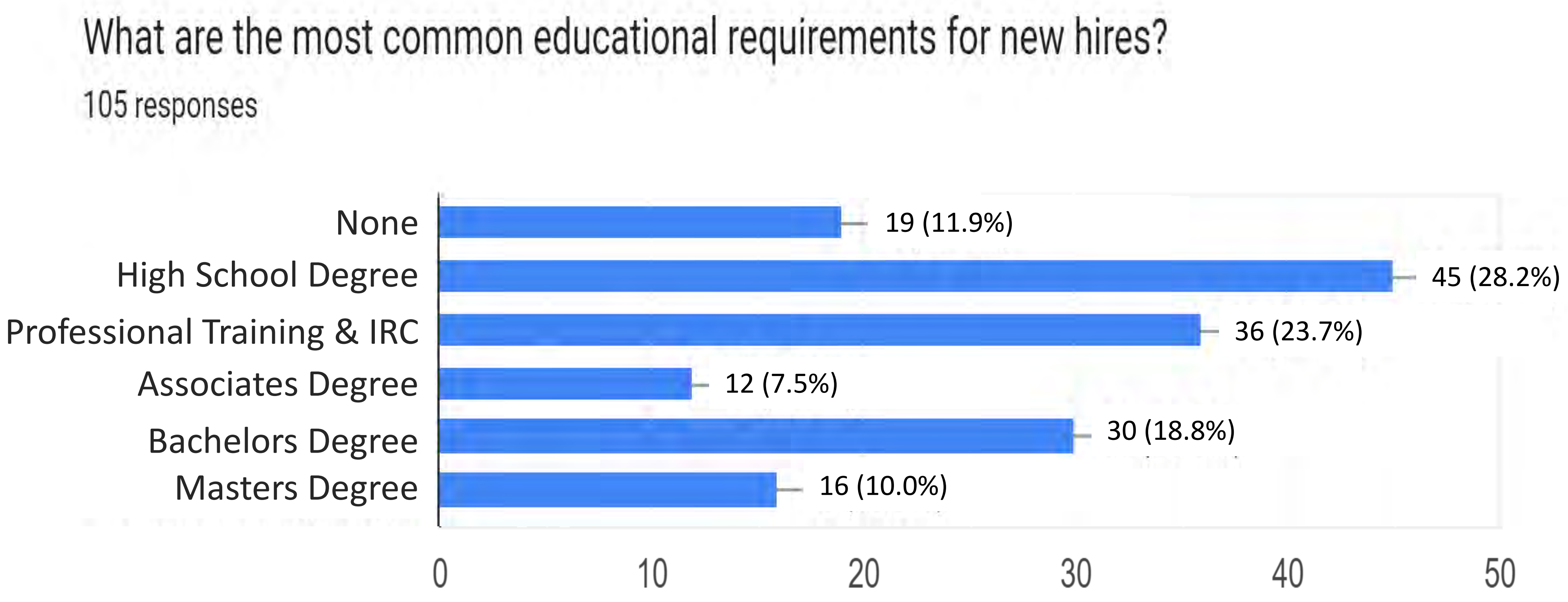
Question #7


How many employees work at all of your company's locations?
105 responses
8.6%
23.8%
24.8%
38.1%
1-10
10-20
20-50
50-100
100+

Highlight Resource Gaps

- **Educational Needs**
  - High School degrees, Professional Trainings, and Industry Recognized Credentials (IRCs) are the most needed (Question 8)
- **Required Certifications & Licenses**
  - 67% of respondents work at companies that require a special license or certification (Question 9)
- **Experience Requirements**
  - 83% say that entry level-positions at their companies require no or very little experience (Question 11)
- **Training Practices**
  - 54% of companies offer work-based learning apprenticeships or internships (Question 12)

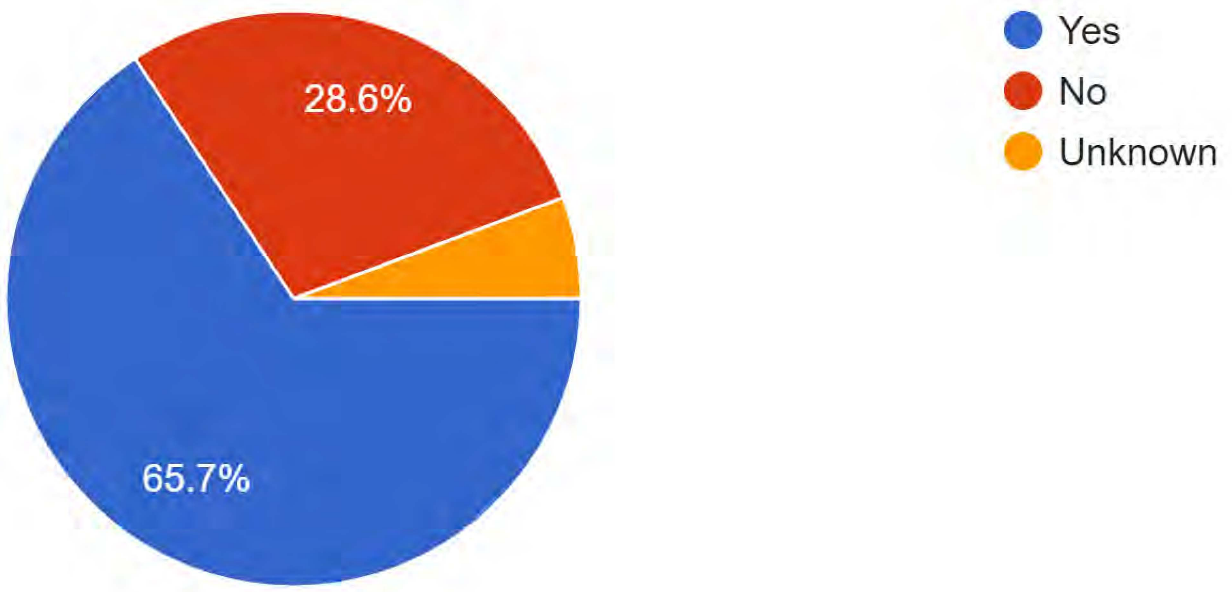
Question #8


What are the most common educational requirements for new hires?
105 responses
None
High School Degree
Professional Training & IRC
Associates Degree
Bachelors Degree
Masters Degree
19 (11.9%)
45 (28.2%)
36 (23.7%)
12 (7.5%)
30 (18.8%)
16 (10.0%)
0
10
20
30
40
50

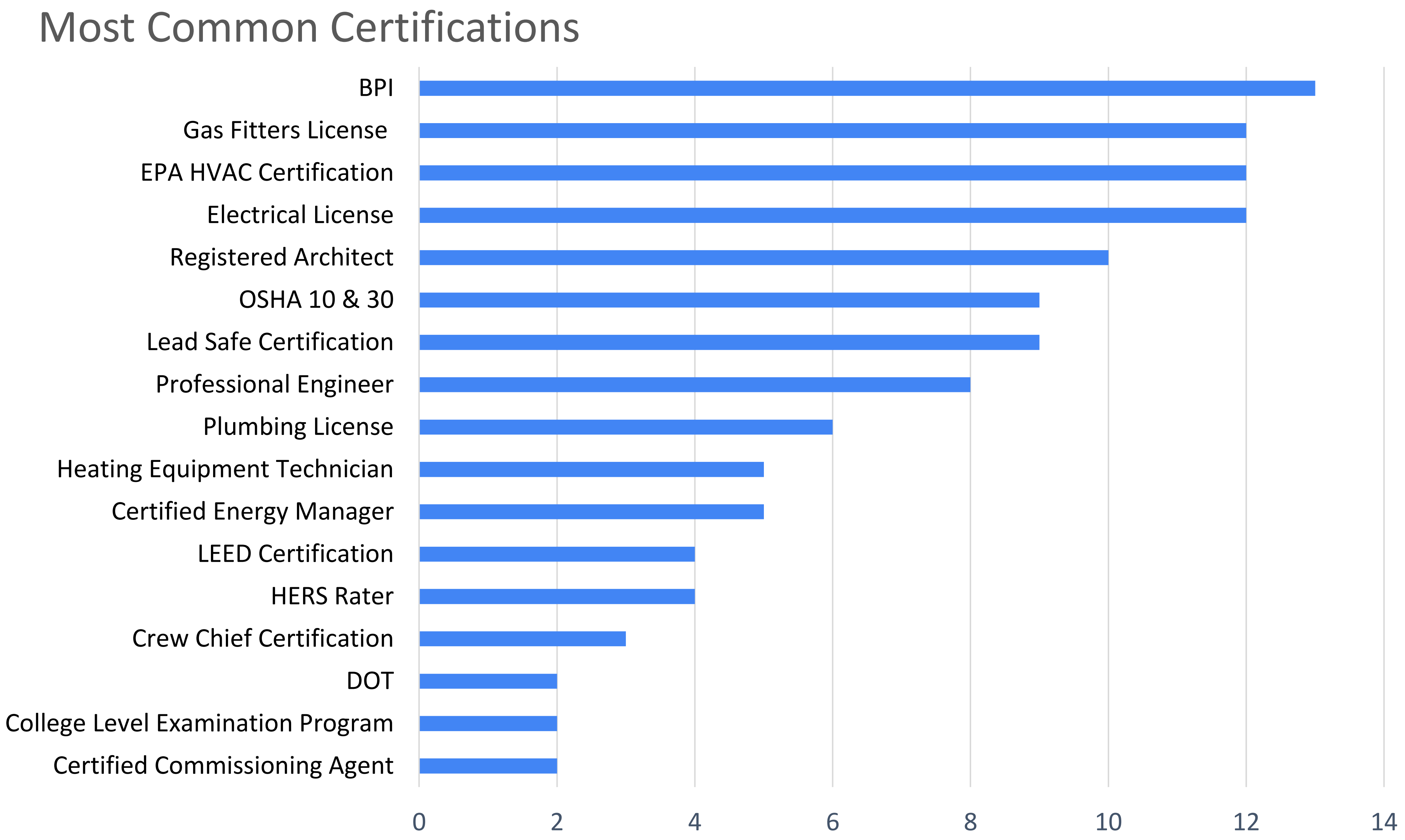
Question #9

Do most of the employees at your company need to hold special licenses or certifications?

105 responses



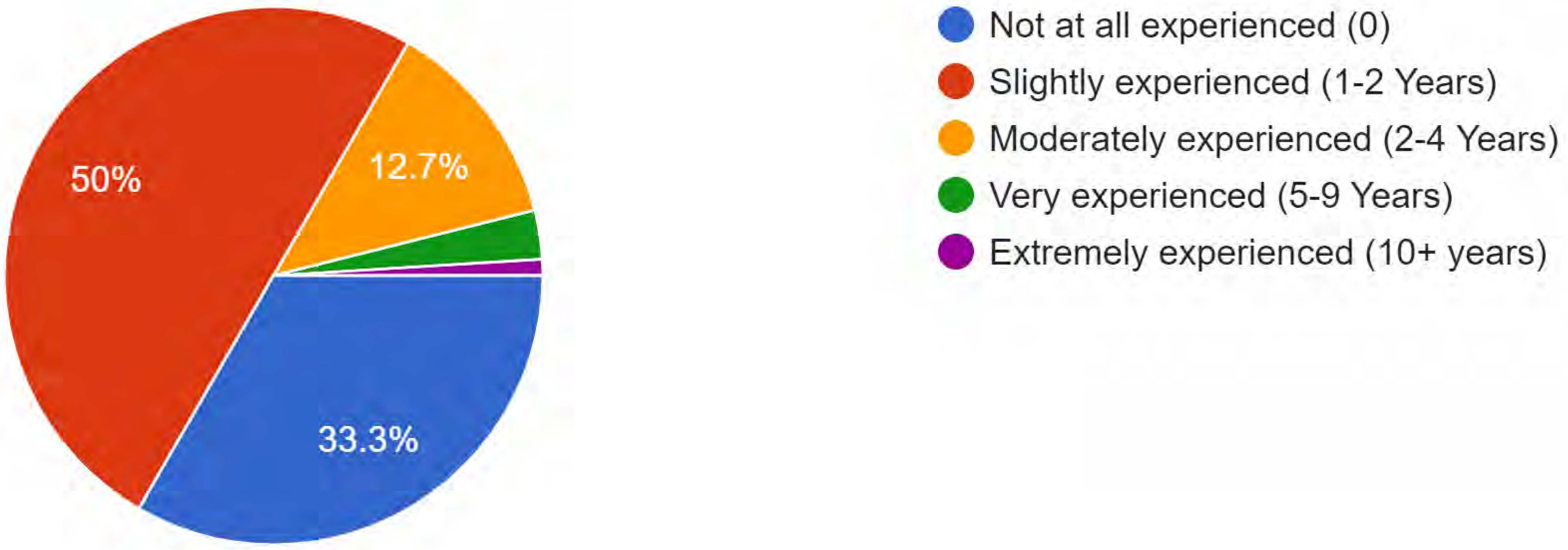
Question #10


Most Common Certifications
BPI
Gas Fitters License
EPA HVAC Certification
Electrical License
Registered Architect
OSHA 10 & 30
Lead Safe Certification
Professional Engineer
Plumbing License
Heating Equipment Technician
Certified Energy Manager
LEED Certification
HERS Rater
Crew Chief Certification
DOT
College Level Examination Program
Certified Commissioning Agent
0
2
4
6
8
10
12
14

Question #11

How experienced are applicants for entry-level positions required to be?

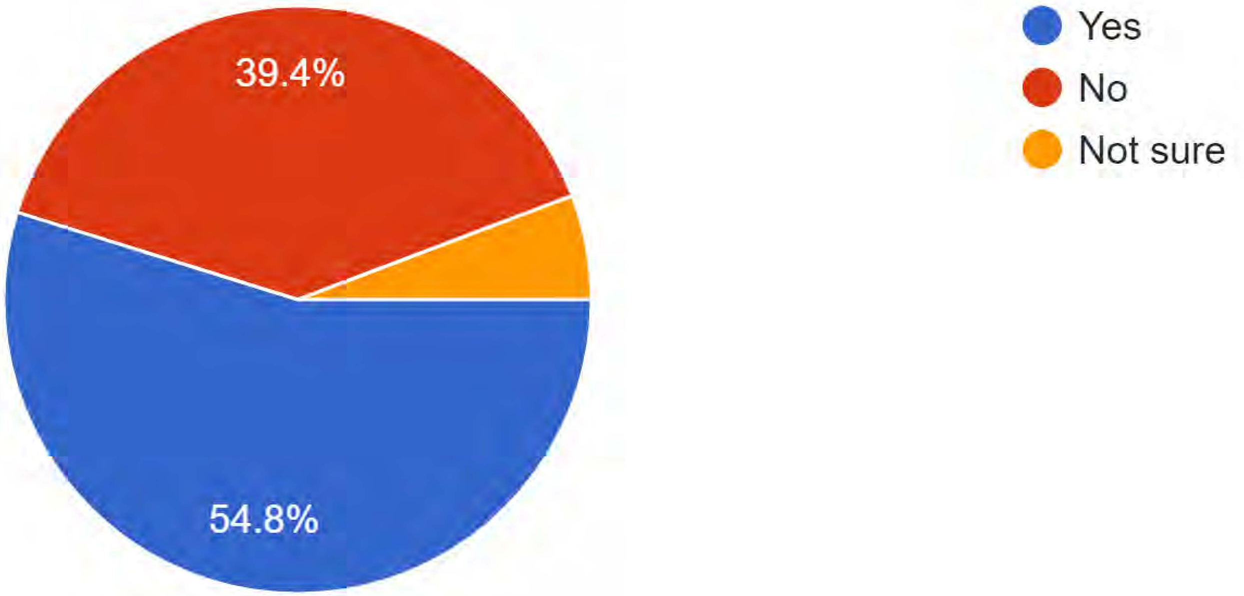
102 responses



Question #12

Does your company currently offer any work based learning programs such as apprenticeships or internships?

104 responses



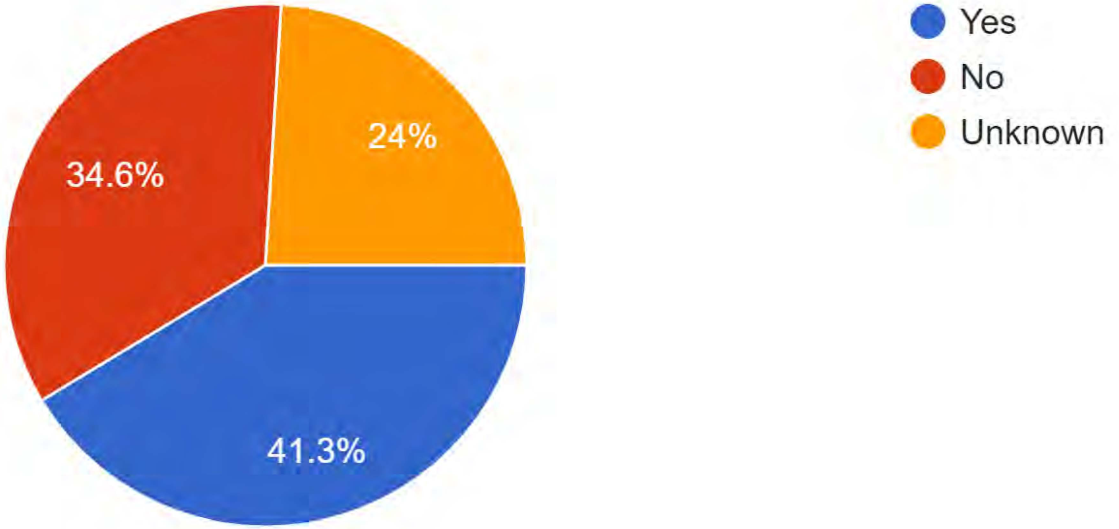
Understand Hiring History & Goals

- **Hiring History**
  - 59% of companies have hired in the last 12 months (Question 14)
- **Hiring Difficulty**
  - Most companies that hired stated that it was difficult to find applicants for the position (Question 15)
- **Challenges**
  - The lack of applicants is the most common barrier to meeting hiring goals particularly in the entry-level positions (Questions 18 & 19)

Question #13

Does your company have any Diversity Equity and Inclusion (DEI) goals during the hiring process?

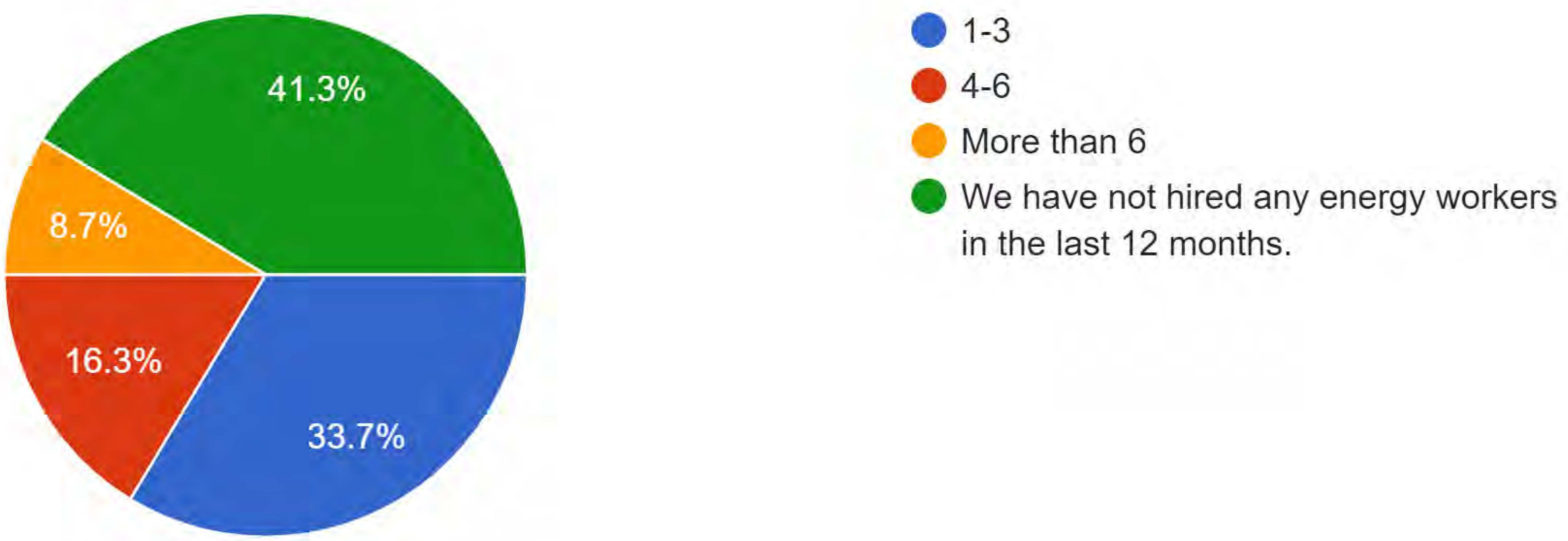
104 responses



Question #14

How many energy workers have you hired over the last 12 months, either for new positions or to replace former workers?

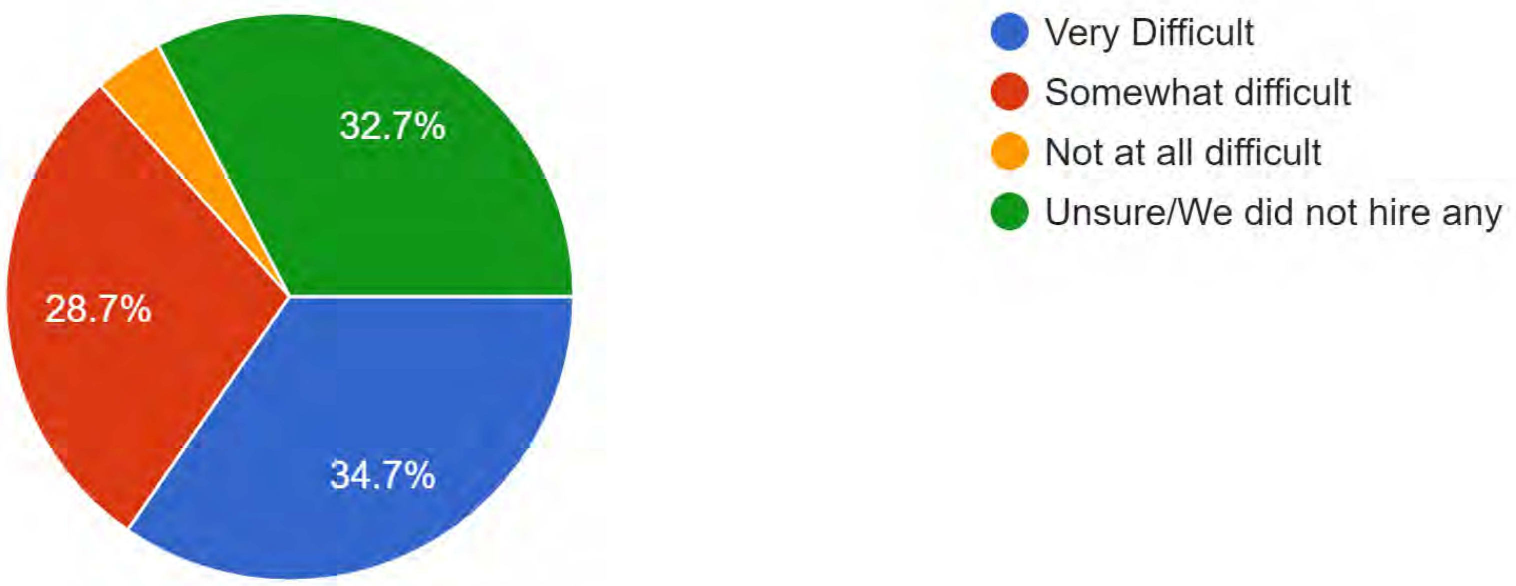
104 responses



Question #15

In thinking of the energy workers you have hired in the last 12 months from the previous question, please indicate the level of difficulty finding qualified applicants to fill the positions.

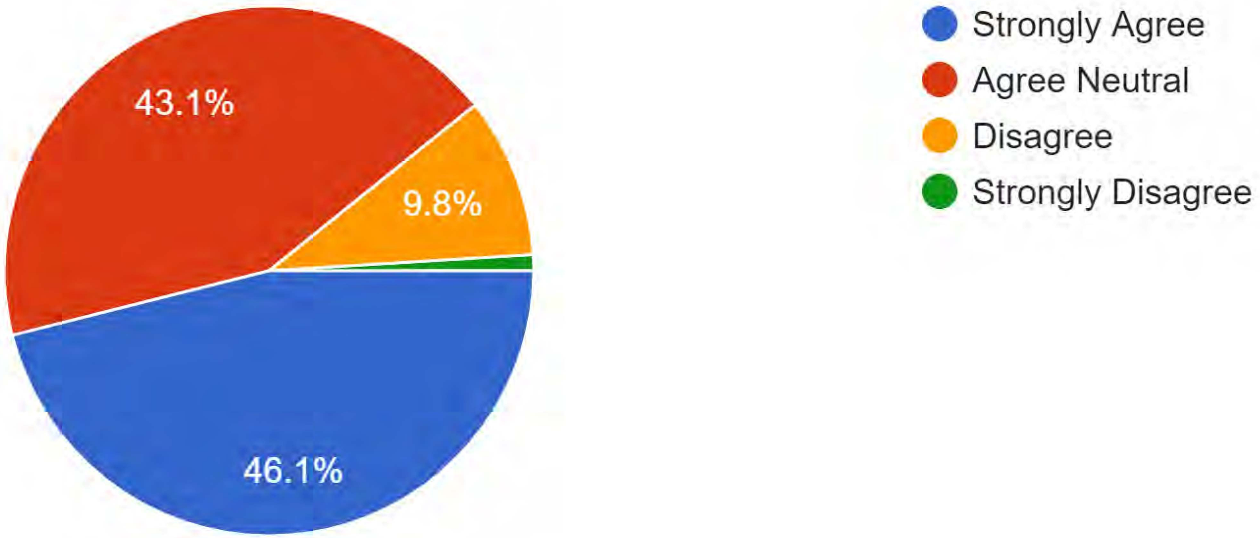
101 responses



Question #16

Please indicate at what level you agree with the following statement. "It is difficult to hire for entry-level positions"

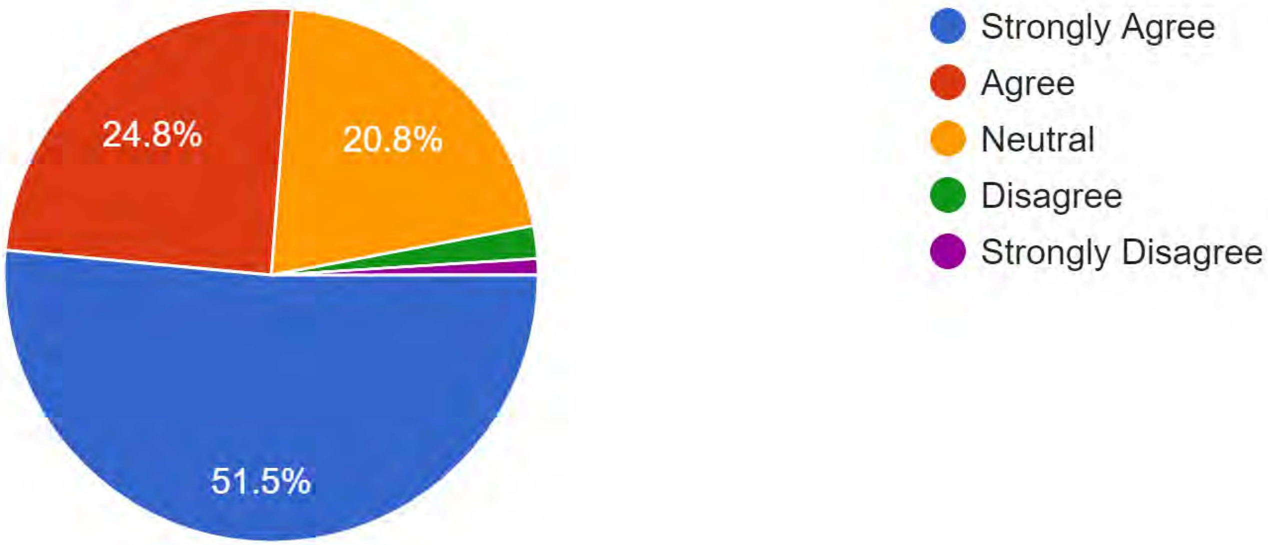
102 responses



Question #17

Please indicate at what level you agree with the following statement. "It is difficult to hire for mid-level positions".

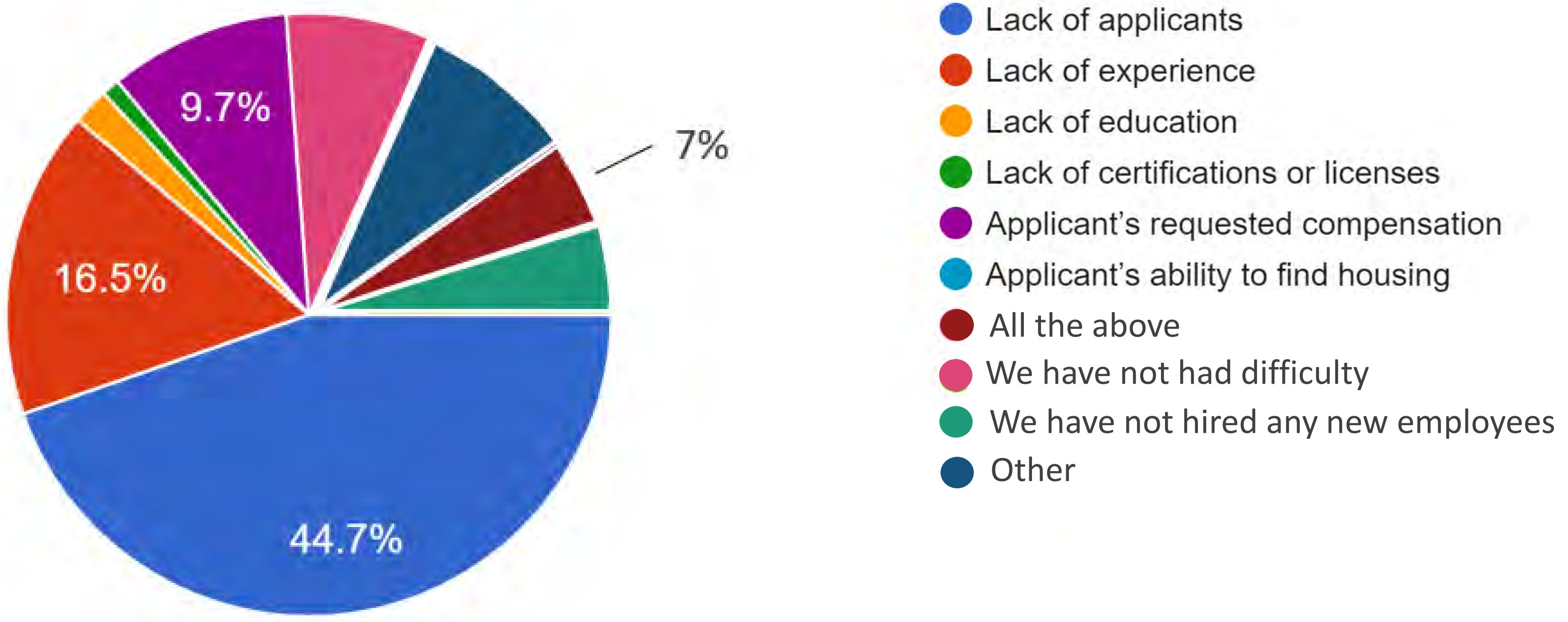
101 responses



Question #18

Which of the following factors have challenged your ability to hire new entry-level employees?

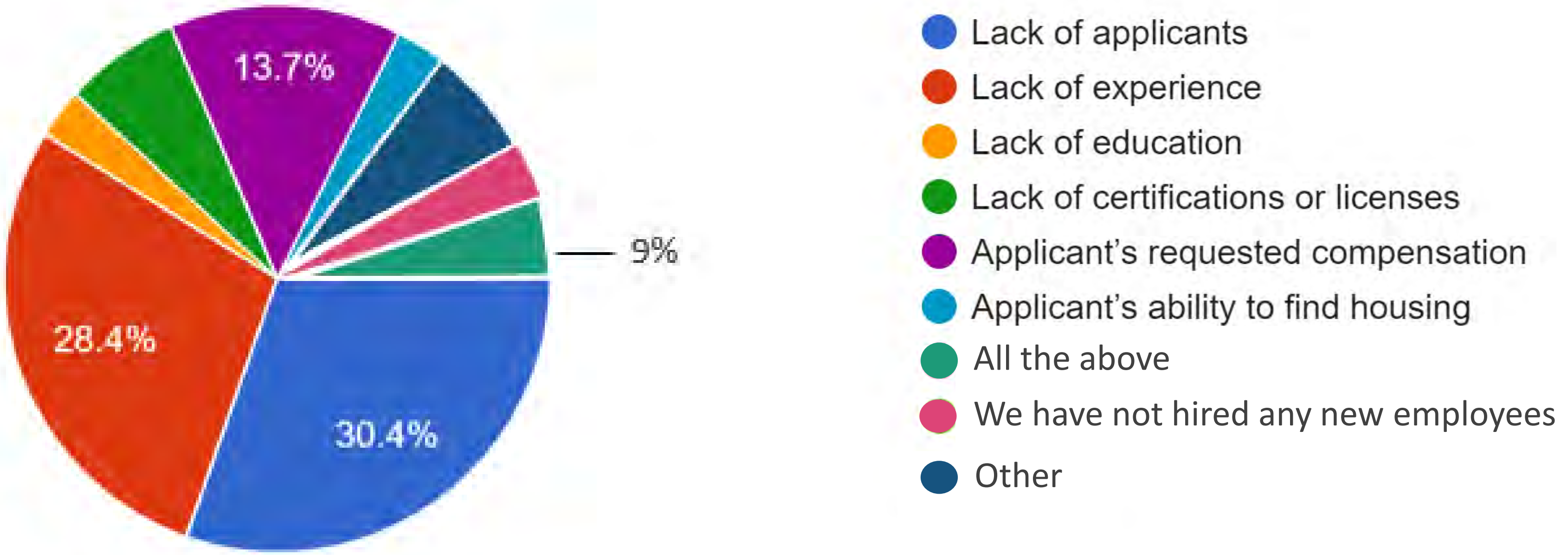
103 responses



Question #19

Which of the following factors have challenged your ability to hire new mid-level employees?

102 responses



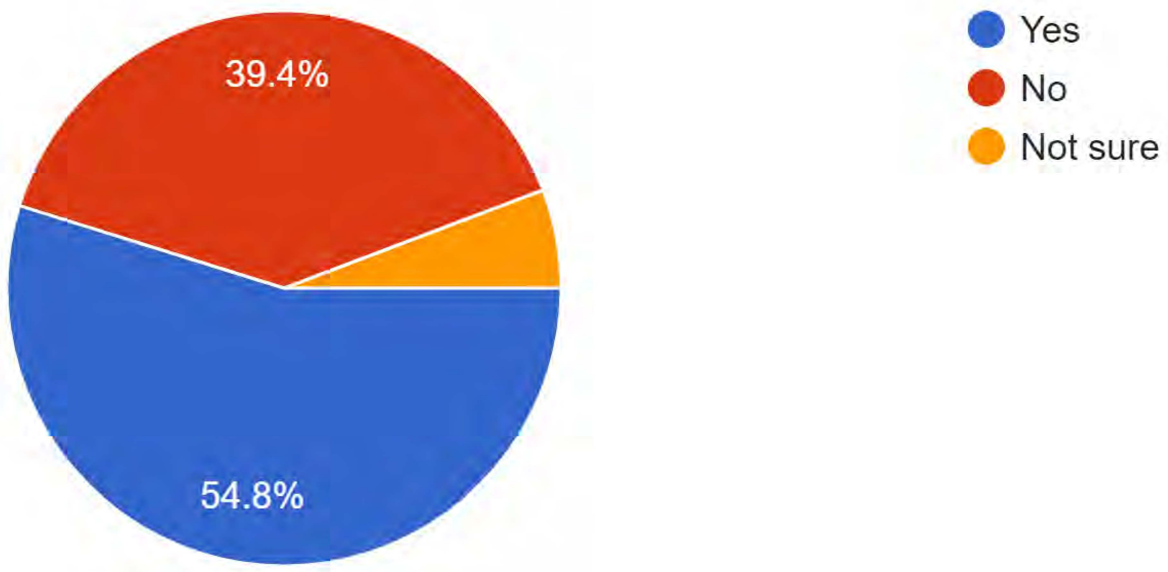
Identify Solutions

- **Identify Existing Internal Training Practices**
- **Potential Types of Assistance**
- **Ways for NHSaves to promote WFD**

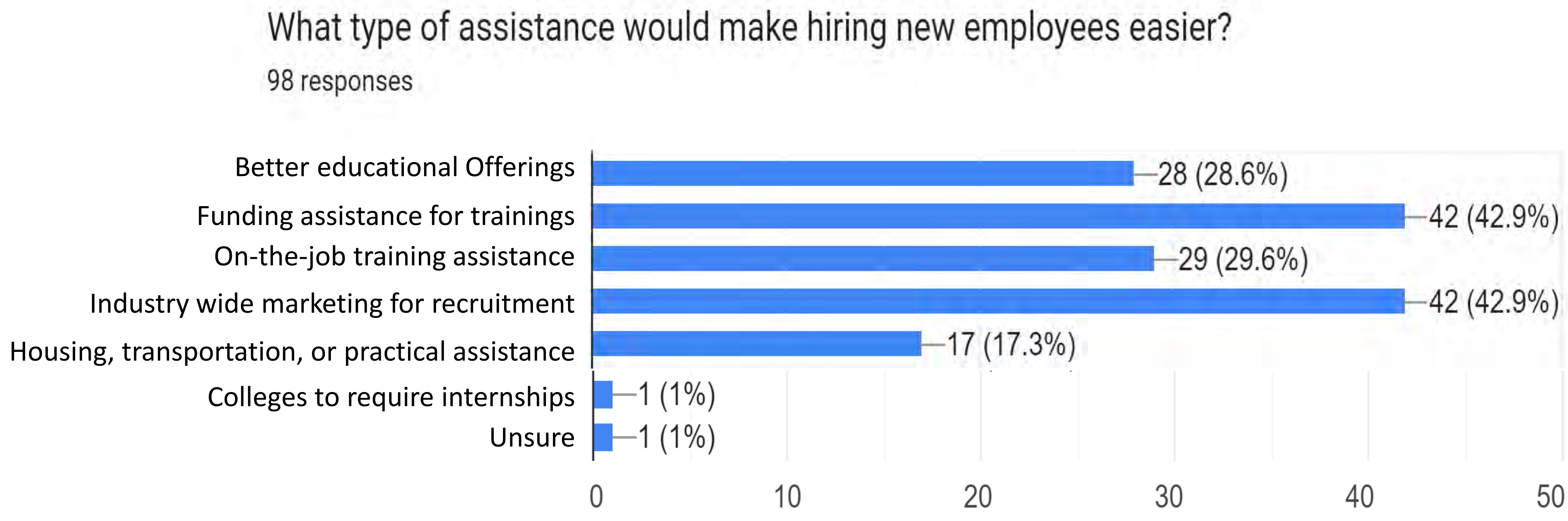
Question #20

Does your company currently offer any work based learning programs such as apprenticeships or internships?

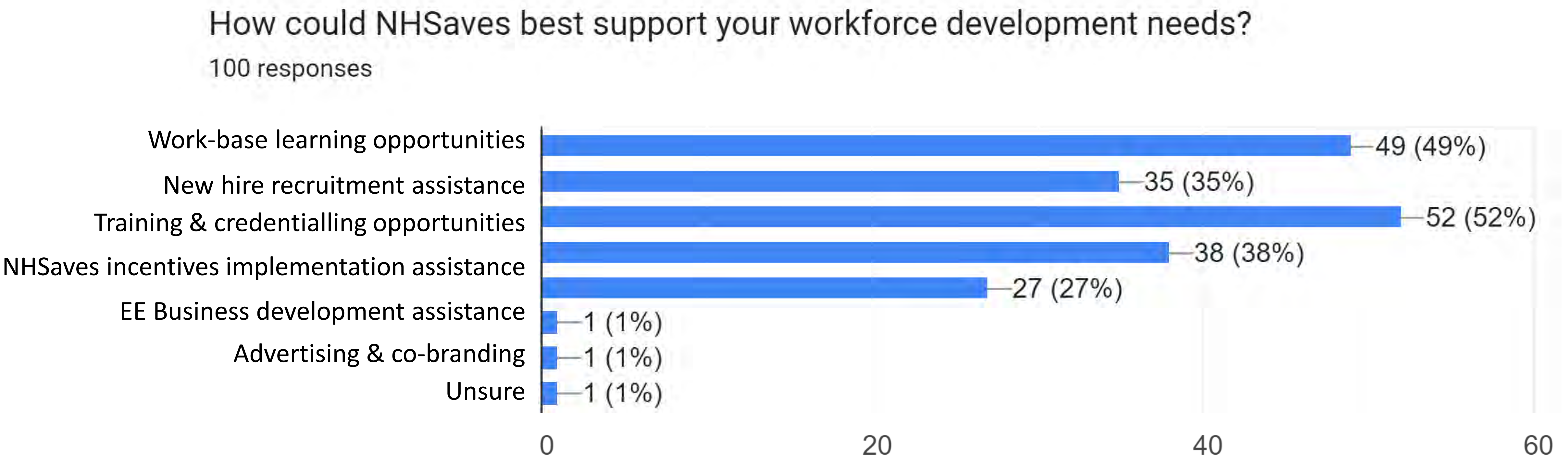
104 responses



Question #21


What type of assistance would make hiring new employees easier?
98 responses
Better educational Offerings
Funding assistance for trainings
On-the-job training assistance
Industry wide marketing for recruitment
Housing, transportation, or practical assistance
Colleges to require internships
Unsure
28 (28.6%)
42 (42.9%)
29 (29.6%)
42 (42.9%)
17 (17.3%)
1 (1%)
1 (1%)
0
10
20
30
40
50

Question #22


How could NHSaves best support your workforce development needs?
100 responses
Work-base learning opportunities
New hire recruitment assistance
Training & credentialling opportunities
NHSaves incentives implementation assistance
EE Business development assistance
Advertising & co-branding
Unsure
49 (49%)
35 (35%)
52 (52%)
38 (38%)
27 (27%)
1 (1%)
1 (1%)
1 (1%)
0
20
40
60

Survey Findings

Key Takeaways

- **The sample set of respondents show that energy efficiency companies are relatively small**
  - Most respondents work for small companies that are between 1-20 employees (Questions 6 & 7)
  - 80% of these respondents have worked with NHSaves in the past 12 months (Question 2)
- **82% of respondents find it difficult to meet hiring goals** (Questions 16 & 17)
  - The lack of applicants and lack of experience are the two most common reasons why meeting hiring goals for all skill levels (Questions 18 & 19)

Key Takeaways

- **Training is critical for energy efficiency employees**
  - Professional training and credentialing are the second most common educational requirements for new hires after a high school degree (Question 8)
  - 65% of respondents say that employees need to have a license or certification (Question 9)

Key Takeaways

- **Types of assistance that would make hiring easier ranked by choice** (Question 21)
  1. Industry wide marketing for recruitment
  2. Educational offerings
  3. On the job training assistance
  4. Funding assistance for trainings

- **Ways in which NHSaves could promote WFD ranked by choice** (Question 22)
  1. Training credentialing opportunities
  2. Work based learning opportunities
  3. NHSaves incentives implementation assistance
  4. New hire training assistance

Proposed Solutions

1. **NHSaves could serve as a valuable platform to increase awareness about energy careers**
   - Improve visibility for specific jobs and show career potential in EE field.
2. **Continue to support trainings**
   - Provide training for earning and maintaining the most common credentials (Question 10)
   - Provide trainings for individuals looking to get into the energy efficiency field – bridge skill level gap for entry level applicants.

Proposed Solutions

3. **Identify new ways to offer trainings**
   - In the field and onsite trainings
   - Work based-learning opportunities
   - Apprenticeships
   - Integrate NHSaves trainings into onboarding process
4. **Continue to provide support for contractors looking to participate in the NHSaves program**
   - 38% of respondents said that incentives and implementation assistance would help with their workforce development needs (Question 22)
   - Further reduce the clerical burden contractors face when participating in program

Appendix G

Federal EE Training and WFD grant Opportunties

Federal Energy Efficiency Training and Workforce Development Grant Opportunities

Date April 2023
By Andy Duncan, Foster Sustainable Energy LLC

FUNDING SOURCES

Inflation Reduction Act (IRA), August 2022

Infrastructure Investment and Jobs Act (IIJA), also called the Bipartisan Infrastructure Law (BIL), November 2021

GRANT OPPORTUNITIES

IRA Sec. 50123 Home Energy Efficiency Contractor Training Program (formerly HOPE)

Amount & Timing: $200 million, available through FY31, likely a competitive grant program

Eligibility: State energy offices

Description: "To develop and implement a State program to 'provide training and education to contractors involved in the installation of home energy efficiency and electrification improvements, including improvements eligible for rebates under a HOMES rebate program or a high-efficiency electric home rebate program, as part of an approved State energy conservation plan under the State Energy Program.'"

"State may use funding to (1) to reduce the cost of training contractor employees; (2) to provide testing and certification of contractors trained and educated under a state program; and (3) to partner with nonprofit organizations to develop and implement a state program. States' administrative costs may not exceed 10 percent."

Status: US DOE, SCEP issued a joint request for information (RFI) on 12/15/22, with a 1/26/23 deadline.

NH Prospects: Possibly some or all of this fund could distributed to states via formula grants, but likely some or all of the fund will be available through competitive grant. It will depend on what the HOMES program requires, but will likely mesh well with existing NHSaves residential retrofit EE programs, such as HPwES and HEA.

Potential Next Steps: Wait for further announcement from US DOE. Strategize with NH DOE about potential viability of a NH-based grant application.

IIJA Sec. 40503, Energy Auditor Training Grant Program (EAT)

Amount & Timing: $40 million, FY22 – FY26, competitive grant program

Eligibility: State energy offices

Description: "…Grants to eligible States to train individuals to conduct energy audits or surveys of commercial and residential buildings." Eligible uses: "A) To cover any cost associated with individuals being trained or certified to conduct energy audits by— (i) the State; or (ii) a State-certified third-party training program; and (B) to pay the wages of a trainee during the period in which the trainee receives training and certification."

https://www.energy.gov/scep/energy-auditor-training-grant-program

Status: US DOE issued a joint request for information (RFI) on 12/15/22, with a 1/26/23 deadline.

NH Prospects: NH doesn't have as strong energy auditor training infrastructure as other states, but Lakes Region Community College has been training residential energy auditors since 2009.

Potential Next Steps: Wait for further details, and consider the need, existing resources, and grant-writing capabilities.

IIJA Sec. 40513, Career Skills Training Program (CST)

Amount & Timing: $10 million, until expended, compet

Eligibility: Nonprofit partnerships*

Description: "…Grants to eligible entities to pay the Federal share of associated career skills training programs under which students concurrently receive classroom instruction and on-the-job training for the purpose of obtaining an industry-related certification to install energy efficient buildings technologies." *Eligible entities are further defined in 40513(a), including participation from industry and labor organizations; experience implementing worker skills training programs; and the ability to involve target populations.

Status: US DOE issued a joint request for information (RFI) on 12/15/22, with a 1/26/23 deadline.

NH Prospects: The "non-profit partnerships" eligible entities makes this grant fund appealing as a consortium approach to an application. However, $10 million spread nationwide is a very small grant fund.

Potential Next Steps: ##

IIJA, Sec. ##, "Building Training and Assessment Centers" (BTACs)

Amount & Timing: $10 million, available until expended, competitive grants

Eligibility: Institutions of higher education

Description: "The Building Training and Assessment Centers Program is designed to provide grants to institutions of higher education to establish building training and assessment centers to educate and train building technicians and engineers on implementing modern building technologies."

"BTAC students and trainees will conduct critical energy efficiency assessments and upgrades to improve the environmental performance of commercial and institutional buildings. Consistent with the Justice40 Initiative, the programs will provide services in areas that have been historically underserved and underfunded." https://www.energy.gov/eere/amo/articles/new-clean-energy-workforce-training-funding-available

Status: Notice of intent 12/6/22

NH Prospects: This could be something that UNH, perhaps teamed with CCSNH, may be interested in.

Potential Next Steps: Wait for additional information.

OTHER FEDERAL FUNDING OPPORTUNITIES

IRA Sec. 50131 **“Assistance for Latest and Zero Building Energy Code Adoption”** can include workforce training, as well as education and outreach. But the focus is on states and communities adopting the latest energy codes or zero energy codes. A notice of intent was issued 3/31/23.

IIJA **“Energy Efficiency and Conservation Block Grant (EECBG) Program Competitive FOA”** $8.8 million fund, aimed at states under 2 million population. 10-20 grants awarded. Concept papers due 6/5/23. From the, “Project Examples:” “Stand up an energy efficiency and electrification workforce training program to serve several neighboring communities and hire a part-time program administrator.” (FOA, 4/5/23, p. 3)

U.S. DOL H1-B **“Building Pathways to Infrastructure Jobs Grant Program,”** $80 million, FOA 4/5/23

“This grant program will train job seekers in advanced manufacturing; information technology; and professional, scientific, and technical services occupations that support renewable energy, transportation, and broadband infrastructure sectors.”

ADDITIONAL NOTES

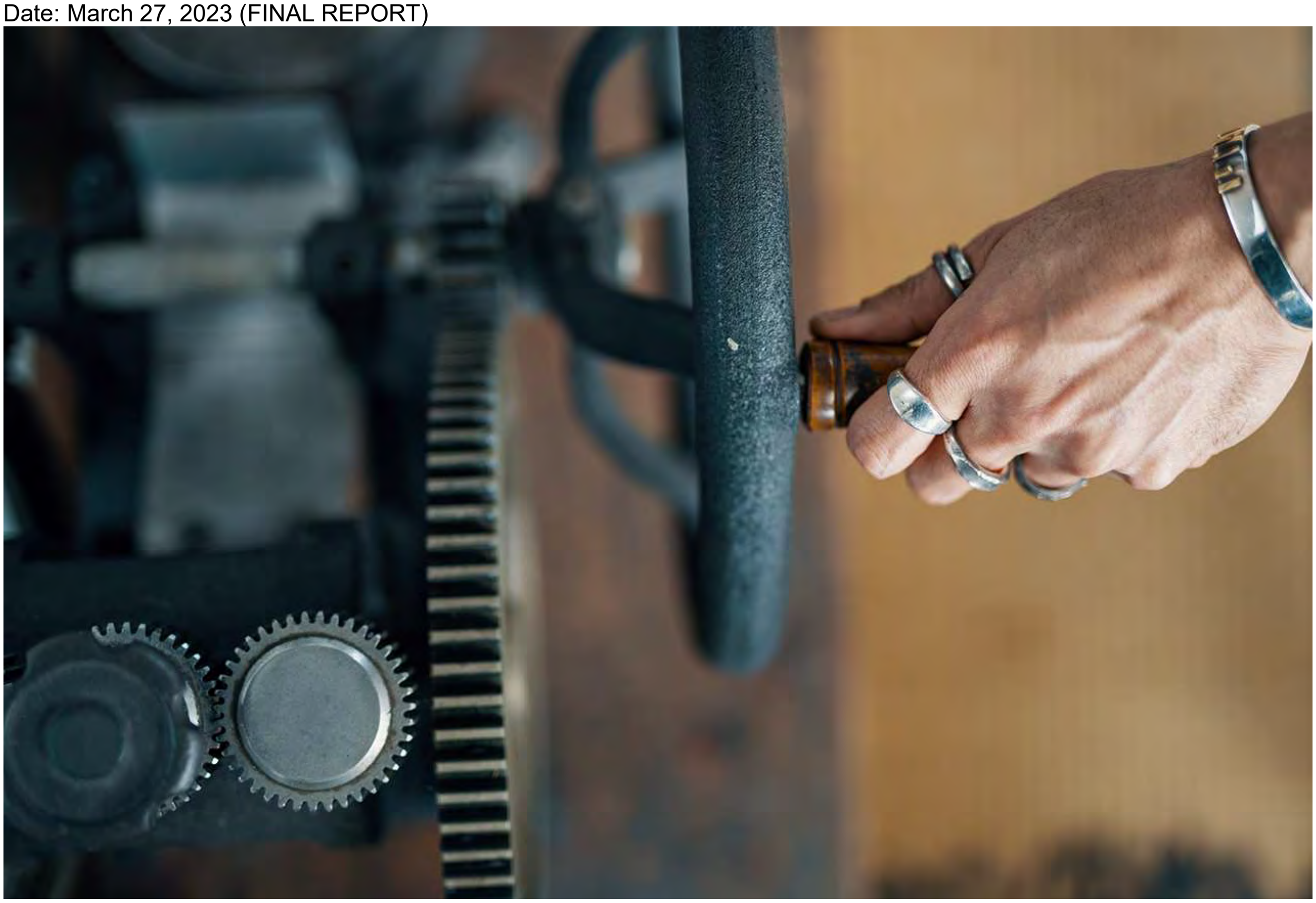
For all of these federal grant opportunities, *“The BIL and IRA implementation processes should advance equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. BIL and IRA implementation efforts for the EAT and CST support the goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities (the Justice40 Initiative)”*

“We define “underserved communities” as BIPOC individuals, LGBTQ+ individuals, women, immigrants, veterans, opportunity youth, individuals with disabilities, individuals in rural communities, individuals without a college degree, individuals with or recovering from a substance use disorder, and justice involved individuals.”

Economic Impacts of the NHSaves Programs

Submitted to the New Hampshire Evaluation, Measurement, and Verification (EM&V) Working Group

Prepared by: DNV, in collaboration with Anmol Soni, PhD, Louisiana State University
Date: March 27, 2023 (FINAL REPORT)



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DNV

1 EXECUTIVE SUMMARY

1.1 Background

New Hampshire statutes frequently mention the importance of economic benefits associated with energy policies and programs. For instance, the New Hampshire Revised Statutes on integrated least-cost resource planning state: "The following order of energy policy priorities shall guide the commission's evaluation: energy efficiency and other demand-side management resources; renewable energy sources; all other energy sources. *The Commission must consider potential environmental, economic, and health-related impacts of each option proposed by a utility to meet its customers' needs*."[1]

The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[2] (the Plan) in an order on April 29, 2022,[3] in which it found that the Plan has the potential to positively impact the New Hampshire economy "through achievement of energy savings and through the long-term multiplier effect of energy efficiency projects on the local economy." It also directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to "comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy." The New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG) engaged a team of independent evaluators from DNV and Louisiana State University (LSU) (the evaluation team) to conduct this study in response to these directives.[4] The evaluation team developed a workplan for this study in coordination with the members of the EM&V WG, and independently executed the research according to that workplan.

1.2 Methods

There are two general phases during which energy efficiency programs create economic impacts:[5]

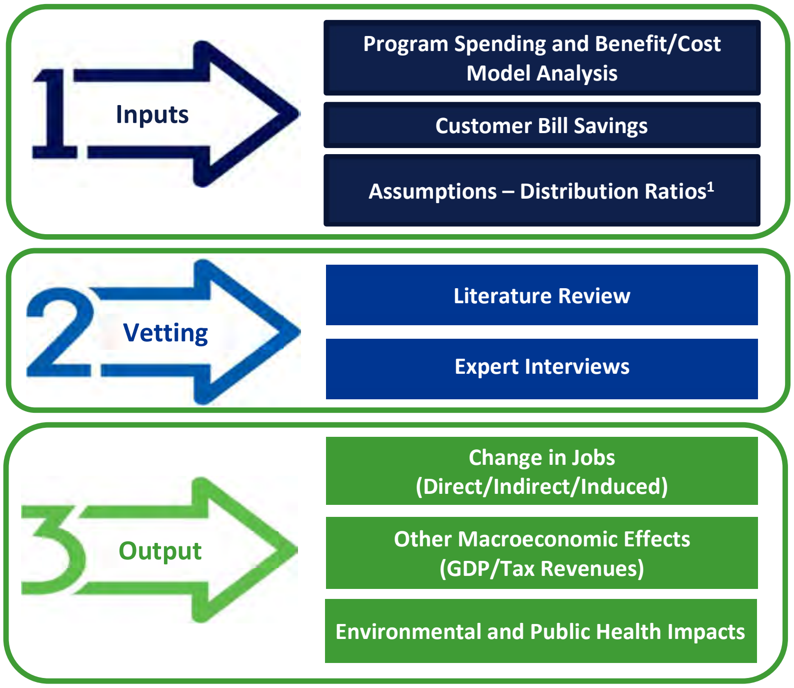
1. The implementation phase, during which economic impacts result from the production and installation of energy efficiency equipment, and
2. The savings phase, after energy efficiency measures are installed and result in energy bill savings that is re-allocated to other spending that creates economic impacts.

The evaluation team used an Input-Output (I/O) modeling approach to analyze the economic impacts from the implementation and savings phases of the 2021 and 2022 NHSaves programs. I/O models allow comprehensive analyses examining industry-wide effects of economic activities and major shifts across sectors,[6] based on economy-wide social accounting matrices that incorporate spending patterns within and across sectors. The evaluation team also estimated the economic value of the health benefits associated with the NHSaves programs, using EPA's Co-Benefit Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) and Avoided Emissions and Generation Tool (AVERT). Finally, the team interviewed officials at 10 organizations with expertise and knowledge of the NHSaves programs to provide context and insights on the economic impacts of the programs as modeled.

The evaluation team modeled economic impacts using a three-stage approach, summarized in Figure 1-1.

[1] NH Rev Stat § 378:39 (2021)
[2] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[3] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF
[4] The EM&V WG consists of: (1) representatives from the NH Utilities, (2) staff from the NH Department of Energy (3) independent evaluation consultants under contract to the NH Department of Energy, and (4) an EESE Board member appointed by the Board Chair. This research was conducted under a contract that was competitively procured by the EM&V WG in 2022.
[5] Synapse Energy Economics. New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire, Oct. 2019.
[6] Miller, Ronald E, and Peter D Blair. 2009. *Input-Output Analysis: Foundations and Extensions*: Cambridge University Press.

Figure 1-1. **Summary of approach for estimating economic impacts**



[1]Distribution ratios reflect the proportions in which program spending is apportioned across different industries/economic sectors.

Key limitation: The economic analyses in this report reflect the overall economic output and employment effects of the NHSaves programs, and are not an accounting of the full costs and benefits of the NHSaves programs. The results presented in this report are complementary to the other gains from energy efficiency projects in New Hampshire as reflected in the Granite State Test (GST),[7] including utility system avoided costs, other fuel and water resource savings, and non-energy benefits such as participants' reduced operations and maintenance costs or improved comfort. Cost-effective energy efficiency programs, by definition, provide a lower-cost alternative to supply-side resources. Even programs with negligible local employment impacts, if cost-effective, have net benefits that ensure they return more to the state's ratepayers in terms of avoided system costs and other energy and non-energy benefits than they cost, regardless of their employment and other economic impacts.

1.3 Results

Table 1-1 summarizes the economic impacts modeled for this study, including their definitions and values. Except where noted, all economic impacts presented in this report reflect impacts on the New Hampshire economy specifically. All employment effects reflect full-time-equivalent (FTE) jobs.[8] Note that employment effects during the implementation phase represent jobs that are created for one program year (2021 or 2022), and so the number of jobs is equivalent to the number of job-years. Employment effects during the savings phase occur in proportion to customer bill savings, over the useful life of the measures installed by the programs. As such, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.

[7] The GST is the primary cost-effectiveness test for the NHSaves programs. The NH Utilities calculate the GST using Benefit-Cost models that are filed alongside program plans and reports. The GST was developed through a stakeholder process that culminated in a consensus recommendation to adopt the test, followed by Commission approval of the test. See https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/ORDERS/17-136_2019-12-30_ORDER_26322.PDF The New Hampshire legislature has also established it as the primary cost-effective test for New Hampshire's energy efficiency programs. See https://gencourt.state.nh.us/bill_status/legacy/bs2016/bill_status.aspx?lsr=717&sy=2022&sortoption=&txtsessionyear=2022&txtbillnumber=HB549
[8] FTEs measure total full-time, part-time, and temporary employees, based on the total number of hours worked divided by the number of hours in a full-time schedule.

Table 1-1. Summary of NHSaves' impacts on the New Hampshire economy[1]

Phase	Impact	Definitions	Values
Implementation (program years 2021-2022)	Employment[2]	*Direct effects* accruing to industries involved in production and installation activities	2021: 380.79 jobs (5.09 per $1M) 2022: 359.68 jobs (5.09 per $1M)
		Indirect effects on industries supplying inputs to the sectors benefiting directly	2021: 126.05 jobs (1.68 per $1M) 2022: 118.99 jobs (1.68 per $1M)
		Induced effects, which are second order effects due to increased consumer spending from the income gains made in sectors with direct and indirect effects	2021: 249.13 jobs (3.33 per $1M) 2022: 224.64 jobs (3.18 per $1M)
	New Hampshire gross domestic product (GDP)[2]	Value added reflects the total in-state economic activity generated by the NHSaves programs. It includes direct, indirect, and induced effects. Aggregated across all industries, this value represents the program's contribution to state GDP	Estimated value added associated with the programs was $97 million in 2021, and $87 million in 2022[3]
	Local and state tax revenues	Additional tax revenues generated by the economic activity associated with NHSaves program spending, modeled according to New Hampshire's tax regime	Total estimated tax revenue generation of approximately $3.8 million in 2021 and $3.2 million in 2022
Savings (year of implementation through the end of measures' useful life)	Customer bill savings effects[4]	Gains in employment associated with reduced utility bills, including (1) induced effects from additional disposable household income (e.g., spending on goods and services), and (2) direct, indirect, and induced effects from increased production in the C&I sector	About 1480 total additional job years resulting from long-term bill savings for low-income, residential, and C&I sectors over the lifetime of the program measures
	Public health benefits	Annual monetary value of avoided healthcare costs for New Hampshire citizens from emissions reductions resulting from the NHSaves programs in 2021[5]	Annual benefits range from $68,000 to over $153,000 at a 7% discount rate and from about $76,000 to over $172,000 at a 3% discount rate[6]
		Annual monetary value of avoided healthcare costs for citizens in the contiguous U.S. from emissions reductions resulting from the NHSaves programs in 2021[5]	Annual benefits range from $649,000 to almost $1.5 million at a 7% discount rate and from $727,000 to over $1.6 million at a 3% discount rate[6]

[1] All impacts represent incremental economic effects of each program year independently, relative a no-program counterfactual.
[2] Employment and state GDP effects shown in this table are based on a conservative modeling assumption for the local purchase percentage (LPP), which represents the share of program-rebated materials that are purchased from in-state manufacturers or wholesalers. The team also modeled employment effects with a more aggressive assumption for LPP, as presented in Section 4.1.
[3] These results are generally consistent with other estimates of the impacts of public programs on GDP, which typically find multiplicative effects whereby GDP grows by a factor of 1 or more times the amount of program spending.
[4] Bill savings impacts result from participant energy cost savings, System Benefit Charge costs, and long-term utility system avoided costs. For the NHSaves programs, the net impact of these factors are reductions in overall utility system costs and total customer bills.

[5] Due to limitations in modeling tools and underlying data, the team modeled one year of emissions reductions and associated health impacts from the 2021 programs. The results do not reflect the full emissions and health impacts of 2021 measures over their useful lives.
[6] The range of health impacts estimates reflect the use of different underlying epidemiological studies. The low estimates reflect mortality impacts of PM2.5 as evaluated by the American Cancer society, and the high values reflect results from the Harvard six-city mortality study.

1.3.1 Context for economic impacts

The economic and regulatory context in which the NHSaves programs operate should be considered alongside the quantified economic impacts presented above. In particular, the NHSaves programs experienced uncertainty and funding instability associated with Commission decisions affecting the 2021 and 2022 period modeled in this study.[9] It was not feasible to quantify the economic impacts of these dynamics as part of this study, but based on expert interviews, the uncertainty and funding instability dampened the programs' economic benefits. Interviewees cited the following impacts:

- **Workforce disruption.** Almost all interviewees cited workforce disruptions caused by the decisions. Several noted that the 2021–2023 plan had originally included significant increases in program funding and savings goals, and that despite some uncertainty around the plan due to COVID-19 and other factors, they took steps to prepare for expected funding increases by hiring or otherwise ramping up in advance of the 2021 program year. This ramp-up exacerbated the impact of the subsequent decisions, which in some cases included layoffs of contractors or other staff.
- **Customer impacts.** Most interviewees we spoke with also cited customer impacts caused by the decisions. For customers with projects in progress at the time of the decisions, many of the projects were put on hold, some of them indefinitely. For customers considering participating but without projects in progress, they often did not know if they would be able to participate because the NH Utilities could not tell customers what to expect in terms of funding. Some larger customers faced particular challenges financing projects, such as affordable housing projects that utilize multiple inter-related funding sources, for which predictable timing is important in planning and assembling financing. Similarly, large industrial participants require predictable timing in project funding in order to align with their annual capital planning cycles, and funding uncertainty negatively impacted their ability to install efficient equipment through NHSaves.

The scope of this review included accounting for the NHSaves programs' out-of-state expenditures. The evaluation team took several steps in our I/O modeling to account for inter-state flows of program funding, as described in sections 3.1 and 3.2. The team also interviewed experts for context and insights on the inter-state impacts of the programs, and several themes emerged:

- The vast majority of installation contractors are based in-state, particularly for weatherization projects. However, multiple interviewees noted that NH is a relatively small state with a large population close to the state's borders—particularly with Massachusetts and southern Maine—providing significant opportunities contractors in neighboring states to work in New Hampshire, and vice versa.
- Interviewees said the types of firms most often based out-of-state are specialized firms with expertise in complex custom projects and controls measures, and other equipment types where higher levels of program support and customer adoption in other states have led to growth in the workforce for those technologies (e.g., heat pumps).
- Interviewees said that a key reason NHSaves needs to utilize out-of-state contractors in some cases is that states face competition for workforce, and neighboring states have large, well-funded programs that over time have led to growth in the contractor workforce in those states.

An overarching issue raised in the interviews was that New Hampshire has significant out-of-state expenditures on supply-side resources, and that these expenditures should be considered alongside analyses of out-of-state expenditures on

[9] Specifically, in December 2020, the Commission ordered the 2021 programs to operate at 2020 funding levels rather than the higher levels proposed in the 2021-2023 plan, until the Commission could fully consider the plan. Then, in November 2021, the Commission issued an order denying the 2021-2023 plan and ordering a steady, significant reduction in program funding starting in 2022. Although the funding reductions were partially restored in 2022, the Commission's decision limited the flow of funding and initiation of new projects for much of 2022, impacting workforce and customer decisions. See DE 20-092, Order No. 26,440, December 29, 2020; and DE 20-092, Order No. 26,553, November 12, 2021.

energy efficiency resources. Despite being a net electricity exporter, New Hampshire relies heavily on imports of other sources of energy—particularly fossil fuels for heating and transportation. Specifically, according to EIA data from 2022, New Hampshire does not produce fossil fuels, and over $2 billion flowed out of the state for energy imports across all fuels and end uses.[10]

1.3.2 Comparison of results

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. A comparison of results from recent studies that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs shows that the employment effects of the NHSaves programs—ranging from about 10 to 14 jobs per $1 million in program investment—are similar to the employment effects found in state-level studies from other jurisdictions. In addition to these implementation period jobs, the team's estimates of employment effects from customer bill savings suggest that the total jobs resulting from the NHSaves programs is at the high end of the range for comparison programs.

1.4 Conclusions and considerations

The 2021 and 2022 NHSaves programs—both residential and commercial and industrial (C&I)—had significant positive economic impacts on New Hampshire's economy, including short-term and long-term employment effects, increased state GDP, state and local tax revenues, and monetized public health benefits. These impacts are complementary to other gains from energy efficiency projects in New Hampshire as reflected in the GST, including utility system avoided costs, other fuel and water resource savings, and non-energy benefits.

It is important to note that these quantified impacts are best estimates, which reflect underlying assumptions and limitations in modeling tools and data. The team documented these assumptions and limitations and presented ranges of conservative and aggressive estimates throughout the report for in-state impacts and other factors. Despite some amount of imprecision, which is inherent in economic modeling, the scale and scope of quantified impacts provides clear evidence of the economic benefits of the programs. In addition, as described in the National Standard Practice Manual,[11] jurisdictions "should account for all relevant, substantive impacts (as identified based on policy goals), even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value."

In addition to quantitative modeling, the team's interviews with officials from multiple organizations with expertise and knowledge of the NHSaves programs validate the importance of the programs in supporting and growing the local workforce and in providing New Hampshire businesses and residents with funding to support energy efficiency investments. The value of the programs can be seen in part by the disruptions to local workforce and customers that occurred when the programs' continuity became uncertain. The programs also provide a tool for workforce recruitment and retention that can help New Hampshire compete with surrounding states that offer similar state-wide energy efficiency programs.

There are several areas of analysis covered in this study that were limited due to schedule and scope constraints, summarized in the list below, which could be explored in greater depth. This could include primary New Hampshire data collected from customers and other market actors via surveys, interviews, or other methods to validate and expand on the team's modeling results, while considering tradeoffs between costs, rigor, and value of additional research.

[10] EIA data shows total energy expenditures of $4.6 billion, total consumption of 296 trillion Btu, and total in-state energy production of 149 trillion Btu. U.S. Energy Information Administration, New Hampshire State Energy Profile, updated Sept 2022. https://www.eia.gov/state/print.php?sid=NH.

[11] The NSPM is a publication of the National Efficiency Screening Project (NESP), which works to improve cost-effectiveness assessments of customer-funded electric and gas energy efficiency programs. The NSPM includes a set of fundamental principles for cost-effectiveness analysis, which have been applied in multiple jurisdictions nationwide. See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

- Analysis of inter-state workforce effects of the NHSaves programs, to help quantify the qualitative insights from expert interviews on workforce competition and use of in- and out-of-state contractor workforce
- Updating health impacts analysis for future program years to reflect updated ISO-NE data on electricity generation mix and updated demographic data underlying epidemiological models
- Further analysis of long-term customer bill savings and discount rate sensitivity analyses, to provide additional insight in response to the Commission
- Analysis of secondary energy consumption related to economic activity spurred on by the NHSaves programs—also known as the “rebound effect”—to provide additional insight in response to the Commission.

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2 INTRODUCTION

The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[12] (the Plan) in an order on April 29, 2022,[13] in which it found that the Plan has the potential to positively impact the New Hampshire economy "through achievement of energy savings and through the long-term multiplier effect of energy efficiency projects on the local economy." It also directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to "comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy, quantifying the factors noted in the 2022–2023 Plan at Bates pages 6 and 7[14] by properly accounting for discounting that reflects ratepayers' time-preference, and by estimating the energy savings to reflect both the energy intensity and the spillover impacts also associated with future incremental economic activity prompted by the Plan." A subsequent order of clarification, issued June 21, 2022,[15] states that "the study and reporting requirement calls for sensitivity analysis using a range of discount rates to demonstrate: 1) the impact of time-preference on benefits and costs, and 2) to account for the impact of economic activity resulting from quantifiable cost savings that will result in future energy consumption." In a separate request issued on November 1, 2022, the Commission directed the NH Utilities to "use existing practices and the best data available to provide calculations that, after adjusting for free-ridership and out-of-state expenditures, provide estimates of the positive economic impacts of the Energy Efficiency Program on NH ratepayers." The Commission ordered this review of economic impacts to be submitted by March 31, 2023.

The DNV team with Dr. Anmol Soni of Louisiana State University (LSU) (the evaluation team), in coordination with the New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG), designed this study to be responsive to the Commission's various requests to the greatest extent possible within the given timeframe, as shown in Table 2-1.

Table 2-1. Response to Commission reporting requirements

Commission Reporting Requirement	Source	Research Scope
Comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy, quantifying the factors noted in the 2022–2023 Plan	4/29 order	Addressed, results in sections 4.1 and 0
Sensitivity analysis using a range of discount rates to demonstrate the impact of time-preference on benefits and costs, and to account for the impact of economic activity resulting from quantifiable cost savings that will result in future energy consumption.	6/21 clarification order	Partially addressed, results in Section 4.3.3
Use existing practices and the best data available to provide calculations that, after adjusting for free-ridership and out-of-state expenditures, provide estimates of the positive economic impacts of the Energy Efficiency Program on NH ratepayers.	11/1 data request	Addressed, results in sections 4.1, 0, and 4.3.2

[12] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[13] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF
[14] The factors listed in the plan are (1) customer energy cost savings, (2) continued energy savings, (3) peak demand reduction savings, (4) a strong state economy, (5) a highly trained workforce, and (6) a cleaner environment.
[15] https://www.puc.nh.gov/Regulatory/Orders/2022orders/Documents/26-642.pdf

3 METHODOLOGY

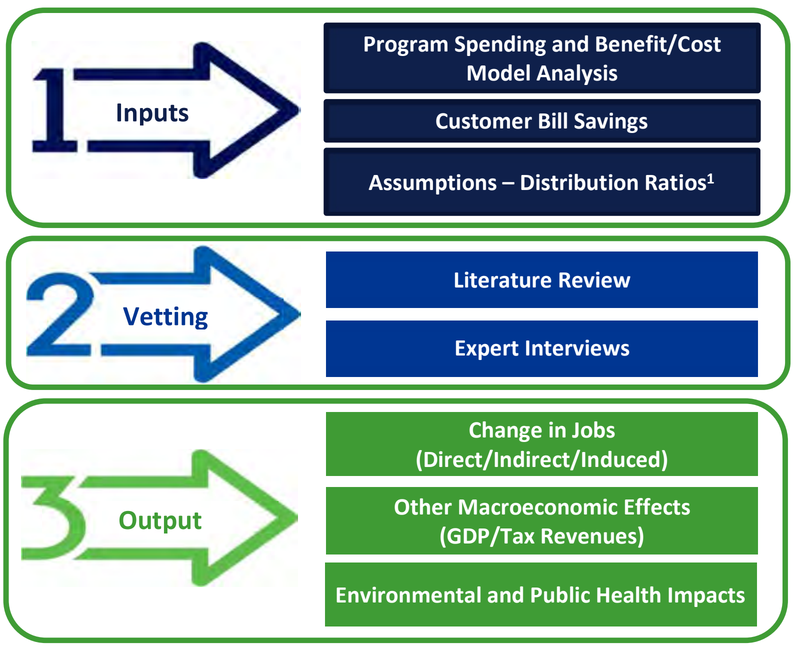
A large body of research has shown that investments in cost-effective energy efficiency have a positive impact on a state's economy. Economic impacts primarily result from direct, indirect, and induced workforce impacts; customer cost savings; public health benefits; and other macroeconomic effects such as increased gross domestic product (GDP) and tax revenues.

There are two general phases during which energy efficiency programs create economic impacts:[16]

1. The implementation phase, during which economic impacts result from the production and installation of energy efficiency equipment, and
2. The savings phase, after energy efficiency measures are installed and result in energy bill savings that is re-allocated to other spending that creates economic impacts.

The evaluation team used an Input-Output (I/O) modeling approach to analyze the economic impacts from the implementation and savings phases of the 2021 and 2022 NHSaves programs. I/O models allow comprehensive analyses examining industry-wide effects of economic activities and major shifts across sectors,[17] based on economy-wide social accounting matrices that incorporate spending patterns within and across sectors. The evaluation team modeled impacts on New Hampshire's economy using a three-stage approach, summarized in Figure 3-1 and detailed in the following sections.

Figure 3-1. **Summary of approach for estimating economic impacts**



[1]Distribution ratios reflect the proportions in which program spending is apportioned across different industries/economic sectors.

3.1 NHSaves program data analysis

The first step in developing inputs for the I/O modeling was to gather and analyze information from the NH Utilities on actual and planned program spending and customer bill impacts from the NHSaves programs. As agreed with the EM&V WG, given the timing of the study, the evaluation team based the analysis on 2021 actual spending from the 2021 B/C models used for annual reporting, and 2022 planned spending from the 2022-23 plan B/C models.[18] For customer bill impacts, the

[16] Synapse Energy Economics. New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire, Oct. 2019.
[17] Miller, Ronald E, and Peter D Blair. 2009. *Input-Output Analysis: Foundations and Extensions*: Cambridge University Press.
[18] Actual 2022 spending for the full program year would not be available until the March 31 deadline for this study.

team used the bill and rate impacts as modeled and filed with the 2022-23 plan, reflecting bill impacts associated with the two years of NHSaves programs as planned. The team collected and analyzed B/C and bill impact models for the four electric and two gas operating companies: Eversource, Unitil, Liberty, and NHEC electric models; and Liberty and Unitil gas models.[19]

3.1.1 B/C model review

The primary source of data used to model the economic impacts from the implementation phase of the NHSaves programs was the NH Utilities' B/C models. The B/C models include six categories of program spending data, as follows:[20]

- **Internal administration**: internal utility costs associated with program design, development, regulatory support, and quality assurance. Costs include employee labor, benefits, expenses, materials, and supplies.
- **External administration**: external costs associated with program administration. This includes contractors and consultants used in support of program design, development, regulatory support, and quality assurance.
- **Customer rebates and services**: Costs associated with incentives that reduce the cost of equipment as well as costs for services to speed adoption. This includes direct rebate dollars paid to distinct participants, as well as indirect incentives for equipment discounts. It also includes services such as technical audits, employee and contractor labor to install measures, expenses, materials, and supplies.
- **Internal implementation services**: Tracking of internal utility costs associated with delivering programs to customers, including labor, benefits, expenses, materials, and supplies.
- **Marketing**: Costs for marketing, advertising, trade shows, toll-free numbers, and NHSaves website. Types of expenses include labor, benefits, consultants, contractors, expenses, materials, and supplies.
- **Evaluation**: Costs for EM&V activities including labor, benefits, expenses, materials, supplies, consultants, contractors, and tracking systems.

The evaluation team compiled spending data from each utility's B/C model and cleaned and analyzed the data to develop inputs for I/O modeling. The spending categories required different levels of analysis and different general assumptions regarding allocation of the funding to labor and materials, as well as to in-state and out-of-state recipients. These assumptions are shown in Table 3-1 and discussed in more detail below.

Table 3-1. NHSaves program spending categories and general assumptions

Spending category		Level of analysis	In-state/out-of-state assumption	Labor and materials assumption
Internal Administration		Program-level	All in-state staff	All labor and overhead[3]
External Administration		Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]
Customer Rebates & Services	**Rebates**	Measure-level with IMPLAN industry mapping	All in-state recipients	Labor[4] and materials proportion applied at sub-program level based on review of program documents and data, utility staff input, and PERI/IMT research[1]
	Services	Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]
Implementation Services		Program-level	All in-state staff	All labor and overhead[3]
Marketing		Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]

[19] The B/C model analysis includes all the NH Utilities, but the customer bill savings analysis includes only the three electric and two gas investor-owned utilities regulated by the Commission. The bill savings analysis does not include NHEC, which offers energy efficiency as part of the NHSaves plan, but is a customer-owned cooperative not regulated by the Commission in the same way as the investor-owned utilities.
[20] See NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 5 - Market Barriers

Spending category	Level of analysis	In-state/out-of-state assumption	Labor and materials assumption
Evaluation	Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]

[1] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012.
[2] Analysis of NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1, RR 1-006B. See section below for further details.
[3] Labor was modeled using the IMPLAN code for management of companies and enterprises, which includes both employee compensation and share of overhead costs.
[4] Refers to project installation labor.

As noted, the modeling exercise relied entirely on the program spending values reported in the NH Utilities' B/C models for 2021 and 2022. Overall funding declined by more than $4 million over the two years. The largest absolute change in funding was in the Energy Star Products program, which saw a 22% decline, and the greatest increase was in the residential engagement and C&I customer engagement programs (included in the All Others category in Table 3-2).

Table 3-2. Total program spending, 2021 actual and 2022 planned

Program	2021 (actual)	2022 (planned)	Change
Energy Star Homes (ES Homes)	$3,449,257	$3,979,650	$530,393
Home Performance with Energy Star (HPwES)	$11,263,490	$10,794,370	-$469,121
Energy Star Products (ES Products)	$9,735,295	$7,600,158	-$2,135,137
Home Energy Reports	$555,043	$483,512	-$71,530
Residential Active Demand Response	$159,209	$190,156	$30,947
Home Energy Assistance (HEA)	$14,464,427	$14,066,713	-$397,714
Large Business Energy Solutions (LBES)	$15,892,231	$14,558,651	-$1,333,580
Small Business Energy Solutions (SBES)	$16,471,108	$15,279,584	-$1,191,524
Municipal Energy Solutions (Muni)	$1,879,379	$1,943,528	$64,150
All others	$833,240	$1,561,498	$728,258
Total	**$74,702,678**	**$70,457,819**	**-$4,244,860**

Accounting for participant costs and free-ridership. Customer rebates represent the largest share of program spending by a wide margin and were of particular importance in the I/O modeling. In most cases, program spending on rebates is accompanied by participant contributions toward the cost of energy efficiency upgrades.[21] The B/C models include measure-level total resource cost (TRC) data, which reflects the total incremental cost of an energy efficiency measure relative to the baseline measure—including both the program's and the participant's share. Participant contributions are attributable to some extent to the programs, but the extent of attribution varies by program, measure type, and other factors. New Hampshire has not conducted extensive research on program attribution levels—i.e., free-ridership and spillover—but the NH Utilities' B/C models include free-ridership and spillover estimates for certain measure types and delivery pathways, such as midstream and lighting offerings, taken from neighboring jurisdictions. For this analysis, the evaluation team used these factors to estimate the share of customer contributions that could be attributed to the programs. For example, at the ends of the attribution spectrum, the team assumed programs with 0% free-ridership and spillover (i.e., 100% net-to-gross) can claim 100% of participants' share of project costs as attributable to the program. In contrast, programs with 100% free-ridership and 0% spillover (i.e., 0% net-to-gross) cannot claim any of the participants' share of project costs as attributable to the program. The evaluation team applied these free-ridership and spillover factors to estimate the portion of participant spending attributable to the programs, addressing the Commission's directive to adjust for free-ridership.

[21] The primary exception to this is the low-income Home Energy Assistance program, which does not require any customer co-pay.

Accounting for out-of-state expenditures. Several spending categories include program expenditures for external contractors and consultants that may reside outside of New Hampshire, including spending on customer rebates that is directly paid to contractors but is then passed through to New Hampshire-based customers.[22] To determine the proportion of contractor and consultant spending that flows to out-of-state recipients, the evaluation team reviewed and analyzed cost data from several recent NH Utilities filings.[23] Table 3-3 provides the data from these filings on the NH Utilities' 2021 spending on outside contractors and consultants, including the portion of this spending for rebates—which are required to flow to New Hampshire-based customers—as well as the non-rebate portion—which may or may not ultimately flow to New Hampshire-based recipients.

Table 3-3. NHSaves 2021 statewide contractor and consultant expenses

State/Country[1]	Total Contractor and Consultant Expenses	Rebate Portion (100% pass-through to NH customers)	Non-Rebate Portion
NH	**$29,668,388**	**$26,566,101**	**$3,102,286**
CA	$7,034,417	$5,738,082	$1,296,336
MA	$15,713,696	$14,619,373	$1,094,323
TX	$1,101,425	$740,242	$361,183
NY	$396,292	$53,318	$342,974
GA	$1,538,904	$1,239,306	$299,599
RI	$440,426	$165,199	$275,228
IL	$1,451,318	$1,227,080	$224,238
PA	$634,687	$440,885	$193,802
WI	$211,162	$32,300	$178,862
CO	$169,355	$0	$169,355
VA	$141,903	$52,492	$89,411
CT	$360,792	$272,795	$87,997
OH	$63,430	$0	$63,430
NJ	$51,610	$18,898	$32,712
MN	$89,265	$76,065	$13,200
VT	$254,676	$243,935	$10,741
ND	$5,533	$0	$5,533
FL	$105,768	$101,000	$4,768
AZ	$12,050	$9,550	$2,500
ME	$2,006,320	$2,004,220	$2,100
MD	$163,317	$163,317	$0
CANADA	$42,954	$0	$42,954
IRELAND	$9,507	$0	$9,507
INDIA	$1,344	$0	$1,344
Total	**$61,668,540**	**$53,764,159**	**$7,904,381**

[22] Customer rebates, by definition and program rules, are provided only to eligible customers of the NH Utilities who must reside in New Hampshire. Internal administration expenditures are also assumed to be for New Hampshire-based staff for purposes of our analysis.
[23] NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1

[1]Based on business address used for payments.
Sources: NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1

The team estimated the share of non-rebate spending flowing to out-of-state contractors and consultants using the values in Table 3-3. As the NH Utilities noted in their filings, the business address of a given contractor or consultant does not necessarily reflect the location of the individual(s) working with the programs. The NH Utilities' 2021 data does not track contractor and consultant expenses based on the location of the employees working with the programs, and a comprehensive review of these expenses was not within the scope of this study. However, multiple contractors that are shown in the NH Utilities' filings as being out-of-state businesses based on their corporate address employ New Hampshire-based staff who work for the programs. Based on this review, we modeled several scenarios assessing the sensitivity of the results to the share of contractor and consultant expenses flowing to out-of-state recipients. Table 3-4 shows the share of non-rebate contractor and consultant spending that flows to in- and out-of-state recipients under a range of assumptions about the extent to which non-rebate funding sent to out-of-state business addresses is passed back to New Hampshire-based employees of those businesses. The evaluation team ran a sensitivity analysis of the economic impacts using the middle two assumptions: 25% and 50% of spending on out-of-state business addresses being passed back to New Hampshire-based employees (see Section 4.3.2.)

Table 3-4. Non-rebate contractor and consultant expenses to out-of-state recipients

Assumed share of spending on out-of-state business addresses that is passed through to New Hampshire-based employees	Share of total non-rebate expenses flowing to in-state recipients	Share of total non-rebate expenses flowing to out-of-state recipients
0% passed through to New Hampshire-based employees	39.2%	60.8%
25% passed through to New Hampshire-based employees	54.4%	45.6%
50% passed through to New Hampshire-based employees	69.6%	30.4%
75% passed through to New Hampshire-based employees	84.8%	15.2%

Accounting for labor and materials. For customer rebate spending, the team estimated the share of program spending on the purchase of equipment or materials and the share for labor by installation contractors, technical/engineering vendors, and other project-specific (i.e., non-administrative) labor. Some programs, such as residential weatherization, involve labor-intensive activities installing relatively low-cost materials such as spray foam and weatherstripping, while other programs such as midstream or upstream lighting and appliances involve equipment markdowns or point-of-purchase rebates and do not include program spending for installation or other project-specific labor. The team developed estimates for the share of labor and materials spending based on a review of the programs, discussion with utility staff, and application of labor cost shares from research by the Political Economy Research Institute (PERI), a nationally recognized independent research unit at the University of Massachusetts Amherst.[24]

Table 3-5 below shows the labor and materials assumptions used in modeling.

Table 3-5. Assumptions for labor and material costs, by program

Program/Subprogram	Percent materials[1]	Percent labor[2]	Source
Energy Star Homes (ES Homes)	25%	75%	Estimated based on program review and discussion with utility staff
Home Performance with Energy Star (HPwES)			
HPwES Weatherization	20%	80%	PERI/IMT[3]

[24] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012. PERI is a nationally recognized source of expertise on economic modeling of employment impacts and has been cited in regulatory filings by the NH Utilities and other energy efficiency program administrators throughout the country in estimating the employment impacts of their programs.

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Program/Subprogram	Percent materials[1]	Percent labor[2]	Source
HPwES HVAC Systems	70%	30%	PERI/IMT[3]
HPwES 3rd Party Financing	0%	100%	Assumed for financing program
Energy Star Products (ES Products)			
ES Lighting	100%	0%	Estimated based on upstream program design and discussion with utility staff
ES Appliances	90%	10%	Estimated based on midstream program design and discussion with utility staff
ES HVAC Systems	90%	10%	Estimated based on midstream program design and discussion with utility staff
Home Energy Reports	5%	95%	Assumed due to home energy reports program design
Residential Active Demand Response	5%	95%	Estimated based on demand response program design and discussion with utility staff
Home Energy Assistance (HEA)			
HEA Weatherization	20%	80%	PERI/IMT[3]
HEA HVAC Systems	70%	30%	PERI/IMT[3]
Large Business Energy Solutions (LBES)			
LBES Retrofit	69%	31%	PERI/IMT,[3] weighted by spending by end use
LBES New Equipment & Construction	63%	37%	PERI/IMT,[3] weighted by spending by end use
LBES Midstream	90%	10%	Estimated based on midstream program design and discussion with utility staff
Small Business Energy Solutions (SBES)			
SBES Retrofit	66%	34%	PERI/IMT,[3] weighted by spending by end use
SBES New Equipment & Construction	69%	31%	PERI/IMT,[3] weighted by spending by end use
SBES Midstream	90%	10%	Estimated based on midstream program design and discussion with utility staff
SBES Direct Install	70%	30%	PERI/IMT,[3] weighted by spending by end use
Municipal Energy Solutions (Muni)			
Muni Retrofit	65%	35%	PERI/IMT,[3] weighted by spending by end use
Muni New Equipment & Construction	64%	36%	PERI/IMT,[3] weighted by spending by end use
Muni Direct Install	70%	30%	PERI/IMT,[3] weighted by spending by end use

[1] Estimated share of projects' incremental cost attributed to equipment/materials purchased.
[2] Estimated share of projects' incremental cost attributed to labor by installation contractors, technical/engineering vendors, or other project-specific implementation (i.e., non-overhead, non-administrative) labor.
[3] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012.

3.1.2 Bill impacts review

The team used the bill and rate impact model results filed by the NH Utilities for the 2022–2023 program years to model the economic impacts of customer bill savings due to the NHSaves programs.[25] The evaluation team incorporated these data in our model to quantify the economic impact during the NHSaves programs' savings phase, which occurs once energy efficiency measures are installed and begin to return savings through reduced energy bills. These bill impacts result from participant energy cost savings, system benefit charge costs, and long-term utility system avoided costs. For the NHSaves

[25] Both the B/C model analysis and bill savings analysis reflect the impacts from 2 program years. However, the bill savings reflects a more recent two-year period (2022-2023), because the NH Utilities estimate and file bill savings for the entire period of their filed plans, not for individual years. As such, the available bill savings values were for either the 2021-23 plan, or the 2022-23 plan update. We used the 2022-23 values for our analysis as they reflect a two, not three-year period, and were more recently updated, following the 2021 funding changes.

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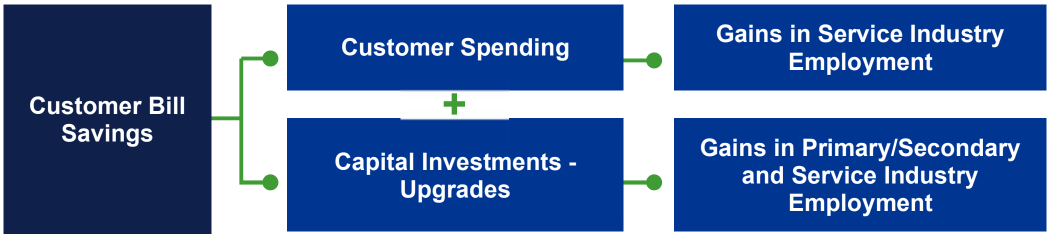
programs, the net impact of these factors are reductions in overall utility system costs and total customer bills.[26] The team's I/O modeling accounts for the impacts of bill savings on the economy as depicted in Figure 3-2.

Figure 3-2. Summary of customer bill savings impacts on the New Hampshire economy



The NH Utilities estimated the bill and rate impacts of the 2022–2023 plan using the model developed by Synapse Energy Economics.[27] The evaluation team used the impacts as modeled by the NH Utilities and filed with the plan,[28] rather than separately re-modeling the impacts. Using this model, the NH Utilities estimated that over the life of the measures installed across all programs, the 2022–2023 programs will reduce the revenue requirements of the regulated electric utilities by -0.4% on average, or -$158.8M in total, and reduce the revenue requirements of the regulated gas utilities by -1.0% on average, or -$58.5M in total.[29] Table 3-6 shows the changes in revenue requirements by utility, as filed.

Table 3-6. Long-term revenue requirement changes due to 2022–2023 plan, by utility

Utility	Percent Change	Dollar Change (millions)
Eversource	-0.40%	($135.70)
Liberty Electric	-0.50%	($16.20)
Unitil Electric	-0.10%	($6.90)
Electric Total	**-0.40%**	**($158.80)**
Liberty Gas	-2.00%	($44.80)
Unitil Gas	-0.40%	($13.70)
Gas Total	**-1.00%**	**($58.50)**

Source: NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

There are several limitations to the rate and bill impact analysis, as described by the NH Utilities in the 2022–2023 plan.[30] Most significantly for purposes of our analysis of the economic impacts of customer bill savings, the rate and bill model is limited to electric and natural gas system cost savings. The NHSaves programs result in significant customer bill savings

[26] As described in the *National Standard Practice Manual,* energy efficiency resources create both upward and downward pressures on rates, and the net impact on rates will be a result of a variety of factors. Energy efficiency creates upward pressure on rates "as a result of (a) the recovery of efficiency program administration and implementation costs; and (b) the recovery of lost revenues resulting from EE programs." It creates downward pressure on rates "as a result of avoided costs, including reduced generation capacity costs, reduced T&D costs including reduced line losses, reduced environmental compliance costs, reduced utility credit and collection costs, and reduced wholesale market prices from price suppression effects." Bill impacts result from these rate impacts, but vary between participants and non-participants, and depend on the level of savings achieved on a customer basis. See National Efficiency Screening Project (NESP), *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, Appendix C*, Spring 2017.

[27] Synapse. New Hampshire Rate, Bill, and Participation Impact Analysis, A User's Guide to the RBP Models, Aug 2020. 20200805-Electric-ME-Report-Guide-To-RBP-Models.pdf (nh.gov)

[28] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

[29] A utility's revenue requirement is the total amount of money it must collect from customers to pay all costs including a reasonable return on investment, and it is approved by regulators as part of a rate case. As detailed in the model user's guide, "to synthesize the rate and bill impacts across the customer sectors, the models estimate the net change in the utility's revenue requirement due to the planned efficiency programs. The change in revenue is dispersed across each rate class differently, depending on the efficiency programs and the rate class structures. Each rate class will experience a different change in revenue and therefore rate impact." Synapse. New Hampshire Rate, Bill, and Participation Impact Analysis, A User's Guide to the RBP Models, Aug 2020. 20200805-Electric-ME-Report-Guide-To-RBP-Models.pdf (nh.gov)

[30] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

from reduced consumption of oil, propane, or other unregulated fuels, particularly among residential customers. These bill savings are not accounted for in the bill and rate impacts filed by the NH Utilities, nor are they accounted for in our analysis. In addition, the values filed by the NH Utilities reflect long-term revenue requirement changes that use the same discount rate assumptions as in the B/C model filed with the 2022–2023 plan (see Section 4.3.3.2). Re-analysis and modeling of the bill and rate impacts of the plan under different discount rate assumptions was not feasible within the timeframe of this study.

3.2 IMPLAN modeling

The core of the economic impact modeling was performed with IMPLAN, which is an industry-standard input-output model developed by the U.S. Forest Service in the 1970s to produce accurate estimates of forest resource economic impacts. IMPLAN allows users to generate three measures of employment changes.[31]

- **Direct employment effects**, which are benefits accruing to industry involved in production and installation activities.
- **Indirect employment effects**, which refer to the changes in industries supplying input to the sectors benefiting directly.
- **Induced employment effects**, which are the second-order effects due to increased consumer spending resulting from the income gains made in the sectors witnessing direct and indirect effects.

In addition to employment impacts, outputs of the IMPLAN model include local, state, and federal GDP impacts and tax impacts associated with the programs. The software accounts for New Hampshire's particular tax regime in the modeling—i.e., no sales tax and limited income tax (interest and dividends income only). The following sections describe the steps the evaluation team took to develop modeling inputs for IMPLAN.

3.2.1 Meta-analysis of energy efficiency I/O literature

The evaluation team began by conducting a search of recent literature on deploying I/O models to estimate the employment effects of energy efficiency programs. The objective of the literature review was to ensure our modeling approach was consistent with other recent research in the field, and we also leveraged the literature to identify certain modeling assumptions such as assumptions for the share of spending on labor and materials across programs.

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. For example, in its analysis of energy efficiency programs in the state of Colorado—also referenced in prior NHSaves program plans—PERI concluded that every million dollars spent on energy-efficient measures, such as building retrofits, supports 6.2 direct jobs, 2.7 indirect jobs, and 3.3 induced jobs.[32] In a similar analysis in Pennsylvania, $1 million in building retrofits was associated with 6.6 new jobs.[33] Recent studies have also examined the impacts of large scale federal and state level programs on macroeconomic indicators such as GDP and employment. We focused our review on studies in the last five years that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs. Section 4.4 provides a summarized comparison of the results of these studies, and APPENDIX A. LITERATURE REVIEW SOURCES provides the full list of studies the team reviewed and Section 4.4 presents a table with the detailed employment intensity numbers from these other studies.

3.2.2 Distribution ratios and industry code matching

Distribution ratios reflect the proportion in which program spending is apportioned across different industries/economic sectors. The evaluation team reviewed the measure-level program spending data from the B/C models, matching them to

[31] The team modeled employment impacts in terms of full-time-equivalent jobs per year. This is a comparable metric to job-years but allows more granular results that can be separately reported for each year of program impacts, rather than reporting a single job-years value representing multiple years of impacts. Also see Pollin, R., Chakraborty, S., Lala, C., Semieniuk, G. *Job Creation Estimates for Colorado Through Inflation Reduction Act Modeling State-Level Impacts of Climate, Energy, and Environmental Provisions,* at https://peri.umass.edu/economists/shouvik-chakraborty/item/download/1037_fd083b171774ebd2af03bd349aa60ee4

[32] See Pollin, R., Wicks-Lim, J., Chakraborty, S., & Hansen, T. (2019). A Green Growth Program for Colorado. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*. Study available at: https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado

[33] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2021). Impacts of the Reimagine Appalachia & Clean Energy Transition Programs for Pennsylvania. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*.

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industry-specific codes from IMPLAN, which are primarily built on a dataset of 546[34] economic sectors. These sector definitions are based on the North American Industry Classification System (NAICS) codes published by the US Office of Management and Budget.[35] This matching process was used to develop distribution ratios (also referred to as Bills of Goods[36,37,38]) across different industries, reflecting the flow of program dollars to sectors (e.g., construction) and sub-sectors (e.g., materials processing).

Given the level of detail in the NH Utilities' B/C model, the evaluation team was able to allocate measure-level rebate spending to the relevant industries with a high degree of accuracy, for each utility over the two-year period being studied. The ability to deploy information directly from the NH Utilities' B/C models provides this analysis a greater level of detail and depth than most prior I/O modeling-based analyses. Studies typically deploy top-down approaches that either rely on distributing total program spending across industrial sectors based on assumed distribution ratios[39,40] or more recently, with PERI's analysis in Maine[41] that uses target energy intensity numbers to estimate the overall clean energy potential and total required spending on clean energy projects.

To take advantage of the granular, measure-level program spending data, we modeled the effects of each sub-program individually, distributing each measure-level spending value into materials and labor costs (Table 3-1). IMPLAN allows users to model economic impacts in different ways.[42] One of these approaches is setting up each activity as a commodity event. Commodity events are not tied to specific industries and allow for flexibility when estimating the effects of output from different industries. As an example, electricity can be produced from different sources such as fossil fuels, renewable energy, or nuclear energy. Instead of modeling each source of electricity generation separately, by deploying the effect as a commodity event, the study modeled the overall effect of electricity. All material components and labor inputs were modeled as commodity events for the relevant commodity sectors summarized in APPENDIX B. IMPLAN METHODS.

For program rebate spending on materials (e.g., insulation, light bulbs, HVAC equipment, etc.), it is important to account for in- and out-of-state production and purchase of material inputs. To address this, the team modeled two different scenarios for IMPLAN's local purchase percentage (LPP) values. LPP indicates the share of each measure's total economic effect that will be retained within the region being examined (in this case, the state of New Hampshire).[43] Specifically, LPP ratios represent the extent to which the model assumes commodities are purchased from in-state manufacturers or wholesalers. In applying LPP values, users can supply their own estimates or use IMPLAN's internal values. The team modeled two scenarios for LPP—a conservative and an aggressive scenario:

- For the conservative scenario, the team allowed IMPLAN to determine this ratio using the regional purchase coefficient (RPC)[44] included within the software. The regional purchase coefficient values reflect the proportion of total demand in the state that is supplied by local producers. For example, if the RPC of a particular commodity is 50%, that would imply that half the total demand for the commodity is supplied locally. The RPCs included in the version of IMPLAN deployed in this study are estimated econometrically based on economy-wide trade flow data.

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[34] https://support.implan.com/hc/en-us/articles/360058813353-546-Industries-Conversions-Bridges-Construction-2019-Data
[35] The only exception to the IMPLAN-NAICS links relevant for this study is the construction sector in IMPLAN which is based on the type of building structures from the Bureau of Economic Analysis' Benchmark Input-Output model. See https://support.implan.com/hc/en-us/articles/115009674668-Sectoring-Schemes and https://support.implan.com/hc/en-us/articles/115009505667-Special-Industry-Definitions
[36] Brown, M. A., Soni, A., & Li, Y. (2020). Estimating employment from energy-efficiency investments. *MethodsX, 7, 100955.*
[37] Brown, M. A., Li, Y., & Soni, A. (2020). Are all jobs created equal? Regional employment impacts of a US carbon tax. *Applied Energy, 262, 114354.*
[38] Baer, P., Brown, M. A., & Kim, G. (2015). The job generation impacts of expanding industrial cogeneration. *Ecological Economics, 110, 141-153.*
[39] Baer, P., Brown, M. A., & Kim, G. (2015). The job generation impacts of expanding industrial cogeneration. *Ecological Economics*, *110*, 141-153.
[40] Pollin, R., Garrett-Peltier, H., Heintz, J., & Hendricks, B. (2014). Green growth: A US program for controlling climate change and expanding job opportunities. *Center for American Progress*, 2.
[41] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2020). A program for economic recovery and clean energy transition in Maine. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*.
[42] https://support.implan.com/hc/en-us/articles/360019638713-Explaining-Event-Types
[43] https://support.implan.com/hc/en-us/articles/115009499327-Local-Purchase-Percentage-LPP-
[44] https://support.implan.com/hc/en-us/articles/115009499527-Regional-Purchase-Coefficient

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- To compute more aggressive in-state effects, the study also deployed a 100% LPP with the assumption that all commodities could be purchased from local manufacturers or wholesalers.

For project installation labor, the team redistributed the program spending on labor across the major construction sectors in IMPLAN. For residential programs these include construction, and repair and maintenance of new residential buildings (single and multi-family). For non-residential programs, we split the spending values between construction of new health care, manufacturing, power and communications, and educational and vocational structures and between new construction and maintenance/repair of non-residential structures.

The team also developed distribution ratios for the program-level costs of administration, internal implementation, services, marketing, and evaluation, in alignment with the NH Utilities' accounting definitions for those cost categories. Specifically, we attributed those costs to IMPLAN industry sectors representing management and consulting services. To allow for accurate within state impacts, we modeled these administrative costs as commodity outputs. Since the evaluation team, in consultation with utilities, had established that internal administration and implementation spending remains in-state (Table 3-1), the LPP values for these spending categories were set at 100%. For other administrative expenses (external administration, marketing, evaluation, and services), the study estimated two scenarios—first, where the passthrough to New Hampshire-based employees is 50% and, second, where the pass-through falls to 25%, as shown in Table 3-4. In all cases, the effects are modeled as commodity events allowing us to compute the indirect (material and supplies effects) and the induced effects of additional direct employment in the management and consulting services sectors, which include employee compensation, materials, supplies, and other overhead.

The full table of matched industry codes is provided in APPENDIX B. IMPLAN METHODS.

3.2.3 Modeling bill savings effects

As noted in Section 3.1.2, the team modeled bill savings effects using the bill and rate impact model results filed by the New Hampshire utilities. Since the programs witnessed uncertainties and funding instability in 2021, the team relied on the most up-to-date filings from March 1, 2022, reflecting the 2022-23 plan.[45] The reduction in revenue requirements for the regulated electric and gas utilities due to the 2022–2023 programs was estimated to be $217.3 million in total across all utilities, all customer sectors, and both years of the plan. The impact of customer bill savings varies across customer sectors, due to their different financial circumstances and organizational structures. To apportion these bill savings across the low-income, residential, and C&I sectors, the team apportioned the bill savings for each sector according to that sector's projected lifetime kWh and MMBtu savings for electricity and gas, respectively, from the 2022-23 plan, as shown in Table 3-7.

Table 3-7. NHSaves projected bill savings distributed across sectors

Sector	Share of 2022–2023 lifetime electric savings	Share of 2022–2023 lifetime gas savings	Reallocated electric bill savings	Reallocated gas bill savings	Total bill savings
Low-Income	2.5%	6.7%	$3,917,172	$3,947,093	**$7,864,265**
Residential	20.2%	33.8%	$32,150,545	$19,787,417	**$51,937,961**
Commercial & Industrial	77.3%	59.4%	$122,732,283	$34,765,490	**$157,497,773**
Total	**100%**	**100%**	**$158,800,000**	**$58,500,000**	**$217,300,000**

The bill savings values for each sector were used to compute the employment effects of lower energy spending across the three sectors. It should be noted that these effects will materialize over long periods of time. As noted in the 2022–2023 plan filings, many of these measures last for close to two decades—the average measure life was 12.2 years for 2022 planned electric measures, and 16.6 for planned gas measures—and the total job gains are distributed over the entire period.

[45] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

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Residential sector bill savings

The residential sector bill savings impact analysis is based on reapportionment of residential savings across different income categories. IMPLAN's state-level descriptive data includes shares of households by annual income levels. Since the residential programs are available to all types of households, we assume that savings from reduced energy bills are distributed proportionally across the different income levels, as shown in Table 3-8.[46]

Table 3-8. New Hampshire household annual income distribution and bill savings allocation

Income category	Number of households	% of total	Bill savings by household income category
Households <$15k	3,792	7%	$3,455,758
Households $15-30k	58,625	10%	$5,343,840
Households $30-40k	41,089	7%	$3,745,338
Households $40-50k	39,077	7%	$3,562,006
Households $50-70k	78,551	14%	$7,160,102
Households $70-100k	99,079	17%	$9,031,328
Households $100-150k	107,835	19%	$9,829,410
Households $150-200k	52,352	9%	$4,772,035
Households >$200k	55,272	10%	$5,038,146
Total	**569,793**	**100%**	**$51,937,961.38**

Source: IMPLAN demographics data for New Hampshire

As noted earlier, IMPLAN allows for modeling energy bill savings as additional household income, which results in employment gains through induced spending by households. Since bill savings are modeled as gains in income, they only flow through the economy as induced effects and not direct or indirect effects on the economy. Since households do not engage in direct production activity, this "additional" income is then used in induced economic activity (e.g., restaurant services, recreation).

Low-income sector bill savings

The evaluation team modeled low-income customer bill savings based on the share of 2022-23 planned savings for the low-income Home Energy Assistance (HEA) program. HEA is an income-targeted program generally serving participants with household income that is at or below 60 percent of the state median income for their household size.[47] The average household size in New Hampshire is 2.46 persons.[48] For households with three persons, 60% of the state median income equates to $62,950, so we allocated the low-income bill savings for both electricity and gas proportionally among households with annual incomes of less than $70,000 (see Table 3-9). As with residential bill savings, since low-income

[46] This is a simplifying assumption made for purposes of this review. In reality, savings are likely distributed unevenly across income levels, with higher income households seeing greater levels of savings due to higher baseline energy consumption driven by factors such as larger home sizes and more energy-using equipment (e.g., central air conditioning). As a result, this analysis may overstate the impacts of low-income participant bill savings and understate the impacts of higher-income residential participant bill savings. Further analysis of household savings distribution was not possible within the scope and timeline of this study.

[47] Program eligibility requirements also allow for serving customers who are eligible for the New Hampshire Electric Assistance Program, or anyone residing in subsidized housing or municipal or nonprofit organizations serving those in need. See https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/assistance-programs-eligibility for information on program eligibility.

[48] https://www.census.gov/quickfacts/NH

savings accrue directly to households, we modeled them as additional household income, which results in induced economic activity (e.g., services, recreation).

Table 3-9. New Hampshire low-income distribution and bill savings allocation

Income category	Share of households below $70,000 annual income	Program savings share (IMPLAN inputs)
Households <$15k	15%	$1,168,041
Households $15-30k	23%	$1,806,219
Households $30-40k	16%	$1,265,928
Households $40-50k	15%	$1,203,959
Households $50-70k	31%	$2,420,118
Total	**100%**	**$7,864,265**

Source: IMPLAN demographics data for New Hampshire

C&I sector bill savings

The team followed a somewhat different approach for modeling commercial and industrial sector bill savings. As noted above, IMPLAN provides information across 546 industry/commodity sectors, which we used to identify the share of different sectors across the state's economy. The team then apportioned the total C&I savings across different sectors in the same proportion as the share of these sectors in the state's output. We assume that all C&I sector savings are redirected towards additional industry activity, and model these impacts as industry output in the same proportion as the share of these sectors industries in the total output, shown in Table 3-10. IMPLAN defines total output as the monetary value of the total production in any sector. In other words, total output reflects the production for each industry in a given year plus the net inventory changes in the sector. We used output as the basis for reapportioning the total savings across all major sectors/industries since it provides a good picture of the total share of each sector in the state's economy.

Table 3-10. Share of industries in the New Hampshire output[1]

Description	Share of economic output
11 - Agriculture, Forestry, Fishing and Hunting	0.2%
21 - Mining, Quarrying, and Oil and Gas Extraction	0.2%
22 - Utilities	1.7%
23 - Construction	5.5%
31-33 - Manufacturing	15.3%
42 - Wholesale Trade	6.6%
44-45 - Retail Trade	6.1%
48-49 - Transportation and Warehousing	1.5%
51 - Information	3.9%
52 - Finance and Insurance	8.7%
53 - Real Estate and Rental and Leasing	11.7%
54 - Professional, Scientific, and Technical Services	8.3%
55 - Management of Companies and Enterprises	2.9%

Description	Share of economic output
56 - Administrative and Support and Waste Management and Remediation Services	3.5%
61 - Educational Services	1.1%
62 - Health Care and Social Assistance	7.8%
71 - Arts, Entertainment, and Recreation	1.1%
72 - Accommodation and Food Services	4.1%
81 - Other Services (except Public Administration)	2.9%
9A - Government Enterprises	0.8%
9B - Administrative Government	6.0%
Total	**100.0%**

[1]Output = total production + net inventory changes[49]

3.3 Expert interviews

To provide context for the I/O modeling results, the evaluation team interviewed individuals from ten organizations with expertise and knowledge of the NHSaves programs. These interviewees included two vendors and three large, multi-project participants in the NHSaves programs. The interviews covered topics including (1) NHSaves program impacts on workforce and customers, including impacts from recent regulatory decisions and changes in funding levels, (2) the flow of program funding to in-state and out-of-state recipients, (3) local workforce needs and opportunities, (4) how changes in energy bills impact other spending by customers. Table 3-11 provides a list of organizations interviewed for the study.

Table 3-11. Organizations interviewed on NHSaves' economic impacts

Interviewee Organization	Description
ACEEE	Non-profit organization promoting energy efficiency via technical and policy analyses, advisory services, and collaborative partnerships
BAE Systems	Large industrial customer with energy-intensive engineering and laboratory facilities in New Hampshire. *NHSaves participant*
GDS Associates, Inc.	Engineering and energy consulting firm. *NHSaves vendor*
Lake Region Community Developers	Community-based affordable housing development and services non-profit. *NHSaves participant*
NH Business and Economic Affairs	State agency created to enhance the economic vitality of New Hampshire and promote it as a destination for domestic and international visitors
NH Department of Environmental Services, Air Division	State agency created to protect and restore the environment and public health in New Hampshire through wise management of the state's environment
NH Community Development Finance Authority	Quasi-governmental agency providing technical assistance and financing to support community economic development initiatives
NH Department of Energy	State agency created to promote and coordinate energy policies and programs in the state
Resilient Buildings Group	Consulting firm providing energy efficient building management and construction services. *NHSaves vendor*

[49] https://support.implan.com/hc/en-us/articles/360035998833-Understanding-Output

University of New Hampshire Facilities Management	Department providing professional services for University renovation, repair, and new construction projects. *NHSaves participant*

3.4 Health impacts modeling

Energy efficiency programs can offer benefits to individuals, businesses, and society, including lower energy bills and improved grid reliability, as well as a range of public health impacts. These health impacts can include reductions in the frequency and/or severity of health problems caused by emissions and other outputs of fuel combustion and extraction required for supply-side resources. Such health impacts have been widely researched and include reductions in the number of premature deaths, incidences of respiratory and cardiovascular illnesses, and missed days of work and school. There are a range of economic benefits associated with these health impacts, including reduced medical costs, and increased economic productivity of the impacted population.

New Hampshire's energy-related statutes and Commission orders frequently mention public health, and New Hampshire stakeholders previously considered these impacts for purposes of cost-effectiveness testing of the NHSaves programs, although they ultimately decided against including public health impacts in the Granite State Test (GST). As noted above, the economic impacts modeled in this study are additional to program cost-effectiveness.[50]

The evaluation team estimated the economic value of the health benefits associated with the NHSaves programs using EPA's Co-Benefit Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) and Avoided Emissions and Generation Tool (AVERT).

- COBRA is an EPA software tool that produces estimates of public health and associated economic impacts due to changes in air pollution stemming from energy policies and programs. Researchers can model multiple scenarios by specifying increases or decreases in criteria pollutants, as well as discount rates options.[51] COBRA relies in part on epidemiological models for the statistical value of life and changes in adult mortality and non-fatal heart attacks.
- AVERT is an EPA software tool designed to estimate the impact of energy programs and policies on the emissions produced by the power sector. AVERT estimates annual marginal rates of avoided criteria pollutants such as particulate matter (PM2.5), nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon dioxide (CO_2), volatile organic compounds (VOC), and ammonia (NH_3) from electric power plants at a county, state, or regional level.

The team used COBRA to model the economic value of the health benefits associated with emissions reductions caused by the NHSaves programs. For electric programs, the team used AVERT to estimate those emissions reductions, and for gas programs, the team used EPA emissions factors for residential and business end-user combustion to estimate criteria pollutants. See APPENDIX C. AVERT AND COBRA METHODS for more details on the sources and methods used for this analysis.

Limitations. COBRA and AVERT are useful for modeling the overall health impacts of changes in criteria pollutants, but both have limitations that should be considered in applying the results.

- AVERT provides a snapshot of regional electricity dispatch and does not consider changes in dispatch over time due to fuel prices, curtailments, transmission system changes, or other factors. Therefore, the use of AVERT for forward

[50] Cost-effectiveness testing is used to screen programs to determine which have benefits that exceed their costs, and therefore merit using ratepayer dollars to fund. Despite New Hampshire stakeholders' decision to exclude public health impacts from cost-effective testing under the GST, there is clear evidence that energy efficiency programs produce public health benefits that result in economic impacts for the state.

[51] COBRA uses a discount rate to express future economic values in present terms because not all health effects and associated economic values occur in the year of analysis. COBRA assumes changes in adult mortality and non-fatal heart attacks occur over a 20-year period. EPA recommends using both 3% and 7% discount rates. The 3% interest rate corresponds to the interest rate on government backed securities, whereas the 7% interest rate reflects the opportunity costs of capital.

looking scenarios is not recommended.[52] In addition, AVERT models generation dispatch impacts at the regional level, agnostic of the location of electricity reductions. In reality, dispatch decisions are location sensitive.

- COBRA also has limitations in the applicability of its results over time. Each COBRA run represents benefits from emissions reductions in a specific year, based on epidemiological models embedded in the software, which use demographic profiles and other information that reflects impacts for a specific point in time. To analyze multiple years of emissions impacts, the model should be separately run for each year and the results aggregated for each run.

The team modeled the annual emissions reductions and associated health impacts of the 2021 NHSaves programs. It is important to note that these modeling results are based on first year savings only, so they reflect only annual, one-year impacts, and not the full impacts of the savings from the 2021 measures over their useful lives. The limitations noted above should be considered if applying these results to programs' lifetime savings.

[52] For detail, see AVERT User Manual Version 2.3 (epa.gov)

4 RESULTS

4.1 Employment effects

The following section details the employment effects of the 2021 and 2022 NHSaves programs, during both their implementation phase (2021–2022) and savings phase (implementation through the end of measures' useful lives). Except where noted, all economic impacts presented in this report reflect impacts on the New Hampshire economy specifically. All employment effects reflect full-time-equivalent (FTE) jobs. [53] Note that employment effects during the implementation phase represent jobs that are created for one program year (2021 or 2022), and so the number of jobs is equivalent to the number of job-years. Employment effects during the savings phase occur in proportion to customer bill savings, over the useful life of the measures installed by the programs. As such, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.

For the implementation phase, as detailed in Section 3.1.1, the team used programs' free-ridership-adjusted total resource cost (TRC) data to estimate the direct, indirect and induced employment effects of program rebates for the 2021 (actual) and 2022 (planned) program years.[54] The team also estimated the effects of internal and external administrative spending on total employment under different scenarios. For the savings phase, the team used the bill and rate impact model results filed by the NH Utilities for the 2022–2023 program years to model the economic impacts of customer bill savings due to the NHSaves programs. Customer bill impacts result from participant energy cost savings, system benefit charge costs, and long-term utility system avoided costs. For the NHSaves programs, the net impact of these factors are reductions in overall utility system costs and customer bills. The following sub-sections describe the findings in greater detail.

4.1.1 Implementation phase

In the conservative LPP scenario,[55] the NHSaves programs generated approximately 756 jobs in 2021 and 703 jobs in 2022—approximately 10 jobs per $1 million in program spending, in both years, as shown in Table 4-1 and Table 4-2. It is important to note that in addition to employment generated from program rebates, the management and implementation of energy efficiency programs is also associated with many local jobs. As described earlier, the study modeled the effects of internal administrative expenses as well as external administration costs including services, marketing, and evaluation. In the conservative scenario, administration and services employment contributes over 40% of the total employment created in 2021. In the aggressive LPP scenario,[56] the share of jobs from program rebates increases, and the share of administration and services-based employment effects decreases to about a third and a quarter of the total jobs generated in 2021 and 2022, respectively.

At the program and sub-program level, there are a range of employment effects, which vary based on two factors.

1. The total number of jobs associated with a program is driven in part by the size of the program budget. For instance, in terms of total jobs, the four programs with the largest budgets—LBES, SBES, HEA, and HPwES—also created the largest number of jobs in both years.
2. The total number of jobs associated with a program is also driven by its employment intensity—that is, the number of jobs created for every $1 million in program spending. At over 14 jobs per million in program spending in 2021 and

[53] FTEs measure total full-time, part-time, and temporary employees, based on the total number of hours worked divided by the number of hours in a full-time schedule.

[54] In most cases, program spending on rebates is accompanied by participant contributions toward the cost of energy efficiency upgrades. The NH Utilities' B/C models include measure-level TRC data, which reflects the total incremental cost of an energy efficiency measure relative to the baseline measure—including both the program's and the participant's share. Participant contributions are attributable to some extent to the programs, but the extent of attribution varies by program, measure type, and other factors. Attribution levels are reflected in the NH Utilities' B/C models via free-ridership and spillover estimates for certain measure types and delivery pathways, such as midstream and lighting offerings, taken from neighboring jurisdictions. For purposes of our analysis, the evaluation team used these factors to estimate the share of customer contributions that could be attributed to the programs.

[55] Where LPP was set equal to RPC, as described in Section 3.2.2. LPP indicates the share of the economic effect of rebated measures that will be retained within the region being examined (in this case, the state of New Hampshire). Specifically, LPP ratios represent the extent to which the IMPLAN model assumes commodities are purchased from in-state manufacturers or wholesalers.

[56] Where LPP was set to 100%.

2022, ES Homes had the highest employment intensity, and HPwES also had high employment intensity at nearly 14 jobs per million in 2021. At the other end of the range, ES Products had the lowest employment intensity in both years, followed by the Home Energy Reports program. These differences are due to programs' different distribution ratios, which reflect the proportions in which program spending is apportioned across different industries/economic sectors. For example, ES Homes and HPwES require relatively more material and local project construction or installation contractors, whereas the Home Energy Reports program primarily involves spending on labor and overhead.

It is important to note that the employment effects of different programs do not reflect a comprehensive accounting of the costs and benefits of the programs. Cost-effective energy efficiency programs, by definition, provide a lower-cost alternative to supply-side resources. Even programs with negligible local employment impacts, if cost-effective, have net benefits that ensure they return more to the state's ratepayers in terms of avoided system costs and other energy and non-energy benefits than they cost. Table 4-1 and Table 4-2 show the employment estimates by sub-program for 2021 and 2022, including jobs from program rebates, administration and services-based jobs, and jobs per $1 million in program spending.

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Table 4-1. New Hampshire implementation period FTE employment estimates, 2021 program year (actual)[1]

Program	Sub-program	Total Program Costs	Conservative LPP: Rebate Employment	Conservative LPP: Administration and Services Employment	Conservative LPP: Jobs per million $ in program costs	Aggressive LPP: Rebate Employment	Aggressive LPP: Administration and Services Employment	Aggressive LPP: Jobs per million $ in program costs
ES Homes		$3,449,257	34.81	13.75	14.08	35.18	13.75	14.18
HPwES	Weatherization	$11,263,490	94.20	62.33	13.99	100.04	62.33	14.67
	HVAC Systems		0.98			2.82		
	3rd Party Financing		0.01			0.01		
ES Products	Lighting	$9,735,295	1.58	36.52	4.78	8.86	36.52	10.39
	Appliances		4.53			23.05		
	HVAC Systems		3.94			32.69		
Home Energy Reports		$555,043	1.52	2.63	7.47	1.73	2.63	10.95
Residential Active Demand Response		$159,209	0.001	1.38	8.71	0.15	1.38	9.65
HEA	Weatherization	$14,464,427	65.45	51.67	9.77	87.23	51.67	12.04
	HVAC Systems		24.15			35.27		
LBES	Retrofit	$15,892,231	77.64	71.48	11.31	159.70	71.48	18.65
	New Equipment & Construction		28.92			55.20		
	Midstream		1.65			10.06		
SBES	Retrofit	$16,471,108	40.32	70.23	9.25	73.50	70.23	15.85
	New Equipment & Construction		20.77			27.35		
	Midstream		12.21			63.61		
	Direct Install		8.83			26.45		
Municipal	Retrofit	$1,879,379	7.04	8.32	10.58	16.06	8.32	18.99
	New Equipment & Construction		3.50			8.24		
	Direct Install		1.03			3.07		
Others[2]		$833,240	0.01	4.58	3.35	2.36	4.58	8.32
Total		**$74,702,678**	**433.07**	**322.90**	**10.12**	**774.35**	**322.90**	**14.69**

[1] All impacts represent incremental effects of each program year independently, relative a no-program counterfactual.
[2] Other programs include C&I active demand and education, residential education, and Energy Rewards RFP.

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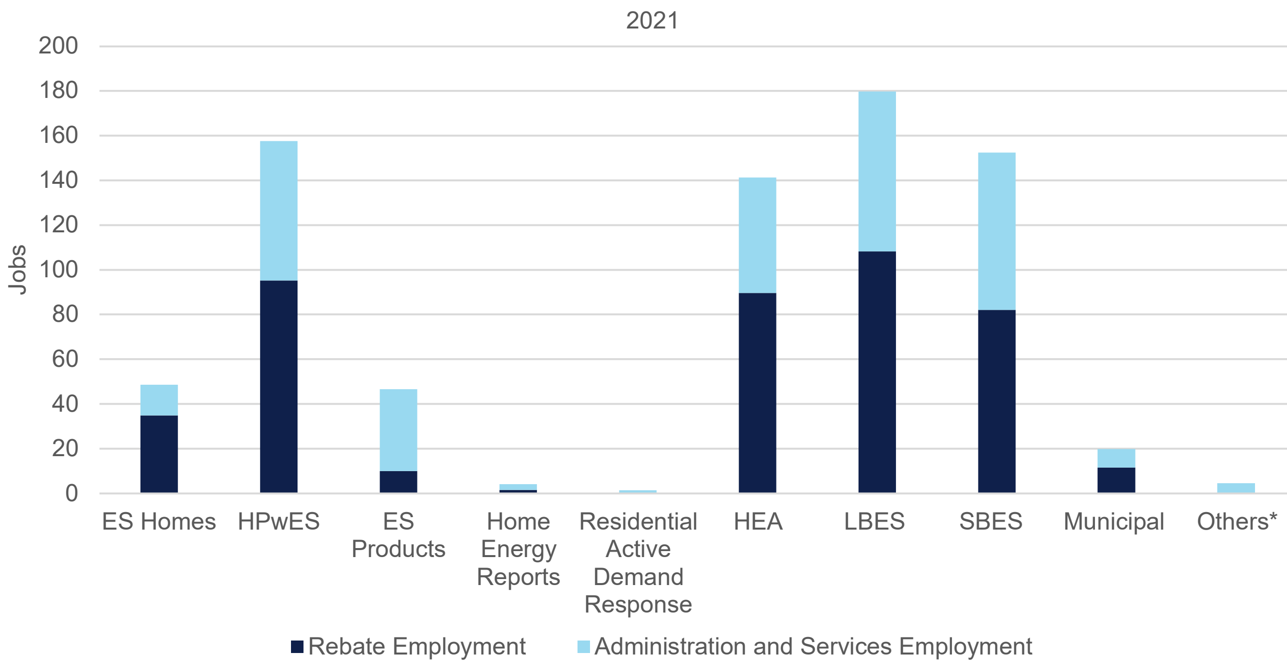
Table 4-2. New Hampshire implementation period FTE employment estimates, 2022 program year (plan)[1]

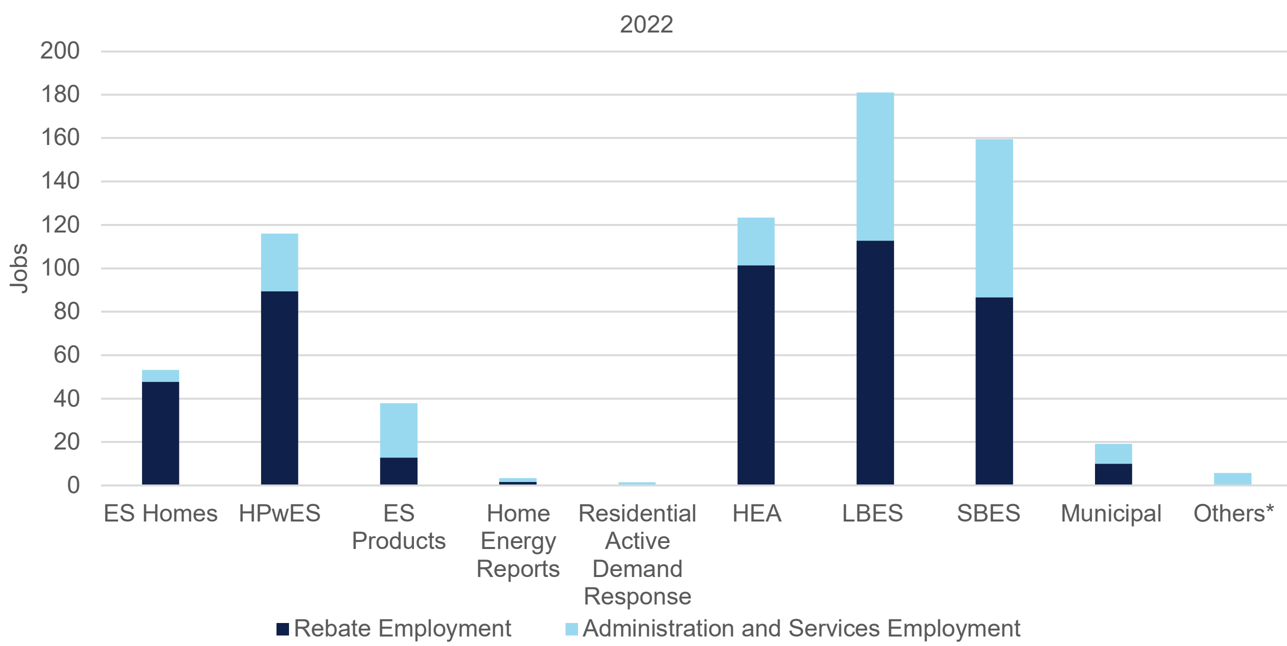
Program	Sub-program	Total Program Costs	With LPP (Conservative estimates)			Without LPP (Aggressive estimates)		
			Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs	Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs
ES Homes		$3,979,650	47.70	5.44	15.34	48.01	5.44	13.43
HPwES	Weatherization	$10,794,370	88.30	26.53	10.74	93.46	26.53	11.41
	HVAC Systems		1.09			3.11		
	3rd Party Financing		0.03			0.03		
ES Products	Lighting	$7,600,158	0.91	25.02	4.97	2.59	25.02	11.47
	Appliances		5.36			16.22		
	HVAC Systems		6.52			43.38		
Home Energy Reports		$483,512	1.60	1.81	7.04	3.63	1.81	11.24
Residential Active Demand Response		$190,156	0.00	1.47	7.73	0.00	1.47	7.73
HEA	Weatherization	$14,066,713	69.56	21.93	8.77	74.39	21.93	10.53
	HVAC Systems		31.84			51.85		
LBES	Retrofit	$14,558,651	82.66	68.22	12.44	159.17	68.22	19.70
	New Equipment & Construction		28.72			52.92		
	Midstream		1.44			6.05		
SBES	Retrofit	$15,279,584	47.47	72.83	10.44	86.11	72.83	17.69
	New Equipment & Construction		18.75			41.60		
	Midstream		9.33			35.81		
	Direct Install		11.15			33.93		
Municipal	Retrofit	$1,943,528	7.10	9.10	9.85	15.71	9.10	16.22
	New Equipment & Construction		2.94			6.72		
	Direct Install		0.00			0.00		
Others[2]		$1,561,498	0.00	5.70	5.45	0.00	5.70	5.45
Total		**$70,457,819**	**462.46**	**240.84**	**9.98**	**775.15**	**240.84**	**14.42**

[1] All impacts represent incremental effects of each program year independently, relative a no-program counterfactual
[2] Other programs include C&I active demand and education, residential education, and Energy Rewards RFP.

Figure 4-1 shows the total employment results from the 2021 and 2022 NHSaves programs, by program and type of program spending—customer rebate or administration and services spending. As shown, rebate spending is the driver of most employment for all programs, except for ES Products, which due to its midstream/upstream design, involves relatively less project installation labor and therefore lower local employment effects.

Figure 4-1. Total employment estimates for the 2021 and 2022 NHSaves programs, by program[1]

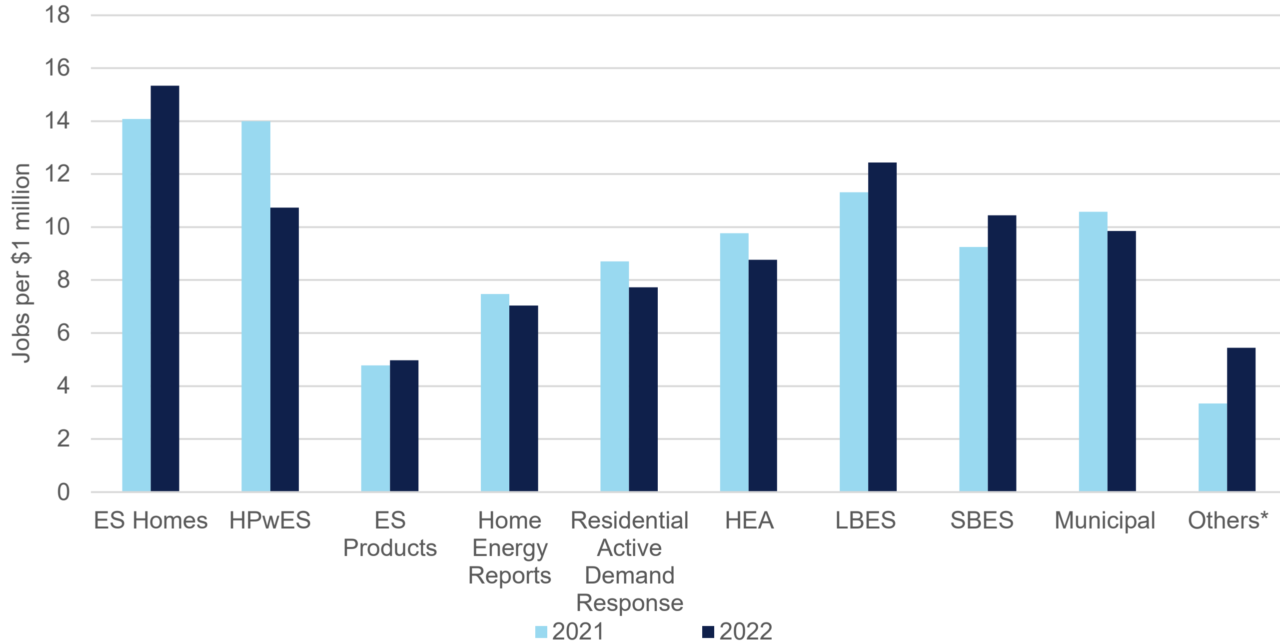




[1]Results shown for the conservative LPP scenario.

Figure 4-2 shows employment intensity—in terms of jobs per $1 million in program spending—for each NHSaves program in 2021 and 2022. As noted above, ES Homes had the highest employment intensity at over 14 jobs per million in 2021 and 2022, and HPwES also had high employment intensity at nearly 14 jobs per million in 2021.

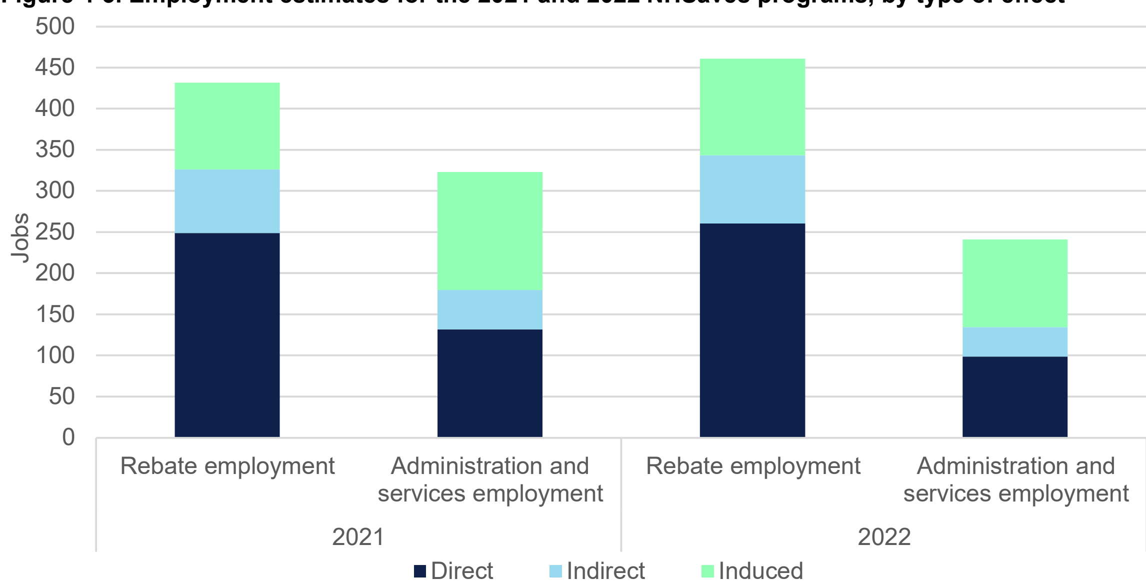
Figure 4-2. Employment intensity estimates for the 2021 and 2022 NHSaves programs, by program[1]



[1]Results shown for the conservative LPP scenario.

Figure 4-3 shows employment estimates for 2021 and 2022 by type of effect—direct, indirect, and induced—and type of program spending. As shown, customer rebates generated the largest share of jobs, primarily through direct employment effects—i.e., employment in industries involved in production and installation activities.

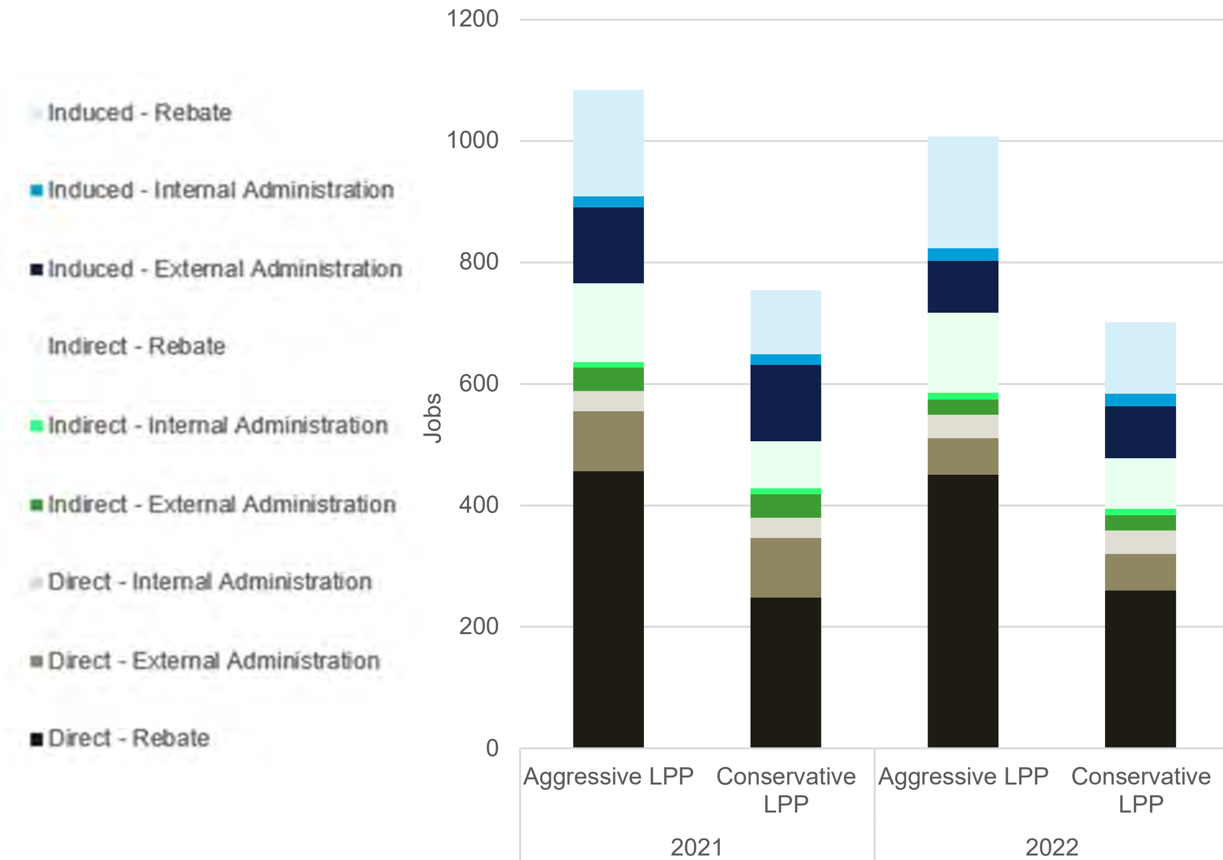
Figure 4-3. Employment estimates for the 2021 and 2022 NHSaves programs, by type of effect[1]



[1]Results shown for the conservative LPP scenario.

Figure 4-4 further breaks out employment, by type of effect, program spending, and LPP scenario (conservative or aggressive). As shown, the increase in jobs between the scenarios is due to increased rebate-generated employment, particularly for direct employment effects.

Figure 4-4. Employment estimates for 2021 and 2022 NHSaves programs, by scenario and type of effect



4.1.2 Savings phase

As shown in Section 3.2.3, the NH Utilities estimated that the 2022–2023 NHSaves programs will result in over $217 million in total customer bill savings over the useful life of the measures installed.[57] These bill savings result in increased customer (e.g., household) spending and industrial investment and outputs, which in turn create employment gains across sectors. The total NHSaves projected customer bill savings for the low-income, residential, and C&I sectors are estimated to result in about 1480 additional job years. (As noted above, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.)

The bill savings estimates the team modeled were limited to projected savings in electricity and natural gas bills. New Hampshire households also rely on delivered fuels such as oil and propane, and the NHSaves programs result in significant reductions in delivered fuel consumption, with associated bill savings.[58] Bill savings for those fuels were not included in the

[57] Both the B/C model analysis and bill savings analysis reflect the impacts from 2 program years. However, the bill savings reflects a more recent two-year period (2022-2023), because the NH Utilities estimate and file bill savings for the entire period of their filed plans, not for individual years. As such, the available bill savings values were for either the 2021-23 plan, or the 2022-23 plan update. We used the 2022-23 values for our analysis as they reflect a two, not three-year period, and were more recently updated, following the 2021 funding changes.

[58] According to the 2022-2023 NHSaves Plan, the programs will result in savings of 3.6 million MMBtu from delivered fuels such as oil and propane over the lifetime of the measures installed in 2022 and 2023—compared to projected savings of 5.4 million lifetime natural gas MMBtu.

analysis since the NH Utilities' bill and rate models do not include delivered fuel impacts. As such, the results of this analysis reflect a conservative estimate of the economic impacts of customer bill savings.

The overall increase in jobs for each sector closely mirrors the distribution of bill savings. Because the C&I sector sees both direct, indirect, and induced effects, it has the highest employment intensity at 7.3 job years per $1 million in bill savings. Among households, the low-income sector showed a slightly higher employment intensity (6.06 job years per $1 million) than the residential sector overall (5.45 jobs per $1 million). Table 4-3 shows the modeled bill savings employment effects for the 2022–2023 NHSaves programs.

Table 4-3. Bill savings employment effects, 2022–2023 programs

Sector	Employment (job years generated)				Total bill savings	Job years per million	Share of job years generated	Share of total bill savings
	Direct	Indirect	Induced	Total job years				
Low Income	N/A[1]	N/A[1]	47.67	47.67	$7,864,265	6.06	3.2%	3.6%
Residential	N/A[1]	N/A[1]	283.16	283.16	$51,937,961	5.45	19.1%	23.9%
C&I	697.89	176.37	275.41	1149.67	$157,497,773	7.30	77.7%	72.5%
Grand Total				**1480.49**	**$217,300,000**	**6.81**	**100%**	**100%**

[1]Because residential and low-income bill savings accrue to households which are not engaged in direct production and employment activities, these bill savings result in induced effects but not direct or indirect effects.

4.1.2.1 Residential sector bill savings

Long-term residential sector bill savings (approximately $52 million) were associated with a little over 283 additional job years over the life of the residential program measures. Household bill savings employment effects are modeled as induced effects (e.g., increased household spending on services), and the effects accrue to households in proportion to their share in the state. Households with annual incomes between $70,000-$100,000 contributed the largest number of total induced job years (52.50), in part because they are one of the largest household income brackets in the state, at 17% of all New Hampshire households (see Table 3-8). In terms of employment intensity (job years per $1 million in bill savings), households between $15,000 and $30,000 in annual income showed the highest intensity at 6.5 additional job years per $1 million, while households with over $200,000 in annual income showed the lowest intensity, at 3.37 per $1 million, as shown in Figure 4-5.

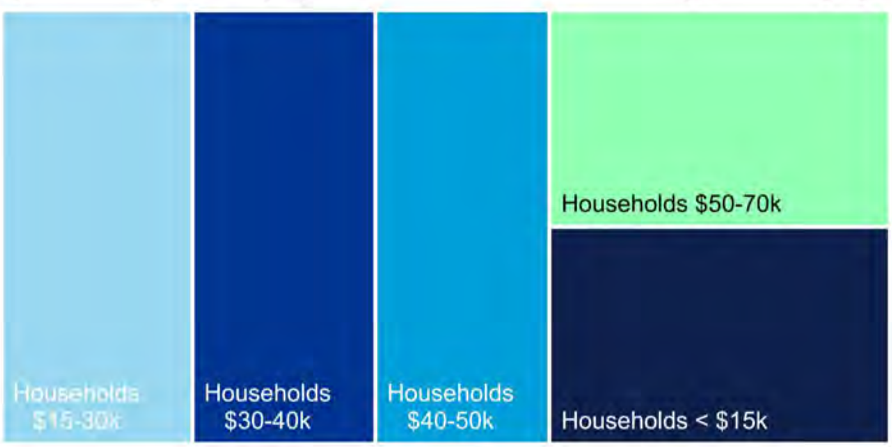
Figure 4-5. Projected employment effects of residential energy bill savings (job years per $1 million)[1]

[1] Residential bill savings were modeled as income gains for households. The figure reflects employment intensity, in job years per $1 million in residential customer bill savings, by annual household income bracket.

4.1.2.2 Low-income sector bill savings

Long-term low-income sector bill savings (approximately $8 million) were associated with a little over 47 additional job years over the life of these program measures. The largest number of total job years accrue to households with annual income between $50,000 and $70,000, again because they represent the largest share of low-income New Hampshire households (31% of low-income households, as shown in Table 3-8). As shown in Figure 4-6, employment intensity is relatively uniform across low-income household income brackets, with all brackets creating 5.8 and 6.5 job years per $1 million in bill savings.

Figure 4-6. Projected employment effects of low-income energy bill savings (job years per $1 million)[1]



[1] Low-income bill savings were modeled as income gains for households. The figure reflects employment intensity, in job years per $1 million in low-income customer bill savings, by annual household income bracket.

4.1.2.3 C&I sector bill savings

Total C&I sector long-term bill savings of $158 million were associated with nearly 1,150 additional job years during the life of the program measures. Since the commercial and industrial sector savings were modeled as increases in industry production, the employment effects included direct (~698 job years), indirect (~176 job years) and induced (~275 job years) effects. Health care and social assistance sectors had the largest effects, with over 142 job years generated, followed by the professional, scientific, and technical sector and the manufacturing sector at 124 and 104 job years, respectively. In terms of employment intensity, the other services sector had the highest intensity at 14.6 job years per $1 million in savings, followed by the education services sector at 13.17 job years per $1 million. The wholesale trade sector had the lowest intensity at 1.1 job years per $1 million. Figure 4-7 shows the distribution of employment effects across C&I sectors.

Figure 4-7. Projected employment effects of C&I energy bill savings, by sector (jobs per $1 million)[1]

Context and validation

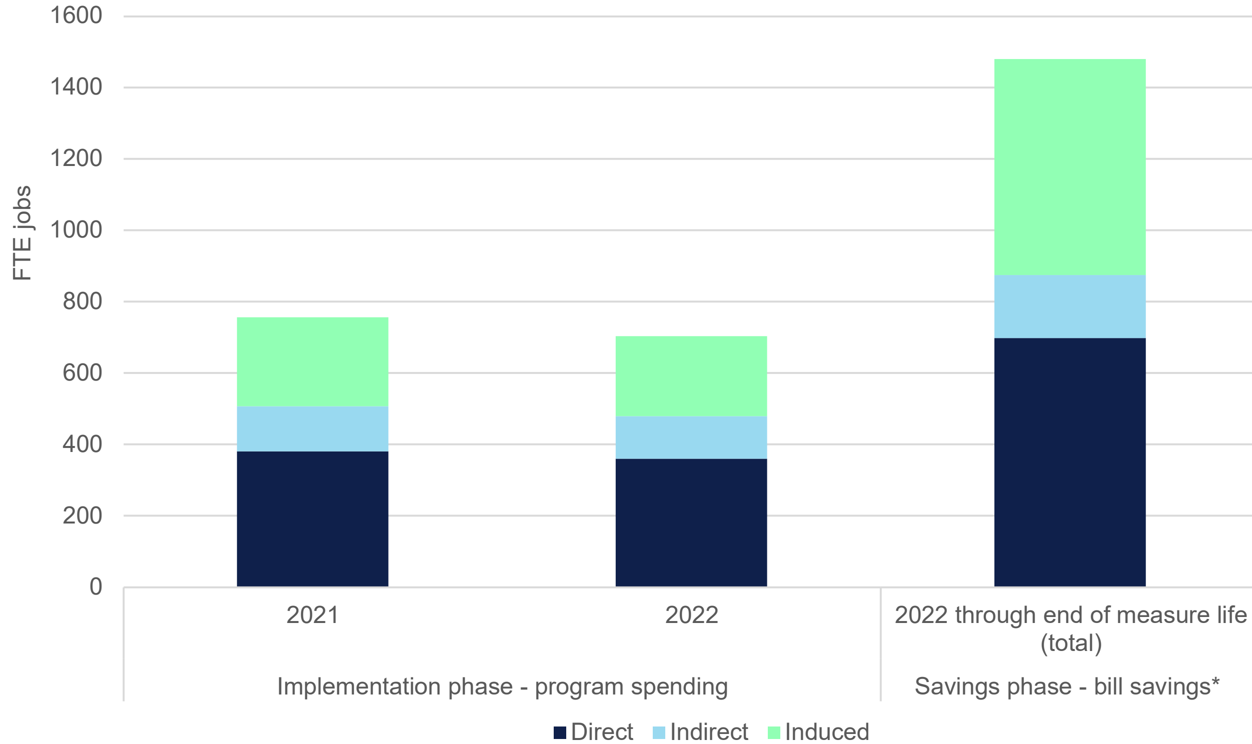
To validate our assumptions about estimating and allocating the economic effects of long-term energy bill savings, we reviewed literature and asked expert interviewees about the topic. Based on the interviews and literature, customer bill savings can get re-allocated in multiple ways, depending on the type of customer and their economic circumstances. Interviewee responses generally corroborate the assumptions and results of our IMPLAN modeling, and help illustrate the financial decisions New Hampshire households and businesses face. According to interviewees:

- Residential bill savings are typically allocated towards other household expenses but given the variability in energy prices and other costs, changing incomes, and changing patterns of home occupancy and working from home, savings from energy efficiency projects may be less noticeable to non-low-income homeowners.
- Low-income bill savings provide added resilience for residents who are resource constrained, and for whom relatively small changes in expenses can have disproportionate impact on daily activities and overall quality of life.
- Large business bill savings may be reallocated towards investment in more energy efficient equipment or toward companies' overall capital, maintenance, or operating budgets.
- Small business bill savings may be reallocated toward hiring or employee compensation, as well as investment in more energy efficient equipment or other budget items. Small business facing financial pressures may also use savings to reduce those pressures and avoid negative financial outcomes.

Across all sectors, interviewees told us that increased energy costs have shifted focus from proactively pursuing energy efficiency for environmental or other reasons toward reactively responding to increasing energy bills by looking for ways to reduce costs. This dynamic does not necessarily change how bill savings are allocated, but rather affects customers' motivations for seeking out and participating in energy savings programs.

Figure 4-8 provides a summary of the employment estimates for both phases (implementation and savings) analyzed in the study. The small decrease in program spending over the two years of the implementation period is reflected in the decline in program-related jobs. The aggregate bill savings would add another projected 1480 jobs over the savings phase, based on total customer bill savings over the useful life of the measures installed, per the NH Utilities' 2022-2023 plan filings.

Figure 4-8: Summary of Employment Estimates for NH Saves Programs and Bill Savings



*Savings phase employment effects represent total FTE job-years, estimated using the 2022 net present value of customer bill savings over the useful life of the energy efficiency measures installed through the NHSaves across two program years.

4.2 Other economic impacts

4.2.1 New Hampshire gross domestic product

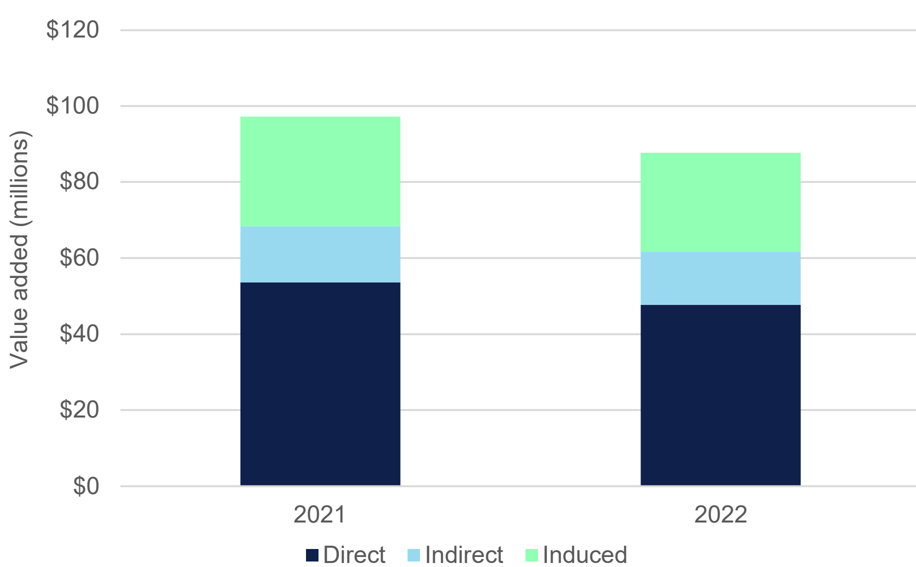
The total economic impact of NHSaves programs modeled in this study can be measured through the changes in value added estimates generated by IMPLAN. Value added reflects the programs' contribution to GDP[59] and is calculated as the total output net of intermediate inputs. As noted in the methodology section, we modeled each sub-program as a combination of output events which reflect direct effects accruing to a particular industry (e.g., spending flowing to HVAC manufacturers or wholesalers), which are then passed through different sectors in the form of indirect effects involving business-to-business transactions (e.g., spending on motors, wiring, etc. for HVAC equipment). Finally, the direct and indirect effects have associated induced effects in the form of increased consumer spending (e.g., restaurant meals, grocery purchases). The total value added reflects the cascading effects of all three levels of spending resulting from the programs.

It is important to note that value added is one way to measure GDP, and it is intricately interlinked with the other impacts measured in this report, including employment. These different metrics reflect the same underlying economic activity, which is the effect of the NHSaves program spending. The NHSaves programs overall added just over $97 million to state GDP

[59] Value added serves as a measure of contribution to the GDP. It is calculated as the total output net of all intermediate input costs. For more please see: https://support.implan.com/hc/en-us/articles/360017144753-Understanding-Value-Added-VA-

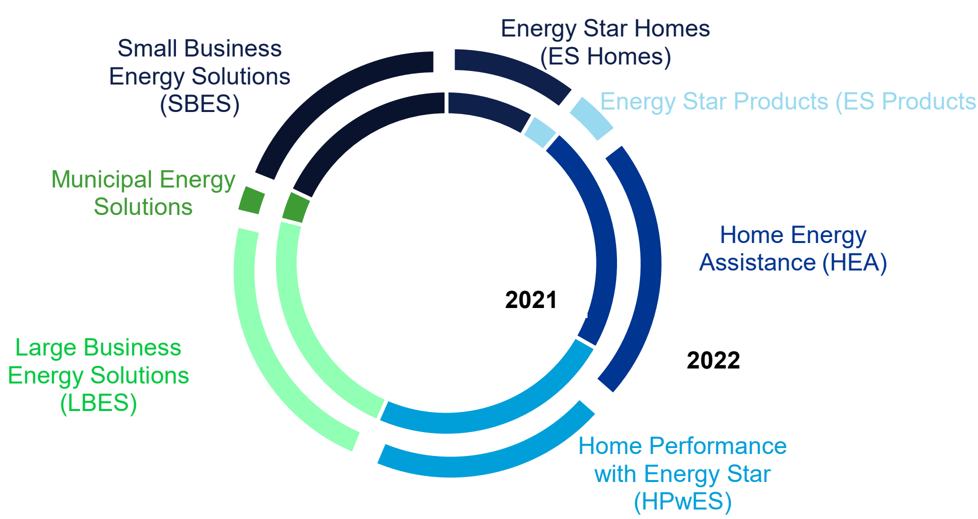
through their total direct, indirect, and induced effects in 2021, and over $87 million in 2022, as shown in Figure 4-9. These estimates reflect the conservative LPP scenario for the share of NHSaves-rebated equipment being purchased from in-state wholesalers and manufacturers. The value added amounts are 1.3 times the program spending in 2021 and 1.2 times the program spending in 2022. These results are generally consistent with impacts of other public programs on GDP, which typically have multiplicative effects whereby GDP grows by a factor of 1 or more times the amount of program spending.

Figure 4-9. NHSaves total value added as a contribution to New Hampshire GDP, 2021 and 2022



Since value added is a function of economic output across sectors, the total effect of each program is directly related to each program's budget, as well as the team's assumed material and labor cost distribution ratios for given programs. In both 2021 and 2022, the HPwES, HEA, and LBES programs had the largest contribution to the state's GDP, as shown in Figure 4-10.

Figure 4-10. NHSaves total value added as a contribution to New Hampshire GDP, 2021 and 2022, by program[1]



[1]2021 values are shown in the inner circle and 2022 values are in the outer circle.

4.2.2 State and local tax revenues

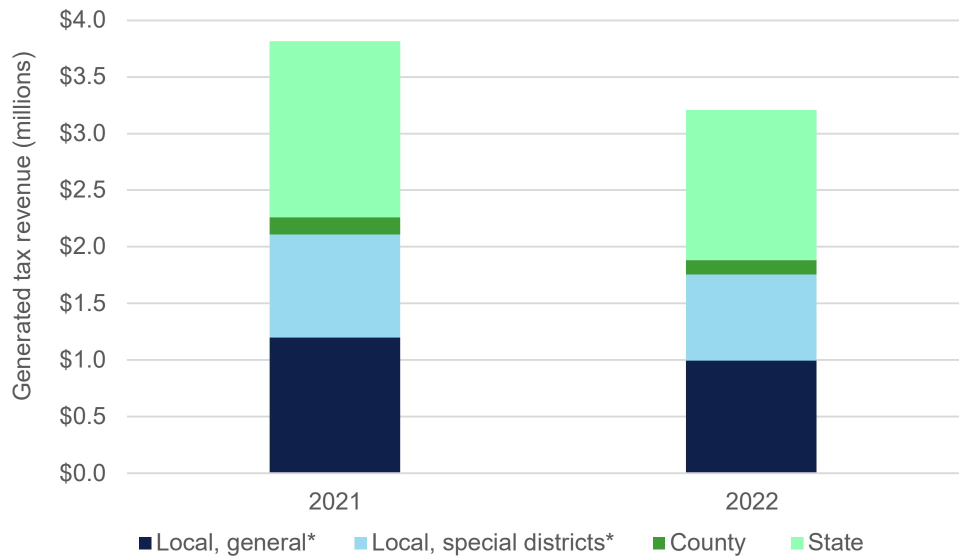
The team's I/O modeling also generated estimates of additional state and local tax revenues generated by the economic activity associated with NHSaves program spending, which are modeled according to New Hampshire's tax regime (e.g., no sales tax, limited income tax). Economic activity generated by the NHSaves programs and detailed in the above sections, such as increased industrial production, employee compensation, or business income, are in many cases taxable. The evaluation team focused on the state and local tax estimates generated for the sub-county, county, special districts, and state governments, and did not model federal tax revenues given the New Hampshire-specific scope of this study. It is important to note that the results for each level of government do not necessarily reflect the governments that levy the tax, but rather they reflect the governments to which the tax dollars ultimately flow.

The total estimated tax revenue generation for all NHSaves programs was about $3.8 million in 2021, and just over $3.2 million in 2022, as shown in Figure 4-11. These estimates reflect the conservative LPP scenario for the share of NHSaves-rebated equipment being purchased from in-state wholesalers and manufacturers. Of these total tax revenue amounts, rebate spending is responsible for approximately $900,000 in 2021 and just over $1 million in 2022, and administrative spending is responsible for the remainder. Administrative expense categories lead to a larger share of direct and indirect tax revenues than rebate spending for two reasons. First, administrative expenses are relatively more human capital-intensive than rebate spending because they reflect spending on managing and implementing programs, whereas rebate spending includes a larger portion of material spending. In addition, a larger share of administrative expenses are incurred in-state, relative to rebate spending. Since rebate spending includes material and out-of-state leakages, the tax revenue from rebates occurs through indirect and induced impacts.

Given New Hampshire's unique taxation structure, most of the tax gains arise from indirect and induced effects. This is because the largest transactions flowing from program funding are the direct purchases of materials (e.g., HVAC measures), and New Hampshire has no sales tax on those transactions, which would show up as direct effects. Primary categories of tax revenues include employer and employee contributions to social insurance taxes, and property taxes.[60] Some of the other tax categories modeled in the software such as taxes on production and imports are applicable but are tied to indirect effects transactions. Other tax categories, such as property taxes, apply to programs' induced effects. For example, property taxes reflected the largest share of tax revenues from the LBES program. Figure 4-12 shows the tax revenue generated by NHSaves at each level of government, by program.

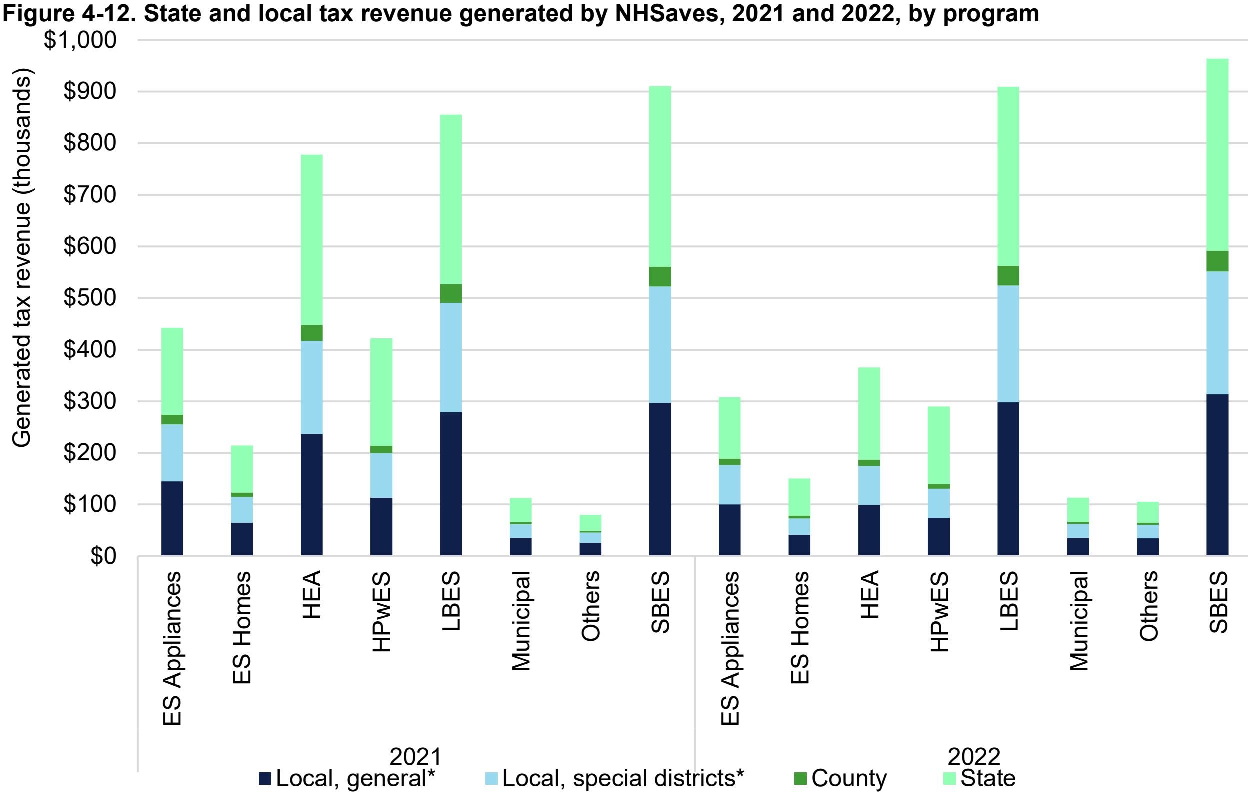
[60] Social insurance taxes include taxes for state government retirement programs, state unemployment taxes, workers' compensation, Medicaid, as well as other federal programs (not modelled in the results presented here), such as Federal Insurance Contributions Act, the Children's Health Insurance Program, Federal Insurance Contributions Act, Federal Unemployment Tax Act, Medicare, military medical, Old Age, Survivors and Disability Insurance, and others. Please see: https://support.implan.com/hc/en-us/articles/360041584233-Taxes-Where-s-the-Tax-

Figure 4-11. State and local tax revenue generated by NHSaves programs, 2021 and 2022



*Local reflects all sub-county level taxes, including general municipal taxes and special districts such as those related to water or transportation infrastructure or other public services.

Figure 4-12. State and local tax revenue generated by NHSaves, 2021 and 2022, by program



*Local reflects all sub-county level taxes, including general municipal taxes and special districts such as those related to water or transportation infrastructure or other public services.
**Other programs include C&I and residential active demand response, education, and behavior (Home Energy Report) programs.

4.2.3 Value of health benefits

The team modeled the estimated monetary value of avoided healthcare costs for New Hampshire citizens from emissions reductions resulting from the NHSaves programs in 2021, as shown in Table 4-4. COBRA outputs a low and high estimate, each at a 3% and 7% discount rate. The low and high estimates reflect the use of different underlying epidemiological studies, particularly on the mortality impacts of PM2.5.[61] The total value ranges from just over $68,000 to over $153,000 at a 7% discount rate and approximately $76,000 to just over $172,000 at a 3% discount rate.

Table 4-4. Estimated annual monetized NH benefits in 2021 (NH only)

Program[1]	Monetary Value (dollars, annual)			
	Low (3%)	High (3%)	Low (7%)	High (7%)
NHSaves Electric Programs	$40,867	$92,260	$36,458	$82,258
NHSaves Gas Residential Programs	$29,059	$65,622	$25,927	$58,510
NHSaves Gas Commercial Programs	$6,393	$14,433	$5,704	$12,868
Total	**$76,319**	**$172,315**	**$68,089**	**$153,636**

[1]Electric program benefits are based on reduced emissions from grid electricity, regardless of the type of end user. In contrast, gas program benefits result from end use combustion, which differs by the type of end user (residential or C&I).

Air pollution does not stop at state boundaries, so the evaluation team also analyzed the avoided healthcare costs for citizens in the entire contiguous United States resulting from emissions reductions attributable to the NHSaves programs. The majority of these benefits would be experienced by citizens of neighboring states; the effects of pollution decreases the farther away from the source one travels. These estimates are substantially greater than the NH-only estimates because many more people would be affected. The savings at a 7% discount rate range from just under $649,000 to almost $1.5 million. The savings at a 3% discount rate range from $727,000 to over $1.6 million.

Table 4-5. Estimated annual monetized NH benefits in 2021 (contiguous US)

Program[1]	Monetary Value (dollars, annual)			
	Low (3%)	High (3%)	Low (7%)	High (7%)
NHSaves Electric Programs	$613,199	$1,383,382	$547,166	$1,233,551
NHSaves Gas Residential Programs	$92,249	$208,245	$82,314	$185,693
NHSaves Gas Commercial Programs	$21,558	$48,669	$19,236	$43,399
Total	**$727,006**	**$1,640,296**	**$648,716**	**$1,462,643**

[1]Electric program benefits are based on reduced emissions from grid electricity, regardless of the type of end user. In contrast, gas program benefits result from reduced end use combustion, which differs by the type of end user (residential or C&I).

It is important to note that these modeling results reflect the impacts of one year of savings from the measures installed during the 2021 program year. As noted in the 2022–2023 plan filings, many of these measures last for close to two decades—the average measure life was 12.2 years for 2022 planned electric measures, and 16.6 for 2022 planned gas measures. The modeling results do not reflect the full impacts of the savings from those measures over their useful lives, which would be significantly larger than the values shown for 2021. However, due to the limitations in the AVERT and COBRA models described in Section 3.4, the team presents the one-year annual values only.

More detailed breakouts of the health benefits are provided in APPENDIX C. AVERT AND COBRA METHODS AND DETAILED RESULTS.

[61] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

4.3 Context and sources of uncertainty

4.3.1 Regulatory and funding uncertainty

The NHSaves programs experienced uncertainty and funding instability during the 2021 and 2022 period modeled in this study. The evaluation team did not quantify the associated economic impacts in the I/O modeling presented in this study, but based on expert interviews, the program uncertainty and instability in funding levels dampened the economic benefits of the programs. Specifically, in December 2020, the Commission ordered the 2021 programs to operate at 2020 funding levels rather than the higher levels proposed in the 2021–2023 plan, until the Commission could fully consider the plan.[62] Then, in November 2021, the Commission issued an order denying the 2021-2023 plan and ordering a steady, significant reduction in program funding starting in 2022.[63] Although the funding reductions were partially restored in 2022, the Commission's decision limited the flow of funding and initiation of new projects for much of 2022, impacting workforce and customer decisions.

The evaluation team interviewed officials at 10 organizations with expertise and knowledge of the NHSaves programs to provide context and insights on the impacts of these decisions. Several key themes emerged from these discussions:

- **Workforce disruption.** Almost all interviewees cited workforce disruptions caused by the decisions. Several noted that the 2021–2023 plan had originally included significant increases in program funding and savings goals, and that despite some uncertainty around the plan due to COVID-19 and other factors, they prepared for anticipated increases by hiring or otherwise ramping up in advance of the 2021 program year. This ramp up exacerbated the impact of the subsequent decisions, which, according to the interviewees, in some cases, led to unanticipated layoffs of contractor or other staff, most notably in the low-income programs. One interviewee noted that the disruptions were more acutely felt by vendors specializing in energy-efficient equipment—e.g., weatherization and LED lighting providers—and less acutely felt by HVAC or other vendors who provide equipment that customers need regardless of whether there is an energy efficient version available. The disruptions also created ongoing challenges in business planning and investment decisions. As one vendor we interviewed noted, contractors need advance knowledge of program funding levels and goals so they can deliver them consistently throughout the year, and uncertainty undermines trust between the trade ally workforce and the program administrators. Several interviewees also noted that firms are recovering from these disruptions but that it takes longer to recover than it did to lose workforce.
- **Customer impacts.** Most interviewees we spoke with cited customer impacts caused by the decisions as well. For customers with projects that were in progress at the time of the decisions, many of the projects were put on hold, some of them indefinitely, according to interviewees. Additionally, in the absence of consistent and reliable funding availability, the NH utilities could not recruit or enroll customers who would have otherwise considered participating in NHSaves programs. As one interviewee said, “It was almost impossible for the utilities to be out there promoting and selling programs, because they didn’t know what they were selling.” The impacts varied depending on the types of projects and customers as follows, according to interviewees.
    - **For small businesses pursuing projects with the promise of program funds**, they often may have had to stop projects such as lighting retrofits, possibly indefinitely. For HVAC or other project types, such customers may have gone ahead with standard efficiency models, rather than high efficiency models.
    - **Large customers can face project financing challenges** due to their multi-layered financing arrangements and capital planning processes. For instance, interviewees involved in developing affordable housing and community buildings for economic development projects said that they use a combination of NHSaves incentives along with

[62] DE 20-092, 2021-2023 NEW HAMPSHIRE STATEWIDE ENERGY EFFICIENCY PLAN, Order Approving Short-Term Extension of 2020 Energy Efficiency Programs and System Benefits Charge Rate, Order No. 26,440, December 29, 2020
[63] DE 20-092, 2021–2023 Triennial Energy Efficiency Plan Order on 2021–2023 Triennial Energy Efficiency Plan and Implementation of Energy Efficiency Programs, Order No. 26,553, November 12, 2021

grant funding, tax subsidies, loans, and other sources to fund projects. These funding sources are inter-related and predictable timing is very important in planning and assembling financing for these projects. For instance, one interviewee said they apply for competitive public funding for affordable housing, and promised funding from NHSaves improves their chances of getting selected. In other cases, grant or other sources require applicants to assess energy savings opportunities and/or identify matching funds for energy improvements, which NHSaves provides. If they think they have this funding and then it falls through, they can end up with a large hole in the budget that risks the overall project's success. One interviewee that develops such projects estimated that 23 (about half) of their ongoing projects, involving a total of over $1 million in incentives, were moderately or significantly impacted by the 2021 decision. A large industrial participant we interviewed said that they fund projects during their annual capital planning season, and having uncertainty or lack of program funding available during that period means they must forgo savings opportunities and lose out on rebates. They estimated that the recent decisions caused them to lose out on over $200,000 in rebates.

Since the period of these decisions, legislation was enacted providing greater stability and certainty regarding the continued funding of the NHSaves programs.[64] However, a subsequent Commission investigation into NHSaves planning, programming, and evaluation raised concerns among stakeholders and trade allies that they would see continued uncertainty and instability in levels of program activity.[65] In addition, the NH Utilities noted that program vendors are still hesitant to commit to program activities in some cases because, although the Utilities understand that the legislation provides more certainty going forward, the vendors do not necessarily believe that to be the case. Further attempts to estimate the economic impacts of the NHSaves programs will require careful analysis of how these ongoing regulatory activities influence workforce and customer expectations and decisions.

4.3.2 In-state and out-of-state impacts

In response to the Commission's directive to adjust for out-of-state expenditures in estimating the economic impacts of the NHSaves programs, the evaluation team reviewed and analyzed data on the NH Utilities' 2021 spending on outside contractors and consultants obtained from recent filings,[66] as described in Section 3.1.1. Using these data, the team estimated the share of non-rebate spending flowing to out-of-state contractors and consultants (rebate spending is assumed to flow solely to NH customers, per program requirements), based on their business address provided by the NH Utilities. However, as the NH Utilities noted in their filings, the business address of a given contractor or consultant does not necessarily reflect the location of the individual(s) working with the programs, and multiple contractors that receive significant program funding and are listed as being out-of-state businesses based on their corporate address employ New Hampshire-based staff who work for the programs.

To account for this in the I/O modeling, the evaluation team ran a sensitivity analysis of economic impacts using two assumptions for the share of program spending that flows from businesses with out-of-state corporate addresses back to New Hampshire-based employees of those businesses: 25% and 50%, as shown in Table 4-6. It is important to note that the far more influential factor for modeling the in- and out-of-state flows of program funding is the LPP.[67] As the results presented in Section 4.1.1 show, the modeled job intensity of the NHSaves programs with conservative LPP assumptions was about 10 jobs per $1 million in 2021 and 2022, but over 14 jobs per $1 million in both years under the more aggressive

[64] HOUSE BILL 549, Signed by Governor Sununu, Feb. 24, 2022
[65] IR 22-042, Investigation of Energy Efficiency Planning, Programming, and Evaluation ORDER OF NOTICE, Aug 10, 2022
[66] NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1
[67] LPP indicates the share of the economic effect of rebated measures that will be retained within the region being examined (e.g., New Hampshire). As detailed in Section 3.2.2, LPP ratios represent the extent to which the IMPLAN model assumes commodities are purchased from in-state manufacturers or wholesalers.

LPP assumption. In contrast, the assumed percentage of pass-through to New Hampshire-based employees changes job intensity by less than 1 job per $1 million between the two scenarios modeled and presented in Table 4-6.

Table 4-6. Non-rebate contractor and consultant expenses to out-of-state recipients[1]

Assumed share of out-of-state spending passed through to New Hampshire-based employees	2021		2022	
	Total jobs generated	Jobs per $1 million in program costs	Total jobs generated	Jobs per $1 million in program costs
25% passed to New Hampshire-based employees	698.59	9.35	664.35	9.43
50% passed to New Hampshire-based employees	755.97	10.12	703.30	9.98

[1]Employment effects in this table are modeled with a conservative LPP (=RPC) assumption. See Section 3.2.2 for details.

4.3.2.1 Context and explanatory factors

In addition to the modeling results, the experts interviewed provided context and insights on the inter-state impacts of the programs. One overarching issue raised in the interviews was that New Hampshire has significant out-of-state expenditures on supply-side resources, and that these expenditures should be considered alongside any analysis of out-of-state expenditures on energy efficiency resources. Despite being a net electricity exporter, New Hampshire relies heavily on imports of other sources of energy—particularly fossil fuels for heating and transportation. Specifically, according to EIA data from 2022, New Hampshire does not produce fossil fuels, and over $2 billion flowed out of the state for energy imports across all fuels and end uses.[68] Further analysis of the in- and out-of-state economic impacts of energy supply expenditures would provide context for the results of our analysis but was not feasible within the timeframe of this study.

With regard to local workforce, interviewees said that the vast majority of installation contractors are based in-state, particularly for weatherization projects. However, multiple interviewees noted that NH is a relatively small state with a large population close to the state's borders, providing significant opportunities for neighboring states' contractors to work in NH, and vice versa. There were several recurring themes on the use of out-of-state contractor workforce by the programs, as follows:

- **Sources of out-of-state contractor workforce.** Program vendors and large customers we interviewed said that Massachusetts is the largest source of out-of-state workforce (and materials) for the NHSaves programs, and that it has a substantial and well-trained energy efficiency workforce that includes specialized firms not always available in-state. Other jurisdictions providing workforce for NHSaves mentioned by interviewees include Maine (particularly near the Seacoast area) and Canada, where contractors are drawn to NH because the exchange rate is highly favorable for working in the U.S. and getting paid in dollars.
- **Types of firms coming from out-of-state.** According to the experts interviewed, the types of firms that are most frequently New Hampshire-based include weatherization contractors, construction management firms, and general contractors. The types of firms most commonly based in other states are specialized firms with expertise in complex custom projects and controls measures. Interviewees also said that there is a relatively large population of in-state contractors for small business projects, but there are many regional firms providing commercial lighting, HVAC, and refrigeration as well. They also said larger industrial equipment often comes from out-of-state.
- **Drivers of out-of-state contractor workforce**. Interviewees said that a key reason for the need for out-of-state contractors is that states face competition for workforce, and neighboring states have larger, more well-funded programs that over time have led to growth in the contractor workforce in those states. They also said that there are certain equipment types where higher levels of program support and customer adoption have led to growth in the workforce for those technologies neighboring states. For instance, one interviewee said that NH has a large base of

[68] EIA data shows total energy expenditures of $4.6 billion, total consumption of 296 trillion Btu, and total in-state energy production of 149 trillion Btu. U.S. Energy Information Administration, New Hampshire State Energy Profile, updated Sept 2022. https://www.eia.gov/state/print.php?sid=NH.

HVAC contractors, but that contractors with expertise in heat pumps often come from neighboring states with more widespread heat pump adoption.

Interviewees mentioned several other issues related to the flow of workforce and program spending between states.

- **The NH workforce benefits from other states' programs**. One interviewee who is currently an NHSaves vendor had previously worked for the Mass Save programs while living in NH, during which time he completed numerous training courses and earned a BPI certification. This education and training were largely funded by the MA programs but provided a foundation for the interviewee's current work for NHSaves.
- **NHSaves can enhance local workforce recruitment**. One agency official we interviewed said that when recruiting businesses to move to New Hampshire, particularly from Canada, they are often concerned by the state's high energy costs. He said that programs such as NHSaves that can help businesses manage energy costs are a key part of the business recruitment "sales pitch."

4.3.3 Long-term impacts

As noted in the New Hampshire Cost Effectiveness Review,[69] I/O modeling is best suited for relatively short-term analysis. Longer term economic impacts (beyond 5 years) are highly uncertain due to a variety of factors, and I/O models as well as EPA's COBRA and AVERT models are based on current economic and energy structures. Large government programs can lead to potential shifts in industry structures which cannot be factored into current I/O matrices. Other structural changes could include, for example, pandemics such as COVID-19 leading to fundamental shifts in building usage affecting the impact of residential and commercial energy efficiency investments, as well as international economic disruptions and military conflicts affecting energy markets. Such changes are highly difficult to anticipate, predict, and model.

However, the evaluation team conducted several analyses that shed light on the Commission's directive to assess the impact of different discount rate assumptions, and to account for the economic activity and energy consumption resulting from future cost savings. These impacts occur specifically during the savings phase of the programs, after energy efficiency measures are installed and result in (1) energy use reductions and corresponding health benefits as discussed in Section 4.2.3, and (2) bill savings that is re-allocated to other spending, creating economic impacts as discussed in Section 4.1.2.

4.3.3.1 Rebound effects

The evaluation team's IMPLAN modeling accounted for the economic activity resulting from future cost savings, as part of the bill savings modeling task as detailed in Section 3.2.3. Specifically, the team's modeling of long-term bill savings treated residential savings as additional household income, which results in employment gains through induced economic activity (e.g., household spending on services, recreation). Modeling of C&I sector bill savings assumed those savings are redirected towards additional industry activity, resulting in additional economic output.

However, the modeling did not account for secondary energy consumption related to this additional economic activity—also known as the "rebound effect" or "'macroeconomic growth effect." As described by Gillingham et al (2015), "the basic premise is that an increase in the efficiency of energy-consuming durables may spur economic growth—and that economic growth requires additional energy consumption."[70] There are multiple theoretical pathways through which this effect occurs, but empirical estimates of its effect are limited and there are steep challenges in developing such estimates. A review of research on the topic described such challenges:[71]

> "For the last century, we have seen large increases in both energy use and the energy efficiency of many durable goods. But in order to claim a causal relationship between energy efficiency and energy use, it must be shown that energy

[69] https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_COST_EFFECTIVENESS_REVIEW.PDF
[70] Gillingham, K, Rapson, D, and Wagner, G. (2015, September 25). The Rebound Effect and Energy Efficiency Policy, Review of Environmental Economics and Policy, Yale University and the National Bureau of Economic Research. Retrieved March 1, 2023, from https://resources.environment.yale.edu/gillingham/GillinghamRapsonWagner_Rebound.pdf
[71] Ibid

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consumption has not increased due to some other factor. …In fact, it is extremely difficult, if not impossible, to separate the effect of energy efficiency improvements from exogenous economic growth and the simultaneous dramatic improvements in energy services."

Similarly, a PERI study of clean energy investments in Maine noted that although increased energy efficiency can result in rebound effects, these effects are likely to be modest in advanced economies where there is already high saturation in energy-using equipment. For example, the study notes that homeowners are not likely to clean dishes more frequently because they have more efficient dishwashers, and although consumers may heat and cool their homes and drive their cars somewhat more given higher levels of efficiency, these increases are modest in advanced economies.[72] In another example, research on the Massachusetts Home Energy Services weatherization program found little evidence of rebound, with about half of participants reporting no changes in cooling and heating setpoints following weatherization of their homes. Among those who did change setpoints, the vast majority reported doing so in a way that would reduce consumption (i.e., higher cooling and lower heating setpoints).[73] Attempting to quantify the rebound effect for the NHSaves programs would require more rigorous analysis that is beyond the scope of this review.

4.3.3.2 Discount rate assumptions

For the customer bill savings analysis, the team relied on the bill impacts values as filed by the utilities. As noted in Section 3.1.2, the values reflect long-term revenue requirement changes that use the same discount rate assumptions as in the B/C model filed with the 2022–2023 plan, shown in Table 4-7. Re-modeling the bill and rate impacts of the plan under different discount rate assumptions was not feasible within the timeframe of this study.

Table 4-7. Discount rate assumptions for customer bill savings analysis

Rate	Value	Source
Nominal Discount Rate	3.25%	Updated October 18, 2021. Based on the June 2021 Prime Rate in accordance with the Final Energy Efficiency Group Report, dated July 6, 1999 in DR 96-150
Inflation	2.03%	Updated October 18, 2021. Based on the inflation rate from Q1 2020 to Q1 2021, per the Federal Reserve Bank of St. Louis
Real Discount Rate	1.19%	Real Discount Rate = [(1 + Nominal Discount Rate)/(1 + Inflation Rate)] – 1

Source: NH Utilities' B/C and Bill and Rate Impacts models for 2022-2023 plan.

For health impacts analysis, we applied the 3% and 7% discount rates built into COBRA, which are reflected in the results as presented in Section 4.2.3. Further discount rate sensitivity analysis for health impacts was also not feasible within the timeframe of this study.

Implementation phase impacts, including employment and other economic impacts, are generally incurred in the same period as the program dollars were spent (2021 and 2022), and the team determined that discounting was not appropriate for these impacts. The team assumes dissipation of these impacts once those years' dollars are spent, an assumption that was validated by our interviews with experts, who widely cited direct workforce disruptions resulting from program funding reductions.

Although comprehensive sensitivity analyses of discount rate assumptions were not feasible within the timeframe of this study, the results suggest that modelled program impacts are less sensitive to discount rate assumptions than to other underlying assumptions. For instance, the value of the health impacts presented in Section 4.2.3 above decrease by about 11% when moving from a 3% discount rate to 7% discount rate. By comparison, the value of the health impacts presented above increases by about 125% between the "low" and "high" scenarios that reflect the two different underlying

[72] Pollin, R., Wicks, J., Chakraborty, S., & Semieniuk, G. (2020, August 27). PERI - A Program for Economic Recovery and Clean Energy Transition in Maine. Political Economy Research Institute. Retrieved February 14, 2023, from https://peri.umass.edu/component/k2/item/1339-a-program-for-economic-recovery-and-clean-energy-transition-in-maine

[73] Navigant. Massachusetts Home Energy Services Realization Rate Assessment (RES 39), Mar. 2020 https://ma-eeac.org/wp-content/uploads/MA-RES-39-HES-RR-Assessment-Executive-Summary_FINALwES_19MAR2020.pdf

epidemiological studies on the mortality impacts of PM2.5.[74] Similarly, the NH Utilities' filings[75] of B/C model results under different discount rate assumptions show that statewide, the programs' GST benefits decrease by about 12% when moving from the 1.41% real discount rate used in the plan to a 3% real discount rate, and they decrease by 15% when moving from a 3% to 5.5% real discount rate. Other sensitivity analyses presented in this report, such as employment effects under conservative and aggressive LPP scenarios, show larger changes in results due to differing assumptions.

4.4 Results comparison

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. Studies have also examined the impacts of large scale federal and state level programs on macroeconomic indicators such as GDP and employment. For example, a 2020 study by PERI[76] estimates the effects of economic stimulus measures in the US economy and concludes that investments of about $600 billion per year over 10 years would create 4.6 million jobs per year in infrastructure and 4.5 million jobs in the clean energy sector. In addition, the study also concludes that public investments in these programs will stimulate private investments worth $300 billion which would result in another 4.5 million jobs. In a similar analysis in the state of Maine, the group concludes that an average annual investment of $2.2 billion in the state would create 15,000 jobs per year.[77]

Table 4-8 provides a comparison of results from recent studies that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs. Differences in scope, jurisdiction, and the type of programs analyzed should be considered in comparing results.[78] For instance, most nationwide studies reflect a higher job intensity compared to region- or state-specific studies. Nationwide studies in the US have typically estimated job intensities in the range of 10 to 15 jobs per $1 million in program investment, as shown Table 4-8. In state-specific studies, these numbers range from about 6 to 12 jobs per million. The results of the team's analysis of the NHSaves programs—around 10 jobs per million in 2021 and 2022 in the conservative LPP scenario—are closer to the higher end of the range of results of state specific analyses. In the more aggressive LPP scenario, the numbers are higher at over 14 jobs per million in both years—closer to the estimates from nationwide studies.

[74] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

[75] NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Attachment RR 1-001C, December 16, 2022.

[76] Pollin, R., & Chakraborty, S. (2020). Job creation estimates through proposed economic stimulus measures. *Political Economy Research Institute (PERI)*. Available at https://peri.umass.edu/publication/item/1297-job-creation-estimates-through-proposed-economic-stimulus-measures

[77] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2020). A program for economic recovery and clean energy transition in Maine. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*

[78] In addition, the evaluation team's analysis presented in this report reflects the most granular, measure-specific review of energy efficiency program economic impacts among the literature we reviewed. The analyses in comparison studies were largely conducted at the aggregate economy level. Most studies do not examine the effects of specific program measures in the way this analysis does.

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Table 4-8. Comparison economic impact studies[79]

Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
Job Creation Estimates for Colorado Through Inflation Reduction Act	Pollin, R., Chakraborty, S., Lala, C., Semieniuk, G.	2022	PERI	Colorado	IMPLAN		9.2	Link
State-Level Employment Projections for Four Clean Energy Technologies	Truitt, S., Elsworth, J., Williams, J., Keyser, D., Moe, A., Sullivan, J. Wu, K.	2022	NREL	USA	IMPLAN		6.04	Link
Employment Impacts of Proposed U.S. Economic Stimulus Program: Job Creation, Job Quality, and Demographic Distribution Measure	Pollin, R., Chakraborty, S., Wicks-Lim, J.	2021	PERI	USA	IMPLAN	Building Retrofits	13.4	Link
						Industrial Efficiency	14.2	
A Program for Economic Recovery and Clean Energy Transition in California	Pollin, R., Wicks-Lim, J., Chakraborty, S., Kline, C., Semieniuk, G.	2021	PERI	California	IMPLAN	Building Retrofits	7.7	Link
						Industrial Efficiency	5.7	
						Grid Upgrades	5.1	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for Pennsylvania	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2021	PERI	Pennsylvania	IMPLAN	Building Retrofits	8.8	Link
						Industrial Efficiency	6.7	
						Grid Upgrades	6.9	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for West Virginia	Wicks-Lim, J., Robert, P., Chakraborty, S., Semieniuk, G.	2021	PERI	West Virginia	IMPLAN	Building Retrofits	7.7	Link
						Industrial Efficiency	3.6	
						Grid Upgrades	4.6	
Estimating employment from energy-efficiency investments	Brown, M., Soni, A., Li, Y.	2020	*MethodsX*	USA	IMPLAN	Residential	12.55	Link
						Commercial	12.64	
Energy Efficiency 2020	IEA	2020	IEA	USA	Publicly available data	Building Retrofits	14.8	Link
						Efficient New Buildings	15	
						Industry Efficiency	10	

[79] Natanael Pabon-Trinidad, an MPA student in the Department of Public Administration at Louisiana State University contributed in compiling this Table.

Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
A Program for Economic Recovery and Clean Energy Transition in Maine	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2020	PERI	Maine	IMPLAN	Building Retrofits	11.8	Link
						Industrial Efficiency	8.1	
						Grid Upgrades	6.9	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for Ohio	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2020	PERI	Ohio	IMPLAN	Building Retrofits	9.7	Link
						Industrial Efficiency	7.6	
						Grid Upgrades	7.4	
Maryland Benefits: Expanding the Results of EmPOWER Maryland through 2015	Baatz, B., Barrett, J.	2017	ACEEE	Maryland	Publicly available data		13.2	Link
Green versus Brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model	Garrett-Peltier, H.	2017	*Economic Modeling*	USA	I-O Models	Weatherization	8.21	Link
						Home Weatherization	7.41	
						Commercial Retrofits	7.26	
						Industrial Energy Efficiency	7.41	
						Smart Grid	6.76	
The job generation impacts of expanding industrial cogeneration	Baer, P., Brown, M., Kim, G.	2015	*Ecological Economics*	USA	IMPLAN	Industrial Cogen	14.48	Link
Verifying Energy Efficiency Job Creation: Current Practices and Recommendations	Bell, C., Barrett, J., McNerney, M.	2015	ACEEE	USA	IMPLAN		5 to 11	Link
Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities	Pollin, R., Garrett-Peltier, H., Heintz, J., Hendriks, B.	2014	Center for American Progress/PERI	USA	IMPLAN		14.6	Link
Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy	Burr, A., Majersik, C., Stelberg, S.	2012	PERI/IMT	USA	IMPLAN	Multifamily Capital Upgrades (weighted)	13.41	Link
						Commercial Capital Upgrades (weighted)	12.94	

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Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
Employment Estimates for Energy Efficiency Retrofits of Commercial Buildings	Garrett-Peltier, H.	2011	PERI	USA	IMPLAN		13.6	Link
The Economic Benefits of Investing in Clean Energy: How the economic stimulus program and new legislation can boost U.S. economic growth and employment	Pollin, R., Heintz, J., Garrett-Peltier, H.	2009	PERI/Center for American Progress	USA	IMPLAN	Building Retrofits	11.9	Link
						Smart Grid	8.9	

5 CONCLUSIONS AND CONSIDERATIONS FOR NEW HAMPSHIRE

Based on the analysis and results presented above, the 2021 and 2022 NHSaves programs had significant positive economic impacts on New Hampshire's economy, including short-term and long-term employment effects, increased state GDP, state and local tax revenues, and monetized public health benefits.

It is important to note that these quantified impacts are best estimates, which reflect underlying assumptions and limitations in modeling tools and data. The team documented these assumptions and limitations and presented ranges of estimates throughout the report that include conservative and aggressive assumptions for in-state impacts and other factors. Despite some amount of imprecision, which is inherent in economic modeling, the scale and scope of quantified impacts provides clear evidence of the economic benefits of the programs. In addition, as described in the National Standard Practice Manual,[80] jurisdictions "should account for all relevant, substantive impacts (as identified based on policy goals), even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value."

In addition to quantitative modeling, the team's interviews with officials from multiple organizations with expertise and knowledge of the NHSaves programs validate the importance of the programs in supporting and growing the local workforce and in providing New Hampshire businesses and residents with funding to support energy efficiency investments. The value of the programs can be seen in part by the disruptions to local workforce and customers that occurred when the programs' continuity became uncertain. The programs also provide a tool for workforce recruitment and retention that can help New Hampshire compete with surrounding states that offer similar state-wide energy efficiency programs.

5.1 Further research

There are several areas of analysis covered in this study that were limited due to schedule and scope constraints, summarized in the list below, which could be explored in greater depth. This could include primary New Hampshire data collected from customers and other market actors via surveys, interviews, or other methods to validate and expand on the team's modelling results, while considering tradeoffs between costs, rigor, and value of additional research.

- Analysis of inter-state workforce effects of the NHSaves programs, to help quantify the qualitative insights from expert interviews on workforce competition and use of in- and out-of-state contractor workforce
- Updating health impacts analysis for future program years to reflect updated ISO-NE data on electricity generation mix and updated demographic data underlying epidemiological models
- Further analysis of long-term customer bill savings and discount rate sensitivity analyses, to provide additional insight in response to the Commission
- Analysis of secondary energy consumption related to economic activity spurred on by the NHSaves programs—also known as the "rebound effect"—to provide additional insight in response to the Commission.

[80] The NSPM is a publication of the National Efficiency Screening Project (NESP), which works to improve cost-effectiveness assessments of customer-funded electric and gas energy efficiency programs. The NSPM includes a set of fundamental principles for cost-effectiveness analysis, which have been applied in multiple jurisdictions nationwide. See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

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APPENDIX A. LITERATURE REVIEW SOURCES

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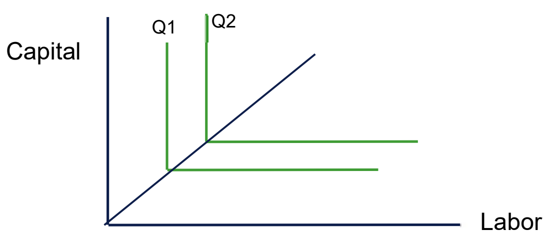
APPENDIX B. IMPLAN METHODS

Input-output (I-O) modeling provides a snapshot view of the economy and is often used to assess how changes in one sector impact the entire economy. I-O modelling has been deployed extensively to estimate the effects of environmental programs including the impacts on GDP, employment, and other economy-wide indicators.[81,82]

The I-O approach relies on exchange among different industries in an economy. The entire economy is represented using a matrix of inputs used to produce outputs known as the Leontief Inverse Matrix. The analysis begins with the n x n matrix A that represents the economy. Each element of the matrix A, aij = xij/xj, represents the inputs needed from industry i to produce one unit of output for industry j. In the symmetric Leontief Inverse Matrix ((I-A)-1), the rows represent the inputs to produce the outputs represented in columns. The coefficient matrix is then post-multiplied by a final demand vector that represents (∆Y)—the change in output for different industries owing to the increase in investments.

IMPLAN deploys a social accounting matrix (SAM) that represents the economy-wide transactions between and within industries, institutions, and households. The SAM is an extension of an I-O matrix as explained in the following paragraphs. The software is based on 546 industries and 536 commodities. Each industry/commodity is, in turn, represented by a Leontief production function (Q = Min(aK, bL))—i.e., the inputs are used in fixed proportions and the resulting isoquants (the relationship between inputs and outputs) are at right angles implying that different inputs are always deployed in fixed proportions to manufacture a commodity (Figure B-1).

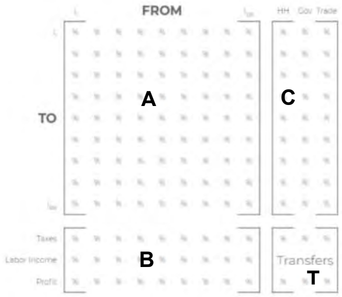
Figure B-1:Representation of a typical Leontief Isoquant Map



The underlying data for a region in each year represents the backward linkages within industries. These linkages include the intermediate inputs, employee compensation, proprietor income (i.e. profits) and taxes.[83] In Figure B-2, for example, block A represents the payments (for intermediate inputs) from each of the 536 industries (in the columns) to all the industries (in the rows). As an illustration, moving down each row in the first column, each cell represents the share of payments from industry 1 to industries 1 through 536. To account for the imports of each commodity from outside the region being examined, the model also weighs the transfers by the regional purchase coefficient of each industry. This is the Input-Output component of the overall SAM.

[81] Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge University Press.
[82] Garrett-Peltier, H. (2017). Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, *61*, 439-447.
[83] https://support.implan.com/hc/en-us/articles/360035967274-Industry-Leontief-Production-Functions-in-IMPLAN

Figure B-2: Illustration of the underlying structure of the SAM in IMPLAN[84]



In addition to the input-output relation based on the production relations presented above, the social accounting matrix also includes information on the total value added (block B) measured through the tax on production and imports, labor income, and profits earned by proprietors. These values are based on the region-specific data contained in IMPLAN. The social accounting matrix also incorporates the flow of payments from household income, government spending and inter-regional trade flows through different forms of spending to each industry (block C). Finally, the SAM also accounts for the transfers from households, government, and inter-region trade in the form of taxes, labor income (that accrues to households and business), and profits to businesses (block T).

Computing Employment Effects in an I-O set-up

To generate the employment effects, the team starts with the economy-wide 1xn vector e of employment multipliers where each element e_i represents the employment needed to generate one unit of output for industry *i*. The post-multiplication product ($e(I-A)^{-1}$) provides the total employment effects of investments in the economy. The analysis generates three types of effects – direct, indirect, and induced, as described below.

- ***Direct effects*** represent the total impact on sectors that get affected by direct spending due to the creation of a new industry. In energy efficiency programs, the direct effects relate to production and installation activities.
- ***Indirect effects*** primarily include the materials and industry demand. These effects accrue to industries supplying inputs to the sectors benefiting directly.
- ***Induced effects*** reflect the second order effects realized in the form of increased spending on consumer goods and services by those earning higher incomes due to the direct and indirect effects.

Distribution ratios and industry code matching

To take advantage of the granular, measure-level program spending data in the NH Utilities' B/C models, we modeled the employment effects of each sub-program individually, distributing each measure-level spending value into materials and labor costs. All material components and labor inputs were modeled as commodity events for the relevant commodity sectors. Table B-1 below provides the list of IMPLAN industries matched against each energy efficiency measure in the NH Utilities' B/C model.

[84] Figure sourced from IMPLAN: https://support.implan.com/hc/en-us/articles/360035967274-Industry-Leontief-Production-Functions-in-IMPLAN

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Table B-1. IMPLAN industry and B/C model measure matching

IMPLAN Industry Name	Measures
Air and gas compressor manufacturing	Air compressors, air nozzles, compressor storage, custom compressor measures
Air conditioning, refrigeration, and warm air heating equipment manufacturing	Air conditioning, chillers, furnaces, heat pumps, other HVAC, refrigeration measures, ice machines, circulator pumps, VRFs, VFDs
Air purification and ventilation equipment manufacturing	Dehumidifiers, air purifiers, demand control ventilation, fan motors
All other industrial machinery manufacturing	Large custom measures
All other electrical equipment and component manufacturing	Advanced power strips
Architectural, engineering, and related services	Comprehensive design, code compliance, Home Energy Raters
Automatic environmental control manufacturing	Boiler controls, RTU controls, energy management systems, lighting controls, hood controls, thermostats
C&I machinery and equipment repair and maintenance	Retro-commissioning
Community food, housing, and other relief services	Workforce development and training
Construction of new multifamily residential structures	EnergyStar Homes measures (multifamily)
Construction of new single-family residential structures	EnergyStar Homes measures (single family)
Electric lamp bulb and part manufacturing	LED lighting (lamps)
Environmental and other technical consulting services	Energy audits, quality assurance, technical assistance
Food product machinery manufacturing	Ovens, fryers, griddles, hot food holding cabinets, steam cookers
Heating equipment (except warm air furnaces) manufacturing	Boilers, circulator pumps, infrared heaters, condensing unit heaters
Household cooking appliance manufacturing	Residential dishwashers
Household laundry equipment manufacturing	Clothes washers, clothes dryers
Household refrigerator and home freezer manufacturing	Freezers, refrigerators, refrigerator recycling
Lighting fixture manufacturing	Lighting fixtures, custom lighting, performance lighting
Maintenance and repair construction of residential structures	Air sealing, duct sealing, contractor fees
Management of companies and enterprises	Administrative and vendor fees, rebate processing, 3rd party financing
Metal window and door manufacturing	Insulated doors
Mineral wool manufacturing	Envelope insulation, duct insulation
Motor and generator manufacturing	Custom motors, case motors, ECM motors
Newly constructed single-family residential structures	Residential code compliance
Other commercial service industry machinery manufacturing	Commercial water heaters, commercial dishwashers
Other major household appliance manufacturing	Residential water heaters
Other plastics product manufacturing	Window inserts
Plumbing fixture fitting and trim manufacturing	Showerheads
Polystyrene foam product manufacturing	Pipe insulation, pipe wrap
Pottery, ceramics, and plumbing fixture manufacturing	Faucet aerators
Pump and pumping equipment manufacturing	Pool pumps
Sheet metal work manufacturing	Heat recovery ventilators
Small electrical appliance manufacturing	Vending misers
Valve and fittings, other than plumbing, manufacturing	Steam traps, pre-rinse spray valves
Water, sewage and other systems	Wastewater treatment facility measures
Wood windows and door manufacturing	Window replacements

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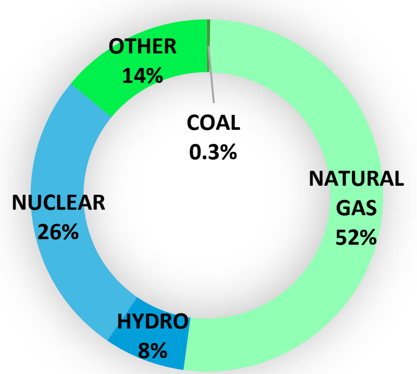
APPENDIX C. AVERT AND COBRA METHODS AND DETAILED RESULTS

Electric generation

The analysis of the NHSaves electric programs' emissions and health impacts is based on the programs' reductions in demand during peak hours.[85] According to Energy Information Administration data, nuclear energy is the main source of electricity generated in New Hampshire.[86] However, during peak hours, fossil fuel generators act as marginal power plants. Power plants operated on fossil fuels, especially coal, are one of the major sources of the criteria pollutants. The NHSaves programs result in savings during ISO New England peak hours, thereby reducing the need for these plants and in turn reducing criteria pollutants. The model also assumes that there are no imports or exports, hence the regions are self-sufficient when it comes to electricity.

In this study, we used AVERT along with COBRA to estimate the health benefits arising from the energy efficiency programs in the power sector. It should be noted that from 2001 to 2020, air emissions from the regional generators in New England have declined drastically. According to ISO New England, the decline can be attributed to decrease in generation from coal and oil powered generation and an increased penetration of renewable resources in the generation fleet. Low emitting gas resources now make up 52% of all electric generation in New England and 98% of the fossil-fueled generation (Figure C-1).

Figure C-1. ISO New England electric generation mix by fuel type, 2022



Source: ISO New England, 2022

End-use combustion

For analysis of the NHSaves gas programs, DNV estimated criteria pollutants using the emission factors provided by the EPA,[87] following the methodology laid in the COBRA user manual.[88] The EPA emission factors report units of pollution (lbs) per million cubic feet (MMcf) of natural gas. To use these emission factors, we converted the savings from MMBtu to MMcf, using the following steps:

- Converted MMBTU to therms by multiplying it by 10
- Converted therms to cubic feet by dividing by 0.01037, per the EIA (In 2020, the U.S. annual average heat content of natural gas delivered to consumers was about 1,037 Btu per cubic foot. Therefore, 100 cubic feet (Ccf) of natural gas equals 103,700 Btu, or 1.037 therms)

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[85] See ISO-NE, https://www.iso-ne.com/about/key-stats/electricity-use/ and https://www.iso-ne.com/about/key-stats/air-emissions.
[86] See https://www.eia.gov/state/analysis.php?sid=NH
[87] See EPA document AP-42, Compilation of Air Emission Factors
[88] See https://www.epa.gov/sites/default/files/2021-03/documents/cobra-fact-sheet-natural-gas.pdf

- Converted cubic feet to MMcf by dividing by 1,000,000
- Multiplied the MMcf of fuel savings by the EPA emission factors for residential and C&I users defined in EPA AP-42
- Divided by 2,000 to convert pounds to tons.

We estimated benefits from residential and commercial gas programs separately given the difference in the emission factors and end uses for those sectors. For the residential sector in particular, end-use combustion fuels include propane, kerosene, wood pellets, and fuel oil. However, modeling end-use combustion for each fuel type was not feasible due to data and project timeline limitations. Therefore, the study assumed all end-use combustion used natural gas. Because combustion of other fuels (particularly oil, kerosene, and wood pellets) creates more criteria pollutants than combustion of natural gas, this assumption resulted in a conservative estimate of the health effects of the programs due to changes in end-use combustion.

Detailed health benefits results

The tables in this section show the detailed breakdown of the health benefits stemming from the 2021 energy savings attributable to the NHSaves program, both for New Hampshire only, as well as the contiguous United States, each at a 3% and 7% discount rate. The tables present both low and high estimates, reflecting the use of different underlying epidemiological studies, particularly on the mortality impacts of PM2.5.[89] The tables illustrate that most of the benefits are attributed to avoided mortality due to the decrease in PM2.5, and the remaining results from effects on morbidity. EPA uses the value of statistical life (VSL) to calculate estimates of mortality benefits.

New Hampshire only, electric

This section documents the detailed COBRA outputs for electric program savings when the pollution effects are limited to New Hampshire only.

Table C-1. Estimated annual monetized benefits from electric savings in 2021, New Hampshire, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.004	0.008	$40,296	$91,160
Nonfatal Heart Attacks *	0	0.004	$64	$593
Infant Mortality	0	0	$127	$127
Hospital Admits, All Respiratory	0.001	0.001	$32	$32
Hospital Admits, Cardiovascular **	0.001	0.001	$46	$46
Acute Bronchitis	0.004	0.004	$2	$2
Upper Respiratory Symptoms	0.066	0.066	$3	$3
Lower Respiratory Symptoms	0.046	0.046	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.07	0.07	$5	$5
Minor Restricted Activity Days	2.388	2.388	$209	$209
Work Loss Days	0.399	0.399	$80	$80
Total Health Effects			**$40,867**	**$92,260**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks.

[89] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

Table C-2. Estimated annual monetized benefits from electric savings in 2021, New Hampshire, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.004	0.008	$35,891	$81,195
Nonfatal Heart Attacks *	0	0.004	$60	$555
Infant Mortality	0	0	$127	$127
Hospital Admits, All Respiratory	0.001	0.001	$32	$32
Hospital Admits, Cardiovascular **	0.001	0.001	$46	$46
Acute Bronchitis	0.004	0.004	$2	$2
Upper Respiratory Symptoms	0.066	0.066	$3	$3
Lower Respiratory Symptoms	0.046	0.046	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.07	0.07	$5	$5
Minor Restricted Activity Days	2.388	2.388	$209	$209
Work Loss Days	0.399	0.399	$80	$80
Total Health Effects			**$36,458**	**$82,258**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

New Hampshire only, gas

This section documents the detailed COBRA outputs for gas program savings when the pollution effects are limited to New Hampshire only.

Table C-3. Estimated annual monetized benefits from residential gas savings in 2021, New Hampshire, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.003	0.006	$28,624	$64,808
Nonfatal Heart Attacks *	0	0.003	$46	$425
Infant Mortality	0	0	$104	$104
Hospital Admits, All Respiratory	0.001	0.001	$23	$23
Hospital Admits, Cardiovascular **	0.001	0.001	$33	$33
Acute Bronchitis	0.003	0.003	$2	$2
Upper Respiratory Symptoms	0.052	0.052	$2	$2
Lower Respiratory Symptoms	0.037	0.037	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.055	0.055	$4	$4
Minor Restricted Activity Days	1.805	1.805	$158	$158
Work Loss Days	0.302	0.302	$61	$61
Total Health Effects			**$29,059**	**$65,622**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-4. Estimated annual monetized benefits from residential gas savings in 2021, New Hampshire, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.003	0.006	$25,495	$57,724
Nonfatal Heart Attacks *	0	0.003	$43	$398
Infant Mortality	0	0	$104	$104
Hospital Admits, All Respiratory	0.001	0.001	$23	$23
Hospital Admits, Cardiovascular **	0.001	0.001	$33	$33
Acute Bronchitis	0.003	0.003	$2	$2
Upper Respiratory Symptoms	0.052	0.052	$2	$2
Lower Respiratory Symptoms	0.037	0.037	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.055	0.055	$4	$4
Minor Restricted Activity Days	1.805	1.805	$158	$158
Work Loss Days	0.302	0.302	$61	$61
Total Health Effects			**$25,927**	**$58,510**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-5. Estimated annual monetized benefits from C&I gas savings in 2021, New Hampshire, 3% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.001	0.001	$6,300	$14,258
Nonfatal Heart Attacks *	0	0.001	$10	$92
Infant Mortality	0	0	$22	$22
Hospital Admits, All Respiratory	0	0	$5	$5
Hospital Admits, Cardiovascular **	0	0	$7	$7
Acute Bronchitis	0.001	0.001	$-	$-
Upper Respiratory Symptoms	0.011	0.011	$-	$-
Lower Respiratory Symptoms	0.008	0.008	$-	$-
Emergency Room Visits, Asthma	0	0	$-	$-
Asthma Exacerbation	0.012	0.012	$1	$1
Minor Restricted Activity Days	0.388	0.388	$34	$34
Work Loss Days	0.065	0.065	$13	$13
Total Health Effects			**$6,393**	**$14,433**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-6. Estimated annual monetized benefits from C&I gas savings in 2021, New Hampshire, 7% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.001	0.001	$5,611	$12,699
Nonfatal Heart Attacks *	0	0.001	$9	$86
Infant Mortality	0	0	$22	$22
Hospital Admits, All Respiratory	0	0	$5	$5
Hospital Admits, Cardiovascular **	0	0	$7	$7
Acute Bronchitis	0.001	0.001	$-	$-
Upper Respiratory Symptoms	0.011	0.011	$-	$-
Lower Respiratory Symptoms	0.008	0.008	$-	$-
Emergency Room Visits, Asthma	0	0	$-	$-
Asthma Exacerbation	0.012	0.012	$1	$1
Minor Restricted Activity Days	0.388	0.388	$34	$34
Work Loss Days	0.065	0.065	$13	$13
Total Health Effects			**$5,704**	**$12,868**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Contiguous US, electric

This section documents the detailed COBRA outputs for electric program savings when the pollution effects are estimated for the entire contiguous United States.

Table C-7. Estimated annual monetized benefits from electric savings in 2021, contiguous US, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.055	0.125	$603,516	$1,365,606
Nonfatal Heart Attacks *	0.006	0.057	$976	$9,070
Infant Mortality	0	0	$2,542	$2,542
Hospital Admits, All Respiratory	0.013	0.013	$495	$495
Hospital Admits, Cardiovascular **	0.013	0.013	$658	$658
Acute Bronchitis	0.065	0.065	$40	$40
Upper Respiratory Symptoms	1.184	1.184	$51	$51
Lower Respiratory Symptoms	0.832	0.832	$22	$22
Emergency Room Visits, Asthma	0.032	0.032	$18	$18
Asthma Exacerbation	1.248	1.248	$93	$93
Minor Restricted Activity Days	39.426	39.426	$3,456	$3,456
Work Loss Days	6.657	6.657	$1,333	$1,333
Total Health Effects			**$613,199**	**$1,383,382**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

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Table C-8. Estimated annual monetized benefits from electric savings in 2021, contiguous US, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.055	0.125	$537,542	$1,216,323
Nonfatal Heart Attacks *	0.006	0.057	$917	$8,521
Infant Mortality	0	0	$2,542	$2,542
Hospital Admits, All Respiratory	0.013	0.013	$495	$495
Hospital Admits, Cardiovascular **	0.013	0.013	$658	$658
Acute Bronchitis	0.065	0.065	$40	$40
Upper Respiratory Symptoms	1.184	1.184	$51	$51
Lower Respiratory Symptoms	0.832	0.832	$22	$22
Emergency Room Visits, Asthma	0.032	0.032	$18	$18
Asthma Exacerbation	1.248	1.248	$93	$93
Minor Restricted Activity Days	39.426	39.426	$3,456	$3,456
Work Loss Days	6.657	6.657	$1,333	$1,333
Total Health Effects			**$547,166**	**$1,233,551**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Contiguous US, gas

This section documents the detailed COBRA outputs for gas program savings when the pollution effects are estimated for the entire contiguous United States.

Table C-9. Estimated annual monetized benefits from residential gas savings in 2021, contiguous US, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.008	0.019	$90,794	$205,483
Nonfatal Heart Attacks *	0.001	0.009	$158	$1,465
Infant Mortality	0	0	$364	$364
Hospital Admits, All Respiratory	0.002	0.002	$77	$77
Hospital Admits, Cardiovascular **	0.002	0.002	$101	$101
Acute Bronchitis	0.01	0.01	$6	$6
Upper Respiratory Symptoms	0.176	0.176	$8	$8
Lower Respiratory Symptoms	0.124	0.124	$3	$3
Emergency Room Visits, Asthma	0.005	0.005	$3	$3
Asthma Exacerbation	0.185	0.185	$14	$14
Minor Restricted Activity Days	5.94	5.94	$521	$521
Work Loss Days	1.002	1.002	$201	$201
Total Health Effects			**$92,249**	**$208,245**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-10. Estimated annual monetized benefits from residential gas savings in 2021, contiguous US, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.008	0.019	$80,869	$183,020
Nonfatal Heart Attacks *	0.001	0.009	$148	$1,376
Infant Mortality	0	0	$364	$364
Hospital Admits, All Respiratory	0.002	0.002	$77	$77
Hospital Admits, Cardiovascular **	0.002	0.002	$101	$101
Acute Bronchitis	0.01	0.01	$6	$6
Upper Respiratory Symptoms	0.176	0.176	$8	$8
Lower Respiratory Symptoms	0.124	0.124	$3	$3
Emergency Room Visits, Asthma	0.005	0.005	$3	$3
Asthma Exacerbation	0.185	0.185	$14	$14
Minor Restricted Activity Days	5.94	5.94	$521	$521
Work Loss Days	1.002	1.002	$201	$201
Total Health Effects			**$82,314**	**$185,693**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-11. Estimated annual monetized benefits from C&I gas savings in 2021, contiguous US, 3% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.002	0.004	$21,222	$48,020
Nonfatal Heart Attacks *	0	0.002	$38	$351
Infant Mortality	0	0	$85	$85
Hospital Admits, All Respiratory	0	0	$18	$18
Hospital Admits, Cardiovascular **	0	0	$24	$24
Acute Bronchitis	0.002	0.002	$1	$1
Upper Respiratory Symptoms	0.04	0.04	$2	$2
Lower Respiratory Symptoms	0.028	0.028	$1	$1
Emergency Room Visits, Asthma	0.001	0.001	$1	$1
Asthma Exacerbation	0.042	0.042	$3	$3
Minor Restricted Activity Days	1.352	1.352	$119	$119
Work Loss Days	0.228	0.228	$46	$46
Total Health Effects			**$21,558**	**$48,669**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-12. Estimated annual monetized benefits from C&I gas savings in 2021, contiguous US, 7% discount rate

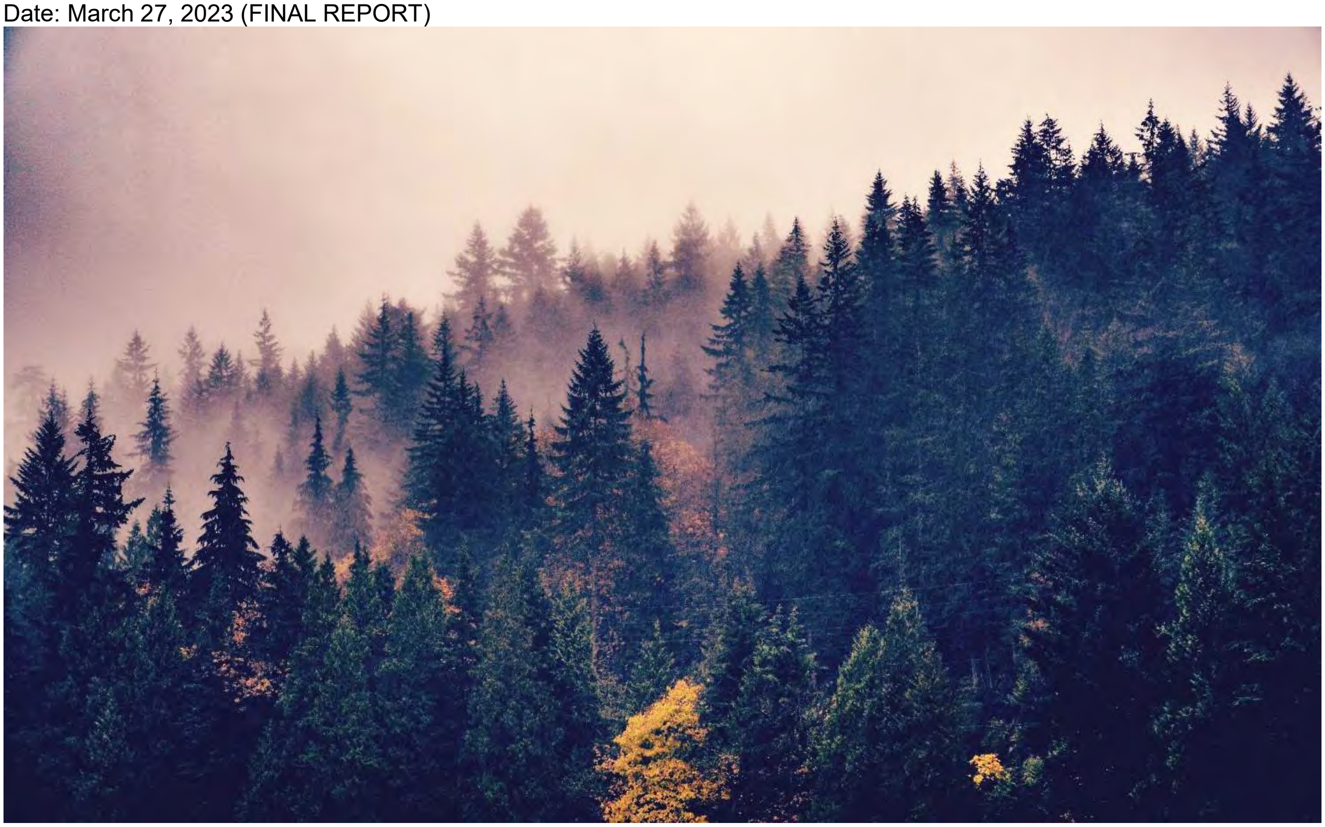
Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.002	0.004	$18,902	$42,770
Nonfatal Heart Attacks *	0	0.002	$36	$330
Infant Mortality	0	0	$85	$85
Hospital Admits, All Respiratory	0	0	$18	$18
Hospital Admits, Cardiovascular **	0	0	$24	$24
Acute Bronchitis	0.002	0.002	$1	$1
Upper Respiratory Symptoms	0.04	0.04	$2	$2
Lower Respiratory Symptoms	0.028	0.028	$1	$1
Emergency Room Visits, Asthma	0.001	0.001	$1	$1
Asthma Exacerbation	0.042	0.042	$3	$3
Minor Restricted Activity Days	1.352	1.352	$119	$119
Work Loss Days	0.228	0.228	$46	$46
Total Health Effects			**$19,236**	**$43,399**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Market Barriers to Energy Efficiency

Submitted to the New Hampshire Evaluation, Measurement, and Verification (EM&V) Working Group

Prepared by: DNV
Date: March 27, 2023 (FINAL REPORT)



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1 EXECUTIVE SUMMARY

New Hampshire statute establishes several principles for the state's energy efficiency programs, including that "*utility sponsored energy efficiency programs should target cost-effective opportunities that may otherwise be lost due to market barriers*."[1] The statute does not establish a specific definition of market barriers, or related terms such as cost-effectiveness. However, in the 2022–2023 NHSaves Plan, the NH Utilities provided a list of the key barriers the programs are designed to overcome. The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[2] in an order on April 29, 2022,[3] in which it found that the "further inquiry and a more in-depth identification of market barriers to energy efficiency and the Plan's ability to remove those barriers going forward is necessary." It directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to identify and quantify the market barriers addressed by the NHSaves programs.

DNV conducted this review in response to the Commission's directives, in coordination with the New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG). The primary objectives of the review were to (1) identify and detail the market barriers addressed by the NHSaves programs, (2) assess the extent to which selected energy efficiency programs such as those in New Hampshire have overcome such barriers, and (3) identify how New Hampshire's programs could continue to do so going forward.

To achieve these objectives, DNV reviewed foundational literature on barriers to energy efficiency broadly, to distill key concepts and research findings that have provided a basis for program interventions since the early days of energy efficiency programs. In addition, DNV identified five selected energy efficiency program offerings for case studies, conducted via a literature review, assessment of NHSaves program offerings and evaluation results, and analysis of NHSaves spending and savings data.[4] This review included analysis of future potential savings opportunities for case study program offerings, based on the 2021–2023 New Hampshire Potential Study.[5]

1.1 Barriers overview

There is a substantial body of literature on barriers to energy efficiency spanning back to the 1990's and earlier. The literature includes several variations of definitions for market barriers, but consistently finds a basis in evidence for the existence and impact of such barriers, and for justification for program interventions to address them. A distillation of the literature suggests the following simplified definition of general barriers: *factors that inhibit adoption of otherwise cost-effective energy efficient technologies and behaviors, resulting in a sub-optimal level of investment in energy efficient technology*.[6] There are several important factors to consider in more specifically defining and assessing market barriers.

1. **The market is complex and heterogenous, and so are barriers**. The market for energy efficiency includes a multitude of technologies, customers, contractors, distributors, manufacturers, and other market actors. Market barriers represent a "complex web of micro-level considerations and constraints that differ greatly by customer group and end use,"[7] and must be "addressed in a highly disaggregate fashion, considering the workings of individual markets."[8] Within a given market, suppliers from upstream manufacturers to midstream distributors to downstream installation contractors

[1] RSA 374-F:3, X. https://www.gencourt.state.nh.us/rsa/html/XXXIV/374-F/374-F-3.htm.
[2] NHSaves, *2022-2023 New Hampshire Statewide Energy Efficiency Plan,* 2022, https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[3] NH PUC, *Order No. 26,621,* 2022. https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF.
[4] In order to accommodate the March 31 deadline, the EM&V WG chose a case study approach based on secondary research. In addition, without explicit direction from the Commission to invest in primary research via surveys and interviews, the EM&V WG preferred the lower-cost secondary research approach.
[5] Dunsky. New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Oct. 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf
[6] In investigatory Docket No. IR 22-042, the NH Utilities provided several similar definitions for market barriers, including "the factors behind the so-called "efficiency gap" – the differential between the level of energy efficiency actually achieved the level judged to be cost-effective at prevailing prices" (LBNL 1992); and "a real or perceived impediment to the adoption of energy efficient technologies or energy efficiency behavior by consumers" (Iowa Administrative Code).
[7] Lawrence Berkeley National Laboratory and National Association of Regulatory Commissioners. *Least-Cost Utility Planning Handbook for Public Utility Commissioners, Volume 2, the Demand Side: Conceptual and Methodological Issues*, December 1988.
[8] Golove, William H. and Joseph H. Eto. *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, March 1996. https://www.osti.gov/biblio/270751.

each face a unique set of financial and operational circumstances, and each confronts a different mix of barriers. Among end use customers, heterogeneity in the population means that technologies that are cost-effective on average may not be cost-effective for certain groups of customers.

2. **The market is ever-changing, and so are barriers**. All markets are dynamic, and the market for energy efficiency is especially so given the broad range of variables—from energy prices, to equipment supply chains, to public policies—that impact market actors and customers. As stated in foundational literature on barriers, "technological and institutional change is an enduring feature of energy service markets. Public policies must be constantly scrutinized for their continuing appropriateness in view of technological advances and the emergence of new market institutions."[9] Chief among these factors is energy prices, which are generally more volatile than other commodities, due in part to customers' limited ability to substitute other fuels when the price of one fuel increases.[10]
3. **Cost-effectiveness is integral to evaluating market barriers**. Market barriers are defined relative to a threshold for cost-effectiveness, above which rational market actors not facing barriers would implement energy efficiency. Any assessment of the extent and magnitude of market barriers must be anchored to a defined threshold for cost-effectiveness. There are multiple perspectives from which to consider the cost-effectiveness of energy efficiency investments, including (1) the perspective of a customer faced with a decision of whether to adopt energy efficiency measure(s), (2) the perspective of society as a whole, in weighing whether the total societal benefits of energy efficiency investments outweigh the total societal costs, and (3) the perspective of regulators within a jurisdiction, who must consider costs and benefits according to the applicable policy goals established in that jurisdiction.[11] Unless otherwise noted, references to cost-effectiveness in this report reflect the customer perspective.

Literature on market barriers consistently identifies a set of specific types of barriers to the adoption of energy efficiency. As with the overall definition of barriers, there are variations in the framing and organization of barrier types throughout the literature, due to inherent subjectivity and overlap in categories. However, the literature we reviewed includes a sufficiently consistent set of barriers to support a general classification into the following categories:

- **Financial** – barriers associated with end users' financial costs of adopting energy efficiency, including limited access to financing, internal competition for capital resources, and transaction costs such as time and labor for project installation
- **Informational** – barriers associated with obtaining information or lacking sufficient information, such as limited awareness of savings potential or limited access to information to assess and verify vendor claims of performance
- **Organizational** – barriers associated with the structure or practices of end-user organizations, including split incentives whereby owners or landlords decide whether to install efficient equipment, rather than occupants who pay energy bills
- **Supply and provision** – barriers associated with energy efficiency suppliers' resources and practices, including workforce capacity and training limitations, and limited product availability
- **Behavioral** – barriers associated with the behavioral patterns of end users, which can include factors such as end user habits, skepticism or lack of trust in the benefits of energy efficiency, or social group dynamics limiting adoption
- **Public policy** – barriers associated with public policies (or lack thereof) causing distortion in market prices or behaviors, including externalities or costs that are associated with transactions, but are not reflected in the transaction price (e.g., the potentially harmful consequences of economic activities on the environment)

The literature also identifies multiple underlying barriers within each category. This deeper understanding of barriers allows for fine-tuning program interventions. For instance, informational barriers in general might be addressed through increased

[9] Ibid.
[10] U.S. Energy Information Administration, *Volatility*, https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2003/10_23/Volatility%2010-22-03.htm.
[11] Cost-effectiveness principles and perspectives are described in more detail in the National Standard Practice Manual (NSPM). The NSPM is a publication of the National Efficiency Screening Project (NESP), which works to improve cost-effectiveness assessments of customer-funded electric and gas energy efficiency programs. The NSPM includes a set of fundamental principles for cost-effectiveness analysis, which have been applied in multiple jurisdictions nationwide. See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

marketing, but if the key underlying barrier for a technology is performance uncertainties (e.g., for emerging technologies with a relatively shorter record of operational performance), an intervention that focused on equipment performance, such as warranties, demonstrations, or certification and labeling, would be more effective.

Market barriers as described in this report are not necessarily market failures as defined in classical economics. Market barriers may slow the adoption of cost-effective efficient technologies, and programs may intervene to circumvent these barriers for individual customers or eliminate them market-wide. In contrast, without such interventions, markets may experience market failures as traditionally defined—that is, situations in which the allocation of resources is economically inefficient, resulting in a net loss of economic value.[12]

1.2 Program interventions

To overcome barriers, programs use a range of interventions that are as varied and targeted as the barriers they are intended to address. The most common types of program interventions are financial—e.g., rebates and financing—and informational—e.g., marketing and educational campaigns.[13] However, successful programs tend to use multi-pronged approaches that include several forms of interventions targeting the same set of customers or technologies. Such approaches acknowledge that customers and suppliers often face multiple barriers and overcoming or reducing one barrier will not always be sufficient to induce participation. For instance, a customer who is unaware of a particular technology (informational barrier) may be informed via advertising, but the advertisement will not be sufficient to induce adoption if they cannot access financing or otherwise afford to install energy saving equipment. Even if informational and financial interventions are effective, customers will be unable to install energy saving equipment if there are no installation contractors available or customers lack the time or expertise to procure and oversee contractors.

Well-designed program interventions are based on careful analysis and insights from customers and suppliers about the barriers they face, ideally drawn from first-hand relationships or primary research. Successful interventions "must be based on a sound understanding of the market problems they seek to correct…[which] can only emerge from detailed investigations of the current operation of individual markets."[14] Table 1-1 provides general categories of program interventions, and the types of information that can support effective design.

Table 1-1. Types of program intervention and information supporting effective design

Intervention Type	Description	Information Supporting Effective Design
Financial incentives	Rebates, discounts, or other incentives (including financing) paid to customers, contractors, distributors, or manufacturers	Data on equipment and project costs, research on customer price sensitivity, access to and preferences for financing
Information and promotion	Marketing and educational materials or campaigns targeting customers, manufacturers, distributors, and retailers. This can also include product assurance via warranties, certifications, labeling, etc.	Market research, program and technology awareness studies, media and audience research
Technical assistance	Engineering, design, and other technical support services, often provided to assist customers with large, complex projects	Research on technological barriers, customers' technical capabilities and limitations, technical assistance vendor capabilities and limitations

[12] See Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* 1996; Eto, Prahl, and Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs*, 1996; New South Wales Government (2017). "A guide to categorising market failures for government policy development and evaluation." New South Wales Department of Industry.
[13] Eto, Prahl, and Schlegel, 1996. The study notes that "if a market barrier is lowered, market adoption of energy-efficient products, services, or practices will increase. We recognize, however, that reducing any one market barrier may not lead to increases in adoption because other barriers may remain or be reinforced, or new barriers may be introduced."
[14] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* 1996.

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Training and trade ally support	Educational and informational resources, training and technical support, joint promotion and advertising support provided to contractors or other trade allies	Technological and engineering expertise, workforce capacity research, market research

1.2.1 Resource acquisition and market transformation programs

Energy efficiency programs generally fall into two broad categories, based on their objectives and design:

- **Resource acquisition programs** are designed to target specific sets of customers and market actors, and specific purchasing decisions. The general objective of these programs is to engage participants by circumventing individual customer barriers to achieve discrete project-level savings typically measured against short-term (e.g., annual) goals.
- **Market transformation programs** are designed to create long-term changes in the structure and function of markets. The general objective of these programs is to eliminate market-level barriers to the supply of energy efficiency, creating widespread changes in markets that persist after program interventions have been removed.

In general, the NHSaves programs are designed to be resource acquisition programs, not market transformation programs.[15] As such, they generally aim to circumvent specific customer or market actor barriers through individual transactions, rather than aiming to eliminate barriers to a particular technology market-wide by achieving systematic changes to the market.

1.3 Barriers and opportunities for selected case study topics

DNV, with input from the EM&V WG, selected topics for case studies that collectively cover all barriers listed in the 2022–2023 NHSaves Plan. These include a range of program offerings, from those with long histories of market transformation, such as retail lighting, to more recently emerging offerings facing steeper barriers, such as advanced lighting controls. The programs and measure types featured in the case studies were selected in part based on their prominence in the NHSaves portfolio, both in terms of their share of recent years' savings and their importance to future program savings opportunities.[16] While there are several markets covered by the NHSaves programs that are not included in our case studies, in general the types of program interventions and the nature of the barriers has broad applicability beyond the selected case study topics.

Some barriers, such as physical health and safety barriers to weatherization projects (e.g., the presence of mold or asbestos preventing blower door-guided air sealing), are unique to specific measures and markets covered in our case studies. Similarly, barriers such as customer skepticism of the performance and savings of new technologies are more prominent in certain areas, such as advanced C&I lighting controls. Other barriers, such as financial barriers, appear in different forms across most markets, and programs consistently offer interventions—i.e., incentives—targeted to the specific customers and market actors involved. Predominant across nearly all markets are overarching barriers related to workforce. Workforce barriers are driven by economy-wide labor supply and demand dynamics, which reach beyond the purview of the NHSaves programs and beyond the geographic boundaries of New Hampshire. In this landscape of diverse and far-ranging barriers, programs including those in New Hampshire have found ways to intervene and circumvent barriers, though there were few areas we reviewed where barriers had been fully eliminated.

Table 1-2 provides a summary of the barriers to adoption of the energy efficiency measures included in each case study topic, and the future opportunities for savings with continued program intervention.

[15] A more detailed explanation of how the NHSaves programs align with these categories was submitted by the NH Utilities in IR 22-042 Investigation of Energy Efficiency Planning, Programming, and Evaluation, Joint Responses to Commission inquiries by NH Utilities, Nov. 30, 2022.
[16] More detail on case study selection criteria is presented in Table 3-1.

Table 1-2. Summary of market barriers and program opportunities for case study topics

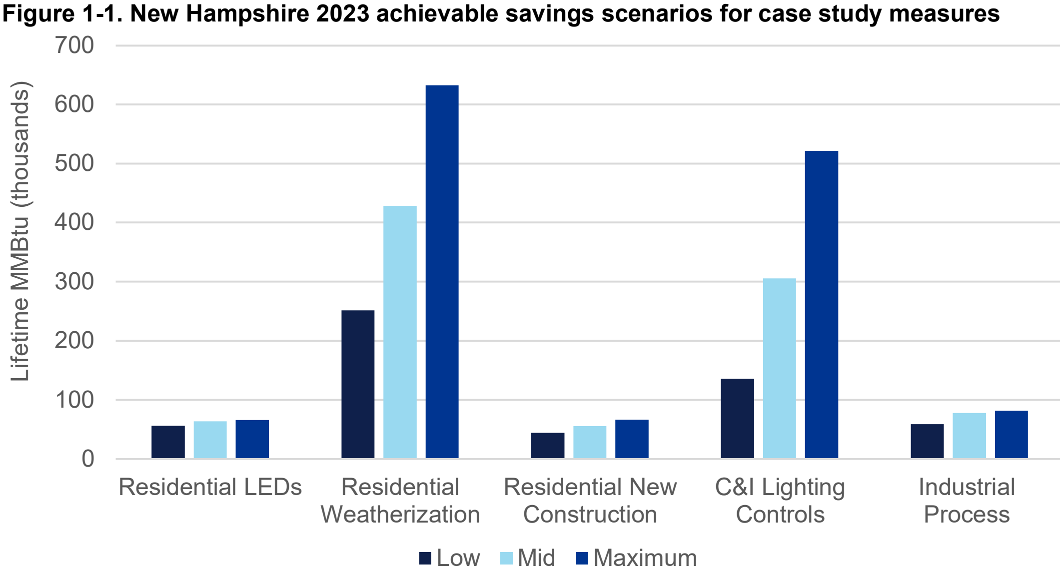
Case study topic	Market barriers characterization	Program opportunities summary
Residential retail lighting	There are minimal remaining market barriers in the retail LED market. It is largely transformed, due in part to significant historic program interventions including incentives and federal lighting standards to eliminate key barriers: • financial barriers (upfront incremental cost of LEDs) and • informational barriers (awareness of savings and performance of LEDs)	There are minimal remaining savings opportunities, limited to the hard-to-reach market (e.g., dollar and discount stores)
Residential weatherization	The weatherization market has faced and continues to face a wide range of barriers that programs have long worked to circumvent, with mixed results. Key types of market barriers include: • financial barriers (upfront cost) • technical and physical barriers (health and safety barriers) • organizational (split incentive between landlords and tenants in rental market) • supply and provision barriers (contractor workforce shortages)	There are significant remaining savings opportunities, primarily for fossil fuel savings. Programs can achieve some amount of savings with financial and other interventions, but may be limited by persistent, widespread workforce barriers, which are driven by broader labor market dynamics that utility programs have limited ability to influence
Residential new construction	Key types of market barriers to efficient residential construction include: • financial (upfront incremental cost of efficient construction); • organizational (split incentive between developers who incur the costs of energy efficient construction and future owners who benefit from savings), and • supply and provision (lack of workforce trained in energy efficient practices)	There are moderate savings opportunities via increased incentives and other interventions to circumvent builder and customer barriers, if programs maintain sufficiently high efficiency requirements relative to the continually advancing construction market and building codes
C&I lighting controls	Advanced C&I lighting controls are in the early stages of market adoption. Key types of market barriers for these technologies include: • financial barriers (upfront incremental cost of controls technology and high transaction costs); • informational barriers (customer awareness and understanding); and • supply and provision barriers (lack of workforce education and awareness)	There are significant remaining savings opportunities if programs and market actors can circumvent these barriers, but the pace of LED replacements means shrinking opportunities if replacements do not include controls
Industrial process	The industrial sector is highly heterogenous and faces a diverse set of barriers. Key types of market barriers include: • financial (upfront costs, access to capital, payback period requirements) • organizational (internal competition for funding, complexities of internal decision making, internal planning cycles) • informational (lack of internal expertise or resources to hire outside experts; lack of information to support program development), • supply and provision (lack of specialized workforce and equipment availability)	There are significant remaining savings opportunities via customized interventions to circumvent barriers on a customer-by-customer basis, particularly enabling strategies such as technical assistance and project planning support

Primary New Hampshire-based research on market barriers has generally been limited. However, the 2021–2023 New Hampshire Potential Study estimated the theoretical impact of barriers on savings opportunities for the NHSaves portfolio using quantitative modeling techniques.[17] To estimate the effect of NHSaves program interventions in overcoming market barriers, the evaluation team re-analyzed the savings opportunities originally modeled for the study. Specifically, the study modeled several achievable savings scenarios that assumed different levels of barriers and included different levels of program incentives and enabling strategies for overcoming barriers—such as contractor training and support, targeted marketing, and financing offerings. The scenarios used to model achievable savings for the 2021–2023 period were:

- **Low achievable savings:** incentives and enabling strategies at the levels of the 2018–2020 NHSaves Plan
- **Mid achievable savings:** incentives raised to a minimum of 75% of incremental cost, and increased enabling strategies
- **Maximum achievable savings:** incentives raised to 100% of incremental cost, and the same enabling strategies as the mid scenario[18]

Using these scenarios, the impact of market barriers on energy efficiency adoption can be estimated based on the growth in savings when moving from the low, to mid, to maximum achievable potential scenarios. This analysis provides an estimate of the scale of savings that barriers are preventing and helps identify what savings programs may be able to achieve by circumventing or eliminating them. Figure 1-1 shows the increase in modeled savings moving from low to maximum achievable potential scenarios for the measures in each case study topic. Larger increases in savings between the scenarios reflect a greater impact from increased incentives and enabling activities to overcome barriers. In other words, greater increases reflect programs or measures where barriers are preventing larger amounts of potential savings from being achieved. In contrast, small increases in savings imply there are few barriers that programs can address. Among case study measures, residential weatherization sees the greatest savings increase—in both percentage and absolute terms—from increased incentives and enabling activities to circumvent barriers. LEDs, in contrast, show a relatively minor increase in savings across the achievable potential scenarios. This pattern is consistent with an assumption of a largely transformed market for retail lighting due to the elimination of barriers for most of the market.

Figure 1-1. New Hampshire 2023 achievable savings scenarios for case study measures



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

[17] Potential studies help inform energy efficiency program planning by establishing guideposts for the amount of savings programs might achieve, as well as more detailed information on savings opportunities for specific customer segments and measure types. Potential studies quantify savings opportunities by obtaining data on existing energy using equipment and building stock, referred to as baseline data. The baseline data is entered into a model with data on efficient equipment and associated savings, costs, customer and market barriers, and other inputs. This model is used to develop various scenarios of potential savings that programs can achieve depending on the level of incentives and other program interventions.

[18] Incremental costs are foundational to energy efficiency program planning and cost-effectiveness testing. They represent the difference in cost between baseline, standard efficiency technologies and the energy efficient measures the programs offer.

On their own, the modelled results from the New Hampshire Potential Study are not definitive evidence of the state of market transformation or elimination of market barriers for the case study measures. However, when considered alongside other indicators, the achievable savings results help identify program areas where market barriers have been largely eliminated, and a market exit strategy should be considered for the programs. Among case studies in our review, retail lighting had the most consistent evidence of market transformation—including studies showing minimal price differences between LEDs and baseline lighting products, and LEDs capturing an overwhelming share of the retail lighting market, even in states without retail lighting programs. In other cases, the Potential Study shows relatively small increases in achievable savings from increased incentives and enabling strategies, but other indicators and research show that customers and market actors continue to face barriers. For instance, our case study of residential new construction found that, despite small increases in achievable savings in the Potential Study, residential new construction programs can continue to achieve savings by increasing program efficiency requirements to ensure participating homes stay ahead of the broader new construction market.

1.4 Conclusions and considerations

Market barriers addressed by the NHSaves programs

Market barriers incorporate a broad and diverse set of obstacles to energy efficiency adoption that vary across customers, technologies, and other dimensions. As stated in the foundational literature , "there is no single market for energy services; instead, the "market" consists of hundreds of end-uses, thousands of intermediaries, and millions of consumers. As a result,…these issues must be addressed in a highly disaggregate fashion, considering the workings of individual markets."[19] The NHSaves programs cover the full spectrum of technologies and customer types, and as such, the programs confront a broad range of barriers. By the same token, they face a wealth of potential savings opportunities from circumventing or eliminating those barriers.

Some barriers, such as physical health and safety barriers to weatherization projects, are unique to specific measures and markets covered in our case studies. Other barriers, such as financial barriers, appear in different forms across most markets, and programs consistently offer interventions—i.e., incentives—targeted to the specific customers and market actors involved. Predominant across nearly all markets are overarching barriers related to workforce, which are driven by economy-wide labor supply and demand dynamics that extend beyond the purview of the NHSaves programs.

Progress in overcoming barriers and transforming markets

In this diverse landscape of barriers, programs including those in New Hampshire have found ways to intervene and circumvent barriers for certain customers and market actors, though there were few areas we reviewed where barriers had been fully eliminated. A key question facing program administrators, stakeholders, and regulators is as follows: in what areas have market barriers been eliminated, if not market-wide, then for a large enough share of customers and market actors whereby program intervention is no longer justified? To definitively answer this question, it is important to have multiple sources of evidence pointing toward the same conclusion.

Our review found that programs vary in the extent to which they have circumvented or eliminated barriers. For retail lighting, it is clear from a preponderance of evidence that programs have helped eliminate market barriers, and program interventions are no longer needed in most cases—and the NH Utilities are discontinuing their offerings in response to this market transformation. However, the other NHSaves programs and offerings covered in our case studies all still face a range of barriers and savings opportunities that justify continued program intervention, with weatherization and C&I lighting controls presenting the greatest opportunities in New Hampshire. In addition, given the ever-changing market for energy efficiency and the continual progress of technological advancement, newer, more efficient technologies are always arising

[19] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* 1996.

which often face a new set of financial, informational, behavioral and other barriers. These advances present opportunities for program intervention even as other opportunities diminish due to market transformation.

Considerations for program interventions in evolving markets

There are clear and significant remaining opportunities for program savings across the markets covered in our case studies. The scope and depth of our analysis does not allow for definitive conclusions about targeting and designing NHSaves program interventions, nor how programs should prioritize resources across programs or among the different types of interventions (e.g., financial, informational, training, etc.). Ultimately barriers are best understood, circumvented, and eliminated through direct interactions between programs, market actors, and the customers they serve. The first-hand knowledge of program implementers and trade allies is critical in this process. As a complement to this expertise, research can provide insights reflecting a broader view, through methods such as surveys, focus groups, or market data analysis.

Due to the scope and timeline of the Commission's requests, the team's case study approach could not comprehensively address all areas of inquiry on market barriers—particularly those such as quantifying end-user costs of addressing barriers and directly quantifying the extent to which New Hampshire programs have removed them. As part of this review, we identified gaps where primary New Hampshire-based research such as customer surveys, market actor interviews, sales data analysis, or other methods would allow for a fuller assessment of the Commission's questions, as shown in Table 1-3. New Hampshire may consider pursuing such research, while weighing the tradeoffs between its costs, rigor, and value to the NHSaves programs and customers in understanding and overcoming barriers.

Table 1-3. Information to support further assessment of barriers and refinement of program interventions

Case Study Topic	Information gaps
Residential retail lighting	Due to high levels of market share and limited remaining savings opportunity, additional research is not recommended for retail lighting
Residential weatherization	Primary research on: • upfront weatherization costs residents are willing to incur, by customer class and measure type, and single family vs. multifamily • workforce capacity, knowledge, and skills gaps • coordination of program offerings and other funding sources to address health and safety barriers
Residential new construction	Primary research on: • homebuyer awareness of and preferences for energy efficient homes, and developer perception of market demand for energy efficiency • incremental costs of energy efficient construction • ENERGY STAR® Homes attribution (NTG) and market penetration
C&I lighting controls	Primary research on: • workforce capacity, knowledge, and skills gaps regarding controls • contractor and customer research on barriers and opportunities for integration of controls into LED retrofit projects • customer research on awareness and perception of controls technologies and persistence of savings
Industrial process	Primary research on: • Industrial stock in New Hampshire • Customer research on internal and external financing processes and sources

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2 INTRODUCTION

The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[20] in an order on April 29, 2022,[21] in which it found that the "further inquiry and a more in-depth identification of market barriers to energy efficiency and the Plan's ability to remove those barriers going forward is necessary." It directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to quantify the market barriers. In a subsequent order of clarification, issued June 21,[22] the Commission stated that the intention of their directive was to comprehensively enumerate the end-users' costs of addressing identified market barriers and quantify as many costs as possible and provide a narrative explanation of the non-quantifiable costs. In a separate request issued on November 1, 2022, the Commission sought information on market barriers related to the scope of this review, including for the Joint Utilities to identify areas where New Hampshire energy efficiency program funds have enabled a technology or practice to become market competitive.[23] Per the Commission's order, this review of market barriers was due by March 31, 2023.

DNV, in coordination with the New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG), designed this review to respond to the Commission's requests to the extent feasible within the given timeframe. DNV presented several options for study approaches, including several approaches that would fully address Commission requests via primary data collection and analysis, but would require longer timelines. These approaches included methods such as general population surveys for selected customer segments, interviews with participating and non-participating distributors, retailers, and contractors, analysis of historical program data, and participant surveys and interviews. In order to accommodate the March 31 deadline, the EM&V WG chose a case study approach based on secondary research.[24]

As shown in Table 2-1, the selected case study approach addresses or partially addresses the Commission's directives. As part of this review, throughout the report we have noted gaps where primary New Hampshire-based research would allow for a fuller assessment and response to the Commission's directives, such as quantifying the end-user costs of addressing barriers or directly quantifying the extent to which New Hampshire programs have removed them.

Table 2-1. Response to commission reporting requirements

Commission reporting requirement	Source	Case study approach
Identify and quantify market barriers listed in the 2022–2023 NHSaves plan	4/29 order, 11/1 data request	Partially addressed: identification and description of barriers, but not quantification
Assess the ability of plans to remove barriers in the future	4/29 order	Addressed, for selected case studies
Enumerate and quantify costs of addressing barriers	6/21 clarification order	Partially addressed: enumeration of costs, but not quantification
Identify previously existing barriers partially or totally removed by programs	11/1 data request	Addressed, for selected case studies
Identify where programs enabled a technology or practice to become market competitive	11/1 data request	Addressed, for selected case studies

[20] NHSaves, *2022-2023 New Hampshire Statewide Energy Efficiency Plan,* 2022, https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[21] NH PUC, *Order No. 26,621*, 2022. https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF.
[22] NH PUC, *Order No. 26,642*, 2022. https://www.puc.nh.gov/Regulatory/Orders/2022orders/Documents/26-642.pdf.
[23] NH PUC, *IR 22-042,* 2022. https://www.puc.nh.gov/Regulatory/Docketbk/2022/22-042/ORDERS/22-042_2022-11-01_NHPUC_PROC-ORDER-RE-RECORD-REQUESTS.PDF.
[24] The EM&V WG also preferred the case study approach due to its lower cost compared to conducting primary research via surveys and interviews. Survey and interview methods require a larger research budget and more staff hours for tasks such as statistical sampling, instrument design, survey and interview fielding, and data analysis, as well as incentives to encourage survey and interview responses. Without explicit direction from the Commission to invest in such research, the EM&V WG decided to pursue a lower-cost approach.

3 METHODOLOGY

The primary objectives of this review were to (1) identify and enumerate the market barriers addressed by the NHSaves programs, (2) assess the extent to which selected energy efficiency programs such as those in New Hampshire have overcome such barriers, and (3) identify how New Hampshire's programs could continue to do so going forward.

To achieve these objectives, DNV identified five selected energy efficiency program offerings for case studies, conducted via a literature review and consultation with internal subject matter experts.[25] The selected case studies document known market and customer barriers, program interventions used to overcome those barriers, and trends in adoption of energy efficient technologies and behaviors. The case studies also provide context on New Hampshire's existing programs and future opportunities for achieving savings by addressing market barriers. In addition to the case studies, DNV reviewed foundational literature on barriers to energy efficiency broadly, to identify and distill key concepts and research findings that have provided a basis for program interventions since the early days of energy efficiency programs.

Further details on these methods are described below, and sources for the literature review are provided in APPENDIX B.

3.1 Case study topic selection

DNV, with input from the EM&V WG, selected case studies that collectively cover all barriers listed in the 2022–2023 NHSaves Plan. These include a range of program offerings, from those with long histories of market transformation, such as retail lighting, to more recently emerging offerings facing steeper barriers, such as advanced lighting controls. The programs and measure types featured in the case studies have been selected in part based on their prominence in the NHSaves portfolio, both in terms of their share of recent years' savings and their importance to future program savings opportunities. Case study topics were selected based on the following tasks.

3.1.1 Review of New Hampshire program documents and data

To help ensure that the selected case studies represent reasonable proxies for New Hampshire's programs and can provide the most relevant and applicable results, DNV reviewed New Hampshire program planning documents, and program savings and spending data. This included reviewing the NH Utilities' 2021 Benefit/Cost (B/C) models to identify the programs and measures responsible for the largest shares of overall savings. In addition, DNV reviewed 2021 program spending on primary mechanisms/interventions for overcoming barriers (such as on-bill financing and awareness/marketing campaigns) from the NH Utilities' filings.[26] DNV also reviewed program websites and materials with information on program offerings and interventions related to selected case study topics.

3.1.2 Review of future savings opportunities

DNV reviewed the 2021–2023 New Hampshire Potential Study to identify the customer segments and measure types that present the greatest remaining savings opportunities for the programs. The team also obtained EM&V WG input on other strategic priorities for the programs beyond savings magnitude, as well as suggestions for selected case study topics that would provide forward-looking insights of value for the programs in achieving their savings goals and other objectives.

3.1.3 Determination of case study topics

Following these steps, DNV identified potential case study topics for EM&V WG feedback, which DNV considered when finalizing the selected case studies. Table 3-1 shows the final selected case study topics and the basis for their selection. There are several markets covered by the NHSaves programs that are not included in our case studies, in general the types of program interventions and the nature of the barriers has broad applicability beyond the selected case study topics.

[25] DNV staff have led or been part of numerous studies nationwide that have covered all selected case study topics. The evaluation team leveraged that body of expertise to identify key studies and highlight the most salient trends and findings on barriers to and adoption of efficient technologies.
[26] See Docket No. IR 22-042, 2021 Program Year Compliance Filing Order No. 26, 261 Report 9.v. Market Barriers, Aug. 31, 2022.

Table 3-1. Selected case study topics

Case study	Share of NH statewide savings (2021 actuals)	Future savings opportunities	Other factors for selection
Residential retail lighting	Large share of electric savings: • 51% of residential MWh (annual) • 20% of residential MWh (lifetime)	Steep decline in savings potential due to the lighting market's continued transformation (*2021-2023 NH Potential Study*)	Prime example of recent energy efficiency market transformation due to program investments Large body of existing research
Residential weatherization	Large share of fossil fuel savings: • 73% of residential MMBtu (annual) • 73% of residential MMBtu (lifetime) Moderate share of electric savings: • 14% of residential MWh (annual) • 28% of residential MWh (lifetime)	Reductions in space heating requirements from envelope measures are a key source of potential natural gas savings (*2021-2023 NH Potential Study*)	Persistent market barriers, but resource acquisition successes State priority to allocate at least 20% of funds for low-income programs (largely weatherization) Recognized customer-centric barriers and non-energy benefits
Residential new construction	Moderate share of electric and gas lifetime savings: • 17% of residential MWh (lifetime) • 17% of residential MMBtu (lifetime)	Growing opportunity due to gradually increasing new housing starts forecasted, and positive net migration into New Hampshire in recent years (*Census Bureau data*)	Body of existing research on market effects and code compliance Well-recognized and successful New Hampshire programs
C&I advanced lighting controls	Small share of current electric savings: • 3% of C&I MWh (annual) • 2% of C&I MWh (lifetime)	Growing opportunity, among the top measures for non-residential electric savings potential (*2021-2023 NH Potential Study*)	Well-researched technical barriers (e.g., limited cross-compatibility among different manufacturers) and customer awareness barriers
Industrial process measures	Moderate share of gas savings: • 18% of C&I MMBtu (annual) • 14% of C&I MMBtu (lifetime) Small share of electric savings: • 3% of C&I MWh (annual) • 4% of C&I MWh (lifetime)	The manufacturing and industrial segment is the second highest saving segment overall, with savings opportunities focused on process measures (and is also far less dependent on lighting savings than other segments) (*2021-2023 NH Potential Study*)	Large energy consumers with strategic program importance Diverse technology- and subsector-specific barriers

3.2 Literature review

Following case study selection, DNV's primary research activity was a literature review, which fell into two primary categories: (1) a review of foundational literature to identify and distill key concepts and research findings into a conceptual framework for market and customer barriers; and (2) program- or technology-specific literature for each of the selected case study topics, with a focus on evaluations from New Hampshire and other Northeast states. A list of all reviewed publications is provided in APPENDIX B.

3.2.1 Foundational literature

The review of foundational literature provided a basis for defining barriers and enumerating those identified in literature spanning from the early years of regulated energy efficiency programs in the United States. This literature review also identified the standard types of program interventions and the metrics programs have used to measure their success in overcoming barriers.

Our review included literature from the 1990s through current day, from sources including the U.S. DOE National Laboratories, industry and academic journals, and policy-focused organizations such as ACEEE. The literature was identified via web searches and queries of online journals, and mining the references cited in each source for additional key sources.

3.2.2 Review of relevant program research and evaluations

To provide a basis for the case studies, we reviewed program evaluations and other research related to the case study topics, primarily focusing on evaluations conducted on behalf of energy efficiency program administrators, regulators, and oversight bodies. We first reviewed any related research conducted on New Hampshire's programs, and then expanded the review to cover publicly available evaluations from other Northeast states, due to the similarity of programs, common program administrators and implementation vendors, overlapping market actors (e.g., distributors, retailers) and base of customers, and shared energy markets (e.g., wholesale electric and gas). We also consulted with internal experts involved in evaluations of case study topics to identify additional studies from beyond the Northeast region, and to ensure our review addressed the most salient findings and cross-cutting trends from the national body of research.

From this literature, the team gathered and synthesized quantitative and qualitative findings on (1) market and customer barriers, (2) program interventions, and (3) trends such as market share and net-to-gross (NTG) results for the measure and program types relevant to each case study. Where New Hampshire research was available, the case studies highlight these findings, and where there has not been New Hampshire research to date, the case studies identify the key research gaps that, if filled, would allow for improved estimates of barriers currently faced in New Hampshire and how programs can target interventions to overcome them.

Finally, the literature review included an in-depth review and re-analysis of data from the 2021–2023 New Hampshire Potential Study to quantify the achievable savings potential for the measures covered in each case study under the different barrier scenarios modeled in the study.

3.3 Scope limitations and opportunities for additional research

Due to the scope of the Commission's requests and the required deadline, the case study approach could not comprehensively address all Commission requests on market barriers—particularly those such as quantifying end-user costs of addressing barriers or directly quantifying the extent to which New Hampshire programs have removed them. As part of this review, throughout the report we have noted gaps where primary New Hampshire-based research such as customer surveys, market actor interviews, sales data analysis, or other methods would allow for a fuller assessment of the Commission's questions.

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4 MARKET BARRIERS OVERVIEW

New Hampshire statute establishes several principles for the state's energy efficiency programs, including that "*utility sponsored energy efficiency programs should target cost-effective opportunities that may otherwise be lost due to market barriers*."[27] The statute does not establish a specific definition of market barriers, or related terms such as cost-effectiveness. However, in the 2022–2023 NHSaves Plan, the NH Utilities provided a list of the key barriers the programs are designed to overcome. The foundational literature we reviewed identifies many of these same barriers, as well as others not listed in the NHSaves plan. The following section provides general definitions of market barriers, an overview of types of barriers identified in the literature and the program interventions commonly used to address then, and different metrics for measuring success in addressing barriers.

4.1 Barriers definitions

There is a substantial body of literature on barriers to energy efficiency spanning back to the 1990's and earlier. The literature includes several variations of definitions for market barriers, but consistently finds a basis in evidence for the existence and importance of such barriers, and for justification for program interventions to address them. A foundational paper on the topic found that "significant opportunities exist to reduce energy utilization by implementing technologies that are cost-effective under prevailing economic conditions but that are not fully implemented by existing market institutions… problems of imperfect information and transaction costs may bias rational consumers to purchase devices that use more energy than those that would be selected by a well-informed social planner guided by the criterion of economic efficiency."[28] Numerous publications from as recently as 2020 have arrived at similar conclusions. (See APPENDIX A for a summary and classification of barriers identified in foundational literature.)

A distillation of the literature suggests the following simplified definition of barriers: *factors that inhibit adoption of otherwise cost-effective energy efficient technologies and behaviors, resulting in a sub-optimal level of investment in energy efficient technology.*[29]

There are several important factors to consider in applying this definition and assessing market barriers.

1. **The market is complex and heterogenous, and so are barriers**. The market for energy efficiency includes a multitude of technologies, customers, contractors, distributors, manufacturers, and other market actors. Market barriers represent a "complex web of micro-level considerations and constraints that differ greatly by customer group and end use,"[30] and must be "addressed in a highly disaggregate fashion, considering the workings of individual markets."[31] Within a given market, suppliers from upstream manufacturers to midstream distributors to downstream installation contractors each face a unique set of financial and operational circumstances, and each confronts a different mix of barriers. Among end use customers, heterogeneity in the population means that technologies that are cost-effective on average may not be cost-effective for certain groups of customers. For instance, capital intensive energy saving equipment must be more fully utilized to achieve the operational savings required for cost-effectiveness, so it may not be cost-effective for customers with intermittent operating schedules (e.g., schools, religious buildings, seasonal properties).[32,33] Furthermore, there are often lower barriers to adopting energy efficiency measures in industries where energy costs represent a larger share of operating costs, such as heavy manufacturing, where energy costs create a natural incentive to pursue efficiency. In contrast, barriers are often more significant among businesses where energy

[27] RSA 374-F:3, X. https://www.gencourt.state.nh.us/rsa/html/XXXIV/374-F/374-F-3.htm.
[28] Howarth R, Andersson B. 1993. Market barriers to energy efficiency. Energy Econ. 15:262–72.
[29] In investigatory Docket No. IR 22-042, the NH Utilities provided several similar definitions for market barriers, including "the factors behind the so-called "efficiency gap" – the differential between the level of energy efficiency actually achieved the level judged to be cost-effective at prevailing prices" (LBNL 1992); and "a real or perceived impediment to the adoption of energy efficient technologies or energy efficiency behavior by consumers" (Iowa Administrative Code).
[30] LBNL and National Association of Regulatory Commissioners 1988.
[31] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, 1996.
[32] Howarth R, Andersson B. 1993. Market barriers to energy efficiency. Energy Econ. 15:262–72.
[33] Sorrell, S., O'Malley, E., Schleich, J., and Scott, S. (2004). The economics of energy efficiency - Barriers to cost-effective investment.

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costs are a smaller share of total operating costs, such as those in the public or service sectors, because even when cost-effective energy efficiency opportunities exist, their financial benefit is less apparent or is outweighed by other factors such as high transaction costs.

2. **The market is ever-changing, and so are barriers**. All markets are dynamic, and the market for energy efficiency is especially so given the broad range of variables—from energy prices to equipment supply chains to public policies—that impact market actors and customers. As stated in seminal research on barriers, "technological and institutional change is an enduring feature of energy service markets. Public policies must be constantly scrutinized for their continuing appropriateness in view of technological advances and the emergence of new market institutions."[34] Chief among these factors is energy prices, which are generally more volatile than other commodities, due in part to customers' limited ability to substitute other fuels when the price of one fuel increases.[35] New Hampshire and the rest of New England have seen particularly sharp increases in electric rates in recent months. These increases impact the level of barriers experienced by customers and other market actors (e.g., reducing financial barriers by increasing the value of energy savings), and the effectiveness of program interventions such as rebates and financing.
3. **Cost-effectiveness is integral to evaluating market barriers**. Market barriers are defined relative to a threshold for cost-effectiveness, above which rational market actors not facing barriers would implement energy efficiency. Any assessment of the extent and magnitude of market barriers must be anchored to a defined threshold for cost-effectiveness. There are multiple perspectives from which to consider the cost-effectiveness of energy efficiency investments, including (1) the perspective of a customer faced with a decision of whether to adopt energy efficiency measure(s), (2) the perspective of society as a whole, in weighing whether the total societal benefits of incremental energy efficiency investments outweigh the total societal costs, and (3) the perspective of regulators within a jurisdiction, who must consider costs and benefits according to the applicable policy goals established in that jurisdiction.[1] This report primarily refers to cost-effectiveness in terms of the customer perspective. The exception to this is the team's quantification of New Hampshire-specific barriers (e.g., analysis of the 2021–2023 Potential Study results in Section 4.5), which assumes the use of the Granite State Test (GST). The GST reflects the regulatory perspective as described in the National Standard Practice Manual (NSPM), and accounts for long-term utility system avoided costs, other fuel and water resource savings, and certain non-energy benefits, as well as the costs of the programs.[36] The GST was developed through a stakeholder process that culminated in a consensus recommendation to adopt the test.[37] The Commission approved the use of the test, and the legislature subsequently established it as the primary cost-effective test for New Hampshire's energy efficiency programs.[38, 39]

Market barriers as described here are not necessarily market failures as defined in classical economics. These barriers are, however, factors that affect consumers' economic decision making, based on their perceived value of energy efficiency investments and their perceived costs of those investments. Program interventions targeting market barriers are designed to improve consumers' value proposition by providing direct rebates (lowering the cost), by mitigating other costs such as transaction or information search costs, or by increasing the perceived benefit such as by providing implicit or explicit endorsement of energy efficiency technologies. In contrast, without such interventions, markets may experience market

[34] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, 1996
[35] U.S. Energy Information Administration, *Volatility*. https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2003/10_23/Volatility%2010-22-03.htm.
[36] The NSPM outlines a process for developing cost-effectiveness tests that "encompasses the perspective of a jurisdiction's applicable policy objectives and includes and assigns value to all relevant impacts (costs and benefits) related to those objectives. The NSPM refers to this as the 'regulatory' perspective, which is intended to reflect the important responsibilities of institutions, agents, or other decision-makers authorized to determine utility resource cost-effectiveness and funding priorities." See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf
[37] NH PUC, *Re: DE 17-136, Electric and Gas Utilities 2018-20 New Hampshire Statewide Energy Efficiency Plan B/C Working Group Recommendations Regarding New Hampshire Cost-Effectiveness Review and Energy Optimization through Fuel Switching Study*, 2019. https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_FILING_WORKING_GROUP_REC.PDF.
[38] NH PUC, *Order No. 26,322*, 2019. https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/ORDERS/17-136_2019-12-30_ORDER_26322.PDF
[39] Bill_Status (state.nh.us) https://gencourt.state.nh.us/bill_status/legacy/bs2016/bill_status.aspx?lsr=717&sy=2022&sortoption=&txtsessionyear=2022&txtbillnumber=HB549

failures as traditionally defined—that is, situations in which the allocation of resources is economically inefficient, resulting in a net loss of economic value.[40]

4.2 Types of barriers

Literature on market barriers consistently identifies a set of specific types of barriers to the adoption of energy efficiency. As with the overall definition of barriers, there are variations in the framing and organization of barrier types throughout the literature, due to inherent subjectivity and overlap in categories. However, the literature we reviewed includes a sufficiently consistent set of barriers to support a general classification into the following categories:

- Financial – barriers associated with end users' financial costs of adopting energy efficiency, including limited access to financing, internal competition for capital resources, and transaction costs such as time and labor for project installation
- Informational – barriers associated with obtaining information or lacking sufficient information, such as limited awareness of savings potential or limited access to information to assess and verify vendor claims of performance
- Organizational – barriers associated with the structure or practices of end-user organizations, including split incentives whereby owners or landlords decide whether to install efficient equipment, rather than occupants who pay energy bills
- Supply and provision – barriers associated with energy efficiency suppliers' resources and practices, including workforce capacity and training limitations, and limited product availability
- Behavioral – barriers associated with the behavioral patterns of end users, which can include factors such as end user habits, skepticism or lack of trust in the benefits of energy efficiency, or social group dynamics limiting adoption
- Public policy – barriers associated with public policies (or lack thereof) causing distortion in market prices or behaviors, including externalities or costs that are associated with transactions, but are not reflected in the transaction price (e.g., the potentially harmful consequences of economic activities on the environment)

There is some disagreement in the literature about the nature of one of the most commonly cited barriers to energy efficiency—upfront costs (also referred to as high first cost, and described in the NHSaves 2022-2023 plan as the incremental price difference between standard and high efficiency goods and services). In particular, some foundational literature states that upfront costs do not, in and of themselves, constitute a market barrier—rather, what studies and programs identify as upfront cost barriers are actually the result of a number of underlying market barriers.[41] Specifically, customers may lack access to financing to cover the higher upfront costs of energy efficient equipment, or they may lack information about equipment performance to properly assess its long-term payback. On the supply side, higher upfront costs for newer energy efficient technologies may be driven by suppliers facing poorer economies of scale for low-volume products and services that have not yet been widely adopted. Regardless of how high upfront cost fits into the market barriers framework, programs have long recognized it as a key barrier and designed and successfully deployed interventions—e.g., financial incentives and financing offerings—to help customers cover the upfront costs of energy efficiency measures that they were otherwise unwilling to pay for.

The NHSaves 2022–2023 Plan cites several barriers that align with these categories, most notably financial barriers, informational barriers, and supplier barriers. As noted in the literature, financial and informational barriers have been the most commonly cited barriers, and are the primary focus of core program interventions such as financial incentives and marketing and awareness campaigns.[42] The third category, supplier barriers, has been well understood since the early days of energy efficiency programs, but has received increased attention in recent years due to a growing shortage of contractor and other workforce, as well as an increase in midstream and upstream program designs targeting distributors and retailers.

[40] See Eto and Golove, 1996; Eto, Prahl, and Schlegel, 1996; New South Wales Government (2017). "A guide to categorising market failures for government policy development and evaluation." New South Wales Department of Industry.
[41] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency* 1996; Eto, Prahl, and Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs*, 1996.
[42] Ibid.

The literature also identifies multiple underlying barriers within each category. This deeper understanding of barriers allows for fine-tuning program interventions. For instance, informational barriers in general might be addressed through increased marketing, but if the key underlying barrier for a technology is performance uncertainties (e.g., for emerging technologies with a relatively shorter record of operational performance), an intervention that focused on equipment performance, such as warranties or demonstrations, would be more effective.

A summarized list of the types of barriers identified in the foundational literature is presented in Table 4-1, alongside the barriers cited in the NHSaves 2022–2023 plan. A full list of categorized barriers from the foundational literature review is provided in APPENDIX A.

Table 4-1. Energy efficiency barriers identified in foundational literature and the NHSaves plan

Barrier Category	NHSaves 2022–2023 Plan	Summary of Foundational Literature
Financial	Incremental price difference between standard and high efficiency goods and services	• Limited access to financing and capital constraints • Hidden costs not captured by the price of efficiency investments, such as technical risks or O&M costs • Hassle or transaction costs, such as the time, materials and labor involved in obtaining or contracting for energy-efficient products or services
Informational	Lack of customer awareness related to: • benefits of energy efficiency • existence of high-efficiency alternatives. • where to purchase high-efficiency equipment/quality installation. how and when to reduce demand during system peaks.	• Lack of awareness of savings potential • Lack of confidence that advice received on pursuing energy efficiency is trustworthy and credible • High information or transaction costs for research on the availability of efficient technologies, to assess and verify vendor claims, find qualified contractors, and judge equipment uncertainties.
Organizational	N/A	• Split incentives, where building occupants who pay energy bills are not responsible for purchasing energy efficient equipment; rather owners, landlords or developers are • Organizational behavior or systems of practice that discourage or inhibit cost-effective energy efficiency decisions, for example, corporate or government procurement rules • Culture and values held by key individuals in a company that influence that company's decisions
Supply and provision	• Insufficient retailer stocking: Midstream (retailers/ distributors) fail to stock high-efficiency products • Building trades lack sufficient cadre of trained personnel, awareness, experience, or commitment to high-efficiency practices, both for existing building renovations and new construction	• Training and skills of professionals • Product or service unavailability: a failure of manufacturers, distributors, or vendors to make a product or service available in a given area or market • Innovation externalities: a firm that develops or implements a new technology typically creates benefits for others, and hence has an inadequate incentive to increase those benefits by investing in technology
Behavioral	N/A	• Non-economic consumer rationality: energy users influenced by factors such as appearance, public or peer opinions, and personal obligation or habit. • Bounded Rationality: The behavior of an individual during the decision-making process that either seems or actually is inconsistent with the individual's goals • Lack of interest and undervaluing energy efficiency benefits due to social group interactions, customs, and habits
Public policy	N/A	• Externalities: costs that are associated with transactions, but that are not reflected in the price paid in the transaction (e.g., the potentially harmful consequences of economic activities on the environment) • Prices faced by consumers in electricity markets may not reflect marginal social costs due to the common use of average-cost pricing under utility regulation. Average-cost pricing could lead to under- or overuse of electricity relative to the economic optimum.

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4.3 Program interventions

To overcome barriers, programs use a range of interventions that are as varied and targeted as the barriers they are intended to address. The most common types of program interventions are financial—e.g., rebates and financing—and informational—e.g., marketing and educational campaigns.[43] However, successful programs tend to use multi-pronged approaches that include several forms of interventions targeting the same set of customers or technologies. Such approaches acknowledge that customers and suppliers often face multiple barriers, and overcoming or reducing one barrier will not always be sufficient to induce participation. For instance, a customer who is unaware of a program (informational barrier) may be informed via advertising, but the advertisement will not be sufficient to induce participation if they cannot access financing or otherwise afford to install energy saving equipment. Even if informational and financial interventions are effective, customers will be unable to install energy saving equipment if there are no contractors available to perform the work.

Well-designed program interventions are based on careful analysis and insights from customers and suppliers about the barriers they face, ideally drawn from first-hand relationships or primary research. Successful interventions "must be based on a sound understanding of the market problems they seek to correct and a realistic assessment of their likely efficacy. This understanding can only emerge from detailed investigations of the current operation of individual markets."[44] The information needed to design effective program interventions can be gathered over time through direct experience working with customers and trade allies, and when needed, through focused research involving surveys, focus groups, market data analysis and other methods.

Table 4-2 provides general categories of program interventions, and the information needed to design them.

Table 4-2. Types of program intervention and information supporting effective design

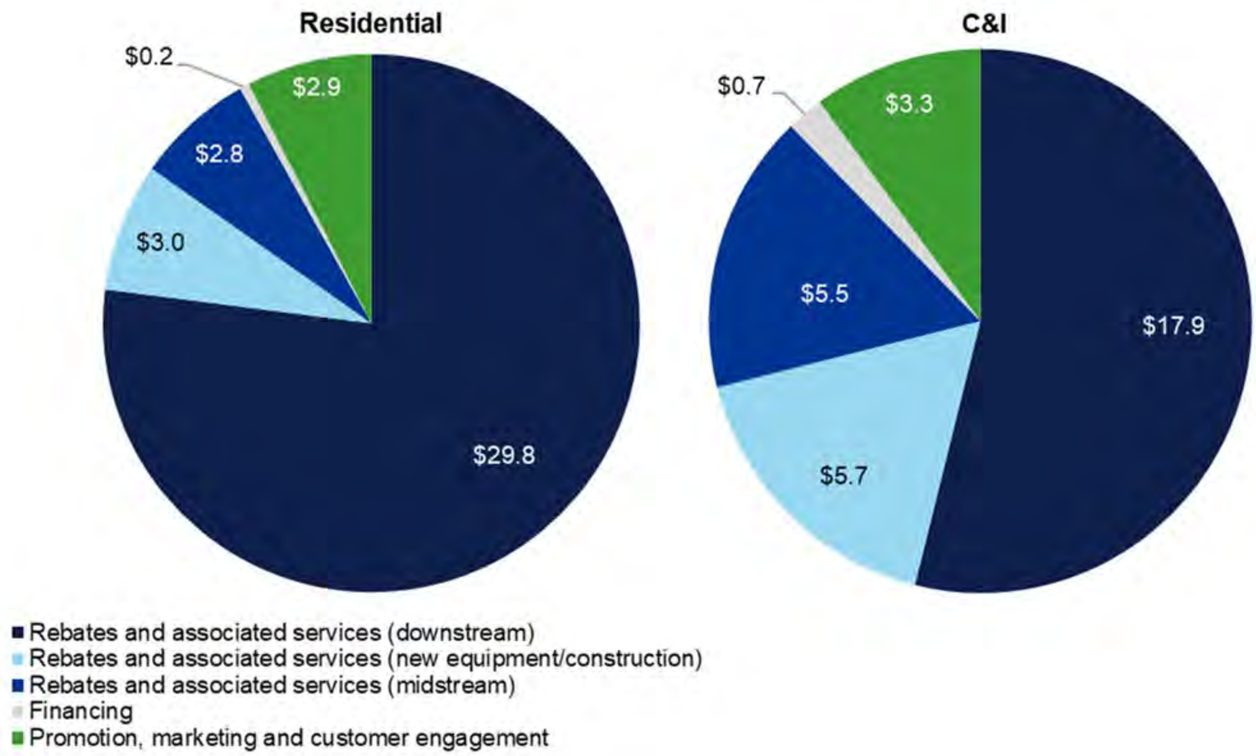
Intervention Type	Description	Information Supporting Effective Design
Financial incentives	Rebates, discounts, or other incentives (including financing) paid to customers, contractors, distributors, or manufacturers	Data on equipment and project costs, research on customer price sensitivity, access to and preferences for financing
Information and promotion	Marketing and educational materials or campaigns targeting customers, manufacturers, distributors, and retailers	Market research, program and technology awareness studies, media and audience research
Technical assistance	Engineering, design, and other technical support services, typically provided to assist customers with large, complex projects	Research on technological barriers, customers' technical capabilities and limitations, technical assistance vendor capabilities and limitations
Training and Trade Ally support	Educational and informational resources, training and technical support, joint promotion and advertising support provided to contractors or other trade allies	Technological and engineering expertise, workforce capacity research, market research

The NHSaves 2022–2023 plan identified several interventions that generally align with the categories above, and Figure 4-1 shows the program spending on those interventions in 2021.[45] Although rebates and associated services comprise the bulk of program spending, it is important to note that this spending covers a range of more specific intervention types beyond

[43] Eto, Prahl, and Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs*, 1996. The study notes that "if a market barrier is lowered, market adoption of energy-efficient products, services, or practices will increase. We recognize, however, that reducing any one market barrier may not lead to increases in adoption because other barriers may remain or be reinforced, or new barriers may be introduced."
[44] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* 1996
[45] See https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF, pages 23 and 45.

direct customer rebates, including technical assistance services, incentives for distributors and retailers to stock and sell efficient equipment, and installation contractor services and incentives. In addition, the dollar amount of spending on interventions should not be considered a measure of their importance or effectiveness in overcoming barriers or inducing participation. For instance, a marketing campaign that reaches hundreds of thousands of customers may be a fraction of the cost of an incentive payment for one large C&I project. However the New Hampshire spending values below provide a general scale of the costs of circumventing different barriers, whether financial (rebates) or informational (promotion and marketing).

Figure 4-1. NHSaves 2021 spending on program interventions, by sector (millions)



The costs programs must incur for energy efficiency—in particular, the cost for customer rebates—is directly related to the level of savings being pursued. All else equal, the first savings achieved will be those with the lowest customer and market barriers, which also tend to require the lowest levels of incentives. Deeper savings levels, in general, require more generous incentives and more effort by program administrators to achieve. This dynamic can be seen in the increasing cost of savings faced by programs as they shift away from highly cost-effective measures such as lighting, where markets have been more transformed, toward measures such as controls, which are generally less cost-effective and less widely adopted due a range of market barriers, as discussed in section 5.4.

4.3.1 Market transformation and resource acquisition

Energy efficiency programs generally fall into two broad categories, based on their objectives and design: [46]

- **Resource acquisition programs** are designed to target specific sets of customers and market actors, and specific purchasing decisions. The general objective of these programs is to engage participants by circumventing individual customer barriers to achieve discrete project-level savings typically measured against short-term (e.g., annual) goals.

[46] A more detailed explanation of these categories of programs was submitted by the NH Utilities in IR 22-042 Investigation of Energy Efficiency Planning, Programming, and Evaluation, Joint Responses to Commission inquiries by NH Utilities, Nov. 30, 2022.

- **Market transformation programs** are designed to create long-term changes in the structure and function of markets. The general objective of these programs is to eliminate market-level barriers to the supply of energy efficiency, creating widespread changes in markets that persist after program interventions have been removed.

In designing interventions and measuring their effectiveness, it is important to consider the objectives and limitations of state energy efficiency programs. Barriers can be driven by factors that are beyond the reach of many program interventions. For instance, national and regional labor and workforce trends, disruptions in global supply chains and international energy markets, and shifting public policies can all influence the level of barriers customers and market actors face. For states such as New Hampshire, where program budgets and local markets are small relative to the regional or national markets in which they operate, it is important to consider the tradeoffs between resource acquisition and market transformation approaches. In general, the NHSaves programs are designed to be resource acquisition programs, not market transformation programs. As such, they generally aim to circumvent specific customer or market actor barriers through individual transactions, rather than aiming to eliminate barriers to a particular technology market-wide by achieving systematic changes to the market. Table 4-3 provides an overview of the tradeoffs, in terms of strengths and limitations, between these two general categories of program designs.

Table 4-3. Resource acquisition and market transformation strengths and limitations

Program Design	Strength	Limitation
Resource acquisition	Ability to identify, predict, and quantify savings impacts, due to the specificity of time, place, equipment, and participants involved in the purchase and installation of energy efficiency measures.	Limited ability to address market barriers that are driven by factors beyond those at play in specific purchasing and installation decisions. Examples of such barriers include organizational barriers (e.g., split incentives), or supply barriers (e.g., equipment stocking, workforce capacity).
Market transformation	Ability to create enduring changes in the structure and function of markets, achieving larger-scale, longer-lasting energy savings and addressing barriers beyond the reach of specific customer purchasing decisions.	Savings impacts are harder to predict and measure, since they occur as an indirect result of program influence via multiple causal relationships between market actors (e.g., manufacturers, distributors, and customers), rather than via direct impacts on customer decisions. In addition, the potential effectiveness of market transformation interventions is limited by the size and reach of a program relative to the broader market it seeks to transform.

Source: Adapted from Eto, Prahl, and Schlegel, 1996.

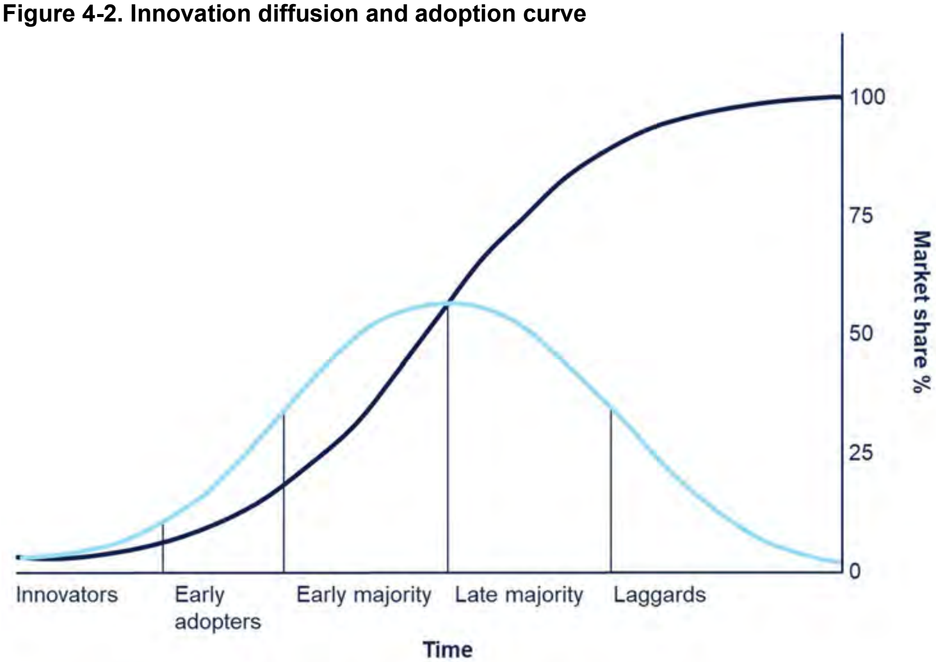
4.4 Measuring success

As barriers are overcome, there are two general frameworks for measuring the resulting increases in energy efficiency, based on the literature we reviewed: (1) technology adoption and (2) technology advancement, as described below. There are also different metrics for measuring program success within these frameworks. Most commonly, program attribution research—also known as net-to-gross (NTG) research—is used to measure the extent to which increases in adoption of energy efficiency are due to program interventions circumventing individual customer or market actor barriers or eliminating them market-wide.

4.4.1 Technology adoption

There are well-established methods for conceptualizing and modeling the adoption of new technologies over time, building on research dating back to the 1960's.[47] These modeling techniques have seen widespread application in industry settings, academic research, DOE National Laboratory research, and federal rulemaking processes.[48] They assume a process for technology adoption and diffusion, by which new, economically superior technologies are adopted gradually at first, and then with increasing speed until reaching a market saturation point at which adoption slows.[49] The models reflect heterogeneity among consumers in their likelihood to adopt, due to differences in financial circumstances, lifespan of existing equipment, and levels of awareness of new technologies, among others. This heterogeneity results in different groups of consumers adopting at different points in time, starting with innovators and ending with laggards, as shown in the light blue curve in Figure 4-2. As successive groups of consumers adopt a given technology, its cumulative market share increases, as shown in the dark blue adoption curve.

Figure 4-2. Innovation diffusion and adoption curve



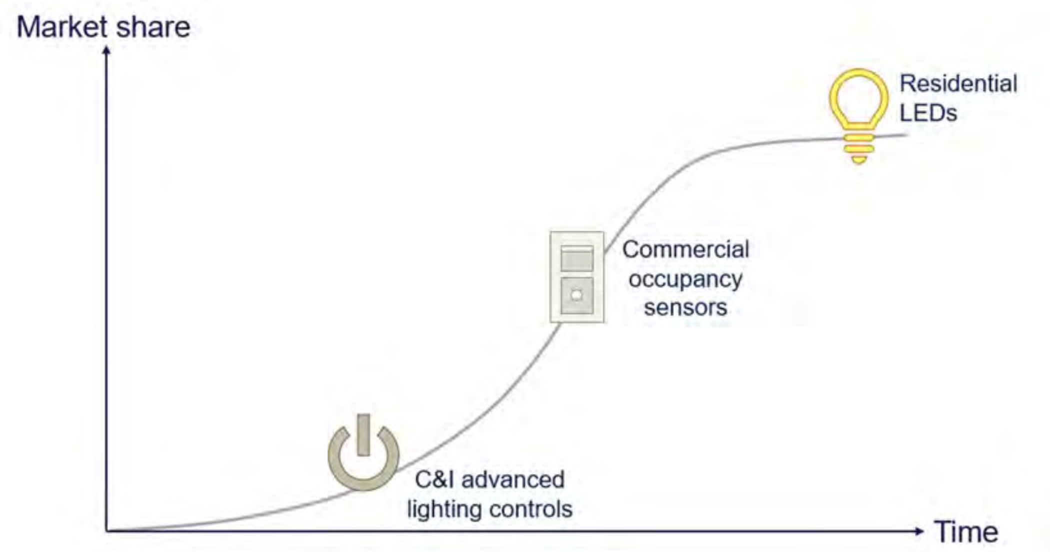
Source: Adopted from E. Rogers. *Diffusion of innovations*. 1962.

Technology adoption tends to follow this S-shaped pattern over time, with initially slow uptake followed by more rapid increase in adoption rates, and finally a levelling off as the market nears its full adoption potential. The adoption of different lighting technologies provides a useful illustration of this dynamic. Figure 4-3 shows a generalized representation of adoption for multiple lighting technologies, based on our literature review (see sections 5.1 and 5.4 for further details). Residential LEDs have generally reached a point of market saturation whereby barriers are mostly overcome, the pace of adoption has slowed as most consumers have already adopted LEDs, and there is little remaining savings to be had. In contrast, advanced C&I lighting controls are in the earlier stages of adoption and are seeing an increased pace of adoption as barriers are overcome for many consumers. Commercial occupancy sensors are at a mid-point in the adoption curve, where a

[47] Bass, F. M. (1969). *A New Product Growth Model for Consumer Durables. Management Science*, Vol. 15 page 224.
[48] Robert Van Buskirk, ***Estimating Energy Efficiency Technology Adoption Curve Elasticity with Respect to Government and Utility Deployment Program Indicators***, 2013, https://www.osti.gov/biblio/1164376; Everett Rogers, ***Diffusion of Innovations, 5th Edition,*** 2003, *https://books.google.com/books?id=9U1K5LjUOwEC*. Simon and Schuster, ISBN 978-0-7432-5823-4; Federal Register, DEPARTMENT OF ENERGY 10 CFR Part 430, *Energy Conservation Program: Energy Conservation Standards for General Service Lamps, A Proposed Rule by the Energy Department*, 2023 https://www.govinfo.gov/content/pkg/FR-2023-01-11/pdf/2022-28072.pdf.
[49] Adam B. Jaffe, *Economics of Energy Efficiency*, Brandeis University and National Bureau of Economic Research; Richard G. Newell, Resources for the Future; Robert N. Stavins, Harvard University, 2004.

majority of commercial businesses have adopted the technology, the pace of adoption is slowing, and barriers remain for a minority of consumers.

Figure 4-3. Adoption of selected energy efficient lighting technologies



Adoption curves are widely used to model the relationship between program interventions and the adoption rate of energy efficient products. This use includes U.S. DOE research to create tools for prioritizing investments in building sector energy efficiency measures, using adoption-based energy savings estimates as a metric to evaluate the potential impact of investments in different technologies in an energy efficiency portfolio. These energy savings estimates reflect the difference in energy usage between a baseline scenario and a program intervention scenario, each of which has different rates of technology adoption. The scenarios can be modeled using sales data and other information on the market share of efficient products in different states with different levels of program activity, to estimate correlations between technology adoption and program interventions. Such techniques have found statistically significant correlations between utility program spending and adoption of efficient appliances, lighting, and other technologies.[50] They have also found that increased adoption of efficiency measures such as building insulation and industrial motors is correlated with other factors, such as higher energy prices and lower costs of adoption.[51]

Adoption curves can also be used to model how different levels of program intervention—e.g., incentive levels, marketing and training initiatives—can impact levels of adoption for different technologies at different points on the adoption curve. For measures on the higher, flatter end of the adoption curve, there will be little proportional adoption for a given increase in program incentives, whereas for measures on the steeper part of the slope, increased program spending will result in greater increases in adoption. Ideally, programs will shift incentives away from those measures further along the adoption curve, and toward other measures where incentives can result in proportionally larger increases in adoption.

In New Hampshire, the 2021–2023 Potential Study used technology adoption curves to estimate the savings potential of different energy efficiency investments.[52] Specifically, the study modeled potential savings by calculating market adoption as a function of customer payback and a technology's underlying market barrier level. The study modeled multiple savings

[50] Robert Van Buskirk, *Estimating Energy Efficiency Technology Adoption Curve Elasticity with Respect to Government and Utility Deployment Program Indicators*, 2013. https://www.osti.gov/biblio/1164376

[51] Adam B. Jaffe, *Economics of Energy Efficiency*, Brandeis University and National Bureau of Economic Research; Richard G. Newell, Resources for the Future; Robert N. Stavins, Harvard University, 2004.

[52] Dunsky. *New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023*, 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf

scenarios with varying levels of program incentives and other "enabling strategies" for reducing barriers. Specifically, the study estimated statewide savings opportunities for the 2021–2023 NHSaves programs at each of the following levels of savings potential:[53]

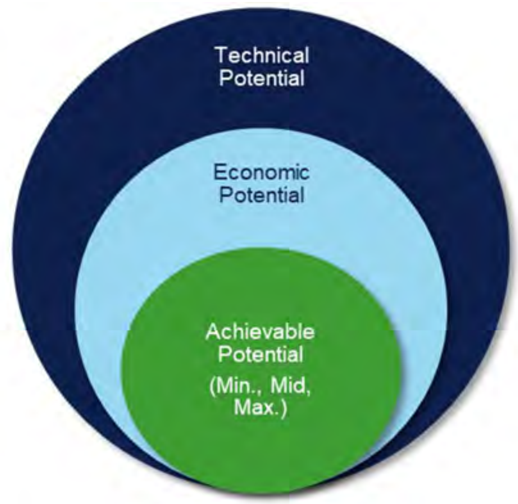
- **Technical potential** reflecting savings from installing all available efficiency measures, without consideration of cost or willingness of users to adopt the measures.
- **Economic potential** is subset of technical potential, reflecting savings from installing all measures that pass cost-effectiveness screening.
- **Achievable potential** is subset of economic potential, reflecting savings that can be realistically achieved given real-world constraints (e.g., the natural turnover rate of equipment) and market barriers. Three achievable scenarios are modeled, using different assumptions for (1) incentive levels, and (2) program "enabling" strategies for reducing barriers—such as contractor training, targeted marketing, and financing offerings. The scenarios are:
  - – Low: Incentives and enabling strategies at the levels of the 2018-2020 NHSaves Plan
  - – Mid: Incentives raised to a minimum of 75% of incremental cost, and increased enabling strategies
  - – Max: Incentives raised to 100% of incremental cost, and same enabling strategies as mid scenario

The sidebar provides an introduction to potential studies, and Section 4.5 includes details on the results of the 2021–2023 Potential Study.

Introduction to potential studies

Potential studies help inform energy efficiency program planning by establishing guideposts for the amount of savings programs might achieve, as well as more detailed information on savings opportunities for specific customer segments and measure types.

Potential studies quantify energy savings opportunities in a jurisdiction by first obtaining data on the existing energy using equipment and building stock in that jurisdiction, referred to as baseline data. The baseline data is entered into a model with data on energy efficient equipment and associated savings, costs, customer and market barriers, and other inputs. Potential studies typically define three scenarios, reflecting different levels of theoretical savings: technical potential, economic potential, and achievable potential. Achievable potential can be further classified into a range of low to high savings scenarios.



4.4.2 Technology advancement

Adoption of a new technology is one stage in a larger process of technology advancement, which generally follows cyclical patterns from development and deployment of new technologies, to broad market adoption and standard practice baselines, followed by development of new codes and standards. The literature defines this process and its stages as follows:[54]

Technological change: the process of invention, innovation, and diffusion whereby greater and/or higher quality outputs can be produced using fewer inputs.

- **Invention**: the development and creation of a prototype new idea, process, or piece of equipment.
- **Innovation:** the initial market introduction or commercialization of new process or product inventions.
- **Diffusion**: the gradual adoption of new process or product innovations by firms and individuals.

[53] Dunsky. *New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023*, 2020.
[54] Adam B. Jaffe, *Economics of Energy Efficiency*, Brandeis University and National Bureau of Economic Research; Richard G. Newell, Resources for the Future; Robert N. Stavins, Harvard University, 2004.

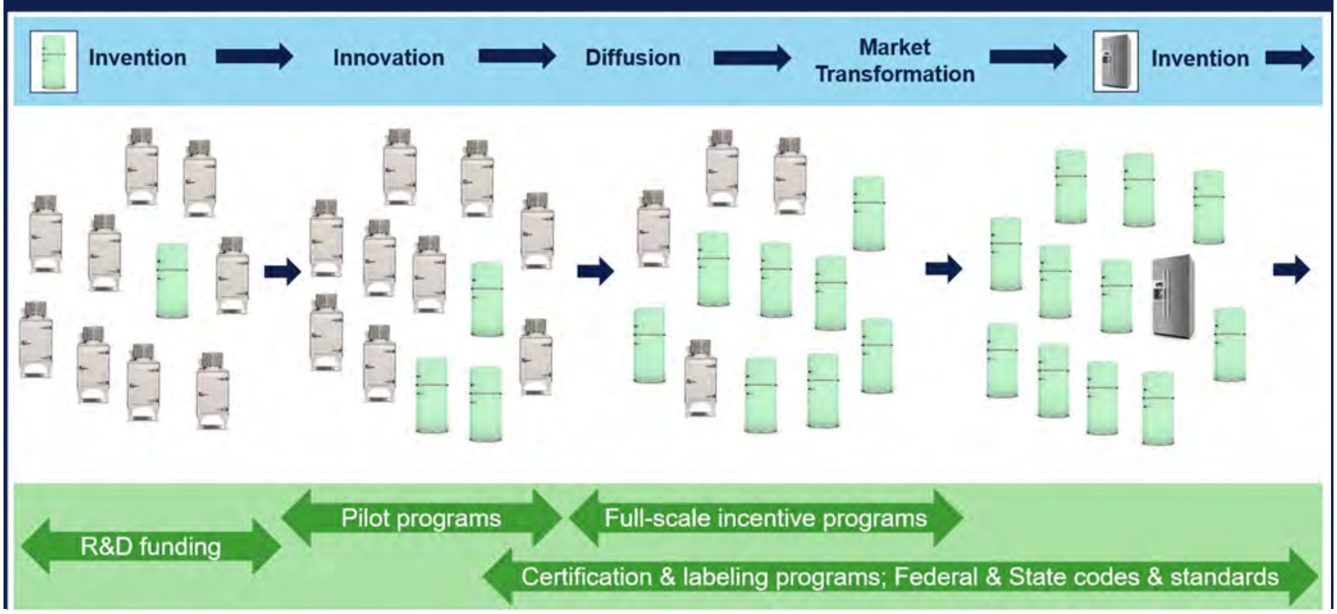
Market transformation: Following widespread adoption, technologies previously considered high efficiency become standard, baseline technologies, and the cycle begins again.

This cycle of technology advancement is influenced by many factors, including program interventions, which often act to accelerate the pace of advancement across the stages. Market transformation programs (see Section 0) are designed to create long-term changes in the structure and function of markets, and in doing so, can spur invention, innovation, and diffusion of efficient technologies. Federal or state codes and standards act in concert with program interventions to assure uniform, minimum levels of efficiency, encouraging innovation and allowing for economies of scale in manufacturing. In addition, energy labeling programs such as ENERGY STAR® help inform consumer decision making and have been found to stimulate private investment in innovations to increase energy efficiency.[55] This framework of policy and program supports has helped spur advancements in efficient lighting and appliances, as shown below for refrigerators.

Market transformation—residential refrigerators

Modern refrigerators use about 70% less energy than the average household refrigerator of the 1970s, while over the same time span refrigerators have grown larger.[56] This advancement was primarily driven by DOE-funded research and innovation in compressor technology,[57] which was followed by more stringent federal energy efficiency standards for refrigerators and adoption of the new compressor technology by manufacturers. Federal standards for refrigerators have been updated multiple times since the 1980s, and each time manufacturers have met the standards with innovations such as improved insulation, compressor efficiency, and fan motor efficiency. Further driving efficiency levels forward during this period, the EPA developed certification and labeling for high-efficiency products under the ENERGY STAR® program, while state energy efficiency programs such as those offered by NHSaves provided incentives and marketing for ENERGY STAR® appliances.[58] Figure 4-4 illustrates this cycle of technological advancement and program interventions.

Figure 4-4. Technological advancements and program interventions, residential refrigerators



[55] Richard Newell, Adam Jaffe, and Robert Stavins, *The Induced Innovation Hypothesis and Energy-Saving Technological Change*, The Quarterly Journal of Economics, vol. 114, no. 3, 1999. Pages 941–975.
[56] Andrew deLaski and Joanna Mauer, *Energy-Saving States of America: How Every State Benefits from National Appliance Standards,* An ASAP and ACEEE White Paper, 2017.
[57] National Research Council, *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000*, National Academies Press, 2001.
[58] David Austin, Congressional Budget Office, *Addressing Market Barriers to Energy Efficiency in Buildings*, 2012.

Beyond program and policy interventions, energy prices are a key factor that has been found to influence the pace of advancement of energy efficient technologies. For example, researchers have found significant positive correlations between the price of energy and the number of patent applications for energy conservation technologies such as waste heat devices, heat pumps, and fuel cells. Other research has found that increases in energy prices have been followed by increased innovations in the energy efficiency of commercialized technologies such appliances, automobiles, and aircraft.[59] The effect of energy prices on technology advancement can be enhanced by requirements for energy efficiency product labeling (e.g., ENERGY STAR®), according to literature we reviewed.[60] Researchers hypothesized that labeling increased consumers' responsiveness to energy prices, and thereby increased suppliers' incentive to offer more energy efficient models as energy prices increased.

4.4.3 Net program impacts

Understanding the extent to which increases in technology adoption are due to program interventions requires research on program attribution—also known as net-to-gross (NTG) research. This area of research helps measure the impact of programs on customer decisions to purchase energy efficient equipment, and on other market actors' decisions to stock, promote, and sell energy efficient equipment. Savings from energy efficiency programs can be measured in terms of their gross impacts, and their net impacts, as follows:

- **Gross savings** reflects the difference in energy consumption with the energy-efficiency measures promoted by the program in place versus what consumption would have been without those measures in place
- **Net savings** reflects the difference in energy consumption with the program in place versus what consumption would have been without the program in place. Net savings account for the impact of:
  - **free-ridership**—savings from participants who would have implemented a measure or practice in the absence of the program, and
  - **spillover**—energy savings that are due to the program but occur outside of participants' program-rebated projects.[61]

Using these savings values, a NTG ratio can be calculated as the ratio of net savings to gross savings. Simply, it reflects the amount of gross program savings that can be attributed to the program.

As markets transform, NTG generally decreases, since fewer customers face barriers and program technologies start to become standard practice—that is, an increasing share of customers would purchase the technologies without program intervention. In general, higher NTG values reflect markets and technologies where program intervention is needed to circumvent barriers, and lower NTG values indicate markets and technologies where barriers have increasingly been circumvented or eliminated without the need for program intervention.

4.5 Quantifying barriers in New Hampshire

There have been several evaluations in New Hampshire that included some research on barriers, although primary New Hampshire-based research quantifying barriers has been limited. Recent evaluations of the ENERGY STAR® Homes, Home Energy Assistance (HEA), and Home Performance with ENERGY STAR® (HPwES) programs identified some specific barriers to energy efficient weatherization and residential new construction based on qualitative surveys and interviews (see sections 5.2 and 5.3), but the evaluations did not quantify the impact of these barriers or the costs to overcome them.

[59] Adam B. Jaffe, *Economics of Energy Efficiency*, Brandeis University and National Bureau of Economic Research; Richard G. Newell, Resources for the Future*;* Robert N. Stavins, Harvard University, 2004.
[60] Richard Newell, Adam Jaffe, and Robert Stavins, *The Induced Innovation Hypothesis and Energy-Saving Technological Change,* The Quarterly Journal of Economics, vol. 114, no. 3, 1999. Pages 941–975.
[61] DOE, National Renewable Energy Laboratory, *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 21: Estimating Net Savings – Common Practices,* https://www.nrel.gov/docs/fy17osti/68578.pdf.

However, as noted in Section 4.4.1, the 2021–2023 New Hampshire Potential Study did estimate the impact of barriers on savings opportunities for the NHSaves portfolio using quantitative modeling techniques. Specifically, the study modeled several achievable savings scenarios that assumed different levels of barriers and included different levels of program incentives and enabling strategies for reducing barriers—such as contractor training and support, targeted marketing, and financing offerings. The scenarios used to model achievable savings for the 2021–2023 period were:[62]

- **Low achievable:** incentives and enabling strategies at the levels of the 2018–2020 NHSaves Plan
- **Mid achievable:** incentives raised to a minimum of 75% of incremental cost, and increased enabling strategies
- **Maximum achievable:** incentives raised to 100% of incremental cost, and the same enabling strategies as mid scenario[63]

It is important to note that the study did *not* include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

The team re-analyzed this data to estimate the scale of savings that barriers are preventing and identify what savings programs may be able to achieve by overcoming them. In general, the NHSaves programs are designed to be resource acquisition programs, not market transformation programs. As such the Potential Study model represents achievable saving from circumventing specific customer or market actor barriers as part of individual transactions, rather than achievable savings from market-wide elimination of barriers. Using the Potential Study's achievable savings scenarios, the impact of market barriers on adoption of energy efficiency can be estimated based on the growth in savings when moving from the low, to mid, to maximum achievable scenarios. Specifically, larger increases in savings between the scenarios reflect a greater impact from increased incentives and enabling activities to circumvent barriers. In other words, greater increases reflect programs or measures where there is more potential savings to be unlocked by circumventing barriers. Figure 4-5 shows residential and business sector lifetime electric and gas savings for the 2023 program year, for each of the three achievable scenarios modeled in the study. As shown in the figure, there is a significant increase in potential savings moving from the low to mid to maximum achievable scenarios, with the residential sector showing a larger percentage increase, particularly for gas savings, and the business sector showing a larger absolute increase in savings due to increased program incentives and enabling activities to circumvent barriers.

[62] In addition to achievable savings, the study modeled economic savings potential, which reflects savings from the installation of all measures that pass cost-effectiveness screening, regardless of barriers.
[63] Incremental costs are foundational to energy efficiency program planning and cost-effectiveness testing. They represent the difference in cost between baseline, standard efficiency technologies and the energy efficient measures the programs offer.

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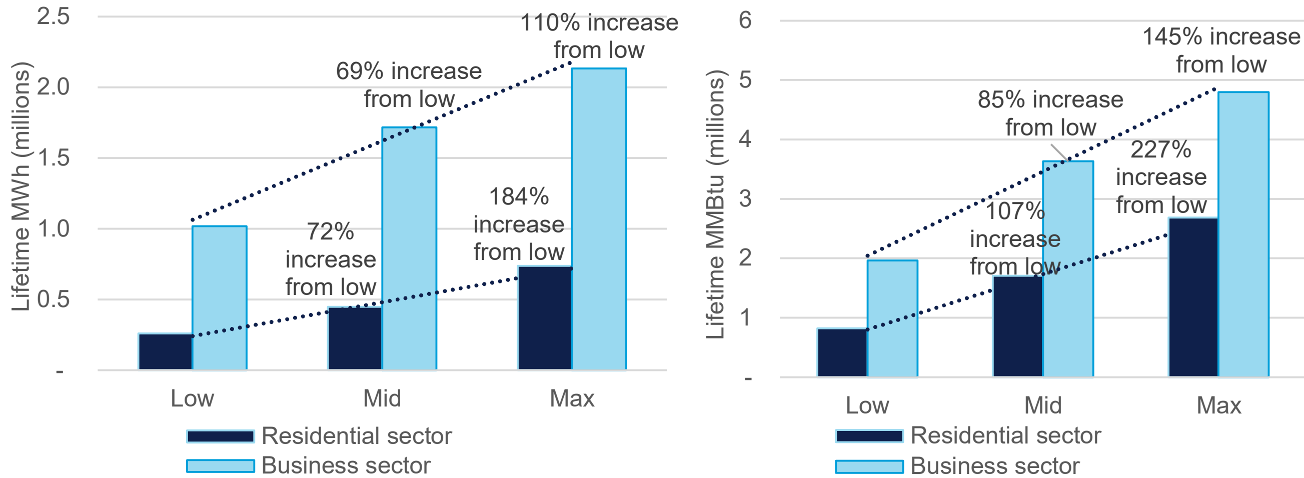
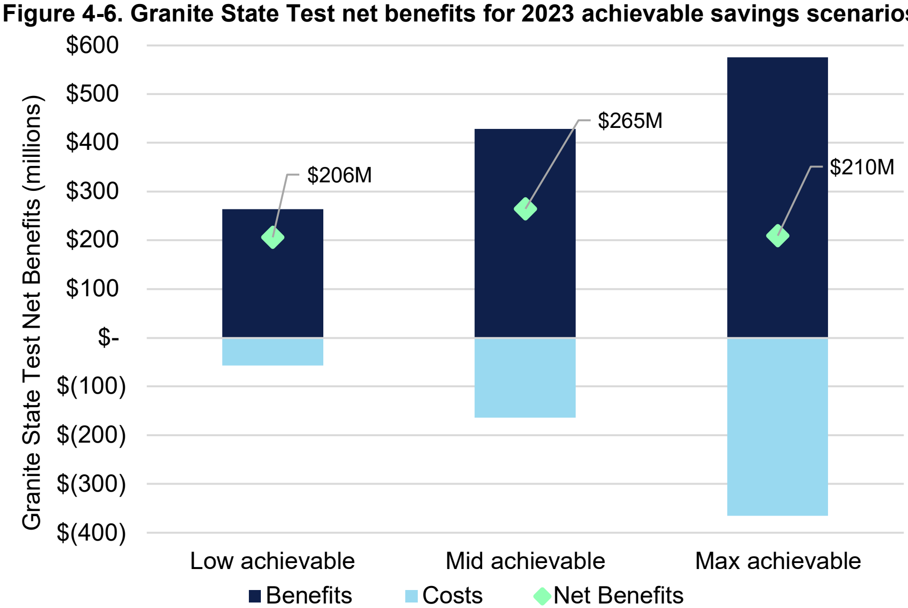
Figure 4-5. Achievable savings scenarios, 2023 electric (MWh) and gas (MMBtu) lifetime savings



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

These increased savings levels require increased levels of program spending on incentives and enabling strategies. To account for both the savings and the costs, the NHSaves Potential Study also modeled portfolio-wide benefits and costs for each scenario, using the GST.[64] As shown in Figure 4-6, the scenarios all have positive net benefits, with the mid-level achievable scenario seeing the greatest net benefits under the GST. As noted in the Potential Study, there are diminishing returns to increasing incentive levels to 100% of incremental costs, as in the maximum achievable scenario. That is, the increase in adoption of energy efficient technologies is smaller, in terms of benefits, than the increase in program costs needed to cover the full incremental costs of those technologies.

Figure 4-6. Granite State Test net benefits for 2023 achievable savings scenarios



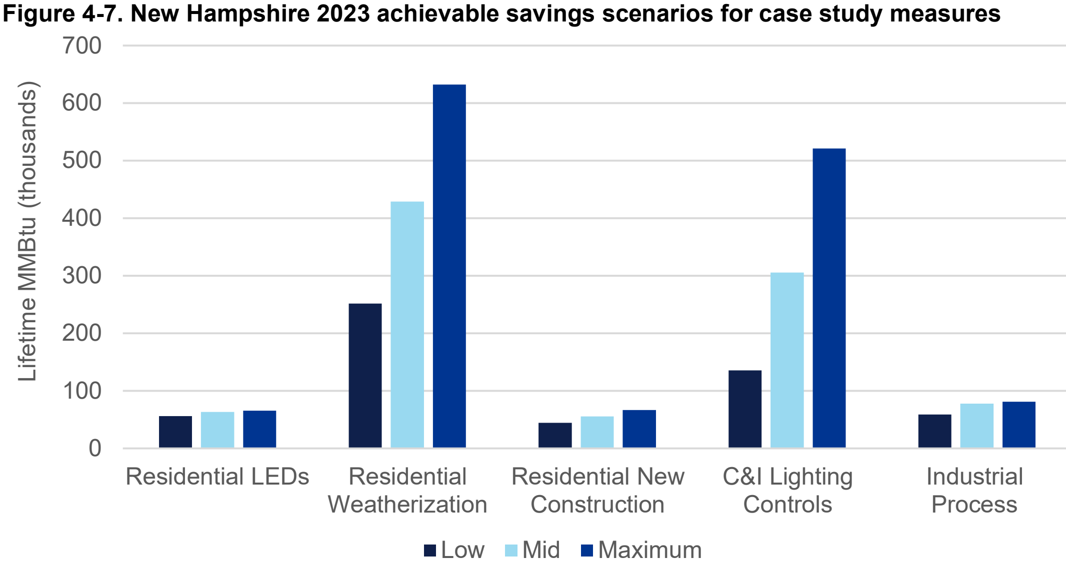
Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

[64] As noted above, this report as well as the 2021-2023 Potential Study assumes the Granite State Test (GST) to assess program cost-effectiveness. The GST was developed through a stakeholder process that culminated in a consensus recommendation to adopt the test, followed by Commission approval and subsequent legislation establishing the GST as the primary cost-effective test for New Hampshire's energy efficiency programs. See https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/ORDERS/17-136_2019-12-30_ORDER_26322.PDF and https://gencourt.state.nh.us/bill_status/legacy/bs2016/bill_status.aspx?lsr=717&sy=2022&sortoption=&txtsessionyear=2022&txtbillnumber=HB549.

This analysis of portfolio-wide savings scenarios and net benefits provides some insight on the impact of barriers on program savings, but it obscures important differences between programs, measure types, and customer segments. For instance, within the residential sector, there are minimal increases in achievable savings for lighting measures between the low, mid, and maximum scenarios (see Section 5.1) due to the greater extent of market transformation for lighting, while there are much larger increases in achievable savings for weatherization measures between the scenarios (see Section 0). The actual portfolio savings and net benefits achieved in coming years will depend in large part on the mix of measures the programs incentivize. As markets transform and barriers are overcome for highly cost-effective lighting measures, programs will see an increasing share of savings and costs for less cost-effective non-lighting measures, decreasing overall portfolio net benefits. These differences are key to planning future programs, and Section 5 includes qualitative and quantitative information on the different impact of barriers for the measures included in each case study topic.

Figure 4-7 shows how modeled savings increases moving from low to maximum achievable potential scenarios for the measures in each case study topic. As with Figure 4-5, larger increases in savings between the scenarios reflect a greater impact from increased incentives and enabling activities to overcome barriers. In other words, greater increases reflect programs or measures where barriers are preventing larger amounts of potential savings from being achieved. In contrast, small increases in savings imply there are few barriers that programs can mitigate. Among case study measures, residential weatherization sees the greatest savings increase—in both percentage and absolute terms—from increased incentives and enabling activities to overcome barriers. LEDs, in contrast, show a relatively minor increase in savings moving from the low to maximum achievable potential scenarios. These low barriers are consistent with an assumption of a largely transformed market for retail lighting.

Figure 4-7. New Hampshire 2023 achievable savings scenarios for case study measures



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

On their own, the modelled results from the New Hampshire Potential Study are not definitive evidence of the state of market transformation or elimination of market barriers for the case study measures. However, when considered alongside other indicators, the achievable savings results help identify program areas where market barriers have been largely eliminated, and a market exit strategy should be considered for the programs. Among case studies in our review, retail lighting had the most consistent evidence of market transformation—including studies showing minimal price differences between LEDs and baseline lighting products, and LEDs capturing an overwhelming share of the retail lighting market, even in states without retail lighting programs. In other cases, the Potential Study shows relatively small increases in achievable savings from increased incentives and enabling strategies, but other indicators and research show that customers and market actors continue to face barriers. For instance, our case study of residential new construction found that, despite small increases in achievable savings in the Potential Study, residential new construction programs can continue to achieve savings by increasing program efficiency requirements to ensure participating homes stay ahead of the broader new construction market.

5 MARKET BARRIERS CASE STUDIES

New Hampshire-specific market research on most of the following case study topics exists but is fairly limited in its coverage of market barriers. More broadly in New England and the Northeast, the research is more robust, so publicly available research from peer states is incorporated below where necessary to portray the broader market and the relevant barriers. Any figures reproduced from non-DNV research are shown in gray borders with sources for the original reports. The case studies identify gaps where primary New Hampshire-based research such as customer surveys, market actor interviews, sales data analysis, or other methods would allow for a fuller assessment of the Commission's lines of inquiry, particularly on quantifying end-user barriers and the extent to which New Hampshire programs have circumvented or eliminated them.

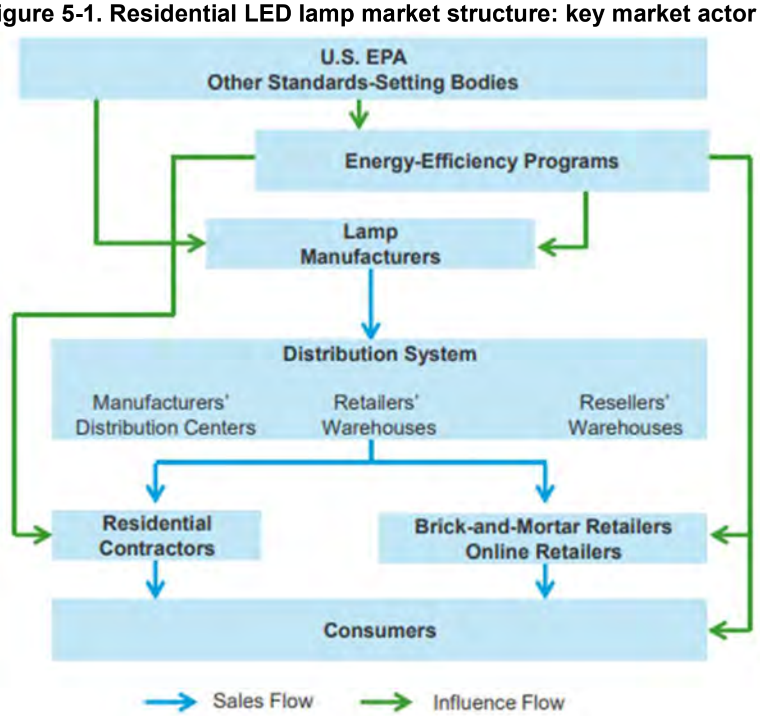
5.1 Residential retail lighting

5.1.1 New Hampshire program overview

Retail lighting has been an energy efficiency offering for over two decades in New Hampshire. Retail lighting offerings have changed forms over time and have been included in each NHSaves plan since the Energy Efficiency Resource Standard (EERS) was established, as part of the ENERGY STAR® Lighting program. The program incentivizes high-efficiency lighting in retail channels to increase ease of adoption and reduce barriers associated with the technology, and in recent years, the program has focused incentives on light-emitting diode (LED) Bulbs (general service lamps, linear, other specialty, and reflector) and LED fixtures. Program bulbs can replace any number of bulb technologies, such as incandescent or CFL, in an existing fixture. The program's upstream delivery model seeks to reduce barriers around retailer stocking practices, customer awareness, and upfront cost by incentivizing the stocking and sale of high efficiency products. This delivery model also reduces customer and supplier burden by avoiding the need for rebate forms or project paperwork.

NHSaves and other state energy efficiency programs have worked in concert with federal and industry bodies to set standards and encourage the manufacture, stocking, and sales of high efficiency lighting, as illustrated in Figure 5-1.

Figure 5-1. Residential LED lamp market structure: key market actor groups



Source: DNV, 2015. Final Report of Massachusetts LED Market Effects: Baseline Characterization. Prepared for the Massachusetts Energy Efficiency Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC).

DNV

5.1.1.1 Energy Independence and Security Act

Passed by Congress in 2007, the Energy Independence and Security Act (EISA) included critical policy interventions in the lighting market that underlie the discussion of barriers and interventions in the following section. Specifically, EISA requires certain general service lamps (GSL)[65] to meet specified standards for lumens[66] per watt. Although EISA did not explicitly ban incandescent lamps, the standards it established could not be met by traditional incandescent lamps. As such, EISA began to push some traditional incandescent lamps out of the market and force a shift to high-efficiency technologies.

EISA included a second, more stringent phase of regulations, originally set to begin in 2020, requiring at least 45 lumens per watt for all GSLs, and effectively eliminating most of the remaining incandescent and halogen screw-in lamps from the market. However, the impact of this phase was delayed due to the federal regulatory process and changes in the administration. Specifically, during the Obama administration, revised guidelines on the efficiency of GSLs were instated, and then rolled back during the Trump administration. In August 2021, the Department of Energy proposed reinstating these standards, including expanding the definition of GSLs to include other lamp types such as reflectors and candelabras that were previously exempt. As part of this reinstatement, a 45 lumens per watt standard applied to a majority of bulb types, rendering a majority of incandescent and halogen lamps not up to standard. This standard allowed for the production of non-compliant lamps through December 2022, and the sale of non-compliant lamps through July 2023.[67] DOE has stated that it will enforce penalties on non-compliant retailers beginning in July 2023.

5.1.2 Barriers

5.1.2.1 Financial barriers

Price—more specifically, the upfront incremental cost difference between a high efficiency product and its baseline technology counterpart—is a well-established barrier to adoption of energy efficiency, and lighting is not unique. The energy savings from LEDs is substantial—the LED equivalent to a 60-watt incandescent bulb uses roughly 6-8 watts, or 85%–90% less energy than its predecessors[68]—but customers must pay higher upfront costs in order to benefit from these savings. Retail pricing research has previously found that nearly all LED lighting technology types are higher priced than their first tier EISA compliant baseline counterparts.[69] However, this price differential has steadily decreased since LEDs were first introduced in retail outlets. In 2015, research on pricing and customer barriers found that initial upfront cost was still the primary barrier to increased LED adoption, but that research and development efforts by manufacturers and program interventions were driving down customer costs.[70] As recently as 2019, market research found that programs should continue to play a role in supporting LEDs, as they were not yet cost-competitive with baseline technologies, which were still widely available in stores and expected to remain so for several years.[71] However, continued declines in LED prices since then is further evidence of the rapid transformation of the retail LED market and the gradual elimination of upfront cost barriers on a market-wide level.

These price trends can be seen in Figure 5-2 for New Hampshire and other New England states, taken from recent lighting sales data research in the Northeast. [72] The trends were also found in states without upstream lighting programs, which saw decreasing prices as the nationwide market transformed due in part to programs' upstream influence on manufacturers.

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[65] EISA defines a general service lamp as a standard incandescent or halogen lamp that: 1) is intended for general service applications, 2) has a medium screw base, 3) falls within a range of 310 to 2,600 lumens, and 4) is capable of being operated at a voltage at least partially within the range of 110 and 130 volts.
[66] Lumens are a measure of the total quantity of visible light emitted.
[67] Dan Eisenberg, Aaron Goldber, and Jack Zietman, *U.S. Department of Energy Finalizes Rules to Impose Stringent Efficiency Standard on Most Lamps,* 2022. https://www.bdlaw.com/publications/u-s-department-of-energy-finalizes-rules-to-impose-stringent-efficiency-standard-on-most-lamps/.
[68] Superior Lighting, *Guide to Buying Equivalent Wattage LED Lights,* 2016. https://www.superiorlighting.com/blog/guide-to-buying-equivalent-wattage-led-lights-1c400f/.
[69] Energize CT, *Connecticut R1963b Short term residential lighting report,* 2020 https://energizect.com/sites/default/files/documents/R1963b_STLighting_FINAL%20Report_102920_0.pdf.
[70] DNV, Massachusetts LED Market Effects: Baseline Characterization, 2015. https://ma-eeac.org/wp-content/uploads/LED-Market-Effects-Baseline-Characterization-Final-Draft.pdf.
[71] Ibid.
[72] NMR Group Inc., *2019 Regional Lighting Sales Data Analysis (MA20R22-E) FINAL*, 2020 https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/14263212.

Figure 5-2. Market-level LED price trends, 2016–2019[73]

Source: NMR, *Connecticut R1963A, Short term residential lighting report*, 2020.

According to this research, the low shelf prices of LEDs in Connecticut, Massachusetts, and Rhode Island were due in part to those states having relatively high per-bulb program incentives (i.e., program spending of more than $5 per household).[74] New Hampshire was classified as a "moderate program state" (i.e., program spending of between $0 and $5 per household), which in part explains the higher shelf price of LEDs in 2019 in New Hampshire relative to states with more aggressive programs. The researchers also concluded that the low average LED price in non-program areas reflects several factors, including that (1) retailers discounted LED prices in non-program states because those states had lower costs of living across the board than program states, and (2) the average prices include both ENERGY STAR® and non-ENERGY STAR® LEDs, the latter of which are less expensive but often lower quality. Regardless of these factors, the results provide additional evidence that the market for retail lighting had been nearly transformed by the end of the 2010s.

5.1.2.2 Informational barriers

Consumer awareness of and confidence in efficient lighting technologies have been historic barriers to adoption of LEDs and their predecessors, compact fluorescent lights (CFLs). Interventions including state efficiency program marketing and education as well as federal standard setting, certification and labeling initiatives have evolved over time to address these barriers. Energy efficiency programs nationwide began promoting CFLs in the 1990's, but despite many years of program support, consumer awareness of CFLs increased very slowly, and those who were aware were often dissatisfied with the technology due to performance issues such as lighting quality, lamp size and shape, and environmental concerns. To address informational barriers, regional groups including the Northeast Energy Efficiency Partnership (NEEP) worked with retailers to provide training and marketing resources and with manufacturers and program administrators to adjust program requirements. The U.S. DOE introduced the first ENERGY STAR® specification for CFLs in 1999, establishing national standards for product quality to guide manufacturers and provide customers with product assurance.[75]

[73] SCS Analytics, *Connecticut R1963b Short term residential lighting report,* 2020. https://energizect.com/sites/default/files/documents/R1963b_STLighting_FINAL%20Report_102920_0.pdf.
[74] NMR Group Inc., *2019 Regional Lighting Sales Data Analysis (MA20R22-E) FINAL*, 2020 https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/14263212.
[75] Kelly K, Rosenberg M. *Some Light Reading: Understanding Trends Residential CFL and LED Adoption*. ACEEE Summer Study on Energy Efficiency in Buildings, 2016. https://www.aceee.org/files/proceedings/2016/data/papers/7_703.pdf.

Following the introduction of retail LEDs as an alternative to CFLs in the 2000's, customer awareness showed little improvement initially, and many customers remained skeptical of claims of performance after disappointing experiences with CFLs—despite LEDs' better performance and lighting quality, and significantly longer useful life.[76] Through the early 2010's, research found that customers and market actors cited performance concerns as well as a general lack of familiarity with LED products as barriers to their adoption. In part in response to these concerns, programs like the U.S. DOE's Solid State Lighting program and the DesignLights Consortium set standards for product quality, and in 2010 EPA added an ENERGY STAR® specification for LEDs, which it continued to update as the market progressed.[77] Manufacturers also partnered with these efforts to establish LED performance criteria and testing protocols to help address quality concerns.[78]

Building on this foundation, manufacturers, as well as retailers and energy efficiency program administrators, launched widespread marketing and education campaigns to spur sales of new LED products. Recognizing consumer familiarity with the ENERGY STAR® label, these information efforts often leveraged ENERGY STAR® branding—including in the program names themselves, as was the case with New Hampshire's ENERGY STAR® Lighting program. By the mid-2010's, customer awareness had improved significantly from when LEDs were first introduced in retail channels. For instance, 2015 research found that 84% of retail customers in Massachusetts and 80% in non-program comparison states had heard of LEDs, and this trend of increased awareness has continued since then.[79]

5.1.2.3 Supply and provision barriers

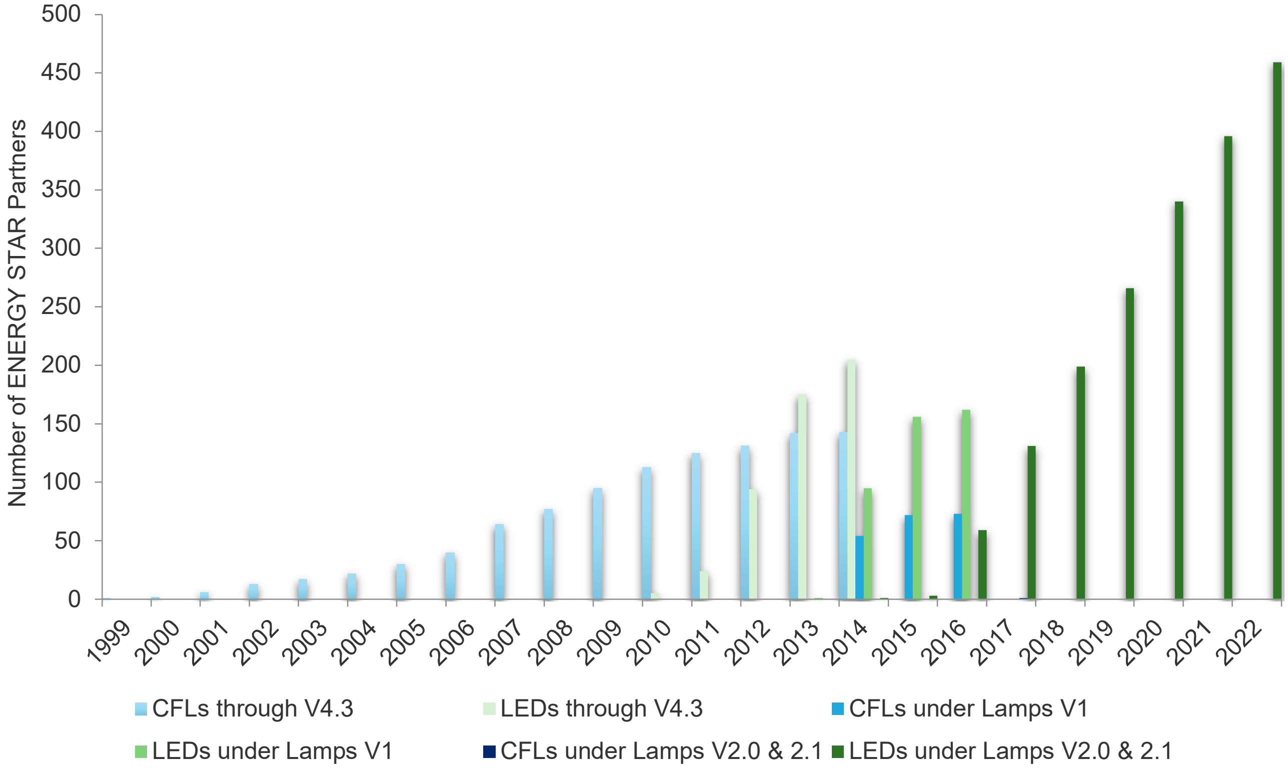
Retail stocking and manufacturer practices have posed historic barriers to adoption of efficient lighting products including LEDs and CFLs, but state energy efficiency program interventions and federal and other organizational support has helped to overcome them. In the early 2000's, consumers often purchased replacement lamps at grocery stores instead of the big box stores like Wal-Mart and Home Depot that are the predominant source of lighting today. Historically, the grocery retail channel did not heavily stock CFLs and this lack of availability became an early barrier to their adoption.[80]

Starting around 2010, the stocking of CFLs was on a steadily increasing trajectory in states with large energy efficiency programs. In Massachusetts, retail shelf stocking research found that the share of shelf space devoted to CFLs among stores that participated in the state's ENERGY STAR® lighting program had grown from 33% of all bulb shelf space in 2010 to 68% in 2012 and 62% in 2013.[81] Similarly in California in 2011, shelf stocking research found that advanced CFLs were present in 87% of retail stores, including 100% of hardware and home improvement stores—though only 56% of discount and 67% of grocery stores.[82]

In the mid-2010s, the stocking of CFLs began to decline as LEDs gained a stronger foothold and began appearing on retail shelves in greater numbers, particularly in states with upstream lighting programs. By 2015, Massachusetts research found that 44% of retailers in Massachusetts and 32% in non-program comparison areas stocked LED products. This trend of increased retail stocking of CFLs, and then LEDs, was mirrored further up the supply chain, in the share of ENERGY STAR® partners—e.g., manufacturers—with ENERGY STAR®-qualified lighting products, as shown in Figure 5-3. In more recent years, the trend of increasing partners has continued for each new iteration of ENERGY STAR® specifications.[83]

[76] Ibid.
[77] Ibid.
[78] DNV, *Massachusetts LED Market Effects: Baseline Characterization*, 2015. https://ma-eeac.org/wp-content/uploads/LED-Market-Effects-Baseline-Characterization-Final-Draft.pdf.
[79] Ibid.
[80] Pacific Northwest National Laboratory, *Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market*, 2006.
[81] Cadmus & NMR, *Massachusetts Residential Lighting Shelf Survey and Pricing Analysis FINAL REPORT,* 2014.
[82] DNV KEMA Energy & Sustainability, 2012. *Fall 2011 California Lighting Retail Store Shelf Survey Report*. Prepared for the California Public Utilities Commission Energy Division. https://www.calmac.org/publications/2011_CALIFORNIA_LIGHTING_RETAIL_STORE_SHELF_SURVEY_FINAL_REPORT_CALMAC.pdf.
[83] The EPA maintains a list of the ENERGY STAR qualified lamps which can be used as an indicator of lamp manufacturing organizations interest in producing lamps that meet certain quality standards by analyzing the number of ENERGY STAR® partners with qualifying lamps over time. EPA has issued multiple versions of these product specifications, with the first LED specification, version 1.0, going into effect on August 31, 2010.

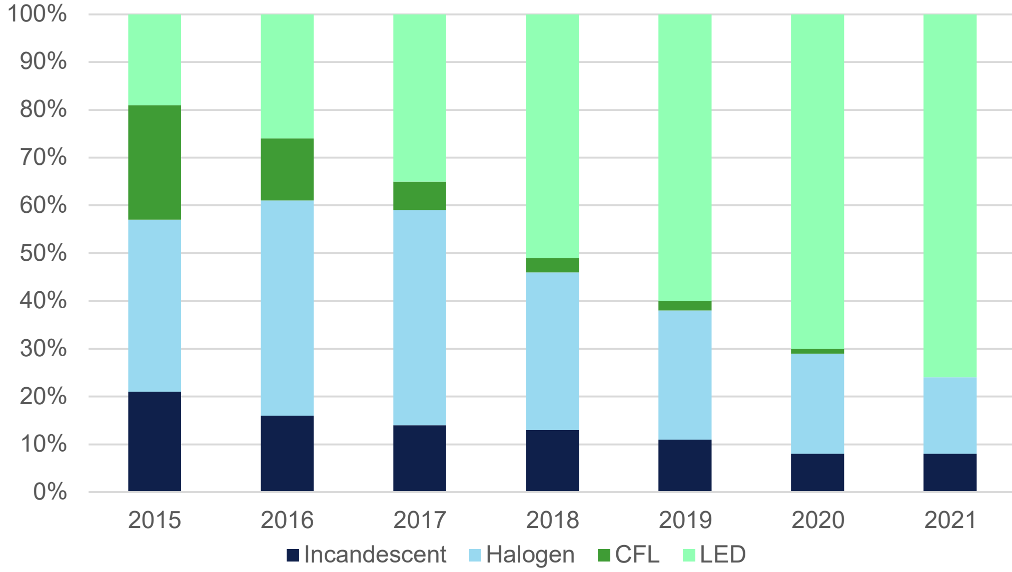
Figure 5-3. Number of ENERGY STAR® Partners with qualifying lighting products, by year and technology



Source: DNV analysis of US EPA. Archived CFLs Qualified Product List, 2014; Archived Integral LED Lamps Qualified Product List, 2014; ENERGY STAR® Qualified Lamps Product List, 2016; ENERGY STAR® certified light bulbs list, 2023.

Data on nationwide sales provide a broader view of the rapid evolution of the retail lighting market, first away from CFLs and toward LEDs in the mid-2010s. In the late 2010s, the growth of LEDs continued, and they began increasingly displacing baseline halogens and incandescent lamps, as shown in Figure 5-4. As of 2021, CFLs had all but disappeared from retail shelves, and their market share reflected this, and halogen and incandescent lamps represented less than 25% of sales.

Figure 5-4. U.S. retail lighting market share by technology, 2015 to 2021



Source: DNV analysis of LightTracker data. https://www.creedlighttracker.com.

In the Northeast, where most states have had high levels of upstream lighting program activity, stocking practices were generally ahead of the national trend, resulting in a small and shrinking presence of baseline lamps on store shelves by 2020. For example, 2020 research in Connecticut found that baseline halogen and incandescent bulbs were still available in the retail market in certain channels—e.g., grocery and hardware stores—but that other channels such as club stores did not carry any baseline lighting products. The study recommended the programs discontinue promotions and incentives at such stores where the "product choice landscape already favors efficient LED products."[84] Meanwhile, a 2020 study in New Hampshire found, based on interviews with 19 manufacturers and retail buyers (collectively termed suppliers), that following many years of program activity, most suppliers reported limited variation in stocking practices between program areas and non-program areas (although three did report some remaining differences in the share of LEDs stocked between program and non-program areas).[85] These stocking results add to the evidence of market transformation across the region.

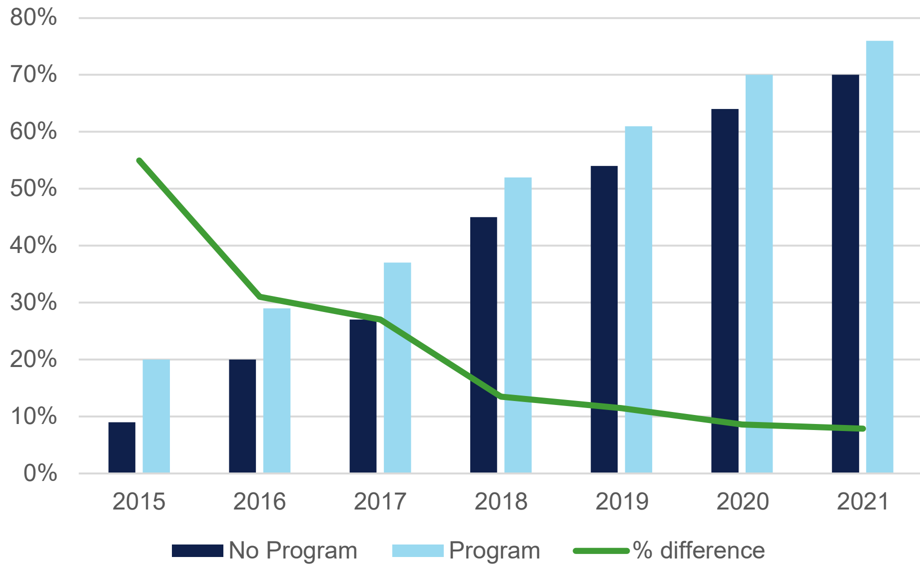
5.1.3 Market trends

As shown in Figure 5-4 and discussed in the above sections, retail LEDs have seen widespread adoption in New Hampshire, in New England, and nationally. The influence of state energy efficiency programs on this trend can be seen in Figure 5-5 below, which shows the difference in LED market share between states with and without upstream lighting programs. Program states have consistently seen higher LED market share than non-program states, but this gap has shrunk as the broader market has transformed. Specifically, in 2015, LED market share in program states was 55% higher than in non-program states, but by 2021, program states' market share was only 8% higher than non-program states.

[84] SCS Analytics, *R1963B: SHORT TERM RESIDENTIAL LIGHTING REPORT*, 2020. https://energizect.com/sites/default/files/documents/R1963b_STLighting_FINAL%20Report_102920_0.pdf

[85] NMR, *New Hampshire Lighting Supplier Insights report,* 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200814-NH-Lighting-Supplier-Insights.pdf.

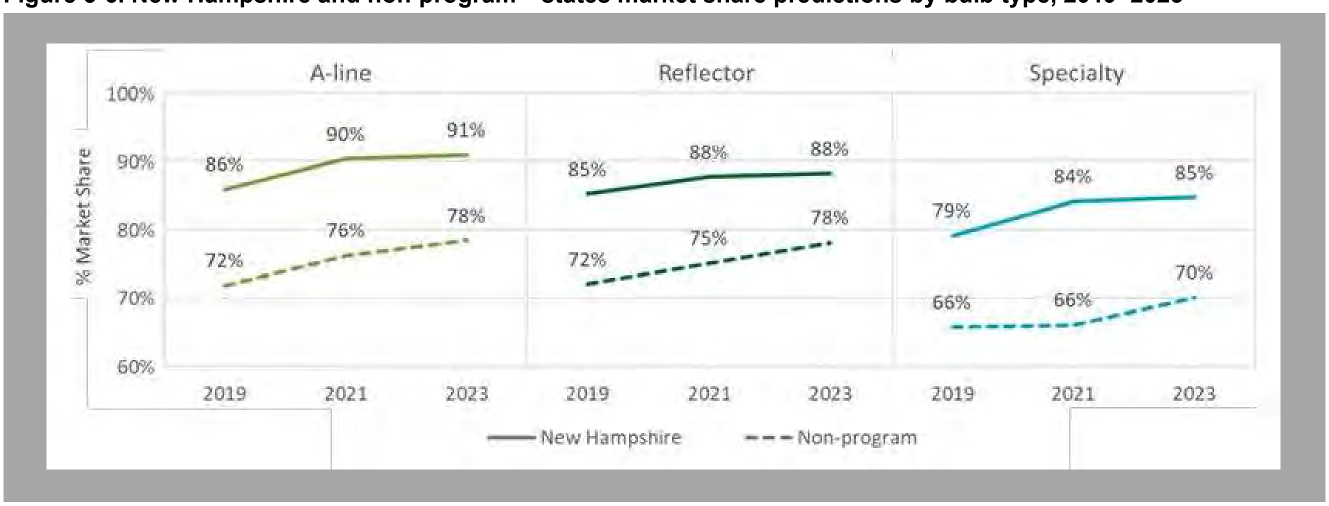
Figure 5-5. LED Market Share in Program and Non-Program States, 2015-2021



Source: DNV analysis of LightTracker data. https://www.creedlighttracker.com.

Similarly, in New Hampshire, market share has been found to outpace non-program states, but by a decreasing amount. Figure 5-6, from the 2020 New Hampshire Lighting Supplier Insights report, shows the growth in market share (i.e., percent of retail lighting sales) and projected increases from 2019 to 2023 for New Hampshire and non-program states, by lamp type, based on interviews with lighting suppliers.[86]

Figure 5-6. New Hampshire and non-program[87] states market share predictions by bulb type, 2019–2023



Source: 2020 New Hampshire Lighting Supplier Insights report, page 4. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200814-NH-Lighting-Supplier-Insights.pdf.

5.1.3.1 Net-to-gross (NTG) ratios

As noted in Section 4.4.3, NTG ratios reflect the extent to which adoption of energy efficiency measures can be attributed to the programs that offer them. Specifically, higher NTG ratios indicate a higher level of program influence and lower levels of

[86] The report notes some methodological limitations that may have caused these market share estimates to be higher than broader trends in program state market share would suggest. These include the fact that the team interviewed only program partners and used question wording that forced LED-focused suppliers to report a 100% LED market share.
[87] Non-Program state defined as state without retail lighting program such as Kansas, Alabama, etc.

free-ridership among participants. Lower NTG scores reflect a larger share of participants who would have adopted the efficient measure with or without the program. Generally, more transformed markets will see lower NTG values.

NTG ratios have not been directly evaluated for retail lighting in New Hampshire, but they have been studied throughout the Northeast and nationwide. According to the New Hampshire Technical Reference Manual, New Hampshire applied Connecticut's 2020 NTG values to the NHSaves programs in 2021, one year behind, to account for the relatively slower pace of market transformation, due in part to fewer program LED bulbs per home in New Hampshire (2.5 bulbs per home in 2019) compared to Connecticut (4 bulbs per home in 2019).

Regardless of state, the trend for retail lighting is evident below in Table 5-1, which shows a steadily decreasing level of savings that can be attributed to programs as LEDs have become the dominant technology in the retail lighting market. This trend mirrors the other trends above showing increasing market share, decreasing upfront prices, and increasing supplier manufacture and stocking of LEDs.

Table 5-1. Retail lighting net-to-gross values in the Northeast

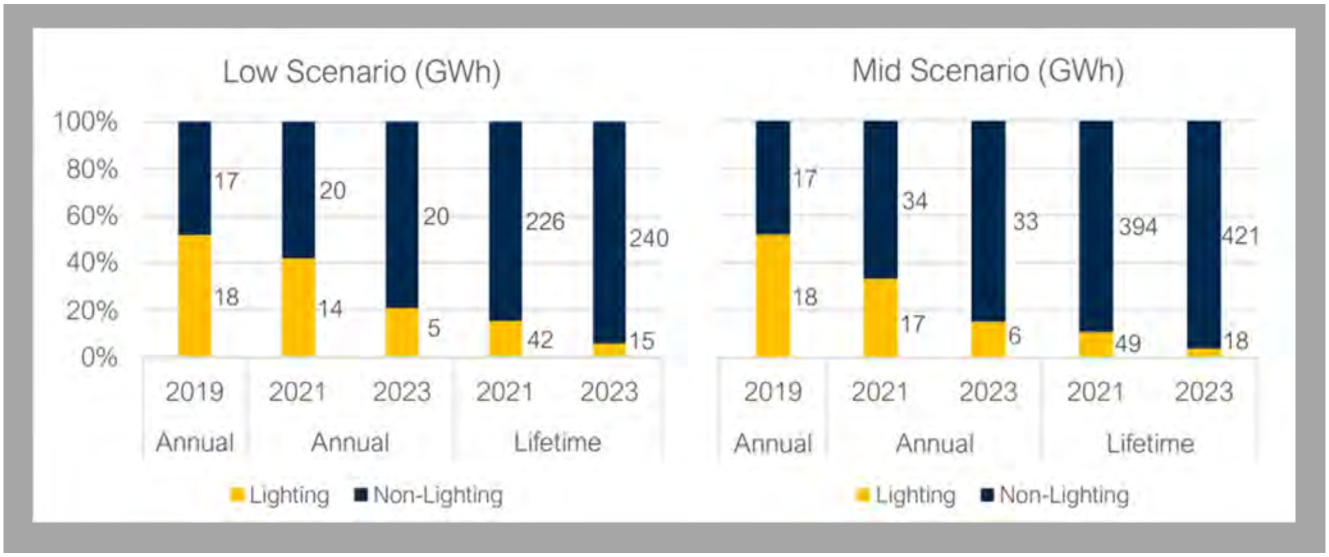
Measure	CT 2016[1]	CT 2017[1]	CT 2018[1]	MA & RI 2018[2]	CT 2019[1]	NY 2019[3]	NY 2020[3]	CT 2020, NH 2021[4]	CT 2021[1]
Residential LEDs (all except hard-to-reach)	57%	47%	40%	25% (A-line) 35% (specialty, reflector)	36%	35%	31%	33%	30%
Residential LEDs (hard-to-reach channels)	77%	67%	60%		56%			53%	50%

[1]NMR, CT R1615 LED Net-to-Gross Evaluation, 2017.
[2]NMR Group, Inc., *MA NTG Consensus Panel Report,* 2018 and NMR Group, Inc., *RLPNC 17-11 LED NTG Consensus Process Products,* 2018.
[3]DNV*, Free-ridership and Spillover Evaluation, Residential and Commercial Portfolio Report,* 2022.
[4]NH Technical Reference Manual & CT-NMR LED NTG Evaluation 2017, "The 2020 Connecticut net-to-gross values are applied to New Hampshire for 2021 to account for the relatively slower pace of market transformation, due in part to fewer program bulbs per home in New Hampshire (2.5 bulbs per home in 2019) compared to Connecticut (4 bulbs per home in 2019)."

5.1.4 Future opportunities

As noted in Table 3-1, retail lighting previously accounted for a large share of NHSaves savings—51% of residential annual MWh and 20% of residential lifetime MWh in 2021. According to the NH Potential Study, the incremental additions in savings associated with retail lighting are diminishing, as shown in Figure 5-7. NH Utilities acknowledged this result in the 2022-23 Plan, which included a "planned reduction in investment in high-efficiency lighting measures in the electric programs. Focus will shift to lighting retrofits and customer segments that still have market barriers."

Figure 5-7. Lighting as a share of overall residential savings for low and mid scenario, New Hampshire



Source: Dunsky. New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Oct. 2020

The historical trends and recent research, along with the full implementation of EISA starting this year, provide compelling evidence that the retail lighting market has been fully transformed, in significant part due to the long-term engagement of state energy efficiency programs. Removing any remaining doubt about the completeness of this transformation, the U.S. EPA released a letter on March 13, 2023 to all ENERGY STAR® Lighting brand owners and interested parties, which stated the following:[88]

"With this letter, the U.S. Environmental Protection Agency (EPA) is finalizing the sunset of the ENERGY STAR® specifications for lamps and luminaires effective December 31, 2024. Recessed downlights, discussed more below, will be covered by a new specification moving forward. Lighting requirements will be removed from the ENERGY STAR® ceiling fan and ventilation fan specifications effective August 1, 2023. Fans with lighting will still be eligible. … Multiple commenters suggested that the marketplace still needs part or all the ENERGY STAR® lighting program to avoid losing the significant efficiency gains associated with lamps and luminaires. To the contrary, historical efficiency gains for lamps and luminaires will be secured by way of the sales prohibition of inefficient light sources in the United States that will be enforced starting this summer."

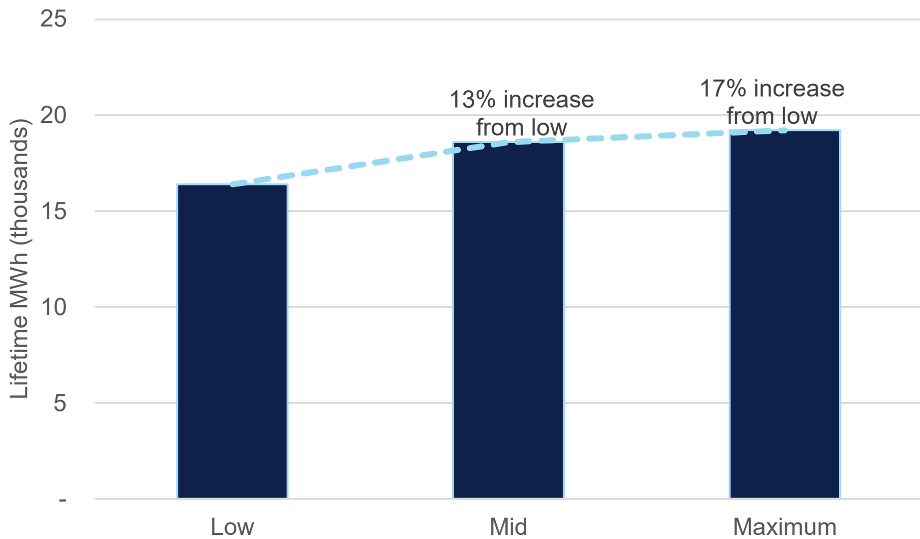
5.1.4.1 New Hampshire Potential Study achievable savings

To estimate the scale of retail lighting savings that the NHSaves programs may be able to achieve by overcoming barriers, the evaluation team analyzed savings opportunities for retail lighting as originally modeled for the 2021–2023 New Hampshire Potential Study. As shown in Figure 5-8, residential LEDs see relatively small increases in achievable savings resulting from increased incentives and enabling activities to overcome barriers, which is consistent with an assumption of a largely transformed residential lighting market and few remaining barriers.[89] These results—which do not account for more recent developments such as full implementation of EISA—suggest that at the time of the study, there were little remaining residential LED lighting savings opportunities for the NHSaves programs. In the period since the study, any savings opportunities have effectively disappeared.

[88] U.S. EPA, *ENERGY STAR® Lighting Sunset Memorandum*, 2023. https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Lighting%20Sunset%20Memo.pdf

[89] It is important to note that the study did not include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

Figure 5-8. New Hampshire achievable savings scenarios for residential LEDs, 2023



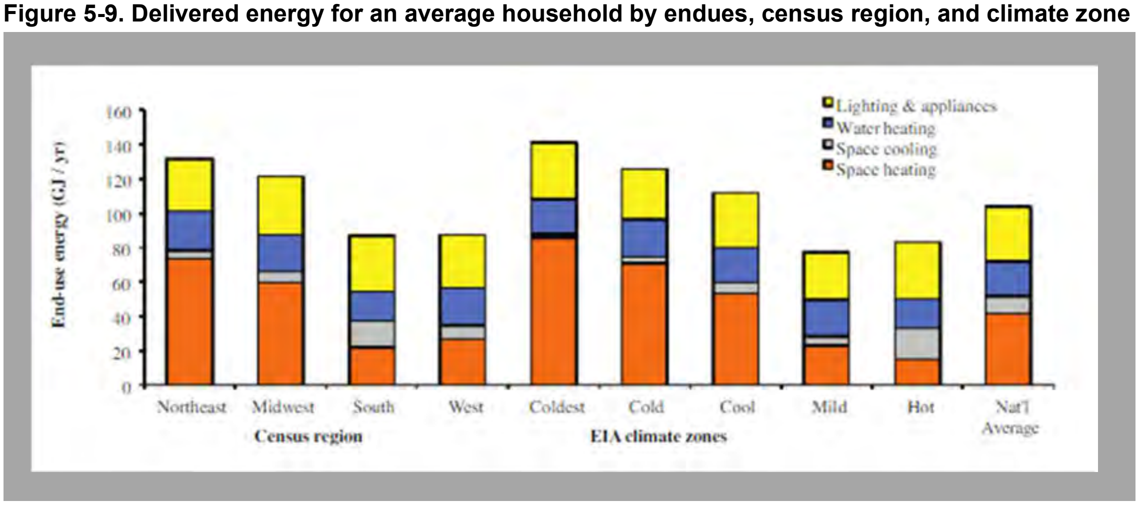
Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

5.2 Residential weatherization

Measures such as air sealing and building shell insulation are primary components of most weatherization programs. Wi-Fi-enabled thermostats and heating equipment, duct repairs and sealing, window and door repairs and replacement, and pipe and tank insulation can also be included in residential weatherization programs.[90]

Household energy use for space heating comprises a significant portion of overall energy use, particularly in the Northeast. As shown in Figure 5-9, due to differences in climate and housing stock, energy costs in the Northeast and cold climates are higher than in other regions, demonstrating the potential for savings from weatherization in these regions.[91]

Figure 5-9. Delivered energy for an average household by endues, census region, and climate zone



Source: Bradshaw et. al., *Comparing the effectiveness of weatherization treatments for low-income American urban housing stocks in different climates,* Energy and Buildings, 2014.

[90] U.S. Department of Energy, *Weatherization Assistance Program*, 2021. https://www.energy.gov/sites/default/files/2021/01/f82/WAP-fact-sheet_2021_0.pdf
[91] Bradshaw, Jonathan, Elie Bou-Zied, and Robert Harris, *Comparing the effectiveness of weatherization treatments for low-income American urban housing stocks in different climates*, Energy and Buildings, 2014. https://www.academia.edu/23454980/Comparing_the_effectiveness_of_weatherization_treatments_for_low_income_American_urban_housing_stocks_in_different_climates.

5.2.1 New Hampshire program overview

The NH Utilities have administered weatherization programs for over 20 years, originally focused on electric savings in low-income households and expanding to cover fossil fuel savings and market rate households in the past decade. Weatherization programs in New Hampshire are broadly similar to those in nearby states such as Vermont,[92] Maine,[93] Connecticut,[94] and Massachusetts.[95] Weatherization measures are currently offered through the market-rate Home Performance with ENERGY STAR® (HPwES) program and the low-income Home Energy Assistance (HEA) program. These measures include blower door guided air sealing and insulation, coupled with home energy audits. Home energy audits and blower door tests are prerequisites for participation in the HPwES and HEA programs, with exceptions for cases with health and safety barriers like asbestos and mold, which present health concerns if a blower door test is performed.

The market-rate HPwES program contractors take a "whole-house" approach. The program prioritizes treatment of homes that exceed a threshold of energy use intensity, regardless of their primary heating fuel type. HPwES currently offers financing at 2% annual percentage rate (APR) for Home Energy Efficiency Improvement Loans and a revolving on-bill financing option at 0% interest.[96] Previously, the incentive cap per project was $4,000. In the 2021–2023 program cycle, the Utilities increased the cap to $8,000. If a gas project reaches this cap, the customer's electric utility may incent the customer with an additional $8,000.[97] To qualify, homes must meet a threshold Home Heating Index (HHI) score, which is calculated using location, conditioned square footage, and annual heating fuel usage. The NH Utilities also offer a Visual Audit pathway for those customers who do not meet the HHI threshold and are exploring opportunities for virtual assessments.

The low-income HEA Program offers incentives covering up to the full project cost for this customer segment, with rebates previously capped at $8,000. In the 2021 to 2023 term, the NH Utilities raised the incentive cap to $20,000, including heating systems. NHSaves coordinates delivery of the HEA program with Community Action Agencies (CAAs), which implement the program alongside the federal Weatherization Assistance Program (WAP).[98] The New Hampshire CAAs operate and deliver WAP services, through which they offer funds for health and safety improvements for weatherization (discussed further in Section 5.2.2.1). As described in a recent program evaluation, *"to facilitate the use of collaborative funding, the eligibility criteria for the HEA Program mirrors the eligibility guidelines of other assistance programs. New Hampshire residents are eligible to receive HEA benefits if they qualify for the state fuel assistance program (currently household income is equal to or less than 60% of the state's median income), the electric assistance program (currently household income is equal to or less than 200% of the federal poverty guideline) or live in subsidized housing".*[99]

5.2.2 Barriers

Market barriers to weatherization in New Hampshire span multiple categories, including financial, technical and physical, organizational, informational, and supply and provision.

5.2.2.1 Financial barriers

Residential weatherization measures can produce significant lifetime energy and cost savings and non-energy benefits,[100] but upfront costs, access to financing, and perceived risk present barriers to acquiring this longer-term savings. A recent DNV study found that almost half of responses from weatherization contractors in a Northeast state say that residential customers cited high upfront costs as a barrier to installing weatherization improvements.[101] Additionally, older housing

[92] Efficiency Vermont, *Weatherization*, 2023. https://www.efficiencyvermont.com/services/renovation-construction/weatherization.
[93] Efficiency Maine, *Weatherization*, 2023. https://www.efficiencymaine.com/at-home/weatherization/.
[94] CT DEEP, *Weatherization*, 2023. https://portal.ct.gov/DEEP/Energy/Weatherization/Weatherization-in-Connecticut.
[95] Mass Save, *Building Insulation and Weatherization*, 2023. https://www.masssave.com/business/rebates-and-incentives/building-insulation-and-weatherization
[96] NHSaves, *Energy Audits & Weatherization*, 2023. https://nhsaves.com/learn/rebate/weatherization/.
[97] NHSaves, 2021-2023 New Hampshire Statewide Energy Efficiency Plan https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/INITIAL%20FILING%20-%20PETITION/20-092_2020-09-01_NHUTILITIES_EE_PLAN.PDF
[98] Opinion Dynamics, *New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL,* 2020. Page 6.
[99] Ibid.
[100] U.S. DOE, *WAP Fact Sheet*, 2018. https://www.energy.gov/sites/prod/files/2018/03/f49/WAP-fact-sheet_final.pdf.
[101] DNV, CONFIDENTIAL CLIENT STUDY, 2022.

stock, like that found in New Hampshire, can add time and complexity to weatherization projects, although older homes generally present greater opportunities for savings.[102] According to the American Community Survey, 12.2% of U.S. homes were built in 1939 or earlier, while in New Hampshire, that number is 19.6%.[103]

Costs for weatherization projects can vary widely across the country, depending on the age of the home, presence of health and safety hazards, and other factors. According to the New Hampshire Department of Energy, the average cost of weatherization for low-income households is $6,500 per home.[104] According to the U.S. Department of Energy, the average per home cost of weatherization through the federal WAP program was $4,695 in 2021.[105] Costs also depend on the types of measures being installed. For instance, costs associated with measures like thermal windows can range from $315 to $800 per window, which may be prohibitive for many customers.[106]

Financial barriers differ by customer class, and as such the NHSaves weatherization programs offer financial interventions for two targeted customer classes: low-income and market-rate customers. However, heterogeneity in New Hampshire's customer base means that technologies that are cost-effective for low-income or market-rate customers on average may not be cost-effective for certain customers within those classes. "Thrifty" or moderate-income customers were identified as a hard-to-reach customer class in a 2020 report on HPwES. These are *"customers who keep their thermostats set at low temperatures because they cannot afford to heat their homes to a comfortable level. These may be moderate-income customers who do not qualify for income-based assistance programs, but still struggle financially."*[107]

> *"Several representatives from CAAs noted that there are a large number of participants that do not meet the income qualifications for the HEA Program, have a need to weatherize their homes, but cannot afford the Home Performance with ENERGY STAR® Program co-pay."*
>
> *- New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL, 2020. Page 46*

Some NHSaves program offerings address financial barriers for moderate-income customers, such as the zero-percent moderate income financing offering established during the 2019 program year. As described in the 2021–2023 plan, *"The NH Utility buys down the lender interest rate to zero percent and the lender additionally extends the maximum loan term to 10 years. These actions combine to result in a lower monthly loan payment for moderate-income customers compared to the payment for the typical Residential Energy Efficiency Loan. The lending partner determines whether the customer is within a moderate-income bracket and eligible for a loan based on income review and lending criteria."*[108]

The NHSaves programs offer rebates and loans to overcome financial barriers to weatherization, spending approximately $10,583,646 on these interventions for market-rate customers and $13,076,492 for low-income customers in 2021.[109]

5.2.2.2 Technical and physical barriers

Technical and physical barriers to weatherization impede measure installation. For instance, accessing wall and ceiling interiors is often more technically challenging than installing light bulbs, water conservation devices, or thermostats. In some

[102] National Trust for Historic Preservation, Energy Advice for Owners: Historic and Older Homes. https://archive.epa.gov/region5/sustainable/web/pdf/energy-advice-for-owners-of-older-homes.pdf.
[103] U.S. Census Bureau, *Why we ask questions about…Year built and year moved in,* https://www.census.gov/acs/www/about/why-we-ask-each-question/year-built/.
[104] New Hampshire Department of Energy, *Weatherization Assistance FAQ*, 2023. https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/weatherization-assistance-program/faq.
[105] U.S. Department of Energy, *Weatherization Assistance Program*, https://www.energy.gov/sites/default/files/2021/01/f82/WAP-fact-sheet_2021_0.pdf, 2021.
[106] https://modernize.com/windows/energy-efficient/thermal-windows.
[107] New Hampshire Utilities, *Home Performance with ENERGY STAR® Program Evaluation Report 2016-2017 – FINAL*,2020. Page 38.
[108] NHSaves, *2021-2023 New Hampshire Statewide Energy Efficiency Plan* https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/INITIAL%20FILING%20-%20PETITION/20-092_2020-09-01_NHUTILITIES_EE_PLAN.PDF.
[109] NH Utilities 2021 reported program spending

cases, limited spaces between walls do not allow for insulation at all. Such barriers are exacerbated in multifamily buildings because of the logistics and permissions needed to insulate or otherwise weatherize units with shared walls.

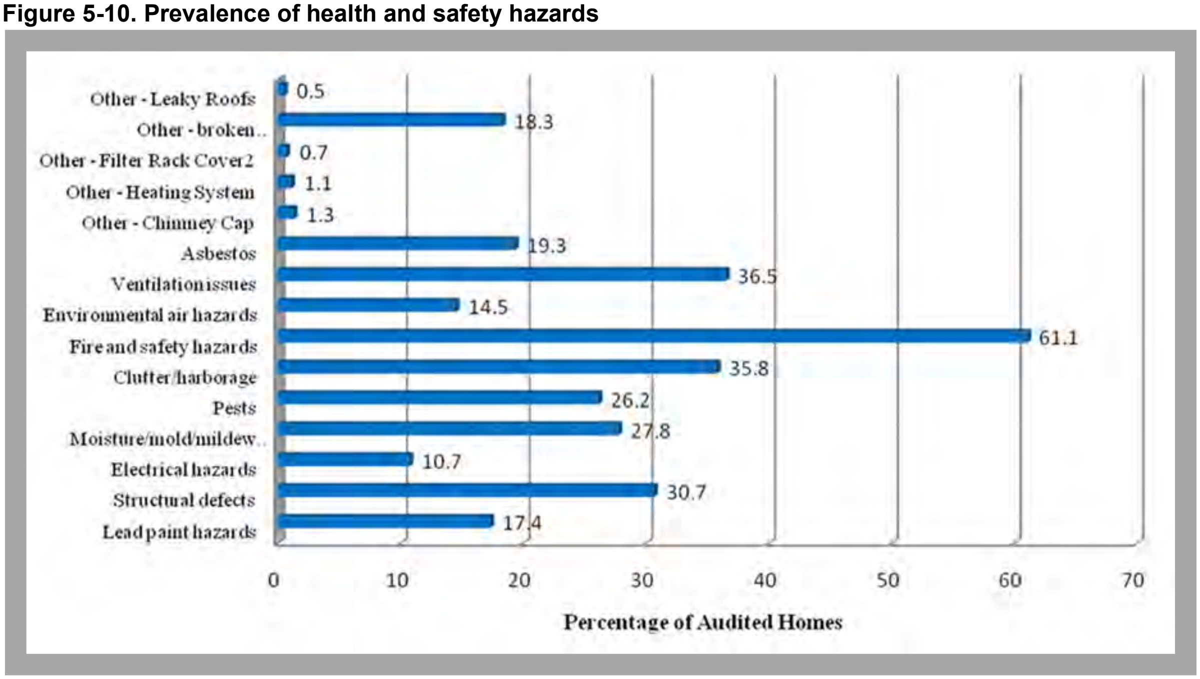
Manufactured housing is prevalent in New Hampshire and poses a particular set of technical and physical barriers. These homes are often underserved by weatherization programs due to such barriers.[110] As detailed in the recent evaluation of the HEA program: *"[HEA] Program staff also indicated that manufactured homes… are a difficult segment to serve through the HEA Program due to limited opportunities to install additional insulation. Specifically, walls cavities in manufactured homes tend to be thin and therefore lack space to add supplemental insulation… contractors sometimes have difficulty accessing certain areas due to low ceiling clearance… Along with a moderate income offering, including measures aimed at this type of housing stock…may help HEA Program teams to serve more participants with manufactured homes."*[111]

Health and safety barriers

Health and safety issues in a home often preclude residents from implementing weatherization measures. As described by the New Hampshire DOE, *"major plumbing, electrical or structural deficiencies, major moisture problems—roof leaks and very wet basements all could slow down progress."*[112] Research from the Green and Healthy Homes Initiative (GHHI) found that nearly 13% of homes audited by GHHI in cities across the United States were ineligible for participation in weatherization programs due to health and safety barriers.[113] Health and safety barriers to weatherization identified in this study included, but were not limited to, the presence of asbestos, ventilation issues, fire and safety hazards, excessive clutter, pests, the presence of moisture, mold, and mildew, electrical hazards, structural defects, and lead paint hazards.[114] See

Figure 5-10 for the prevalence of these barriers as studied by GHHI.

Figure 5-10. Prevalence of health and safety hazards



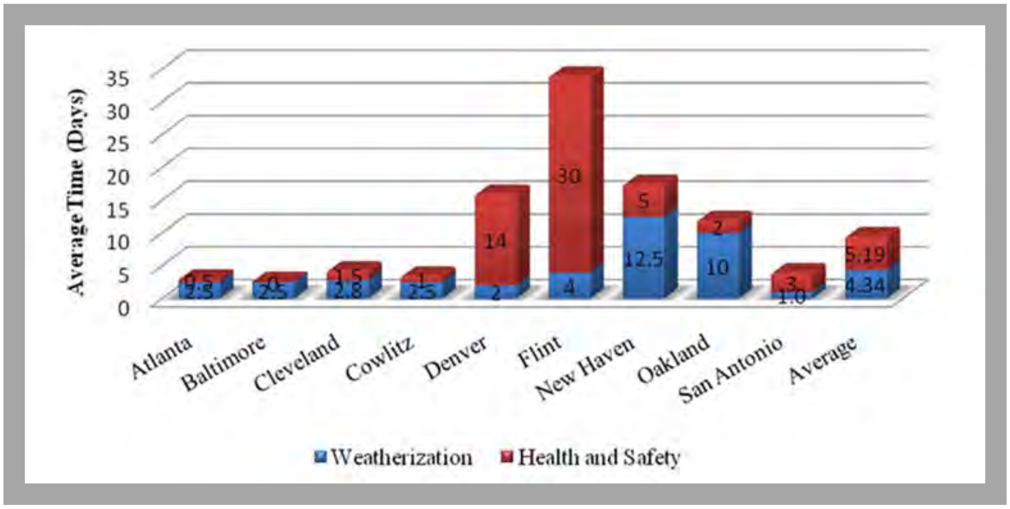
Source: Ruth Ann Norton, Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization (Green & Healthy Homes Initiative, 2010),

[110] Emmeline Luck, Northeast Energy Efficiency Partnerships, *Recognizing Energy Inequities for Building Decarbonization* and *Near-Term Solutions for Centering Energy Equity*, https://neep.org/solutions-low-carbon-states-and-communities/equitable-home-and-building-decarbonization, 2021.
[111] Opinion Dynamics, *New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL, June 11, 2020.* Page 46.
[112] New Hampshire Department of Energy, Weatherization Assistance FAQ, 2023. https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/weatherization-assistance-program/faq
[113] Ruth Ann Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization*,Green & Healthy Homes Initiative, 2010/ Page 6.
[114] Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization*, Page 8.

Page 8.

The time needed to remediate these health and safety barriers can sometimes be greater than the time required for the weatherization projects themselves. As shown in Figure 5-11, based on sites studied by GHHI, the average time spent on necessary remediation of health and safety barriers for weatherization (5.19 days) outweighs the average time spent installing the weatherization measures (4.34 days). Due to its older housing stock, weatherization times in the Northeast may be longer than in other places.[115]

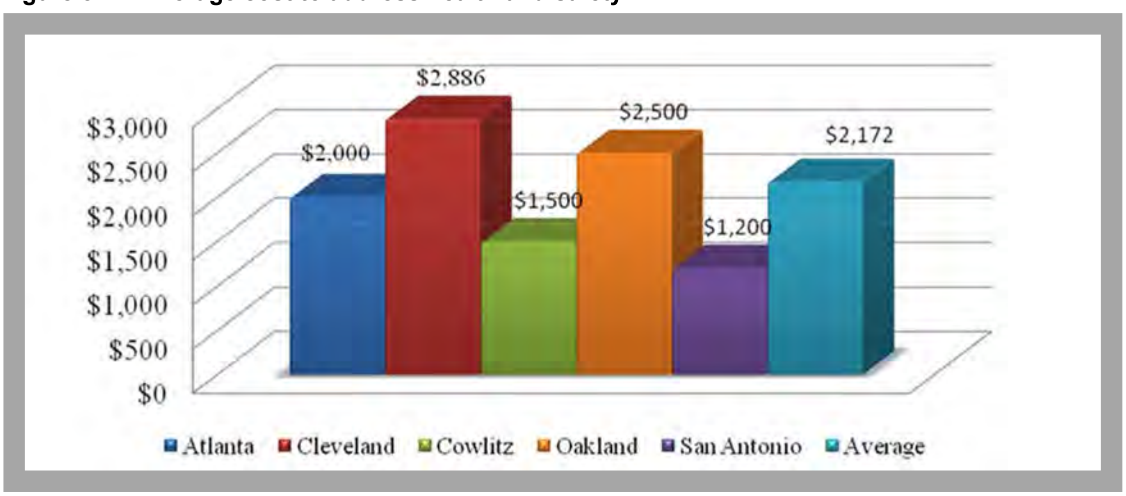
Figure 5-11. Time duration for weatherization and health and safety



Source: Ruth Ann Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization* (Green & Healthy Homes Initiative, 2010), Page 7.

In addition to time, addressing health and safety concerns adds significant costs to weatherization projects. Based on GHHI research, the average cost to address health and safety issues was $2,172 per residential property in 2010 ($2,998.78 in 2023 dollars using a CPI inflation calculator[116]), as shown in Figure 5-12. Homes in Northeast communities with older housing stock may require more investment of time and resources to remediate health and safety issues for weatherization improvements.[117]

Figure 5-12. Average cost to address health and safety



Source: Ruth Ann Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization* (Green & Healthy Homes Initiative, 2010), Page 7.

[115] Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization*, Page 7.
[116] CPI Inflation Calculator, https://data.bls.gov/cgi-bin/cpicalc.pl?cost1=2172&year1=201001&year2=202301
[117] Norton, *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization*, Page 7.

NHSaves programs partially address health and safety hazards remediation for weatherization for the low-income customer class, and federal WAP funding provides additional support. However, according to the New Hampshire Department of Energy, *"there are limits on repairs and various programs to address some additional problems."*[118] WAP may cover some health and safety costs for weatherization, as may the HEA program. However, additional programs require additional paperwork, meaning increased time and inconvenience costs for customers and administrators. Furthermore, larger structural repair needs may not be covered by the allocated rebate funds.

> *"Program teams indicated that a substantial portion of HEA participants require health and safety upgrades prior to completing insulation or air sealing works (65% of participating households received health and safety measures). The WAP currently funds many of these upgrades, and representatives from CAAs suggested adjusting program requirements and funding to allow more health and safety upgrades through the HEA Program may help program teams serve more participants"*
> *- New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL, 2020. Page 46.*

The NH Utilities are actively working on attaining funds to improve financial and technical and physical barriers. As stated in the 2021-2023 plan, "d*uring the 2021-2023 term, the NH Utilities will continue to work with stakeholders, local non-profits, and foundations in order to procure funds to be used to enhance offerings or overcome barriers beyond what is typically funded by the NHSaves Programs. This could include pre-weatherization barriers for HEA customers, expansion costs for Community Action Agencies ("CAAs"), funding the copay of moderate-income customers, coordination with efforts that provide interactive benefits with energy efficiency, such as public health, or other identified opportunities."*[119]

> *"The HEA Program provides health and safety measures to participants, such as carbon monoxide detectors, smoke detectors, and bath fans. Larger health and safety barriers are also covered if they can be accommodated within the $8,000 rebate cap and the package is still cost effective."*
>
> *- New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL, 2020. Page 1.*

5.2.2.3 Organizational barriers

Tenants of leased properties face barriers to weatherization, due to the "split incentive" barrier. This barrier results from the property being owned and largely managed by a landlord—who is responsible for deciding whether to weatherize—while the tenant is responsible for paying energy bills and therefore would be the primary beneficiary of weatherization improvements. Foundational literature on energy efficiency market barriers from a national perspective identifies the landlord/tenant split incentive issue as a significant barrier.[120] In New Hampshire, trends show an increase in multi-family housing permits, correlated with higher rental rates. Data from the New Hampshire Department of Business and Economic Affairs shows that 52.7% of permits issued in 2021 were for single-family homes, decreasing from 59.2% in 2020. This reflects a decrease of 28 single family permits. Meanwhile, the number of multi-family permits issued increased by 569 from 2020 to 2021.[121] This trend suggests that split incentive barriers may become more prevalent in coming years.

Despite these barriers, the NHSaves programs have made significant inroads in the multifamily market and are often involved in new construction of multifamily properties, particularly when they involve other public funding or public housing agencies. About 31% of HEA program participants resided in multi-family buildings in 2017. Additionally, the NH Utilities

[118] New Hampshire Department of Energy, *Weatherization Assistance FAQ,* 2023. https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/weatherization-assistance-program/faq
[119] NHSaves, *2021-2023 New Hampshire Statewide Energy Efficiency Plan*, https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/INITIAL%20FILING%20-%20PETITION/20-092_2020-09-01_NHUTILITIES_EE_PLAN.PDF, Page 95.
[120] Steve Sorrell, Eoin O'Malley, Joachim Schleich, and Sue Scott, *The Economic of Energy Efficiency: Barriers to Cost-Effective Investment*, 2004.
[121] New Hampshire Department of Business and Economic Affairs, *Current Estimates and Trends in New Hampshire's Housing Supply*, 2022. https://www.nh.gov/osi/data-center/documents/housing-estimates-trends.pdf.

partner with public housing authorities across the state to complete projects in multi-family buildings, a practice also seen in neighboring states such as Maine.[122, 123] Public housing authorities operate in a different financial environment than private landlords and may not face split incentive barriers to the same degree. For instance, authorities often receive funding from public grant and tax credit sources that include requirements for energy efficiency. Partnering with these authorities provides an opportunity for the NHSaves programs to serve multifamily residents where the split incentive barrier is less acute.

5.2.2.4 Informational barriers

Customer awareness of weatherization was identified as a key barrier in a 2020 New Hampshire report. According to the report, only 6% of eligible non-participants were aware of HPwES. Participating contractors also indicated that awareness among their general customer base was a barrier to weatherization projects.[124]

Programs provide information and marketing to increase awareness of weatherization. For instance, program marketing—either direct or through co-marketing with contractors or other partners—helps to address informational barriers by educating residents on opportunities for savings. Marketing under a statewide brand such as NHSaves, or with utility company branding, can bolster these efforts by providing assurance and credibility to customers; however, programs generally need to balance marketing—which drives demand—with the availability of resources to meet that demand. NH Utilities have invested $149,204 in marketing interventions for their weatherization programs in 2021.[125]

Home energy labeling is another informational intervention growing in prevalence around the U.S., including in states and communities in the Northeast region. This practice helps raise awareness of home energy needs that may lead to weatherization upgrades, and can create a pipeline of eligible customers in need of energy improvements. Communities in New Hampshire have expressed interest in home energy labeling policies and programs.[126]

5.2.2.5 Supply and provision barriers

While financial and informational barriers prevent some customers from pursuing weatherization, workforce constraints present an overarching barrier that impacts customers and trade allies economy-wide. Overcoming other barriers such as lack of awareness will not result in more weatherization if there is an insufficient workforce to serve customers. CAAs reported in 2020 that the capacity of implementation teams is the largest barrier to completing projects through the HEA program. For instance, a CAA staff member cited in the HEA program evaluation stated: *"I can't see spending dollars trying to get more people into the program, because there's already more people in the program than we can get to. And advertising that this program's available isn't going to help, because we still can't get to all the people."*[127] The evaluation also noted that the contractors for HEA largely overlap with those for HPwES, further constraining the available labor pool.[128] In addition to installing weatherization measures, the report cites program enrollment, scheduling, and service delivery coordination activities as accounting for a considerable amount of staff time and capacity. As such, addressing workforce capacity constraints may require assessing administrative and technical staff capacity, in addition to installation contractors.[129]

Lack of training compounds the workforce capacity barrier. CAAs and the NH Utilities reported a skills gap in workers able to complete home energy assessments and measure installations. Additionally, contractors involved in the HPwES program noted high turnover rates and difficulty finding experienced staff members, increasing the need for new employee training and staff development resources.[130] New Hampshire contractors have indicated that utility-sponsored training programs on

[122] Opinion Dynamics, *New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL,* 2020. Pages 17, 47.
[123] https://www.mainehousing.org/programs-services/HomeImprovement/homeimprovementdetail/weatherization
[124] New Hampshire Utilities, *Home Performance with ENERGY STAR® Program Evaluation Report 2016-2017 – FINAL June 11, 2020*. Page 28.
[125] NH Utilities 2021 reported program spending
[126] Northeast Energy Efficiency Partnerships, CONFIDENTIAL WORK WITH NH COMMUNITIES, 2020-2022.
[127] Opinion Dynamics, *New Hampshire Utilities Home Energy Assistance Program Evaluation Report 2016-2017 – FINAL,* 2020. Page 41.
[128] Ibid.
[129] Ibid.
[130] New Hampshire Utilities, Home Performance with ENERGY STAR® Program Evaluation Report 2016-2017 – FINAL June 11, 2020. Page 39.

topics such as best practices for weatherization measure installation might be beneficial to new staff members.[131] Recognizing this challenge, utilities and program administrators across the Northeast region are seeking to increase investments in workforce training.[132] Partnerships with local community colleges and trade allies seeking interns or entry-level staff have also found some success in New Hampshire and elsewhere in building and training the pipeline of new entrants to the workforce.

Despite these efforts, workforce barriers have repeatedly been emphasized in numerous studies across the region and over time, indicating that they are pervasive. Given the scope of labor market dynamics and workforce constraints, the NH Utilities are limited in their ability to mitigate these barriers.[133]

5.2.3 Market trends

5.2.3.1 Market share trends

The market for weatherization services has been growing steadily over recent years, a trend that is expected to continue. Recent market research has found that the global weatherization services market is expected to grow at over 8% annually through the end of the decade.[134] A weatherization study in New York found that around 300,000 homes, or about 30% of existing residences, are likely to pursue weatherization upgrades in the next several years.[135] In Connecticut, the state legislature has established a goal to weatherize 80% of residences by 2030—a goal the state's energy efficiency programs are working to achieve but that faces significant barriers as discussed above, notably health and safety barriers.[136]

5.2.3.2 Net-to-gross trends

New Hampshire programs have not undergone NTG evaluations, but there have been several in other Northeast states that provide context for how programs have influenced the market in their states. Weatherization measures and programs have been consistently found to have NTG values in the 80% to 100% range, as shown in Table 5-2. Weatherization measures generally have low levels of free-ridership, particularly among low-income participants, indicating that relatively few people would pursue weatherization absent program intervention. This trend underscores the importance of programs in overcoming the range of barriers described above.

Table 5-2. Comparison weatherization program NTG evaluation results

	CT, 2016[1]	RI, 2020[2]	MA, 2021[3]	CT 2022[4]
Free-ridership	0.22 (market rate) 0.08 (low-income)	0.14	0.19	0.11 to 0.28 for envelope measures
Participant spillover	0.02 (market rate) 0.03 (low-income)	0.01	0.12	0.07
NTG	0.80 (market rate) 0.95 (low-income)	0.87	0.97[5]	0.79 to 0.96 for envelope measures

[1] NMR (2016), HES/HES-IE Process Evaluation and Real Time Research, Apr. 13, 2016
[2] Cadeo/Illume (2020). 2017-2018 Impact Evaluation of EnergyWise Single Family Program http://rieermc.ri.gov/wp-content/uploads/2020/10/ng-ri-ewsf-impact-and-process-comprehensive-report_final_04sept2020.pdf
[3] Guidehouse (2021). Residential Programs Net-to-Gross Research of RCD and Select Products Measures:
[4] NMR (2022), R1983 NTG FINAL TOPIC MEMORANDUM. Energize Connecticut, https://energizect.com/sites/default/files/documents/R1983_HES%26IE_NTG_FinalTopicMemo_FINAL_20220912_sent_0.docx
[5] Also includes 0.04 in contractor spillover.

[131] Ibid.
[132] DNV, CONFIDENTIAL CLIENT STUDY, 2022.
[133] DNV, CONFIDENTIAL CLIENT STUDIES, 2021, 2022.
[134] Straits Research, *Weatherization Services Market,* 2022. https://straitsresearch.com/report/weatherization-services-market
[135] DNV, CONFIDENTIAL CLIENT STUDY, 2022.
[136] Acadia Center. https://acadiacenter.org/work/connecticut/.

5.2.4 Future opportunities

Research in other states has identified a range of opportunities programs have for achieving additional weatherization savings and overcoming the types of barriers to weatherization described above. Many of these opportunities are available to the NHSaves programs to pursue, although primary research or New Hampshire-specific data would enable the programs to refine and target interventions on the specific barriers New Hampshire customers face.

Funding opportunities

The recently enacted Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) provide significant opportunities for residential weatherization. IIJA included a $3.5 billion investment in the federal WAP, similar to the American Recovery and Reinvestment Act (ARRA)-era WAP appropriation.[137] IRA supports tax credits, rebates, and related programs with the potential to further the benefits of energy efficiency to low- and moderate-income households.[138]

Community partnerships

Partnerships with community-based organizations, including but not limited to CAAs and public housing authorities, provide a meaningful opportunity to engage stakeholders while prioritizing equity and inclusivity. Feedback from utility weatherization program administrators and contractors in another Northeast state highlights the importance of community partnerships for the implementation of weatherization measures.[139] Research from Northeast Energy Efficiency Partnerships describes the need for equitable and inclusive stakeholder engagement and provides examples of implementation methods.[140] New Hampshire utilities have established working relationships with CAAs and housing authorities to implement weatherization, which may be built upon to continuing addressing persistent barriers in the low-income community.

Efficiency measures

- **Efficient windows.** The 2021-2023 Potential Study found that efficient windows present a significant opportunity for weatherization savings in New Hampshire.[141] This may include complete replacement of windows with more efficient versions as well as existing window repairs. DNV research for a confidential Northeast client in 2022 also found that window upgrades present significant opportunity for future energy savings.[142]
- **HVAC and electrification**. Overcoming weatherization barriers provides a path for efficient HVAC upgrades, including heating electrification (i.e., heat pumps). Successful weatherization projects can unlock additional savings opportunities by reducing other barriers. For instance, weatherized homes have lower heating and cooling loads, meaning that HVAC measures can be right-sized and therefore less costly—reducing financial barriers to efficient electrification or other HVAC upgrades. Also, weatherization contractors are often able to provide financing options and information on additional opportunities for more comprehensive home retrofits, reducing financial and informational barriers. While New Hampshire has focused its program goals on reducing electric consumption, electrification is a growing trend throughout the Northeast region, which will impact customer adoption and market supply in New Hampshire as well.[143]

5.2.4.2 New Hampshire Potential Study achievable savings

To estimate the scale of residential weatherization savings that the HPwES and HEA programs may be able to achieve by overcoming barriers, the evaluation team analyzed savings opportunities for weatherization as originally modeled for the

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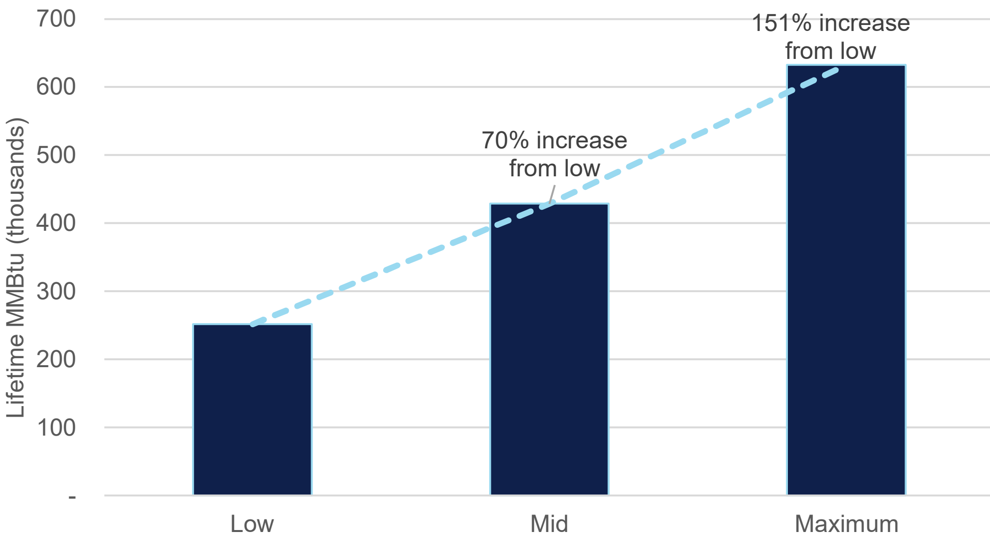
[137] Carols Martin, Joint Center for Housing Studies of Harvard University, *Harnessing the IIJA's Weatherization Assistance Program to Leave No Household in the Cold*, 2023. https://www.jchs.harvard.edu/blog/harnessing-iijas-weatherization-assistance-program-leave-no-household-cold.
[138] Carols Martin et al, Joint Center for Housing Studies of Harvard University, *Targeting Weatherization: Supporting Low-Income Renters in Multifamily Properties Through the Infrastructure Investment and Jobs Act's Funding of the Weatherization Assistance Program and Beyond*, 2023. https://www.jchs.harvard.edu/research-areas/working-papers/targeting-weatherization-supporting-low-income-renters-multifamily.
[139] DNV, CONFIDENTIAL CLIENT STUDY, 2022.
[140] Emmeline Luck, Northeast Energy Efficiency Partnerships, *Recognizing Energy Inequities for Building Decarbonization* and *Near-Term Solutions for Centering Energy Equity*, https://neep.org/solutions-low-carbon-states-and-communities/equitable-home-and-building-decarbonization, 2021.
[141] Dunsky Energy Consulting, *New Hampshire Potential Study: Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023*, Volume I, https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf, 2020. Pages 59-60.
[142] DNV, CONFIDENTIAL CLIENT STUDY, 2022.
[143] Northeast Energy Efficiency Partnerships, *Strategic Electrification,* https://neep.org/equitable-home-and-building-decarbonization-leadership-network/strategic-electrification.

2021–2023 New Hampshire Potential Study.[144] As shown in Figure 5-13, residential weatherization sees significant and steady increases in achievable savings resulting from increased incentives and enabling activities to overcome barriers.[145] This points to relatively low participant cost-effectiveness and high market barriers, both of which are mitigated via the increased program incentives and enabling strategies modeled in the mid and maximum scenarios. These model results also imply that absent all program interventions; barriers would effectively prevent any modeled savings from occurring.

Figure 5-13. New Hampshire achievable savings scenarios for residential weatherization, 2023



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

5.3 Residential New Construction

5.3.1 New Hampshire program overview

The New Hampshire ENERGY STAR® Homes Program provides three offerings to support efficient design and advance the efficiency of New Hampshire's residential construction market: Drive to ENERGY STAR® Code Plus Initiative, ENERGY STAR® 3.1, and the Net Zero Challenge.[146] All three offerings require program participants to exceed current building code requirements, with progressively higher efficiency requirements moving from Drive to ENERGY STAR®, to ENERGY STAR® 3.1, to the Net Zero Challenge.

The ENERGY STAR® Homes program underwent an impact and process evaluation in 2017, reviewing program years 2014–2015.[147] The evaluation concluded that the program is conducted well from an administrative standpoint, and surveyed participants and other stakeholders valued the offering. At the time of the evaluation, the program had yearly been awarded ENERGY STAR® Partner of the Year awards, beginning in 2013, and the state's largest builders were supporters and active participants in the program. The evaluation summarized the benefits delivered, benefits received, and costs incurred by program stakeholders, depicted in Table 5-3. The program interventions summarized below, including incentives, training, home certification, and outreach and education, target the full range of barriers faced in energy efficient new home construction. As detailed below, these include financial, organizational, and supply and provision barriers.

[144] Dunsky. *New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023*, 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf

[145] It is important to note that the study did not include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

[146] NHSaves, Program Highlights, 2021. https://nhsaves.com/wp-content/uploads/2021/11/NHSaves-Program-Highlights.pdf.

[147] ERS, *New Hampshire ENERGY STAR® Homes Program Impact Evaluation (2014–2015).* 2017. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf.

Table 5-3. Benefit cost matrix[148]

Party	Benefits delivered by the party	Benefits received by the party	Costs incurred by the party
Utility	• Incentives • Trainings • Contracted Home Energy Rating System (HERS) rater	• Energy savings towards program and utility goals • Customer relationship with the utility • National recognition by EPA • Helping to move the housing market towards efficient design	• Incentive costs • Additional training costs • Program staff time
HERS rater	• Outreach and education • Home rating services • Recommendations on building systems • Final home certification	• Payment for 3 steps of process • HERS rating work • Lead generation (through outreach) • Trust of builders, HVAC contractors, and other industry partners	• HERS Rater Certification: $1,200-$2,500 • Annual HERS fee: $250-$995/year • REM/Rate per project fee • Cost of annual continuing education units (CEUs) • Time spent with builders who do not complete participation • Additional time spent with contractors for education or tracking down reports
Builder	• Home that meets ES standards • Any necessary reporting	• Program incentive up to $4,000 per home • HERS rater services for free (value of $1,300) • Certification as a distinguishing characteristic, proof to customers of home quality • Additional selling point to customers • Education on best practices	• Additional cost of more efficient materials • Extra time spent to ensure that homes meet requirements • Additional cost of certified HVAC system • Additional cost to find a certified HVAC contractor (if needed)
HVAC contractor	• HVAC system that meets Program standards • All necessary reporting	• Ability to work on certified homes with builders • Certification as a distinguishing characteristic, proof to customers of home quality • Pass-through of incentive/ability to charge more for a system	• ES certification costs: $600-$900 • AE/ACCA annual fees: $600-$800 • Extra cost of HVAC system • Extra time for sealing to ES requirement • Extra administrative time for reporting
Homeowner	• Demanding a certified home that the utilities can claim savings on • Moving the market by purchasing a certified home	• Home that meets Program standards • Energy bill savings • Peace of mind on quality, savings, comfort, durability, value	• Incremental cost of home

In 2021, over 1,300 homes in New Hampshire participated in the ENERGY STAR® Homes Program.[149] According to the NH Utilities, program homes accounted for approximately 25%–30% of all new homes in New Hampshire in recent years. Each participating builder was eligible for up to $4,000 in incentives in addition to professional consultation and certification services. The list below provides details on the financial incentives and technical assistance offerings provided to meet ENERGY STAR® v3.1 standards, as of program year 2023.

- Coverage of all technical guidance and support costs paid directly to the ENERGY STAR®-certified contractor responsible for the construction of the home
- Performance-based incentives up to $4,000 per single-family home/townhouse based on modeled Home Energy Rating System (HERS) performance
- Performance-based incentives up to $1,000 per unit in multifamily buildings based on modeled HERS performance
- Rebates for ENERGY STAR®-qualified lighting and appliances

[148] Table taken from: ERS, *New Hampshire ENERGY STAR® Homes Program Impact Evaluation (2014–2015)*. 2017. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf
[149] NHSaves, New Home Construction, https://nhsaves.com/learn/rebate/new-construction-and-retrofit/.

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5.3.2 Barriers

Three common types of barriers were uncovered during the literature review of New Hampshire and peer jurisdiction residential new construction programs: financial (upfront cost and time), organizational (split incentives), and supply and provision (workforce capacity, awareness, and expertise). Each of these barriers, as well as the program interventions used to overcome them by the NHSaves program and peer programs, are addressed in this section.

5.3.2.1 Financial barriers

The upfront incremental costs associated with energy efficient residential new construction may deter its adoption. This is driven, in part, by developers being focused on limiting construction costs and foregoing capital-intensive energy efficiency offerings.[150] Additionally, financial barriers may take root due to time constraints during construction. For builders who are not already experienced with energy efficiency measures and practices, their use can require increased review time. As one study noted, "time pressures seem to be a key factor affecting investment in energy efficiency."[151] These delays result in uncertainty around ever-changing interest rates, which can be a steep hurdle to maintaining funding commitments, as well as delays resulting in project permits expiring. Further, one study focused on residential new construction in Rhode Island, states "a lengthy approvals process and mandated phasing harm profits. Planners can use these factors as leverage to encourage developers to…build products preferred by planners."[152] Given such cost pressures, the added time required to incorporate energy efficient measures can deter developers from building their homes to higher levels of efficiency.

According to research in the Northeast, trade allies involved in residential new construction estimate that incremental construction costs for building to program efficiency levels are generally around 6%–8% of total project costs, but may be lower for those who are more experienced with energy efficient techniques.[153] These incremental costs were attributable to "purchasing new materials, increased labor (such as for air sealing), HVAC equipment, and hiring HERS raters, who perform home energy audits and assign ratings."[154] Programs use a range of incentives to overcome the upfront cost barrier for uptake of energy efficient measures. Studies have characterized incentive offerings as being important or key to the adoption of energy efficient measures in residential new construction projects.[155,156] These incentives allow builders to overcome upfront cost barriers and increase market adoption of new construction efficiency measures.[157]

5.3.2.2 Organizational barriers

The literature review repeatedly identified split incentives as a market barrier for residential new construction. This barrier is a result of two separate parties being responsible for purchasing the energy efficient measure(s) and utilizing the measure(s). For example, developers may be more invested in the cost of construction and have little to no interest in the efficiency of the installed measures since they will not be responsible for the resulting energy bill,[158] whereas a building owner may be more concerned about costs of operation following construction.[159] The literature review did not identify interventions from peer programs specifically targeting the split incentive barrier, although financial interventions and informational interventions can indirectly mitigate or circumvent split incentive barriers. For instance, incentives help lower

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[150] Golove, William, and Eto, Joseph. *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* LBNL. 1996. https://www.osti.gov/servlets/purl/270751.

[151] Ibid.

[152] Mohamed, Rayman.. *Are profits from subdivision development higher in areas with more regulations? A case study of South Kingstown, Rhode Island and some implications for land use planning,* Housing Policy Debate, Taylor & Francis Journals, vol. 20(3), pages 429-456, 2010. https://ideas.repec.org/a/taf/houspd/v20y2010i3p429-456.html

[153] NMR Group, Inc.. R1602 Residential New Construction Program – Process Evaluation. 2017. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf

[154] Ibid. .

[155] NMR Group, Inc.. *R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction.* 2018. https://energizect.com/sites/default/files/documents/R1707%20NTG%20Study%20for%20CT%20RNC_Final%20Report_10.5.18.pdf.

[156] NMR Group, Inc.. R1602 Residential New Construction Program – Process Evaluation. 2017. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf

[157] NMR Group, Inc.. *R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction.* 2018. https://energizect.com/sites/default/files/documents/R1702-R1710_CodesStandards_Final%20Report_6.29.18_0.pdf.

[158] Eto, Joseph, Prahl, Ralph, and Schlegel, Jeff. *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs*. LBNL. 1996. https://eta-publications.lbl.gov/sites/default/files/lbnl-39058.pdf.

[159] Golove, William, and Eto, Joseph. *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* LBNL. 1996. https://www.osti.gov/servlets/purl/270751.

the cost of energy efficient construction for developers, and promotional materials or home energy labeling can provide information that buyers incorporate into the price they are willing to pay for a new home. Together, these interventions can help align the different incentives of developers and buyers in favor of energy efficiency. A previous study further elaborated on the various policy responses to the split incentive barrier and detailed the benefits and concerns, which can be seen in Table 5-4. NHSaves does not have authority over interventions such as building codes or taxpayer-funded grant programs, but can play a convening role or design programs to coordinate or leverage external interventions.[160]

Table 5-4. Policy responses to the split incentive barrier[161]

	Description	Benefits	Concerns
Contracts			
Green or energy efficiency lease	Landlord and tenant agreement to conserve energy, where landlord retrofit investments are trickled down to tenant.	• Higher rents offset by lower utility costs. • Mutual commitment to conservation.	• Requires cooperation from landlord and tenant. • Continual capital improvements and maintenance necessary. • Currently geared toward commercial leases.
Energy efficiency mortgages (PACE financing)	Externally funded loan attached to the property.	Capital improvements can be done at one time and paid in installments.	• Benefits remain with the property and lien complicates property resale. • Liability for property owner.
On-bill financing	Capital improvements are tied directly to utility company payments.	Capital improvements can be done at one time and paid in installments with no lien issues.	Usually focused on live-in homeowners, not tenants.
Regulation			
Green building codes	Application of higher energy standards for new construction.	Potential to benefit all new housing developments, including buildings for low-income tenants.	• Only applies to new construction. • Higher rent prospects along with higher construction and maintenance cost can create bias against low-income tenants.
Low-income rental mandates	Mandate of higher energy standards for low income housing.	Potential for high scale implementation in low-income rental housing.	Creates serious disincentive to provide low-income housing.
All-in Services			
Weatherization assistance program	• National weatherization program, usually implemented as grants. • Differs from state to state.	• Has highest reach; especially under the U.S. Stimulus Program. • Variety of policy programs and state differentiation/experimentation.	• Cannot be implemented at scale because of cost; inefficient. • No follow-up for maintenance. • Hardly used for low-income rental housing.
Concierge Services	Small niche programs designed to provide comprehensive efficiency assistance with education.	Highest success rate for efficiency gains and behavioral improvements; addresses poverty concerns effectively.	• Cannot be implemented at scale because of cost. • Highest expense.

Source: Bird and Hernandez.

5.3.2.3 Supply and provision barriers

Lack of workforce and/or workforce awareness and expertise can be a barrier for multiple market actors, including but not limited to builders, developers, contractors, and designers.[162] This barrier is driven by not having enough workers to meet market demand overall, and among available workers, not having sufficient training or education regarding energy efficient technologies and building practices. This barrier is exacerbated by challenges retaining workers who have gained knowledge and expertise, who may be drawn to work out of state or to follow different career paths.

In addition, while workforce supply is constrained, market demand for efficient homes has grown. One study from a peer jurisdiction found that new home buyer interviews indicated growing awareness of and interest in energy efficient

[160] Bird, Stephen and Hernández, Diana. "Policy options for the split incentive: Increasing energy efficiency for low-income renters." *Energy Policy*, Volume 48, 2012, Pages 506-514, ISSN 0301-4215. https://doi.org/10.1016/j.enpol.2012.05.053.
[161] Table taken from: Bird, Stephen and Hernández, Diana. "Policy options for the split incentive: Increasing energy efficiency for low-income renters." Energy Policy, Volume 48, 2012, Pages 506-514, ISSN 0301-4215. https://doi.org/10.1016/j.enpol.2012.05.053.
[162] A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs.

measures[163] and a second study found that home buyers placed high importance on energy efficiency.[164] Given recent program and customer focus on all-electric new home construction in New Hampshire and across the region, there will be increased demand for workers who are skilled in this area, and the gap between supply of and demand for trained workforce may increase. More targeted market and customer research may aid in developing interventions to identify and overcome specific workforce barriers.

The New Hampshire ENERGY STAR® Homes Program evaluation specifically addressed workforce barriers. In both New Hampshire[165] and a peer jurisdiction,[166] studies have found rapid turnover for subcontractors (HVAC, plumbing, etc.) who had been involved in new construction programs. In New Hampshire specifically, the evaluation found that HVAC contractors perceived a high burden for meeting the design and administrative requirements necessary to receive ENERGY STAR® certification. Since the time of the evaluation, the program has added a participation pathway which offers a reduced rebate for projects involving HVAC contractors who build to the same program efficiency standards but who are not ENERGY STAR®-certified, helping to circumvent this barrier.

The literature review found a common approach for overcoming workforce awareness and expertise barriers among peer jurisdictions is providing training on energy efficient designs. Developers are inclined to prefer familiar, replicable designs,[167] so providing training to increase knowledge and transforming unfamiliar concepts into familiar concepts may help encourage the adoption of energy efficient designs. One study found that program trainings on code compliance and trainings about building practices were key activities driving savings in non-program homes, providing a key mechanism to impact the overall market.[168] Another study found that a lack of information regarding energy efficient designs contributed to suboptimal home designs,[169] and could be remedied with additional education and training. In a peer jurisdiction, trainings offered by program staff or third-party trade organizations left HERS raters very satisfied with program offerings, while builders cited a desire to receive technical guidance in more practical terms.[170] In the same study, HERS raters stated a need for more extensive air sealing technique trainings for builders, which expanded upon the finding that builders are aware of the necessity of receiving more practical guidance.[171] To overcome workforce awareness barriers, program training offerings should consider the specific needs of the relevant workforce.

5.3.3 Market trends

The review of literature on New Hampshire and peer jurisdiction residential new construction programs provided insights on the market trends detailed below.

5.3.3.1 Market share

The New Hampshire ENERGY STAR® Homes Program evaluation found that the program reached 5% of homes built in 2014–2015.[172] NH Utilities staff estimated that the program has increased its coverage of the market in recent years to around 25% to 30% of new homes in New Hampshire. Increased program participation also increases overall levels of code

[163] Eto, Joseph, Prahl, Ralph, and Schlegel, Jeff. 1996. “A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs.” LBNL. Accessed January 15, 2023. https://eta-publications.lbl.gov/sites/default/files/lbnl-39058.pdf.
[164] NMR Group, Inc. 2017. “R1602 Residential New Construction Program – Process Evaluation.” Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf.
[165] ERS. 2017. “New Hampshire ENERGY STAR® Homes Program Impact Evaluation (2014–2015).” Accessed January 15, 2023. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf.
[166] Eto, Joseph, Prahl, Ralph, and Schlegel, Jeff. 1996. “A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs.” LBNL. Accessed January 15, 2023. https://eta-publications.lbl.gov/sites/default/files/lbnl-39058.pdf.
[167] Golove, William, and Eto, Joseph. 1996. “Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency.” LBNL. Accessed January 15, 2023. https://www.osti.gov/servlets/purl/270751.
[168] NMR Group, Inc. 2018. “R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction.” Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1707%20NTG%20Study%20for%20CT%20RNC_Final%20Report_10.5.18.pdf.
[169] Golove, William, and Eto, Joseph. 1996. “Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency.” LBNL. Accessed January 15, 2023. https://www.osti.gov/servlets/purl/270751.
[170] NMR Group, Inc. 2017. “R1602 Residential New Construction Program – Process Evaluation.” Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf
[171] NMR Group, Inc. 2017. “R1602 Residential New Construction Program – Process Evaluation.” Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf.
[172] ERS. 2017. “New Hampshire ENERGY STAR® Homes Program Impact Evaluation (2014–2015).” Accessed January 15, 2023. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf.

compliance, which paves the way for new practices and technologies to be later mandated by code updates.[173] Code revisions are made through an extensive process involving stakeholder input and analysis of current building practices and tradeoffs of increased requirements, including cost to builders and buyers of more efficient construction. As efficient construction practices advance and penetrate the market, first among participating and then among non-participating builders and contractors, the tradeoffs around code updates lean more toward increased efficiency requirements.

Increased program participation can also provide workforce benefits that enable further growth in the market share of efficient homes. For instance, in a separate residential new construction process evaluation, evaluators found that the program helped grow the HERS rater business in the state.[174] HERS raters are critical to ensuring homes are built efficiently, and so this dynamic can create a positive feedback loop between programs and the workforce needed to implement them.

5.3.3.2 Net-to-gross

Net-to-gross (NTG) ratios have not been directly evaluated for residential new construction in New Hampshire. However, the ENERGY STAR® Homes evaluation noted signs of spillover found in the process evaluation, based on comments made by builders and HVAC contractors stating that their program experience raised performance levels in all homes they are involved with.[175] For instance, several participating builders and HVAC contractors stated that they build their homes to ENERGY STAR® standards, regardless of whether the home is built through the program.

A 2018 Connecticut study of NTG for residential new construction found an overall NTG ratio of 1.56, with high free-ridership (0.69) and higher non-participant spillover (1.25).[176,177] In other words, for every MMBtu of energy saved by program participants, the program resulted in another 1.25 MMBtu of savings among non-participating homes. The high level of spillover was attributed to training and program requirements for key measures such as air infiltration, duct leakage, and insulation installation quality, which impacted construction practices across the market.[178] Similarly, an earlier study of the Massachusetts Residential New Construction Program found significant non-participant spillover (1.39), driven by the same dynamics.[179]

More recent studies have found decreasing NTG estimates, as shown in Table 5-5, which are indicative of reduced program impacts due to broader efficiency advancements in new construction markets. Such results suggest that barriers to efficiency in other states—as defined by program efficiency requirements in those states—are being overcome, increasingly without program intervention. These results may not be indicative of the ENERGY STAR® Homes program and of New Hampshire's new construction market. However, New Hampshire may consider assessing NTG for the program, considering the trend found in peer jurisdictions and the signs of spillover and increasing non-program efficiency levels previously found in New Hampshire.

[173] Eto, Joseph, Prahl, Ralph, and Schlegel, Jeff. 1996. "A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs." LBNL. Accessed January 15, 2023. https://eta-publications.lbl.gov/sites/default/files/lbnl-39058.pdf.
[174] NMR Group, Inc. 2017. "R1602 Residential New Construction Program – Process Evaluation." Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf.
[175] ERS. 2017. "New Hampshire ENERGY STAR® Homes Program Impact Evaluation (2014–2015)." Accessed January 15, 2023. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf.
[176] NMR Group, Inc. 2018. "R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction." Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1707%20NTG%20Study%20for%20CT%20RNC_Final%20Report_10.5.18.pdf.
[177] The study noted that gross savings may decrease as non-program baselines improve, and lighting savings diminish. However, without the program, the study authors surmise that non-program homes would have been somewhat less efficient than actuality, and program homes would have been much less efficient than actuality.
[178] NMR Group, Inc. 2017. "R1602 Residential New Construction Program – Process Evaluation." Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1602_Residential%20New%20Construction_Process%20Evaluation_Final%20Report_8.4.17.pdf.
[179] NMR Group, Inc., 2014. "Massachusetts Residential New Construction Net Impacts Report." Accessed Mar. 9 2023. https://ma-eeac.org/wp-content/uploads/Residential-New-Construction-Net-Impacts-Report-1-27-14.pdf

Table 5-5. Comparison Residential New Construction program NTG evaluation results

	MA, 2011[1]	CT, 2015[2]	MA, 2015[3]	MA, 2017-2019[4]	MA, 2022[4]	MA, 2023[4]	MA, 2024[4]
Free-ridership	0.53	0.69	0.67	0.80	-	-	-
Non-participant spillover	1.39	1.25	0.55	0.75	-	-	-
NTG	1.87	1.56	0.88	0.95	0.49	0.43	0.38

Note: Year reflects the year of construction for program homes covered in the study.
[1] NMR Group, Inc., 2014. "Massachusetts Residential New Construction Net Impacts Report." Accessed Mar. 9 2023. https://ma-eeac.org/wp-content/uploads/Residential-New-Construction-Net-Impacts-Report-1-27-14.pdf
[2] NMR Group, Inc. 2018. "R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction." Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1707%20NTG%20Study%20for%20CT%20RNC_Final%20Report_10.5.18.pdf
[3] NMR Group, Inc. 2018. "Residential New Construction and CCSI Attribution Assessment (TXC48)." Accessed Mar. 9 2023. https://ma-eeac.org/wp-content/uploads/TXC_48_RNCAttribution_24AUG2018_Final.pdf
[4] NMR Group, Inc. 2021. "Low-Rise Residential New Construction NTG Study (MA20X05- B-RNCNTG)." Accessed March 8, 2023. https://ma-eeac.org/wp-content/uploads/MA20X05-B-RNCNTG_Low-rise-RNC-NTG_FinalDraft-07272021.pdf.

5.3.4 Future opportunities

The ENERGY STAR® Homes Program has achieved high levels of participation and has been nationally recognized year over year for its success. However, there is additional room for growth and further market transformation. Although program participants must exceed current building code requirements, code levels and efficient building practices are continually advancing. As such, there will continue to be opportunities for the program to push the market forward, ahead of code and toward the most efficient practices. As found in the 2017 evaluation:

> *"While the Program has done a commendable job promoting, facilitating, and validating the construction of ENERGY STAR v3.0 homes, the larger issue facing the Program is the apparent widespread adoption of efficient construction practices across the market. …[The evaluation results] present convincing evidence that the playing field shifted beneath the Program and nonparticipant homes have improved beyond the baseline assumptions embedded in the Program savings estimates."*

Since the time of the study, the NH Utilities have responded by increasing program efficiency levels (to ENERGY STAR® v3.1), but this dynamic of advancing efficiency levels will likely continue for new home construction, as it has across sectors and technologies, as described in Section 4.4.2. As similarly found in a recent peer program evaluation, "as non-program homes continue to gain in efficiency, the study recommends the program push for higher levels of performance to stay ahead of non-program homes that continue to rapidly increase in efficiency."[180] In addition, as discussed above, the literature review uncovered multiple persistent residential new construction market barriers that programs can still address to achieve further savings, including upfront cost, split incentives, and workforce barriers.

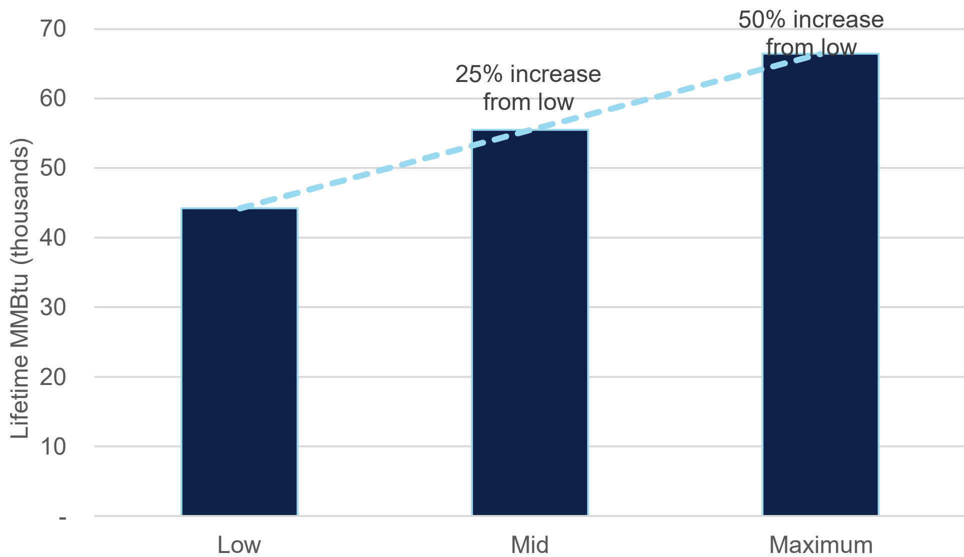
Continued support of the ENERGY STAR® Homes Program will provide a path for incentives and trainings to inject direct support into the residential new construction market, principally for program participants, but likely inducing spillover effects for non-participant homes following trends identified in secondary research. To ensure continued progress in advancing efficiency levels, it is important that the program maintain high standards for efficiency levels of participating homes to ensure they stay ahead of the broader market. Beyond incentives and trainings, interventions such as home energy labeling[181] can help the program overcome barriers related to customer awareness. Along these same lines, the ENERGY STAR® Homes *Drive to Net Zero* pathway—a design and build competition for single and multi-family homes—provides an avenue for promoting and highlighting high efficiency, net zero homes, which can address informational and other barriers.

[180] NMR Group, Inc. 2018. "R1707 Net-to-Gross Study (NTG) of Connecticut Residential New Construction." Accessed January 15, 2023. https://energizect.com/sites/default/files/documents/R1707%20NTG%20Study%20for%20CT%20RNC_Final%20Report_10.5.18.pdf
[181] https://empress.naseo.org/energy-labeling#:~:text=Residential%20home%20energy%20labeling%20refers%20to%20programs%20or,labels%20for%20appliances%2C%20and%20nutrition%20facts%20for%20food.

5.3.4.1 New Hampshire Potential Study achievable savings

To estimate the scale of residential new construction savings that the ENERGY STAR® Homes program may be able to achieve by overcoming barriers, the evaluation team analyzed savings opportunities for residential new construction as originally modeled for the 2021–2023 New Hampshire Potential Study.[182] As shown in Figure 5-14, residential new construction sees moderate, steady increases in achievable savings resulting from increased incentives and enabling activities to overcome barriers.[183] Further, these model results imply that absent all program interventions, barriers would effectively prevent any modelled savings from occurring.

Figure 5-14. New Hampshire achievable savings scenarios for residential new construction, 2023



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

5.4 C&I lighting controls

Lighting controls in C&I facilities are intended to save energy by reducing the total hours of use of a lamp by reducing how often the lamp is "on" through switches and sensors, and/or reducing the lumen output based on the lighting requirements in a space and available lighting from other sources. The types of lighting controls available in the market range from manual switches, occupancy sensors, and timers to advanced lighting controls (ALC), including networked lighting controls (NLC) and luminaire level lighting controls (LLLC). This case study uses the definitions shown below in Table 5-6, derived from recent studies in Massachusetts.[184] More details on controls technologies can be found in those studies.

Table 5-6. Lighting control categories and associated controls

Control type	Basic controls	Standalone Sensor Controls	Room-Based Controls	Luminaire Level Lighting Controls (LLLC)	Network Lighting Controls (NLC)
Features	Manual switch, manual dimmer, time clock	Occupancy sensor, daylight sensor	Code-compliant "kits" with occupancy and daylight sensors; may have	Wireless networked fixture-level integrated occupancy and daylight sensors;	Wired or wireless networked occupancy and daylight sensors;

[182] Dunsky. New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Oct. 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf

[183] It is important to note that the study did not include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

[184] DNV. Massachusetts C&I Lighting Controls Market Study, 2021.

			high-end trim; networking within zone only; fixtures operate as a group	high-end trim; fixtures can be controlled independently or as a zone	high-end trim; fixtures can be controlled independently or as a zone

Source: MA 2020 C&I Lighting Controls Market Study, page 26. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf;

In addition, there is not a large body of recent lighting controls research, and none in New Hampshire. As such, the team relied primarily on several studies from Northeast states with larger energy efficiency program budgets, and different markets than New Hampshire. The section below cites several Massachusetts studies, but it should be noted that the Massachusetts C&I lighting market has been found to be about 2 years ahead of New Hampshire in terms of LED adoption, a trend which is likely relevant for C&I lighting controls as well.[185]

5.4.1 New Hampshire program overview

C&I lighting controls comprised a small share of NHSaves program savings in 2021, accounting for just 3% of annual C&I MWh savings and 2% of lifetime C&I MWh savings. C&I lighting controls have a great deal of remaining energy savings potential, ranking in the top five non-residential measures in the 2021-2023 New Hampshire Potential Study, but programs must overcome several hurdles to for this potential to be realized.

A suite of lighting control options is offered to C&I customers through the NHSaves programs. This includes networked lighting controls, dimming sensors, and occupancy sensors, offered through Small Business Energy Solutions (SBES) and Large Business Energy Solutions (LBES) programs as part of the commercial new construction or major renovation pathways. LED lighting with controls, such as LED troffers with controls, troffer retrofit kits with controls, and high and low bay lighting with controls are also offered through the C&I Midstream Lighting Initiative, which discounts the price of equipment by providing the distributor an incentive for sales of program-eligible measures. Of these, networked lighting controls are a relatively novel technology, while occupancy sensors and dimmers have been in the market for many years.

5.4.2 Barriers

The sections below discuss how adoption of controls is impeded by different types of barriers, but it is important to note that these barriers vary by lighting control type, customer type, and individual customer needs and motivations. Individual customer operating characteristics, such as how facilities are designed, what different spaces are used for, and what their operating hours are, will impact the cost-effectiveness and appropriateness of different control types. Similarly, customer adoption varies by their level of willingness to invest in controls with longer payback periods compared to standard lighting upgrades, and their willingness to engage with control systems.

5.4.2.1 Financial barriers

The upfront incremental cost of lighting controls pose a barrier to their adoption, but this barrier has been found to be less prominent than other types of barriers discussed below. Research into decreases in lighting control savings in Massachusetts in 2014 found that the market was likely saturated with basic occupancy sensors, and that upfront incremental cost was a primary barrier to the installation of more advanced controls[186]. Research conducted in Massachusetts in 2021 again found that upfront incremental cost of advanced controls was a barrier for some customers—though not as significant as other barriers (e.g., informational and technical).

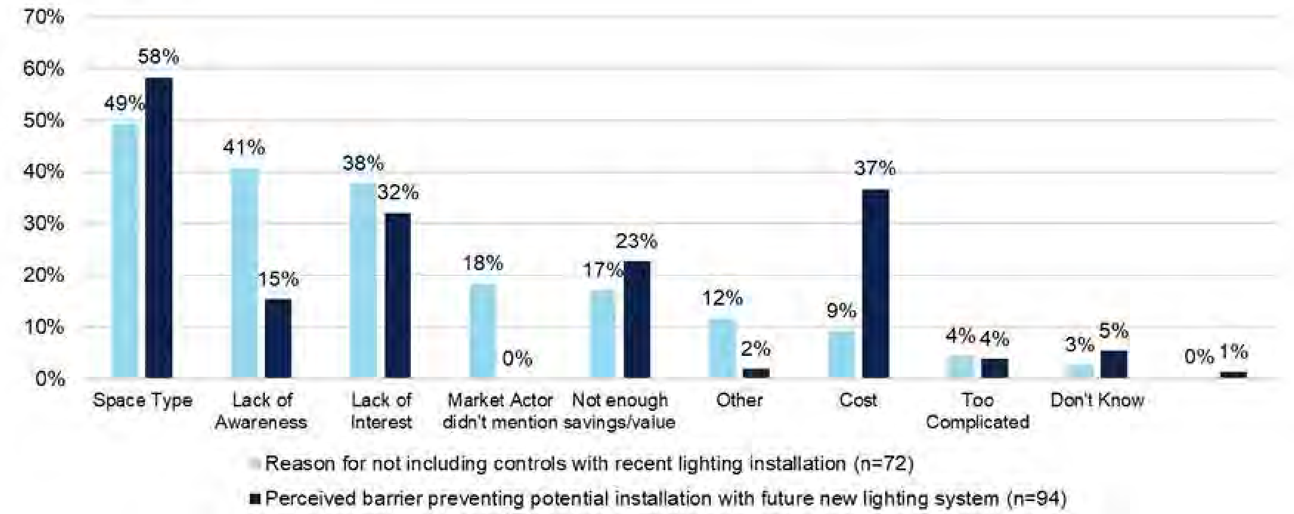
However, as seen in Figure 5-15, only 9% of customers that had recently completed a lighting upgrade that did not include controls indicated that the upfront cost associated with advanced control systems influenced their decision not to include

[185] ERS & Dunsky. New Hampshire Potential Study, 2021-2023 Volume IV: Non-Residential Market Baseline Study, 2020 https://www.puc.nh.gov/Electric/Monitoring and Evaluation Reports/20201016-NHSaves-Potential Study-Final Report-Volume IV.pdf

[186] DNV, Massachusetts Retrofit Lighting Controls Measures Summary of Findings FINAL REPORT, 2014. https://ma-eeac.org/wp-content/uploads/Lighting-Retrofit-Control-Measures-Final-Report.pdf

lighting controls in their recent project. On the other hand, 37% of customers who had not recently installed a new LED lighting system indicated that upfront cost may impact their decision to include lighting controls in a future lighting project. This suggests that customers' perception of the potential upfront cost is a more prominent barrier than the actual cost of controls.

Figure 5-15. Customer reasons for not including advanced controls



Source: DNV, 2020 Massachusetts C&I Lighting Controls Market Study, page 17. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

Other market actors view upfront cost as a significant barrier to increased adoption of advanced lighting controls. In Massachusetts, as seen in Figure 5-16, cost was the most cited barrier by both lighting distributors and manufacturers and roughly half of each group also indicated the current incentive level as another barrier. Customers' uncertainty of the value provided by advanced controls was also cited by almost half of the interviewed distributors as well.

Figure 5-16. Distributor and manufacturer identified barriers to further sales and adoption of advanced lighting controls

Source: DNV. 2020 Massachusetts C&I Lighting Controls Market Study, page 26. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

Similar research on the market for LLLC in the Pacific Northwest also found the real and perceived cost of these controls was a barrier. One manufacturer noted the following about including controls alongside LED replacements: "*the biggest [challenge] is staying ahead of the cost curve…The cost adder for the control—let's say the fixture was X dollars plus 25% to get the control in there. As the cost of lighting has dropped over the years, the cost of controls has not kept pace at the same rate, so controls cost has become a larger cost adder.*"[187] Market actors interviewed for the study also noted they have observed customers declining to include lighting controls in retrofit lighting projects as the energy savings and associated financial benefits resulting from new LEDs meets their needs without adding controls.

Beyond upfront project costs, controls technologies can also face financial barriers due to hidden costs not captured in the price of efficiency investments—specifically, technical appropriateness and performance risks. For instance, when customers perceive that advanced controls are not appropriate for their specific needs in a space (they may need lighting at all times due to safety concerns or security, the space may be low occupancy, or they need to trust the lights will be available when needed), it becomes more difficult to convince these customers that the additional benefits provided by controls outweighs the cost. Control owners in the Pacific Northwest indicated they have had "to remove some automatic control functionality due to safety concerns in a dentist office, delays in lights turning on after a control input, and issues with system components failing shortly after installation."[188]. Challenges like these are hidden costs associated with controls that do not meet the needs of the space. On-going operations and maintenance costs, including tune-ups and reprogramming, and software support are on-going costs customers may incur over the lifetime of the controls system. An ESCO in the Pacific Northwest noted there is a perceived risk that software support of functionality may erode over time and add

[187] NMR and Energy Futures Group. 2019-2020 Luminaire Level Lighting Controls Market Assessment, November 2020. https://neea.org/img/documents/2019-2020-Luminaire-Level-Lighting-Controls-Market-Assessment.pdf

[188] https://neea.org/img/documents/Luminaire-Level-Lighting-Controls-Market-Progress-Evaluation-Report-1.pdf

additional, potentially unforeseen expenses. [189]. A control owner in this area also "reported significant challenges with system commissioning, with no real resolution after several years and multiple calls to the manufacturer"[190].

Finally, controls projects can face financial barriers due to transaction costs associated with project installations. The optimal time to install lighting controls is often in coordination with an LED retrofit as it is the more convenient and cost-effective to fully update the lighting system in a single project rather than through two separate projects. As C&I lighting programs have successfully influenced customers to replace their previous lighting systems with LEDs, it may be many years before current lighting systems need to be updated or replaced. As a result, to install advanced lighting control systems, many customers would have to retrofit their existing lighting systems, increasing not only the total cost of lighting savings (through having to pay for two separate installation projects) but also increasing the transaction costs by potentially interrupting the customers' operations as their lighting system is being modified. In Massachusetts, when customers who recently completed a lighting project without controls were asked if they would consider retrofitting their current LED system to include advanced lighting controls, only 24% were interested.

5.4.2.2 Informational barriers

Manufacturers and distributors report having high levels of awareness of advanced controls but report low levels of awareness among their customers. All manufacturers and distributors interviewed for the Massachusetts lighting control study noted they had familiarity with standalone controls, room-based controls, and LLLCs and all but one manufacturer and two distributors were familiar with NLCs. However, almost two thirds of distributors (63%) and 43% of manufacturers indicated that customer awareness of advanced lighting controls was a barrier to adoption.[191] Manufacturer representatives interviewed in the Pacific Northwest also cited market actors' and customers' lack of familiarity with LLLC and the inadequate communication of the benefits of these systems by market actors as major barriers.[192]

As shown in Figure 5-15 above, 41% of customers who had recently completed a lighting project without controls in Massachusetts indicated they were not aware of advanced controls at the time of their project, though among customers considering a future lighting project, only 15% were unaware of advanced lighting controls. This suggests that more information had become available in the market since prior participants had completed their lighting projects. Overall across both groups, roughly two thirds of customers were aware of advanced lighting controls in 2020, up from 23% in 2018[193]. In addition, only 18% of customers indicated that the market actors they worked with did not mention advanced controls.

The lack of awareness of advanced lighting controls is compounded by their complexity and challenges in communicating these complexities to customers. With the introduction of more advanced controls, such as LLLCs and NLCs, the opportunities for savings increase but the complexity does as well. A manufacturer recently interviewed for research in the Pacific Northwest noted that "some customers and installers are drawn to non-LLLC controls just because it is easier to understand."[194] In Massachusetts, 27% of customers expressed a desire for better guidance and support on determining types of controls appropriate for their space.[195]

Customer skepticism of the usability and function of advanced lighting controls also serves as another barrier to adoption, which is also driven in part by their increasing complexity as well as disappointing experiences with prior controls projects. Similar to residential customers' skepticism of LEDs after negative experiences with CFLs, some C&I customers hesitate to adopt advanced controls because of prior experience with poorly functioning occupancy sensors. Lighting vendors

[189] NMR and Energy Futures Group. 2019-2020 Luminaire Level Lighting Controls Market Assessment, November 2020. https://neea.org/img/documents/2019-2020-Luminaire-Level-Lighting-Controls-Market-Assessment.pdf
[190] NEEA, Luminaire Level Lighting Controls Market Progress Evaluation Report, 2021. https://neea.org/img/documents/Luminaire-Level-Lighting-Controls-Market-Progress-Evaluation-Report-1.pdf.
[191] DNV. 2020 Massachusetts C&I Lighting Controls Market Study. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf.
[192] NMR and Energy Futures Group. 2019-2020 Luminaire Level Lighting Controls Market Assessment, November 2020. https://neea.org/img/documents/Luminaire-Level-Lighting-Controls-Market-Progress-Evaluation-Report-1.pdf.
[193] DNV. 2020 Massachusetts C&I Lighting Controls Market Study. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf
[194] Ibid.
[195] Ibid.

interviewed in 2014 also found customers to be skeptical of new lighting control technologies due to "a bad reputation hangover from the first generation of sensors."[196] Other market actors interviewed in the Pacific Northwest noted that customers value simplicity and remain skeptical of automated controls after negative experiences with occupancy sensors, finding them difficult to operate as they can turn off at inappropriate times or otherwise not work as expected [197]. Recent research in Connecticut found many customers reported that information on advanced technologies provided by contractors, distributors, and retailers was often misleading. The study identified a need for programs to ensure appropriate commissioning and networking for NLCs to improve product performance and help address skepticism barriers.[198]

Finally, as noted above and shown in Figure 5-15, customers' perception of the potential upfront cost of lighting controls is a more prominent barrier than the actual cost of controls for those who have completed projects. This result may reflect an underlying lack of awareness of the true costs of lighting controls and suggests an opportunity for improved communication and education to customers about project costs.

5.4.2.3 Organizational barriers

As discussed in the industrial process case study in section 5.5.2.2 below, C&I customers commonly operate on strict planning and budgeting cycles with prescribed processes for developing business cases and evaluating and approving equipment upgrades. These customers do not always consider or prioritize energy costs as part of this process, so cost-effective energy savings projects may not be identified or planned for as part of the standard planning and budgeting cycle.

Internal organizational walls between facility managers, financial units, and IT departments can further complicate and impede adoption of advanced lighting controls. Advanced control owners in the Pacific Northwest emphasized the importance of engaging with their IT departments, or assigning ownership of the control system to the IT department, before control installation to ensure they are integrated correctly and able to operate effectively.[199] Engaging IT early in the selection and installation process can also help mitigate customer concerns around cyber security. If this engagement does not happen, it can lead to poor performance and limit future adoption. For instance, In Massachusetts, 60% of customers who installed advanced lighting controls needed to adjust, tune, or reprogram them to maintain performance or proper operation,[200] and 52% of manufacturers and 25% of distributors feel that advanced lighting controls are complicated to operate, and this can perpetuate difficulty of adoption.

Corporate financial requirements and processes are also common features of large C&I customers that create barriers to adoption of controls. These features are discussed in more detail in the industrial process case study in Sections 5.5.2.1 and 5.5.2.2 below. Market actors interviewed in the Pacific Northwest noted that adding LLLC to projects extends projects' payback period beyond what is often acceptable to commercial customers, making it almost impossible to include these controls in projects they offer. They also noted that customers pursuing lighting system retrofits are sensitive to budget increases due to internal requirements, further complicating the promotion of advanced controls in these projects.[201]

Finally, management resistance to controls projects has been found to be an organizational barrier to their adoption. When key individuals in an organization do not support projects, they will typically fail to obtain the necessary internal capital and approvals. Even if approved and installed, if key managers are dissatisfied with project performance, they may remove the measures and/or resist future opportunities to pursue efficiency measures. For example, interviewees in a recent

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[196] DNV, *2020 Massachusetts C&I Lighting Controls Market Study,* 2020. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

[197] NEEA, *2019-2020 Luminaire Level Lighting Controls Market Assessment,* 2020. https://neea.org/img/documents/2019-2020-Luminaire-Level-Lighting-Controls-Market-Assessment.pdf.

[198] DNV, *Recommendations for ALC Measure Parameters*, 2022. https://energizect.com/sites/default/files/2022-07/CT%20X1931-4%20ALC%20PSD%20Phase%202%20Memo%20Final060822.pdf

[199] NEEA, Luminaire Level Lighting Controls Market Progress Evaluation Report, 2021. https://neea.org/img/documents/Luminaire-Level-Lighting-Controls-Market-Progress-Evaluation-Report-1.pdf.

[200] 2020 C&I Lighting Controls Market Study. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

[201] NEEA, *2019-2020 Luminaire Level Lighting Controls Market Assessment,* 2020. https://neea.org/img/documents/2019-2020-Luminaire-Level-Lighting-Controls-Market-Assessment.pdf.

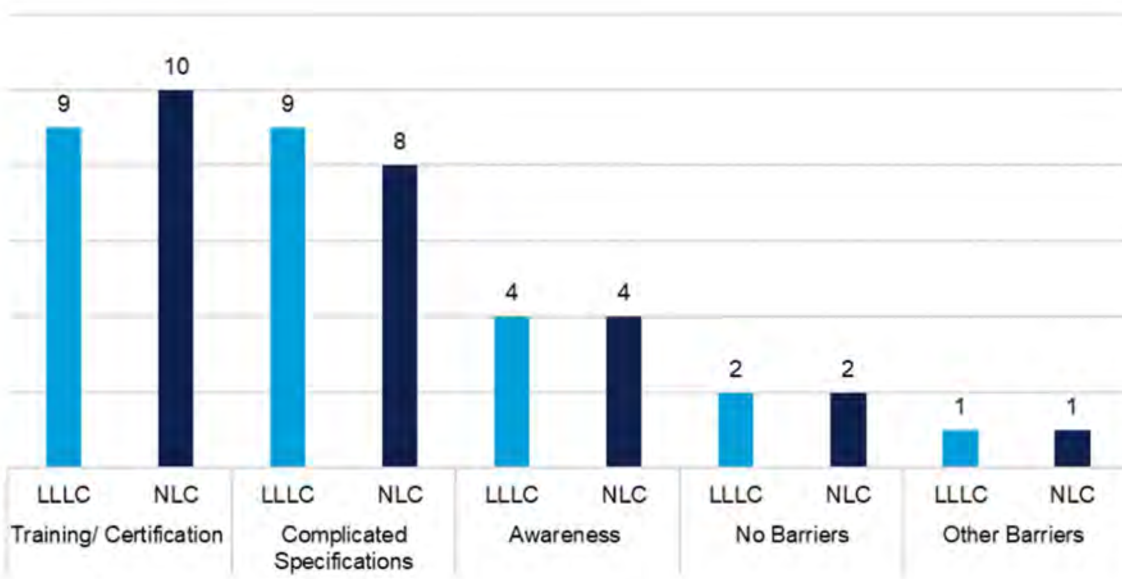
Connecticut study noted that proper setup and commissioning was often an issue for customers, and one respondent provided an example of a business CEO using the bathroom and having the sensors turn the lights off on him. After this event, the CEO had the controls mechanisms removed or disabled.[202]

5.4.2.4 Supply and provision barriers

Adoption of C&I lighting controls is impeded to some extent by the same type of workforce constraints facing the energy efficiency sector and the economy more broadly, as discussed throughout this report. New Hampshire faces this barrier to an equal or greater extent as other states in the region. For instance, DNV interviewed individuals from organizations with expertise and knowledge of the NHSaves programs as part of a parallel study to this market barriers review, covering topics including local workforce needs and opportunities.[203] These organizations included two vendors and three large, multi-project participants in the NHSaves programs. According to the interviewees, complex C&I projects such as controls projects, are one of two program areas (along with weatherization) that face the most significant workforce shortages in New Hampshire. They said that they frequently need to rely on out-of-state firms for projects requiring specialized expertise in complex custom projects and controls measures.

As shown above in Figure 5-16, distributors and manufacturers in Massachusetts cited (1) lack of training and certification skills among the installation workforce and (2) complicated installation requirements as barriers to installation of advanced controls. However, among distributors, 56% cited lack of training and certification, while only 31% cited complicated installations as a barrier. This suggests that training and certification opportunities are a more prohibitive factor than the complexity of the installations themselves. Figure 5-17 below provides additional detail on the contractor-reported training and workforce barriers to adoption of advanced lighting controls in Massachusetts.

Figure 5-17. Contractor (n=12) training and workforce development barriers to LLLC and NLC adoption



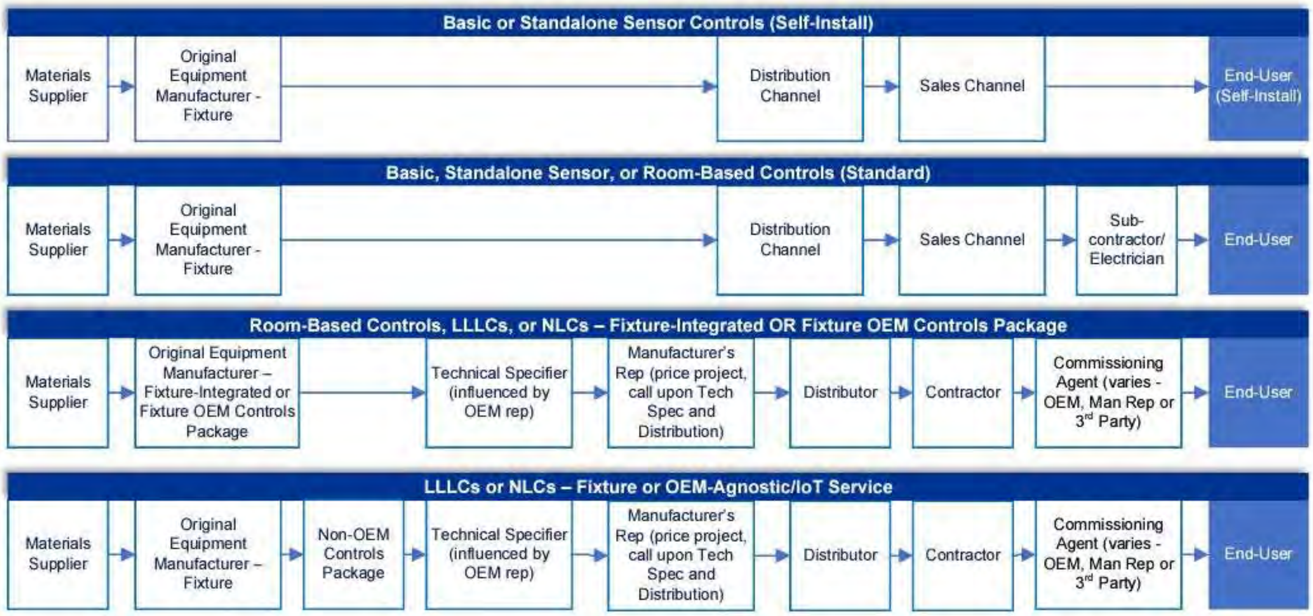
Source: 2020 C&I Lighting Controls Market Study, page 19. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

Various types of lighting control technologies also flow through different supply chains. Each link in each supply chain can represent a possible risk in getting a product from the supplier into the customer's facility.[204] As shown in Figure 5-18, the

[202] Energize CT, *Recommendations for ALC Measure Parameters,* 2022. https://energizect.com/sites/default/files/2022-07/CT%20X1931-4%20ALC%20PSD%20Phase%202%20Memo%20Final060822.pdf.
[203] See DNV. Report on Economic Impacts of the NHSaves Programs, Mar. 2023 (to be filed).
[204] MA EEAC, *2020 C&I Lighting Controls Market Study.* https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

more advanced the control, the greater the quantity of links in the supply chain and the more opportunities for success or failure due to supply issues. Given the complexity of the supply chain for advanced controls, planning and coordinating the timing of project installations is important, particularly if the controls are to be installed as part of larger lighting retrofit projects.

Figure 5-18. Simplified supply chain mapping for control categories[205]



Source: 2020 C&I Lighting Controls Market Study, page 19. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

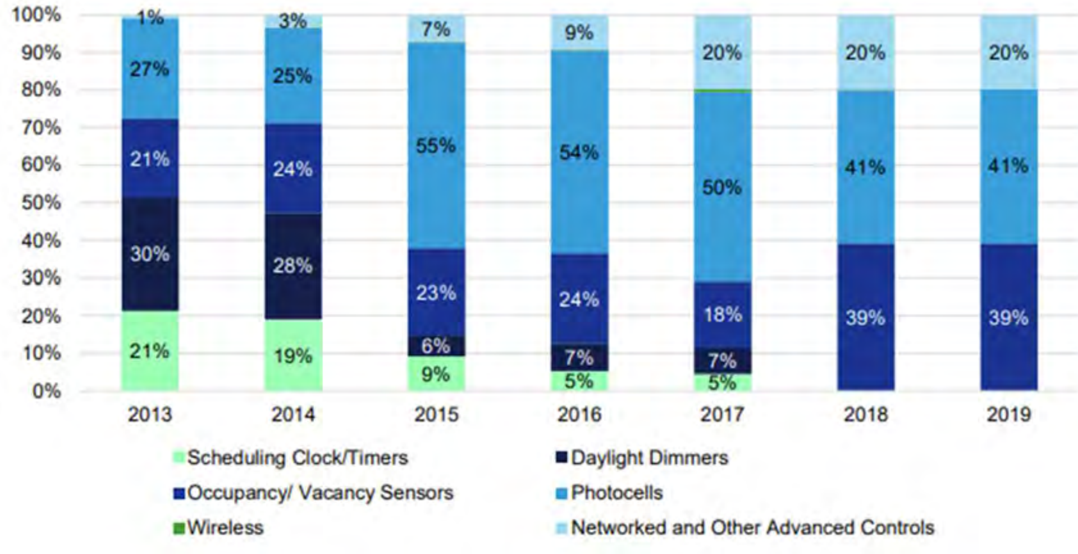
5.4.3 Market trends

Basic lighting controls such as occupancy sensors have been widely adopted in certain subsectors (e.g., offices), but more advanced lighting controls have seen relatively low market uptake in C&I facilities, despite the potential energy and cost savings. Massachusetts research from 2020 found that less than 1% of C&I customers had installed advanced lighting controls and roughly 22% had standalone controls, such as occupancy sensors. There is a pronounced difference between program participants and non-participants with 39% of lighting participants and 16% of non-participant C&I customers having standalone controls. Approximately 15% of lighting systems in Massachusetts were controlled with standalone controls[206]. As noted above, the New Hampshire 2021-2023 Potential Study found that the Massachusetts C&I lighting market was about 2 years ahead of New Hampshire in terms of LED adoption. As such, we can reasonably estimate current adoption of lighting controls in New Hampshire to be similar to what was observed in Massachusetts in late 2020.[207]

Figure 5-19 shows how the mix of lighting controls sold in the Pacific Northwest has shifted from simple controls such as timers and daylight dimmers towards more advanced controls. While advanced controls grew to 20% of reported sales in 2017 through 2019, occupancy sensors and photocells still dominate the market. It is also important to note that this figure only reflects controls projects and does not provide insight into the overall level of adoption of lighting controls over time.

[205] Ibid.
[206] Ibid.
[207] Dunsky. *New Hampshire Potential Study*

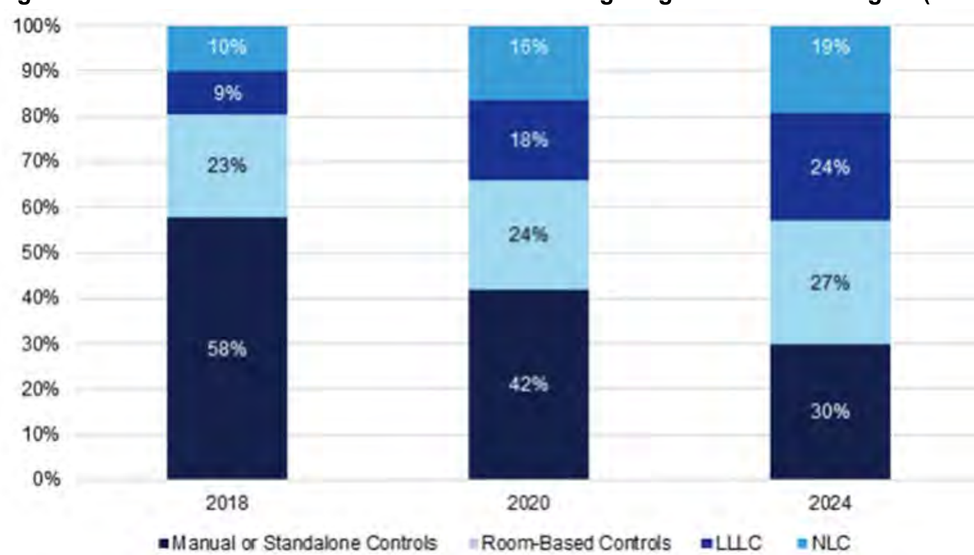
Figure 5-19 Pacific Northwest BPA controls sales data



Source: 2020 C&I Lighting Controls Market Study, page 24. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

Distributors in Massachusetts also provided researchers insights into the mix of lighting control technologies they sold in 2018, and what they anticipated market share would look like in 2020 and 2024. As shown in Figure 5-20, the market share for advanced controls (LLLC and NLC) in 2018 was similar to what waws observed in the Pacific Northwest during the same time. Massachusetts distributors anticipate that the market share of advanced lighting controls will increase by 79% between 2018 and 2021 and another 26% between 2021 and 2024. Most of the increase in advanced controls market share is expected to be offset by a decrease in manual or standalone controls, while market share for room-based controls is expected to remain around 25%.

Figure 5-20 Distributors estimated market share for lighting control technologies (2018 –2024)



Source: 2020 C&I Lighting Controls Market Study, page 23. https://ma-eeac.org/wp-content/uploads/MA20C11-E-LCR_Lighting-Controls-Final-Report_20210630.pdf

5.4.4 Future opportunities

With such low prevalence across the C&I space, there should be many opportunities for increased adoption of lighting controls if the identified barriers to adoption can be mitigated. As stated in the NH Potential Study, *"Advanced lighting controls, including networked lighting, is a growing opportunity as new technologies and products integrate efficiency savings with increased functionality and non-energy benefits. These offer an emerging opportunity that also faces notable challenges including limited cross-compatibility among products from different manufacturers, limited customer awareness of the options and benefits, and timing re-lamping efforts with controls change-outs. Achieving the potential savings from advanced lighting controls will likely require investment to identify the most effective delivery strategies and tracking product development and roll-out."*[208]

Overall, controls are often most convenient and cost-effective to install during a broader lighting retrofit project. With LED lamps and fixtures having high saturation, this poses a large barrier as existing systems likely do not need to be replaced for many years and retrofitting LEDs with controls can be inconvenient, as it may lead to interruption in building operations for a second time, and costly, as labor and equipment needs to be brought in again.

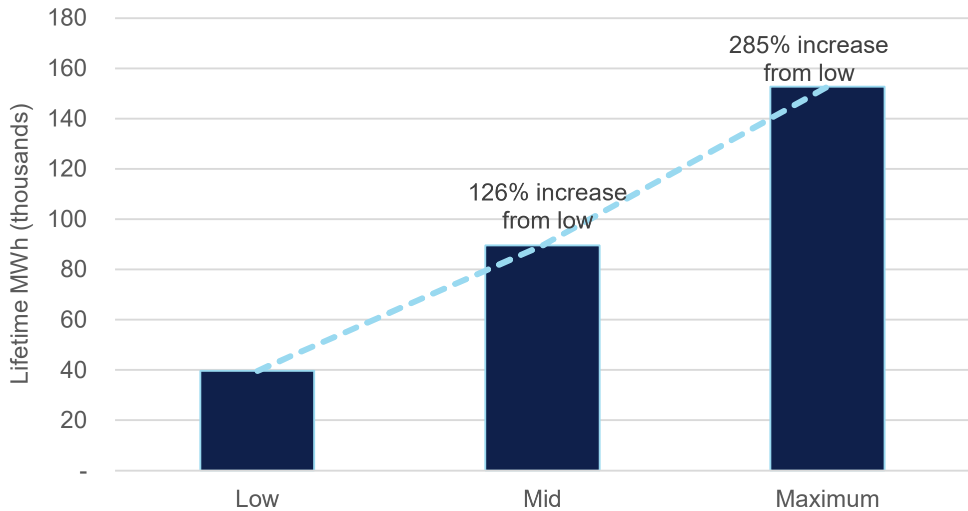
Increasing the adoption of lighting control technologies and their effective use will take investment and efforts from utility programs. Overcoming the barriers identified in this case study relies heavily upon increasing awareness amongst customers of the benefits and use of controls, providing market actors and customers with accurate information on the benefits, lifetime costs, and best type of control for their space and needs, and honing the supply process. The nuance and complexity inherent in complicated advanced control measures requires clear training, workforce development, and understanding throughout the supply chain so distributors, retailers, installers, and customers understand what they are purchasing, how it is used, and how it saves them energy. Appropriate installation can help avoid negative customer experiences that lead to disabling of control systems. Furthermore, utilizing utility programs as a pathway to finding customers at the point of lighting retrofit can ease the difficulty and incremental cost of installing controls as well.

5.4.4.1 New Hampshire Potential Study achievable savings

To estimate the scale of C&I lighting controls savings that the NHSaves programs may be able to achieve by overcoming barriers, the evaluation team analyzed savings opportunities for C&I lighting controls measures as originally modeled for the 2021–2023 New Hampshire Potential Study.[209] As shown in Figure 5-21, C&I lighting controls see significant increases in achievable savings resulting from increased incentives and enabling activities to overcome barriers.[210] This points to relatively high market barriers and low participant cost-effectiveness in the absence of incentives, both of which are mitigated via the increased program incentives and enabling strategies modeled in the mid and maximum scenarios. These model results also imply that absent all program interventions, barriers would effectively prevent any modeled savings.

[208] Dunsky. New Hampshire Potential Study
[209] Dunsky. New Hampshire Potential Study
[210] It is important to note that the study did not include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

Figure 5-21. New Hampshire achievable savings scenarios for C&I lighting controls, 2023



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

5.5 Industrial process measures

5.5.1 New Hampshire program overview

NHSaves has offered a Large Business Energy Solutions (LBES) Program to customers including those in the New Hampshire industrial sector since before 2000. In its current form, it targets customers with an average monthly demand of 200kW or larger, providing them with incentives and other support for the purchase and installation of energy efficient equipment. Energy efficient equipment must be part of a new construction or renovation project, process expansion, replacement of equipment that has reached its end of useful life or to replace less efficient existing equipment.[211] Program interventions include incentives, technical assistance, and free energy audits. Installations of energy efficient technology can be done by industrial customers' in-house staff or vendor/contractors.

The program provides custom incentives for complex or tailored measures, including process measures, that meet eligibility criteria. Eligibility is based on project cost and potential energy savings quantified and evaluated through a benefit/cost model. Technical assistance by an outside engineering firm may be offered through the program to quantify the energy savings potential of a proposed project. The program offers free audits to identify opportunities to improve industrial process energy efficiency. Following the audit, a report is delivered to the customer that provides a menu of potential savings opportunities.

5.5.2 Barriers

The industrial sector is highly heterogenous, with significant variation in types of process measures, usage patterns, and facility types. For example, the Manufacturing Energy Consumption Survey (MECS), a mandatory survey administered by the U.S. Census, covers 21 manufacturing subsectors and 79 industry groups and industries, all with highly specialized equipment.[212] The heterogenous nature of industrial facilities and process equipment complicates efforts to study energy consumption and implement energy efficiency offerings on a large scale. There has not been primary research specifically on energy efficiency adoption in New Hampshire's industrial sector and there are limited program evaluations on industrial

[211] Liberty Utilities, *Large Business Programs*, 2023. https://new-hampshire.libertyutilities.com/acworth/commercial/smart-energy-use/electric/large-business-programs.html,
[212] MECS is a national survey that collects information on the stock of U.S. manufacturing establishments, their energy-related building characteristics, and their energy consumption and expenditures. The MECs survey is required of any manufacturing establishment. See https://www.eia.gov/consumption/manufacturing/about.php

process offerings and equipment nationally. The team leveraged available research from DOE and several jurisdictions with industrial process offerings that have been studied.

The barriers to industrial customers adopting energy efficient process measures are described in this section.

5.5.2.1 Financial barriers

Process equipment upgrades are often a large budget item for industrial businesses, and the incremental upfront cost of high-efficiency technologies can be accordingly large. Industrial businesses face internal competition for capital, which must be allocated across multiple business needs and budget areas. As such, they often have limited capital available for end-use efficiency projects and frequently require very short payback periods for such investments. A 2021 study of equipment saturation in California's industrial and agricultural markets found that concerns of upfront cost were among the most common barriers to adopting energy efficient measures within these sectors.[213] More specifically, the study cited risk of industrial facilities investing in energy efficiency projects and the challenges in accessing capital to make said investments. Industrial customers' access to internal capital designated for energy efficiency projects is commonly limited and requires short payback periods (1–3 years). Specifically, end user interviews found that the median payback period required for internal management approval of energy efficiency projects was 3.5 years—56% of the companies with threshold payback periods had periods of 3.5 years or less.

Financial risks create another barrier to adoption of efficient industrial process measures. The volatility of energy prices and broadly increasing price trends can make accessing and allocating funds for energy efficiency projects difficult.[214] Specifically, volatile prices cause uncertainty in projecting cost savings from efficiency investments, creating an additional barrier to internal capital allocation decisions and approval for energy efficiency projects. The extent of this barrier differs by customer, as energy costs differ depending on several factors, including the energy intensity of production processes. As such, projected cost savings from energy efficiency measures impact business margins differently—for energy intensive businesses, potential cost savings are greater, but so are the impacts of energy price volatility. Complex corporate financing and tax structures, including depreciation periods and treatment of energy costs, can also act as a deterrent to adopting energy efficient measures because they create financial risk and complicate internal financing processes. These challenges may also result in industrial customers facing difficulty securing low-cost financing.[214]

Finally, transaction costs—specifically the costs of business disruption associated with installing an energy efficiency measure—pose a financial barrier to adoption. Studies of large business efficiency programs have found that disruption of production and the associated impact to revenue is generally an important consideration during internal decision making.[215] This is particularly the case for measures that are entirely intended for energy savings purposes, rather than those being implemented as part of planned replacements or upgrades that would have had to happen regardless of whether an efficient technology was involved.

Program interventions

Energy efficiency programs including NHSaves provide custom incentives to help overcome financial barriers. Due to heterogeneity in process measures, facility types, and operations and usage patterns, a one-size-fits-all, prescriptive, technology-specific incentive approach is not feasible. Rather than provide fixed incentives for specific pieces of equipment, programs typically provide incentives based on the amount of energy saved (e.g., cents per kWh or therm). Program staff and vendors also work with customers to address other barriers, such as by coordinating installations to minimize business

[213] DNV andGuidehouse, *Industrial/Agricultural Market Saturation Study: 2021 Potential and Goals Study,* https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/energy-efficiency-potential-and-goals-studies/2021-potential-and-goals-study.

[214] U.S. Department of Energy, *Barriers to Industrial Energy Efficiency,* https://www.energy.gov/eere/amo/articles/barriers-industrial-energy-efficiency-report-congress-june-2015.

[215] Opinion Dynamics, *Connecticut C1901 Commercial and Industrial Energy Efficiency Programs (non-SBEA) Process Evaluation*. 2021.

disruption, and communicating and coordinating incentive agreements to provide a predictable commitment of funding to help alleviate financial risks.

5.5.2.2 Organizational barriers

The organizational structure of industrial customers can result in the costs and benefits of energy efficient projects being split across various business units within a company. Cost is commonly the primary factor in business leaders' decision-making, and the non-energy or co-benefits of energy efficiency projects—which are typically experienced by the specific business unit managing the process line—are not always recognized when forming the business case for these upgrades.[216] This is a variation of the split incentive barrier prevalent in the residential sector between landlords and tenants, or between new home builders/developers and future owners.

Industrial facilities commonly operate on strict planning and budgeting cycles—typically annual—with prescribed processes for developing business cases and evaluating and approving equipment upgrades. Energy resource planning is not always required within industrial businesses, so cost-effective energy savings projects may not be identified or planned for as part of the standard planning and budgeting cycle. In addition, these internal planning cycles may not align with utility and state energy efficiency program cycles, hindering businesses' ability to benefit from offerings.[217] For instance, a large industrial customer with energy-intensive engineering and laboratory facilities in New Hampshire who was interviewed as part of a recent NHSaves evaluation described the complexities of their corporation's internal financial cycle. The interviewee said that their company's central financial department has one fixed bucket of funding each year for equipment upgrades, creating internal competition for funding and challenges in planning and prioritizing facility maintenance and improvements. NHSaves program funding must be identified and arranged at the right time in the planning cycle to use it as part of the business case to secure internal funding for efficiency projects. The interviewee said that predictable program funding was critical to this process.

Program interventions

As described by NH Utilities staff, to address these organizational barriers, utility account executives (i.e., staff who manage relationships with large customers) work closely with large industrial customers to help manage energy needs and costs, including by leveraging NHSaves offerings. This direct relationship approach allows the programs to circumvent organizational barriers by accessing key decision makers responsible for managing overall energy costs. Program staff can provide key information to support developing a business case for energy efficiency upgrades, and coordinate program incentives to align with businesses' internal planning cycles.

5.5.2.3 Informational barriers

The heterogenous nature of the industrial sector requires knowledge of highly specialized processes to identify and execute energy savings opportunities. For example, recent research in California found that lack of knowledge of efficient equipment and knowledge of benefits among facility managers was one of the most common barriers to installing industrial and agricultural energy efficiency measures.[213] Furthermore, businesses that do have general awareness of energy efficiency often lack in-house expertise or the resources to hire outside experts to identify specific opportunities and design energy efficiency projects. This lack of knowledge of technologies, implementation strategies, and financing mechanisms limits businesses' ability to consider energy efficiency in their capital planning cycles. As mentioned in Section 5.4.2.2, incorporating energy efficiency in businesses' planning cycles is critical to obtaining internal capital and gaining management approval for equipment upgrades.

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[216] U.S. Department of Energy, ***Barriers to Industrial Energy Efficiency,*** https://www.energy.gov/eere/amo/articles/barriers-industrial-energy-efficiency-report-congress-june-2015. 2015.
[217] Ibid.

Informational barriers can also impede policy makers and program planners from designing programs to support the industrial sector. Such efforts often rely on data on equipment stocks, manufacturing processes, and other information to understand trends in energy use and inform programs and policies to reduce energy consumption. The heterogeneous nature of industrial process measures can create challenges in gathering and analyzing such data (e.g., metering measures to collect energy consumption data), particularly at an aggregate level needed to develop broad policies and programs. The lack of broad industry data and expertise to evaluate such data can create barriers to identifying and evaluating opportunities to reduce energy consumption and can hinder the development of programs to support industrial facilities adopting energy efficient technologies.[214]

Program interventions

As noted in 5.5.2.2, the NHSaves program engages large industrial customers directly through account executives, and this direct relationship approach is the primary focus for marketing and promotion of industrial offerings. Through these relationships, program staff can provide information on the cost savings, energy savings, and non-energy benefits of efficiency upgrades, and provide technical assistance resources to identify energy savings opportunities. This can include a no-cost, high level scoping study that provides a set of potential energy savings opportunities for the customer, followed by more rigorous technical assistance studies, generally provided at a 50% cost share.

5.5.2.4 Supply and provision barriers

If businesses are able to overcome the financial, informational, and organizational barriers cited above, finding qualified vendors and contractors to install measures can pose yet another barrier to their adoption.[218] Process measures may be unique to an industry, requiring highly specialized knowledge for equipment maintenance and installation. For example, according to a recent interview with a large industrial customer with energy-intensive engineering and laboratory in New Hampshire, a lack of technical expertise for controls and retro-commissioning projects in New Hampshire has caused significant wait times in accessing technical support, resulting in further challenges with financial planning. As noted in other sections in this report, workforce constraints are widespread, including in the energy services sector. These constraints can be especially acute in trying to meet custom, specialized needs, as if often the case for industrial process projects.

5.5.3 Market trends

Market share

Due to the heterogeneity of the industrial sector, it can be cost-prohibitive to gather comprehensive data on the market share of efficient equipment across the sector. New Hampshire has not conducted research in this area, but some studies elsewhere have collected and analyzed data on the prevalence of efficient technologies in targeted subsectors. For instance, recent research in California estimated the saturation of selected efficiency measures, as shown in Table 5-7.[219] While the sample size was small, the study estimated relatively low levels of saturation of energy efficient equipment. Specifically, average estimates provided by end users and vendors indicate that saturation of efficient measures for most industrial and agricultural equipment types was less than 50%, which suggests that there are significant remaining opportunities for energy savings.

[218] Opinion Dynamics, *Connecticut C1901 Commercial and Industrial Energy Efficiency Programs (non-SBEA) Process Evaluation*, 2021.
[219] DNV and Guidehouse, *Industrial/Agricultural Market Saturation Study: 2021 Potential and Goals Study,* 2021. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/energy-efficiency-potential-and-goals-studies/2021-potential-and-goals-study.

Table 5-7. Efficient measure saturation levels by selected subsector, California 2021

Subsector	Energy efficiency measure	End user estimates of measure saturation	Vendor estimates of measure saturation	Average measure saturation estimate
Electronics Manufacturing	Chiller plant optimization	6%	24%	15%
	RCx	44%	No estimates provided	44%
	Low pressure drop filters in cleanroom spaces	39%	36%	38%
Food Production	Refrigeration system optimization	62%	24%	43%
	Boilers and heat recovery	19%	11%	15%
	VFDs on pumps and motors	68%	No estimates provided	68%
Chemical Manufacturing	Heat recovery	30%	12%	21%
	Advanced automation and optimization	29%	33%	31%
	Mechanical drives/VSDs	40%	51%	46%
Dairies	Refrigeration system heat recovery	19%	29%	24%
	VFDs on pumps	31%	32%	32%
	EE fans and ventilation	62%	48%	55%
Water Pumping for Agriculture	Efficient pumps and motors	63%	42%	53%
	Sensors and controls	59%	44%	52%
Greenhouses	LED grow lights	38%	41%	40%
	EE HVAC	42%	46%	44%
	Energy curtains	42%	60%	51%

Source: DNV and Guidehouse, *California Industrial/Agricultural Market Saturation Study: 2021 Potential and Goals Study,* 2021.

Beyond California, the 2018 MECS survey of manufacturing facilities provided estimates of nationwide rates of businesses conducting energy audits to identify potential energy saving opportunities. The level of energy audit activity varied widely among the 79 industries surveyed, ranging from audit rates of over 60% of surveyed businesses in the mils and petroleum refinery subsectors to less than 10% in several subsectors including furniture products and fertilizer production subsectors. The average rate of audit activity across the surveyed industries was 17%.[220] As with the California study, the MECS data indicates that there is significant opportunity for energy savings in the industrial sector.

5.5.4 Future opportunities

Due to the heterogenous and specialized nature of most industrial process measures, program interventions must be tailored and customizable for individual customers. Interventions that are often successful in the residential or small business sectors, such as prescriptive, technology-specific incentives, mass-market outreach and promotion, and support for manufacturing and stocking of equipment by upstream and midstream market actors, would not be feasible or effective for the industrial sector.

The NHSaves programs provide tailored interventions to this sector, including custom incentives, direct customer outreach and engagement, and technical assistance. There are similar program models throughout the Northeast, as well as alternative or additional approaches that utility programs have used to engage industrial customers. For instance, Connecticut and New York both have initiatives focused on continuous engagement of industrial participants through regular

[220] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis, *Energy Management Activities and Energy Savings Tech, table 8.11*, 2018. https://www.eia.gov/consumption/manufacturing/data/2018/#r10.

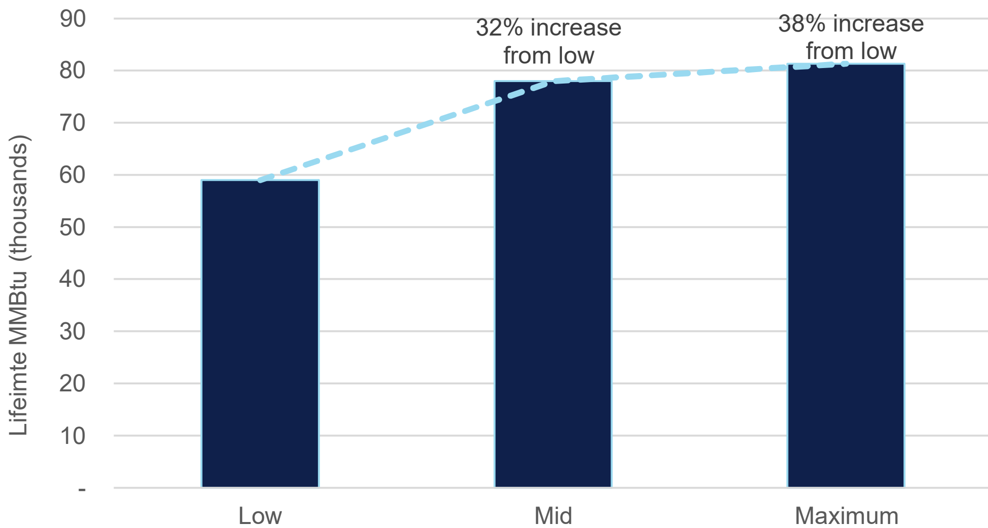
events and facility visits to increase education and awareness of energy saving technologies and identify and coordinate opportunities to use behavioral measures or capital improvements to reduce energy use and costs.[221][222]

Due to limited available market saturation research in New Hampshire, our review cannot reliably estimate the future savings opportunities in the state. More specific insights on these savings opportunities in New Hampshire, and the optimal targeting and design of program interventions, would require deeper analysis on equipment stocks in the state's industrial sector, along with other firmographic data on facility types, manufacturing and production processes, and energy use profiles. More broadly however, the available evidence shows that significant savings opportunities remain within this sector.

5.5.4.1 New Hampshire Potential Study achievable savings

To estimate the scale of industrial process savings that the NHSaves programs may be able to achieve by overcoming barriers, the evaluation team analyzed savings opportunities for process measures as originally modeled for the 2021–2023 New Hampshire Potential Study.[223] As shown in Figure 5-22, industrial process measures see moderate increases in achievable savings from increased incentives and enabling activities between the low and mid scenarios, and a smaller increase from maximizing incentives under the maximum scenario.[224] This suggests that these measures can be cost-effective for participants without large program incentives, but that moderate incentives and enabling activities are important for unlocking savings. These model results also imply that absent all program interventions, barriers would effectively prevent any modeled savings from occurring.

Figure 5-22. New Hampshire achievable savings scenarios for industrial process measures, 2023



Source: DNV analysis of 2021–2023 New Hampshire Potential Study results

[221] Opinion Dynamics, *Connecticut C1901 Commercial and Industrial Energy Efficiency Programs (non-SBEA) Process Evaluation.* 2021.
[222] NYSERDA, *Flexible Technical Assistance Program*, 2023, https://www.nyserda.ny.gov/All-Programs/FlexTech-Program.
[223] Dunsky. *New Hampshire Potential Study, Statewide Assessment of Energy Efficiency and Active Demand Opportunities*, *2021-2023.* 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20201016-NHSaves-Potential%20Study-Final%20Report-Volume%20I.pdf
[224] It is important to note that the study did not include primary research to enumerate and quantify market barriers in New Hampshire. Rather, the study used generalized assumptions of market barrier levels that define maximum adoption rates for each measure based on market research and professional experience. New Hampshire-specific primary research would be needed to ground-truth these model results.

6 CONCLUSIONS AND CONSIDERATIONS FOR NEW HAMPSHIRE

The primary objectives of this review were to (1) identify and enumerate the market barriers addressed by the NHSaves programs, (2) assess the extent to which selected energy efficiency programs such as those in New Hampshire have overcome such barriers, and (3) identify how New Hampshire's programs could continue to do so going forward. Key takeaways from this review are as follows.

Market barriers addressed by the NHSaves programs

Market barriers incorporate a broad and diverse set of obstacles to energy efficiency adoption that vary across customers, technologies, and other dimensions. As stated in the foundational literature, "there is no single market for energy services; instead, the "market" consists of hundreds of end uses, thousands of intermediaries, and millions of consumers. As a result, …these issues must be addressed in a highly disaggregate fashion, considering the workings of individual markets."[225] The NHSaves programs cover the full spectrum of technologies and customer types, and as such, the programs confront a broad range of barriers. By the same token, they face a wealth of potential savings opportunities from circumventing or eliminating those barriers.

Some barriers, such as physical health and safety barriers to weatherization projects, are unique to specific measures and markets covered in our case studies. Other barriers, such as financial barriers, appear in different forms across most markets, and programs consistently offer interventions—i.e., incentives—targeted to the specific customers and market actors involved. Predominant across nearly all markets are overarching barriers related to workforce. Workforce barriers are driven by economy-wide labor supply and demand dynamics, which reach beyond the purview of the NHSaves programs and beyond the geographic boundaries of New Hampshire.

Progress in overcoming barriers and transforming markets

In this diverse landscape of barriers, programs including those in New Hampshire have found ways to intervene and circumvent barriers, though there were few areas we reviewed where barriers had been fully eliminated. A key question facing program administrators, stakeholders, and regulators is as follows: in what areas have market barriers been eliminated, if not market-wide, then for a large enough share of customers and market actors whereby program intervention is no longer justified? To definitively answer this question, it is important to have multiple sources of evidence pointing toward the same conclusion.

Drawing on secondary research, we found that programs vary in the extent to which they have circumvented or eliminated barriers. For retail lighting, it is clear from a preponderance of evidence that programs have helped eliminate market barriers, and program interventions are no longer needed in most cases—and the NH Utilities are discontinuing their offerings in response to this market transformation. However, the other NHSaves programs and offerings covered in our case studies all still face a range of barriers and savings opportunities that justify continued program intervention, with weatherization and C&I lighting controls presenting the greatest opportunities in New Hampshire. In addition, given the ever-changing market for energy efficiency and the continual progress of technological advancement, newer, more efficient technologies are always arising which often face a new set of financial, informational, behavioral and other barriers. These advances present opportunities for program intervention even as other opportunities diminish due to market transformation.

Considerations for program interventions in evolving markets

There are clear and significant remaining opportunities for program savings across the markets covered in our case studies. The scope and depth of our analysis does not allow for definitive conclusions about targeting and design of NHSaves program interventions, nor how programs should prioritize resources across programs or among the different types of interventions (e.g., financial, informational, training, etc.). Ultimately barriers are best understood, circumvented, and

[225] Eto and Golove, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, 1996.

eliminated through direct interactions between programs, market actors, and the customers they serve. The first-hand knowledge of program implementers and trade allies is critical in this process. As a complement to this expertise, research can provide insights reflecting a broader view, through methods such as surveys, focus groups, or market data analysis.

6.2 Further research

Due to the scope and timeline of the Commission's requests, the team's case study approach could not comprehensively address all areas of inquiry on market barriers—particularly those such as quantifying end-user costs of addressing barriers and directly quantifying the extent to which New Hampshire programs have removed them. As part of this review, we identified gaps where primary New Hampshire-based research such as customer surveys, market actor interviews, sales data analysis, or other methods would allow for a fuller assessment of the Commission's questions, as shown in Table 6-1. New Hampshire may consider pursuing such research, while weighing the tradeoffs between its costs, rigor, and value to the NHSaves programs and customers in understanding and overcoming barriers.

Table 6-1. Information to support further assessment of barriers and refinement of program interventions

Case Study Topic	Information gaps
Residential retail lighting	Due to high levels of market share and limited remaining savings opportunity, additional research is not recommended for retail lighting
Residential weatherization	Primary research on: • upfront weatherization costs residents are willing to incur, by customer class and measure type, and single family vs. multifamily • workforce capacity, knowledge, and skills gaps • coordination of program offerings and other funding sources to address health and safety barriers
Residential new construction	Primary research on: • homebuyer awareness of and preferences for energy efficient homes, and developer perception of market demand for energy efficiency • incremental costs of energy efficient construction • ENERGY STAR® Homes attribution (NTG) and market penetration
C&I lighting controls	Primary research on: • workforce capacity, knowledge, and skills gaps regarding controls • contractor and customer research on barriers and opportunities for integration of controls into LED retrofit projects • customer research on awareness and perception of controls technologies and persistence of savings
Industrial process	Primary research on: • Industrial stock in New Hampshire • Customer research on internal and external financing processes and sources

APPENDIX A. MARKET BARRIERS CLASSIFICATION

Table 6-2 provides a categorized list of barriers as identified in the foundational literature, alongside the barriers cited in the NHSaves 2022–2023 plan.

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Table 6-2. Market barriers as classified in foundational literature

Barrier Category	NHSaves 2022-2023 Plan	LBNL and National Association of Regulatory Commissioners (1988)	Eto, Prahl, and Schlegel (1996)	Sorrell, S., O'Malley, E., Schleich, J., and Scott, S. (2004)	Jaffe, Newell, and Stavins (2004)	Bagaini, Colelli, Croci, Molteni (2020)	Gillingham, Newell, and Palmer (2009)
Financial	Incremental price difference between standard and high efficiency goods and services	Limited access to financing and protection from financial risk: energy users face limited access to financing or are unwilling to sink scarce cash or credit into investments with multi-year payback. Irreducible but hidden indirect costs: hidden costs not sufficiently captured by the price of efficiency investments, such as technical risks.	Access to Financing: the difficulties associated with the lending industry's historic inability to account for the unique features of loans for energy savings products (i.e., that future reductions in utility bills increase the borrower's ability to repay a loan) in underwriting procedures. Hidden Costs: Unexpected costs associated with reliance on or operation of energy-efficient products or services - for example, extra operating and maintenance costs Hassle or Transaction Costs: The indirect costs of acquiring EE, including the time, materials and labor involved in obtaining or contracting for an energy-efficient product or service. (Distinct from search costs in that it refers to once a product has been located.)	Access to Capital: (1) an overall limitation on access to capital for the organization; or (2) restricted access to capital for energy efficiency within internal capital budgeting procedures Hidden Costs: The costs of production disruptions, hassle, and inconvenience; identifying opportunities, analysing cost-effectiveness, and tendering; staff replacement, retirement, and/or retraining; possible poor performance of equipment; difficulty and cost of obtaining information on the energy consumption of purchased equipment; and lack of time and the existence of other priorities.	Hidden costs: costs of adoption that are not included in simple cost-effectiveness calculations - for example, learning about reliable suppliers, qualitative attributes of new equipment seeming less desirable	Socio-economic status of building users; lack of funds, high capital costs and financial risk; limited payback expectations / investment horizons; building stock characteristics	Capital liquidity constraints that hinder access to financing for energy-efficient investments and cause some purchasers of equipment to choose the less energy-efficient product owing to lack of access to credit, resulting in underinvestment in energy efficiency
Informational	Lack of customer awareness related to: • benefits of energy efficiency. • existence of high-efficiency alternatives. • where to purchase high-efficiency equipment/quality installation. • how and when to reduce demand during system peaks.	High information or transaction costs: Costs of research to find out about the availability of efficient technologies, to assess and verify vendor claims, find qualified contractors, and judge equipment uncertainties.	Information or Search Costs: The costs of identifying energy-efficient products or services or of learning about energy-efficient practices, including the value of time spent finding out about or locating a product or service or hiring someone else to do so. Performance Uncertainties: The difficulties consumers face in evaluating claims about future benefits. Closely related to high search costs, in that acquiring the information needed to evaluate claims regarding future performance is rarely costless. Asymmetric Information and Opportunism: The tendency of sellers of energy-efficient products or services to have more and better information about their offerings than do consumers, which, combined with potential incentives to mislead, can lead to sub-optimal purchasing behavior.	Imperfect Information: Firms may not be aware of energy efficiency opportunities or may not know how to get information; knowledge of their energy use itself is limited. Credibility and Trust: lack of confidence that advice received on pursuing energy efficiency is trustworthy and credible	Incomplete or Inadequate Information: The lack of information or communication between a home builder or landlord and the buyer or tenant can lead to less energy-efficient equipment or improvements.	Lack of awareness of savings potential Lack of trusted information and experience	Lack of information and asymmetric information that cause consumers to systematically underinvest in energy efficiency because they lack sufficient information about the difference in future operating costs between more-efficient and less-efficient goods necessary to make proper investment decisions
Organizational		Split incentives: users of buildings or equipment are not responsible for purchasing energy efficiency measures; rather owners or landlords are.	Misplaced or Split incentives: Cases in which the incentives of an agent charged with purchasing EE are not aligned with those of the persons who would benefit from the purchase	Split Incentives: occurs when buildings or machinery are leased rather than owned, or when rapid job rotation impedes implementation because any incentive to save energy is diluted if the employee is not in a place to see the program through to the end.		Split incentive	Principal-agent or split-incentive problem describes a situation where one party (the agent), such as a builder or landlord, decides the level of energy efficiency in a building, while a second party (the principal),

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Barrier Category	NHSaves 2022-2023 Plan	LBNL and National Association of Regulatory Commissioners (1988)	Eto, Prahl, and Schlegel (1996)	Sorrell, S., O'Malley, E., Schleich, J., and Scott, S. (2004)	Jaffe, Newell, and Stavins (2004)	Bagaini, Colelli, Croci, Molteni (2020)	Gillingham, Newell, and Palmer (2009)
			Organization Practices or Customs: Organizational behavior or systems of practice that discourage or inhibit cost-effective EE decisions, for example, procurement rules that make it difficult to act on EE decisions based on economic merit.	Principal-agent barriers: Monitoring and control in hierarchical organizations that cause the principal to specify strict investment criteria for the agent to follow, limiting energy efficiency investments. Values and organizational culture: The values held by key individuals in a company are likely to influence that company's performance.			such as the purchaser or tenant, pays the energy billss
Supply and provision	Insufficient retailer stocking: Midstream (retailers/ distributors) fail to stock high-efficiency products Building trades lack sufficient cadre of trained personnel, awareness, experience, or commitment to high-efficiency practices, both for existing building renovations and new construction		Product or Service Unavailability: The failure of manufacturers, distributors or vendors to make a product or service available in a given area or market. May result from collusion, bounded rationality, or supply constraints. Inseparability of Product Features: The difficulties in acquiring desirable EE features in products without also acquiring (and paying for) additional undesired features that increase the total cost of the product beyond what the consumer is willing to pay	Heterogeneity: Off-the-rack technology might not always be suitable. This operates as a barrier if energy efficiency measures that are generally suitable in most firms in a sector are not suitable in certain specific firms.	Adoption and Innovation Externalities: A firm that develops or implements a new technology typically creates benefits for others, and hence has an inadequate incentive to increase those benefits by investing in technology. A successful innovator will capture some rewards, but those rewards will always be only a fraction—and sometimes a very small fraction—of the overall benefits to society of the innovation.	Training and skills of professionals	R&D spillovers may lead to underinvestment in energy-efficient technology innovation owing to the public good nature of knowledge, whereby individual firms are unable to capture the full benefits from their innovation efforts, which instead accrue partly to other firms and consumers
Behavioral		Non-economic consumer rationality: energy users influenced by factors such as appearance, public or peer opinions, and personal obligation or habit.	Bounded Rationality: The behavior of an individual during the decision-making process that either seems or actually is inconsistent with the individual's goals Irreversibility: The difficulty of reversing a purchase decision in light of new information that may become available, which may deter the initial purchase, for example, if energy prices decline, one cannot resell insulation that has been blown into a wall.	Risk: perceived risks that make for more cautious behaviour and could delay or reduce investment in non-essential measures. This includes technical risk that the technology would be found wanting, and business risk or market uncertainty.		Lack of interest and undervaluing energy efficiency benefits, social group interactions Customs, habits, and behavioral aspects	Systematic biases in consumer decision making that may be relevant to decisions regarding investment in energy efficiency, including propsect theory; bounded rationality; and heuristic decision-making
Public Policy			Externalities: Costs that are associated with transactions, but which are not reflected in the price paid in the transaction. Non-externality Pricing: Factors other than externalities that move prices away from marginal cost. An example arises when utility commodity prices are set using ratemaking practices based on average (rather than marginal) costs.		Environmental Externalities: the potentially harmful consequences of economic activities on the environment constitute externalities, which if not fully addressed by policy, result in a level of energy efficiency that is likely too low. Average-Cost Pricing: The incremental costs of increasing electricity supplies are sometimes significantly greater than the average costs of existing electrical capacity, suggesting that consumers face inadequate incentives to conserve electricity, e.g., during peak demand periods.	Lack of specific legislation Complex/inadequate regulatory procedures	Energy Market: Prices faced by consumers in electricity markets may not reflect marginal social costs due to the common use of average-cost pricing under utility regulation. Average-cost pricing could lead to under- or overuse of electricity relative to the economic optimum.

APPENDIX B. LITERATURE REVIEW SOURCES

Foundational literature

The following sources were reviewed to provide a basis for defining barriers and enumerating those identified in literature. These sources also identified the standard types of program interventions and the metrics programs have used to measure their success in overcoming barriers.

- Austin, David, Congressional Budget Office. *Addressing Market Barriers to Energy Efficiency in Buildings*, August 2012.
- Bagaini, Annamaria, Francesco Colelli, Edoardo Croci, Tania Molteni. "Assessing the relevance of barriers to energy efficiency implementation in the building and transport sectors in eight European countries," *The Electricity Journal*, Volume 33, Issue 8, 2020, https://doi.org/10.1016/j.tej.2020.106820.
- Davis, Beth, Jan Harris, and Dan Violette. *REGULATORY SPOTLIGHT: Estimating Energy Savings From Resource Acquisition and Market Transformation Programs*, February 2019. https://guidehouse.com/-/media/www/site/downloads/energy/2019/market-transformation-summit-regulatory-spotlight.pdf.
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- Vaidyanathan, Shruti, Steven Nadel, Jennifer Amann, Casey J. Bell, Anna Chittum, Kate Farley, Sara Hayes, Michelle Vigen, and Rachel Young. *Overcoming Market Barriers and Using Market Forces to Advance Energy Efficiency*, March 2013. https://www.aceee.org/sites/default/files/publications/researchreports/e136.pdf.
- Van Buskirk, Robert. *Estimating Energy Efficiency Technology Adoption Curve Elasticity with Respect to Government and Utility Deployment Program Indicators*, December 2013. https://www.osti.gov/biblio/1164376.

Case study literature

The following sources were reviewed to synthesize quantitative and qualitative findings on (1) market and customer barriers, (2) program interventions, and (3) trends such as market share and net-to-gross (NTG) results for the measure and program types relevant to each case study.

Retail lighting

- DNV. Final Draft Report of *Massachusetts LED Market Effects: Baseline Characterization* Massachusetts Program Administrators and Energy Efficiency Advisory Council Report No.: Final Draft Date: March 1, 2015.
- DNV. *FREE-RIDERSHIP AND SPILLOVER EVALUATION Residential and Commercial Portfolio Report* SUBMITTED TO: National Grid New York. Date: December 20, 2022.
- Itron. *NEW HAMPSHIRE RESIDENTIAL BASELINE STUDY* Submitted to: New Hampshire Evaluation, Measurement and Verification Working Group Prepared by Itron, June 11, 2020.
- Kelly & Rosenberg, DNV. *Some Light Reading: Understanding Trends Residential CFL and LED Adoption*, 2016 ACEEE Summer Study on Energy Efficiency in Buildings.
- NMR Group, Inc. *New Hampshire Lighting Supplier Insights* FINAL August 14, 2020 SUBMITTED TO: New Hampshire Program Administrators.
- NMR. *R1615 Light Emitting Diode (LED) Net-to- Gross Evaluation* FINAL REPORT FOR CONNECTICUT EEB August 7, 2017.
- NMR. *R1963 Short-Term Residential Lighting Report* FINAL September 11, 2020 SUBMITTED TO: Connecticut Energy Efficiency Board.
- SCS ANALYTICS. *R1963b SHORT TERM RESIDENTIAL LIGHTING REPORT* FINAL Prepared for: The CT EEB Evaluation Administration Team, October 29, 2020.

Residential Weatherization

- Opinion Dynamics. *New Hampshire Utilities Home Performance with ENERGY STAR Program Evaluation Report 2016-2017 – FINAL,* June 11, 2020.
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Request from: New Hampshire Public Utilities Commission

Request:

Market Barriers: The Energy Efficiency Program was initiated as part of restructuring to ensure that energy consumption reduction measures are still implemented in the investor-owned utility regulatory environment. Over 20 years later, the Commission is unaware of any study conducted to identify what barriers exist and which have been removed by prior Energy Efficiency Program investments. The Commission requests that the Joint Utilities submit one response to each of the following questions:

1. In the 20 years that ratepayer-funded Energy Efficiency programming has existed in New Hampshire, please identify each area where funding provided under these plans has enabled an energy efficiency technology or practice to become market competitive.

2. Please summarize each program where market barriers have been completely overcome. Please also describe each instance where market barriers have been partially overcome and what the pathway is to eliminate that market barrier fully.

3. Do the Joint Utilities believe that any of the Energy Efficiency programming, either current or discontinued, has created market barriers or enabled excessive free-ridership? If so, please describe how those programs can be improved to eliminate market barriers or excessive free-ridership.

Response:

1. New Hampshire's energy efficiency programs are considered 'resource acquisition' programs and not 'market transformation' programs. Given the small size of New Hampshire, and the relatively small scope of its energy efficiency budgets, market transformative programs are not feasible. Attachment RR 1-005A, "REGULATORY SPOTLIGHT: Estimating Energy Savings From Resource Acquisition and Market Transformation Programs," provides a general overview developed by the evaluation firm Navigant (since re-branded as Guidehouse) for ComEd regulators. It describes the distinction between energy efficiency programs designed to achieve savings from a bottom-up approach (e.g., "resource acquisition") versus those that are in a position to transform the market from the top down. It also describes the appropriate evaluation framework for each, as illustrated in the table below (excerpted from the document). One key distinction between the two types of approaches is

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the timeframe needed to achieve objectives. Setting aside the issue of market size and limited budgets, New Hampshire's annual approach to energy efficiency goal setting and performance incentives are not appropriate for a market transformation model.

	RESOURCE ACQUISITION	MARKET TRANSFORMATION
Scale	Program	Entire defined market
Target	Participants	All consumers
Goal	Near-term savings	Structural changes in the market leading to long-term savings
Approach	Save energy through customer participation	Save energy by mobilizing the market
Scope of Effect	Usually from a single program	Results from effects of multiple programs or interventions
Amount of Program Administrator's (PA's) Control	PAs can control the pace, scale, and geographic location and can identify participants in general	Markets are very dynamic, and the PAs are only one narrow set of market actors; if, how, where, and when the impacts occur are usually well beyond the control of the PAs
What is Tracked, Measured, and Evaluated	Energy savings and number of participants	Interim and long-term indicators of market penetration and structural changes, attribution to the program, and cumulative energy impacts
Timeframe for Cost-Effectiveness	Usually based on first year or cycle savings	Usually planned over a 5-10 year timeframe

While New Hampshire's energy efficiency programs have always considered "market barriers" in the design and implementation of programs, those barriers typically concern *customer* barriers to adopting energy efficiency equipment and services. Namely, the typically higher cost of high-efficiency equipment and services, lack of awareness or information about energy efficiency products and their benefits, lack of access to trusted vendors and contractors, etc. These *customer* barriers are distinct from the market barriers a given *technology* faces when trying to increase its share of the market.

The New Hampshire energy efficiency programs are not designed to cause a currently uncompetitive technology or practice to become competitive at scale, nor is that reflective of the purpose or policy objectives of the NHSaves programs. The NHSaves programs have neither the budget nor the reach to bring about such changes. Paving the way for a new

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technology or practice to become market competitive takes many years and a fundamentally different approach to energy efficiency at large. The NHSaves programs are evaluated on an annual cycle, not with a long-term view related to market transformation.

It is true, however, that in conjunction with interventions made by energy efficiency programs in other jurisdictions, as well as evolving federal codes and standards, the New Hampshire energy efficiency programs have contributed to the transformation of the market for high efficiency lighting and other products in New Hampshire. Each year, the Utilities' programs marginally increase the demand for Energy Star labeled products in the state by offering customers an incentive to shop for and purchase those high efficiency measures.

Energy efficiency standards are periodically updated by the USDOE on a pre-determined schedule to ensure that there is continual improvement in the efficiency of products from washers and dryers to rooftop HVAC systems. As those minimum federal standards are increased, so too are the minimum efficiencies that can qualify for the Energy Star label. In turn, the minimum efficiency that measures must achieve in order to be eligible for a rebate from the NHSaves programs has increased over the years, as well. Over the past 20 years, the NHSaves programs have incentivized customers to purchase increasingly efficient products and equipment, and thereby contributed to the ever-increasing minimum efficiency standards. The NHSaves programs have done this one customer and one rebate at a time.

In the residential new construction market, the NHSaves Programs have been recognized by the EPA's Energy Star program as an Energy Star Homes champion for 10 consecutive years, including 2022. The Utilities' intervention in that market is such that nearly one-quarter of all new residential homes in the state participate in the Utilities' programs, ensuring that they are built to above-code, Energy Star 3.1 standards. These new homes are highly insulated and high performing for the life of the building. The Utilities' partnerships with home builders, HVAC contractors, electricians and other professionals have led to significant savings compared to building to minimum standards mandated by the state's building code, and have led to improvements in knowledge and building practices that spill over into other areas of the construction and renovation industry.

While the impact of the NHSaves programs on the residential new construction program has received the most attention from local and federal partners, NHSaves incentives, contractor networks and training have also had a positive impact on new construction practices in the commercial and industrial space as well as among the community of existing building

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weatherization and HVAC contractors, resulting in continuous improvement in building practices and equipment.

2. Please refer to the response to Question RR 1-005 part 1.

3. No, the Utilities do not believe that the NHSaves programs have created market barriers or enabled excessive freeridership.

REGULATORY SPOTLIGHT

Estimating Energy Savings From Resource Acquisition and Market Transformation Programs

Prepared for ComEd
Prepared by Navigant Consulting, Inc. • Beth Davis • Jan Harris • Dan Violette
Designed by Kristin Salvador

FEBRUARY 2019

This section focuses on the concepts and methods used to estimate savings from resource acquisition and market transformation programs. This section is not intended to cover every approach. Rather, it is intended to illustrate general concepts. It is noted earlier in this report that the line between resource acquisition programs and market transformation programs can be fuzzy. Both program types represent a market intervention and may share similar objectives. As a result, evaluation approaches used for these types of programs can overlap.

The approaches used to estimate energy savings and market impacts from resource acquisition and market transformation programs often vary due to program design and differing goals. These differences in design and implementation tend to provide different types of programmatic data and information, which can drive evaluation choices. The common view is that cost-effective portfolios of energy efficiency activities will include both resource acquisition and market transformation programs to address different market barriers and objectives that may have different time dimensions. As a result, an understanding of how evaluations can assess whether goals are being met and helping programs achieve these goals is a key component of an overall set of energy efficiency activities.

Resource acquisition programs often target and market to specific sets of customers, resulting in tracking data that identifies program participants over a specified period of time.[1] If the evaluation objective is to assess the savings that occurred among this identified set of participating customers, then statistical approaches can be used to examine changes in energy use over time for this group. Many of the evaluation methods used for resource acquisition programs are predicated on having identified program participants, and sampling and analysis procedures are designed to address this estimation problem. In addition, data on program participants can be used to address what have become known as net-to-gross (NTG) issues, where processes can be used to assess customer actions as being program-induced savings, free ridership, or spillover.

Market transformation programs, on the other hand, are designed to influence the market more broadly and often do not have identified sets of customers as participants. The data available from market transformation programs includes market metrics (e.g., equipment stocking practices and trade ally activities) and market-wide adoption of efficient technologies. Customer-specific data is often not available for use as inputs into customer-based evaluation models. Market transformation program evaluations have typically been designed to use data consistent with their implementation design and overall objectives (i.e., market metrics tracked over longer timeframes). In addition, the customer-based concepts of NTG used in resource acquisition evaluations may not fit with market transformation programs.

Differences in resource acquisition and market transformation program evaluation methods may not be due to differences in overall evaluation philosophy; instead, they are driven by differences in the types of data made available by these program designs and the objectives to be verified by an evaluation. The concepts of counterfactual baselines and causality underpin any program evaluation. No regulatory body or program implementer wants to implement a program where the effects of that program would have occurred if the program had not been offered.

1. Some programs included in resource acquisition portfolios may not identify participants through program implementation. One example is a residential mid-market lighting program where big box or hardware stores provide rebates for efficient lighting equipment funded by a program. In these programs there may be a count of the equipment rebated, but individual customers may not be identified. This can pose challenges for statistical approaches commonly associated with resource acquisition programs and has led to attempts to gather customer participant information through customer-intercept surveys or data gathered by the store in which the purchase is made. These mid-market programs represent program types that could be part of resource acquisition or market transformation portfolios.

A starting point for examining distinctions between resource acquisition and market transformation evaluations is provided in a recent report by NYSERDA.[2] The table below is drawn from this report.

	RESOURCE ACQUISITION	MARKET TRANSFORMATION
Scale	Program	Entire defined market
Target	Participants	All consumers
Goal	Near-term savings	Structural changes in the market leading to long-term savings
Approach	Save energy through customer participation	Save energy by mobilizing the market
Scope of Effect	Usually from a single program	Results from effects of multiple programs or interventions
Amount of Program Administrator's (PA's) Control	PAs can control the pace, scale, and geographic location and can identify participants in general	Markets are very dynamic, and the PAs are only one narrow set of market actors; if, how, where, and when the impacts occur are usually well beyond the control of the PAs
What is Tracked, Measured, and Evaluated	Energy savings and number of participants	Interim and long-term indicators of market penetration and structural changes, attribution to the program, and cumulative energy impacts
Timeframe for Cost-Effectiveness	Usually based on first year or cycle savings	Usually planned over a 5-10 year timeframe

2. From MTPA Working Group (2018), *Market Transformation Metrics and EM&V Coordination Report*, NYSERDA, which was derived from Keating, et al. ops cit. Table appears in the Ken Keating, 12/9/14 paper "Guidance on Designing and Implementing Energy Efficiency Market Transformation Initiatives."

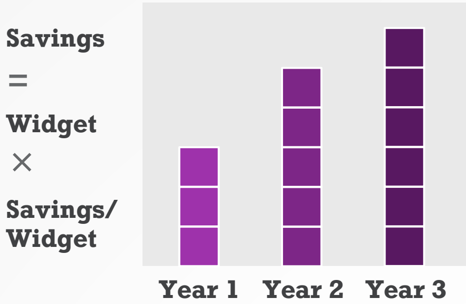


Figure provided as an example only.
Not all methods follow this structure.

Estimating energy savings from typical resource acquisition programs is part of the evaluation, measurement, and verification (EM&V) of the programs. EM&V assesses the performance of energy efficiency activities and provides regulators with verified estimates of energy savings, which can be used to track progress toward goals. EM&V can also involve estimating the cost-effectiveness of energy efficiency activities. There is extensive literature on EM&V of energy efficiency programs, including information from ACEEE,[3] SEE Action,[4] the International Performance Measurement and Verification Protocol (IPMVP) from the Efficiency Valuation Organization,[5] and the Uniform Methods Project from the US Department of Energy (DOE)[6] (this list is not exhaustive). This section provides a high level overview of approaches.

Total program energy savings (assessed through impact evaluations): For utility resource acquisition portfolio evaluations, the evaluator typically will estimate savings for each program in the portfolio[7] and sum the savings for the programs to get portfolio savings. The savings goals at the program and portfolio level are often goals included in an energy efficiency plan. The utility energy efficiency plan is submitted to the regulatory agency and typically covers several years (e.g., 3-5 years). A process to estimate total program savings is outlined below:

- Review savings (ex ante) in the program files. These are savings estimated for each project in the program prior to evaluation.
- Decide on an approach to estimate evaluated savings (ex post) for the program.
  - **Deemed savings** are per-measure energy and demand savings typically provided in a Technical Reference Manual (TRM) or other savings database (e.g., Illinois has the Illinois Statewide Technical Reference Manual[8]).
  - **Measurement and verification (M&V)** can include deemed calculations from TRMs, statistical analysis, and/or computer simulation modeling. A few of these methods are detailed in the next column.

Engineering methods combined with onsite data use algorithms and/or simulation modeling supported by field data measurements on equipment installed through the program. This can include end-use kilowatt-hour metering, equipment runtimes, power measurements, and building orientation and use (where appropriate) to produce high quality savings estimates for a set of sampled sites. The sampling design then allows for extrapolation to the overall set of program participants. This method is often used when the cost of directly metering all participants pre- and post-measure installation is costly and appropriate sample sizes can provide the required program-level precision.

Statistical analyses using comparison groups is another method evaluators use. This method includes randomized controlled trials and quasi-experimental methods. The data in these analyses can come from several sources including monthly, daily, or hourly advanced metering infrastructure (AMI) data as well as site-specific end-use metering. The sophistication of the approach can depend on the types of data available and when they are available. Data available in near real-time is starting to be termed M&V 2.0 or advanced M&V, but the structure of the analyses of this data still uses the same statistical and experimental design constructs (i.e., analyses of consumption data against a comparison/ control construct).

3. ACEEE, *Evaluation, Measurement, & Verification*, https://aceee.org/sector/state-policy/toolkit/emv.
4. SEE Action, *Energy Efficiency Program Impact Evaluation Guide*, https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-program-impact-evaluation-guide.
5. Efficiency Valuation Organization (EVO), *International Performance Measurement and Verification Protocol (IPMVP)*, https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp. The IPMVP protocols were originally developed for use in performance contracting. The methods focused on verifying savings for use in contracts between customers and energy service companies. However, the protocols also provide valuable insights into methods to determine energy savings for any customer-specific project.
6. DOE, Office of Energy Efficiency & Renewable Energy, *Uniform Methods Project for Determining Energy Efficiency Program Savings*, https://www.energy.gov/eere/about-us/ump-home.
7. Some program evaluations can look at synergies across programs. To the extent these synergies examine how separate programs can impact the same end-use or market, these resource acquisition program evaluations can include certain concepts of market transformation.
8. Illinois Energy Efficiency Stakeholder Advisory Group. *Illinois Statewide Technical Reference Manual*. http://www.ilsag.info/technical-reference-manual.html

- Set a baseline approach. Selecting the baseline approach is often the most challenging part of an evaluation. Baseline options include energy use of participants prior to participation, codes and standards, cross-sectional comparison of energy use for non-participants and comparable nonparticipants, or cross-section/time-series analyses where the change in energy use over time is examined for both groups of participants and non-participants. Baselines for energy use of participants prior to participation can be estimated by widget (e.g., baseline for a new efficient air conditioner) or by project (e.g., a facility's energy use prior to installing energy efficiency measures). Baselines can be assumed to be a common practice baseline, existing condition baseline, or some other baseline condition. Randomized control trials are viewed as the most reliable evaluation method and are based on randomly assigning customers to participant and non-participant groups. Where practical concerns make randomization impractical and comparison groups are constructed after or jointly with program participation, best practice quasi-experimental design approaches are used.[9]

- Prepare a sampling plan and data collection instruments for site visits depending on the approach chosen. Data could be collected via surveys or site visits. Data may also be collected directly from the customer who participated in a program, visually confirmed, or measured onsite (e.g., measure lighting hours of use).

- Estimate savings for the program based on the sample design and statistical calculations. The estimate of savings for the program is typically based on the use of a realization rate where the ex post savings (evaluated savings) are divided by the ex ante savings (claimed savings).

Total portfolio energy savings: Portfolio-level savings are the sum of all program-level savings in the portfolio.

9. Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578.http://www.nrel.gov/docs/fy17osti/68578.pdf

RESOURCE ACQUISITION PROGRAM EVALUATION: OTHER ITEMS

Estimating the project, program, and portfolio level savings is one step in the evaluation process. However, there are many other items to consider through the evaluation. A few of these are outlined here.

Attribution (NTG)

Many of the statistical methods described above are designed to provide energy savings that are viewed as attributable to the program, depending on the baseline used.[10] In contrast, some evaluation methods focus on technical savings resulting from the installation of energy efficiency measures for a sample or population of participants and may not fold in other behavioral and market considerations. These methods typically do not consider what would have happened in the absence of the program. They provide the estimated technical savings from the installed measures regardless of the influence of the program on customer actions. In these cases, a gross savings estimate is initially estimated and a NTG ratio is used to produce estimates of attributable savings. The Uniform Methods Project chapter[11] details net savings including the factors most often considered: free ridership, spillover, and market effects.

DOE's Uniform Methods Project defines gross and net savings as follows:

Gross savings: "The difference in energy consumption *with the energy-efficiency measures promoted by the program in place* versus what consumption would have been *without those measures in place*."

Net savings: "The difference in energy consumption *with the program in place* versus what consumption would have been *without the program in place*."

10. Attribution can be complex in that certain aspects of attribution such as non-participant spillover may not be captured by certain experimental designs and may need to be addressed with additional research. See Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578. http://www.nrel.gov/docs/fy17osti/68578.pdf
11. See Violette, Daniel M.et al. (2017). http://www.nrel.gov/docs/fy17osti/68578.pdf

RESOURCE ACQUISITION PROGRAM EVALUATION: OTHER ITEMS

Estimating the project, program, and portfolio level savings is one step in the evaluation process. However, there are many other items to consider through the evaluation. A few of these are outlined here.

Timeframe

Impact evaluations for resource acquisition programs tend to estimate savings for program participants in a given timeframe—often in one year (or a few) of the program. While the evaluation is focused on program participants for one (or a few) year, overall program savings values used in cost-effectiveness tests consider the estimated persistence of savings over time. This is because energy efficiency savings will extend beyond the year in which the measure was installed.[12]

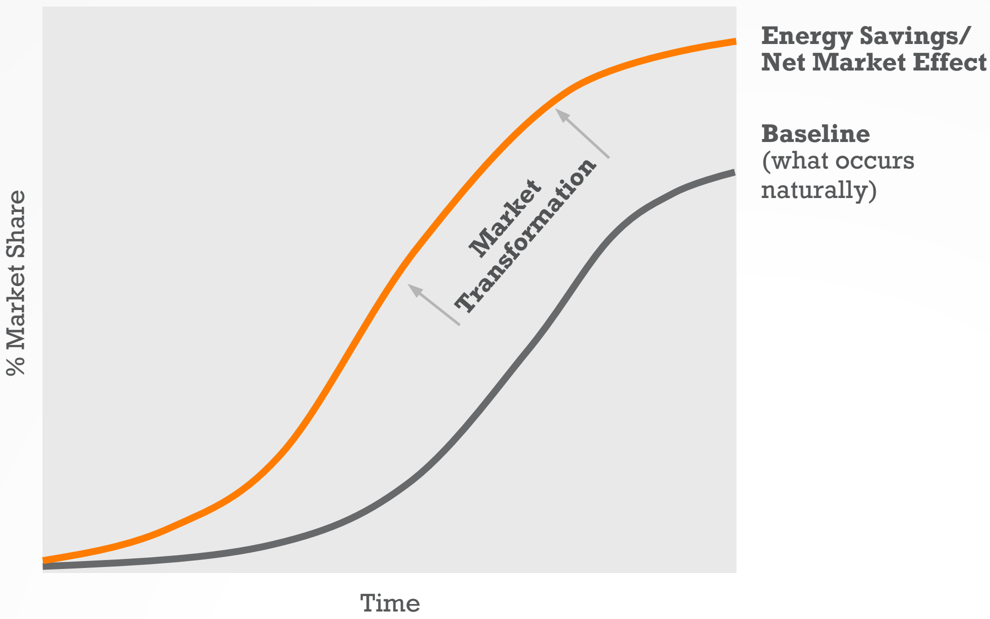
Other Impacts

Other impacts could include non-energy impacts (e.g., comfort, reduced maintenance, health), environmental externalities like avoided greenhouse gas emissions, water savings, job creation, and utility system impacts.

Continuous Improvement

All programs should be part of a continuous improvement framework where implementation processes are reviewed and evaluated, often through a process evaluation.

12. The persistence of program savings from installed energy efficient measures can pose additional estimation challenges. A number of these are discussed in: Violette, Daniel M. (2017) Chapter 13: Assessing Persistence and Other Evaluation Issues Cross-Cutting Protocol -- The Uniform Methods Project. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68569 September 2017. https://www.nrel.gov/docs/fy17osti/68569.pdf



Approaches to estimating energy savings from market transformation initiatives are varied. Different approaches are used in different jurisdictions depending on the market being addressed and the goals set out for that program. A difference that often stands out between market transformation program evaluations and typical resource program evaluations is the difficulty in identifying individual customers as program participants. This somewhat defining characteristic allows for different evaluation approaches and statistical methods to be used in a resource acquisition setting. Conversely, market transformation efforts tend to be market-wide and specific end users of a new technology are not as easily identified. This has led to methods that tend to track market indicators and overall market adoption rates.

Market transformation evaluation should match the evaluation strategy in the program logic. The logic model and the intervention strategy should identify the outputs and outcomes and the metrics that define them. These interim and long-term indicators of market effects become the indicators by which progress can be measured. Examples include market share for energy efficient products and services, the saturation of energy efficient products, price of the product or service compared to less efficient alternatives, availability of efficient products and efficiency services, levels of product or service awareness, knowledge among market actors, and, ultimately, energy and demand savings.

Several organizations have recently convened working groups to discuss market transformation evaluation. Much of the information in this section is drawn from the following resources, all published in 2018:

- NYSERDA's *Market Transformation Metrics and EM&V Coordination Report*[13] (referenced in this section as the NYSERDA Market Transformation Report)
- CPUC Energy Efficiency Market Transformation Draft Staff Proposal[14] (referenced in this section as the CPUC Market Transformation Proposal)
- *ENERGY STAR® Retail Products Platform (RPP): Conditions and Considerations in Evaluating Market Transformation Programs and Evaluation Guidance for RPP* report[15] (referenced in this section as the RPP Report)

13. MTPA Working Group (2018), *Market Transformation Metrics and EM&V Coordination Report*, NYSERDA.
14. CPUC (2018), Administrative Law Judge's Ruling Seeking Comment on Market Transformation Staff Proposal, Rulemaking 13-11-005.
15. Sara Conzemius and Alexandra Dunn (2018). *ENERGY STAR® Retail Products Platform (RPP): Conditions and Considerations in Evaluating Market Transformation Programs and Evaluation Guidance for RPP.* Prepared by ILLUME Advising, LLC, for the State and Local Energy Efficiency Action Network.

Total market transformation initiative energy savings: Approaches for estimating savings from market transformation initiatives have typically varied by the organization implementing the market transformation effort. At a high level, this market-driven savings approach compares a baseline curve for the market to the actual market curve. The list below outlines an approach from New York.

The **NYSERDA Market Transformation Report** notes that the following steps are typically followed when assessing a market transformation program.

1. Define the market targeted by the program or initiative.
2. Develop and refine a program theory and logic model. This model generates hypotheses about the specific ways in which the program will accelerate the pace of development and adoption of the targeted products and practices.
3. Define market metrics that can be used to characterize the market in relation to the program theory and logic model. In the early stages of the initiative, metrics such as the number of products that receive efficiency certification and the variety of certified products on retailer shelves can be used to track market progress. These results can be used to validate or revise the program logic models and to guide changes in program design and management. As the initiative progresses, PAs will want to focus on assessing its impacts on measure adoption and energy use, as described in the next three steps.
4. Characterize the actual past and current level of development and adoption for the targeted technology, using the metrics developed in the previous step.
5. As appropriate, characterize the market baseline—that is, the level of technology development and adoption that will most likely have occurred in the absence of the program.
6. Estimate the energy savings associated with the program-induced sales. NYSERDA outlines two approaches to estimate energy savings.

Measure-/technology-specific programs: This approach uses an algorithm to assess the energy savings from market transformation progress. It would also include removing any program-incented units to avoid double counting.

Total Energy Savings = Change in Units Sold x Unit Energy Savings.

Comprehensive programs: For programs like Strategic Energy Management (SEM), the assessment may be more complex. More data is required to form inputs for an algorithm for this approach.

Total Energy Savings = Change in Adoption of Approach x Average Energy Savings from Adopting

Total market transformation initiative energy savings: Approaches for estimating savings from market transformation initiatives have typically varied by the organization implementing the market transformation effort. At a high level, this market-driven savings approach compares a baseline curve for the market to the actual market curve. The list below outlines an approach from California.

The **CPUC Market Transformation Proposal** details items a Market Transformation Development Plan should include, which would be further detailed in a Market Transformation Accord.

1. Identify a target market that is clearly defined and manageable.
2. Define target technologies, behaviors, sectors, and applications.
3. Assess product (or behavior) performance, including an assessment of energy savings potential and non-energy benefits.
4. Assess competing (not energy efficient) products and the costs and benefits associated with those products.
5. Describe the supply chain, product demand and delivery methods, the role of each market actor, and how the market operates and functions.
6. Present a preliminary assessment of market drivers and barriers.
7. Present a preliminary program theory and logic model, identifying market leverage points and intervention strategies.
8. Describe potential strategies and available or preliminary data for sizing the market and for projecting a naturally occurring adoption curve—i.e., baseline forecast for the market.
9. Describe additional research and/or market assessments needed to finalize the proposal and set an initial baseline forecast that extends over the projected timeline of the program.

Organizations in the Northwest also have a history of assessing impacts from market transformation programs. Examples from the Northwest Energy Efficiency Alliance (NEEA) and Bonneville Power Administration (BPA) are below.

NEEA APPROACH

The NYSERDA Market Transformation Report discussed the NEEA approach as part of its best practices review: "In assessing the market impact from its efforts, NEEA does not claim regional savings; instead, NEEA employs a 'co-created savings' approach. To arrive at 'co-created savings,' total regional savings are assessed using a savings rate multiplied by unit calculation. Then, baseline savings are removed from the total based on third-party research. The remaining savings are categorized as 'co-created savings' and encompass discrete savings from local utility programs and an overarching estimate of net effects. The net effects are not attributed to any particular entity but are considered created across funders through the market-wide engagement by NEEA and its partners."

BPA APPROACH[16]

BPA tracks Momentum Savings. Momentum Savings are defined as: "all the energy efficiency occurring above the Northwest Power and Conservation Council's Power Plan baseline that are not directly reported by utilities and not part of the Northwest Energy Efficiency Alliance's Net Market Effects." The general equation for Momentum Savings is:

Momentum Savings =
Total Market Savings - Total Program Savings

BPA is quantifying Momentum Savings by collecting information on how much energy efficiency is happening in the total market. It builds market models to track changes over time in energy consumption, sales trends, stock turnover, energy savings, and baselines. These models incorporate sales data from the market (e.g., distributors).

The RPP Report also details BPA's approach: "BPA analyzes both the efficient and inefficient products entering the marketplace. The data to support this analysis comes from multiple sources which characterize the building stock (the installed products consuming energy) and the product flow (the new products every year, which create change in the building stock). One critical data source is regular onsite stock assessments, which provide the physical characteristics of buildings and the technologies installed in homes. This is combined with information on the new equipment being sold annually (the product flow), generally via sales data. The combination of the stock- and product-flow data provides a bottom-up look at energy consumption and how that energy consumption changes over time."

The baseline for a market transformation initiative is for the market as a whole. Some jurisdictions use a fixed baseline for a period of time, while others use a baseline that changes over time. The CPUC Market Transformation Proposal notes that Market Transformation Accords should establish an initial forecast market baseline using a Delphi process with PAs and market actors. The paper details approaches for defining baselines and notes these baselines will serve as the basis for energy savings estimates.

The RPP report also says : "The evaluation of market-transformation programs relies heavily on establishing a baseline against which the program impacts can be measured. Unlike resource-acquisition programs, market-transformation evaluations require more upfront coordination between the evaluation and implementation teams, data-collection needs must be clarified prior to launch, metrics established, short-term, midterm, and long-term market indicators defined. Without early and closer coordination, sponsors risk developing indicators that cannot be measured or collecting data that does not meet evaluation needs. Additionally, a comprehensive market study must be conducted to establish the market's baseline conditions."

16. BPA, *Energy Efficiency Market Research & Momentum Savings*, https://www.bpa.gov/EE/Utility/research-archive/Pages/Momentum%20Savings.aspx

Attribution and Causality

This is another area of overlapping interest. However, the methods and terminology developed for resource acquisition and market transformation programs have been designed to meet the needs for assessing each program type in an appropriate context. The concept of NTG is generally associated with resource acquisition programs, although the overall concept of causality is important to both resource acquisition and market transformation program types. No regulatory authority wants to spend funds on impacts that would have occurred even in the absence of a program—whether it is a market transformation or resource acquisition program.

The NYSERDA Market Transformation Report uses the terms causal or program-induced effects as opposed to NTG, which is generally used for methods based around identified program participants more commonly associated with resource acquisition programs. NYSERDA states that, by design, measuring free riders and spillover does not apply to market transformation initiatives, but the causality/attribution of the savings to the program's efforts should still be estimated.

Estimating the energy savings from a market transformation initiative is only one way to evaluate the success of the initiative. Other items are important to consider.

For some initiatives, it may be appropriate to assume any market effect was caused by the program, while for other initiatives evaluators may need to show evidence of causality—e.g., through market actor interviews or Delphi panels. The CPUC Market Transformation Proposal notes that the "baseline reflects an estimate of how all of the non-program market forces and influencing factors would interact and evolve in the market over time if there were no Market Transformation Initiative in place." This is referred to as the counterfactual and is an important concept in both market transformation and resource acquisition evaluations.

MARKET TRANSFORMATION PROGRAM EVALUATION: OTHER ITEMS

Estimating the energy savings from a market transformation initiative is only one way to evaluate its success. Other items are important to consider.

Timeframe

The effects of market transformation initiatives are typically seen after a longer time period than resource acquisition—often 5-10+ years. Market transformation effects may last longer than resource acquisition effects as their intent is to create lasting (permanent) changes to the market.

Other Impacts

Market transformation metrics are important to outline in a logic model and measure over time. Metrics could include market awareness of a product, percentage of sales of efficiency equipment, penetration of equipment in the stock, or stocking practices among others. These metrics provide a way to gauge if the market transformation initiative is effective.

Continuous Improvement

All programs should be part of a continuous improvement framework where implementation processes are reviewed and evaluated, often through a process evaluation.

CONCLUSION

Three Portfolio Themes were derived from the Market Transformation Summit:

- Synergies exist between resource acquisition and market transformation programs.
- A holistic view of energy efficiency activities across resource acquisition and market transformation programs is important.
- Regulatory treatment of market transformation programs will need to differ from resource acquisition programs.

The evaluation of a market transformation initiative should support these themes. The evaluation should recognize that synergies exist between program types and taking a holistic view to evaluating the portfolio of programs is important. In addition, it is important to work with regulators and other stakeholders on evaluation approaches. Key takeaways include the following:

- **Evaluating portfolios with a holistic perspective is important.** A cost-effective energy efficiency portfolio will need programs targeted to specific customer segments with short-term energy reduction goals. Other programs will need to work synergistically with these programs to achieve the longer-term goals involved in transforming markets. Evaluation is needed to provide feedback that assesses the contributions from both resource acquisition and market transformation programs, including the synergies across these programs. The evaluation methods will involve both customer-centric approaches associated mostly with resource acquisition programs and market metrics and tracking for longer-term investment efforts in energy efficiency. Regulators and stakeholders will need to recognize the value of evaluations that support both resource acquisition and market transformation investments.
- **Data availability will drive the evaluation approach.** It is important to recognize that different data availability will influence the choice of the evaluation approach across programs. In some cases, a high level of rigor can be expected for evaluations focused on an identified population of program participants. For other market-based programs, information will have to be accumulated over time. As a result, expectations for evaluations focused on providing different views of the portfolio of energy efficiency activities will need to align with the purpose of the evaluation.
- **Market-based evaluations will require longer timeframes and designs that are aligned with the objectives of these programs.** It will be more difficult to develop standards and protocols for market transformation evaluations across changing technologies and market maturities. These evaluations will likely require additional planning and agreement among stakeholders as well as multi-year timeframes for execution.

Attachment P. SEP and Planned EM&V Studies in 2024-2026

The EM&V Working Group developed a Strategic Evaluation Plan (SEP) for 2024-2026. The SEP provides a priority set of evaluation activities that are essential to effective programs, transparency, and continuous improvement of the NHSaves programs and the New Hampshire energy efficiency market. The EM&V Working Group will continue to update this plan as new information and research results become available.

The SEP is grouped into distinct tasks, as described below.

Activities to support regulatory and other mandated reporting requirements. These activities include ISO-NE certification of utility demand resources, utility modeling and tracking system software, the AESC study, TRM hosting, internal staff time for EM&V and other supporting efforts. These efforts are necessary to meet NH Utilities' reporting requirements.

ISO NE certification of utility demand resources. EM&V activities are crucial to demonstrate compliance for participation in the ISO-NE FCM. The ISO-NE requires each electric utility to annually certify the passive demand resources (i.e., summer kW occurring during system peaks) to receive compensation for their previously committed reductions. Each electric utility must undertake their own distinct certification, which typically begins early each calendar year to be completed by the ISO certification deadline in May.

Utility modeling and tracking system software. This includes upgrades and maintenance of the NH Utilities' jointly funded program modeling and tracking systems (Compass for Home Performance and Targeted Retrofit Energy Analysis Tool (TREAT) for HEA). These systems track efficiency measures installed in residential customers' homes and calculate savings estimates used in scoping and reporting.

AESC Study. This study updates the value of reductions in energy and capacity use resulting from energy efficiency programs. The study models the present value of reducing electricity, natural gas, other fuels as well as water and wastewater as a result of program-based energy efficiency or other demand-side measures. The AESC study is a comprehensive and sophisticated econometric study undertaken on a regional basis on behalf of all six New England states. It is guided by a Working Group that consists of representatives from various state governments, regulatory bodies, and energy efficiency program administrators, including the NH Utilities. The next AESC study is expected to be completed in 2024.

TRM Hosting. Per the EERS settlement agreement filed under DE 15-137 on April 27, 2016, a New Hampshire-specific TRM was finalized at the end of 2020. The TRM is currently hosted on a third-party vendor's web-based platform and is accessible to the public. The platform captures, organizes, and tracks measure definitions, descriptions, savings values, and reference materials in a web-based interface with public access for reports. The EM&V Working Group reviews and updates the TRM on annual basis to reflect changes in technology, baselines and evaluation results. An independent review of the TRM is also planned this term to assess impact factors and other savings assumptions not being updated by formal evaluations.

Internal staff time for EM&V and other supporting efforts. These activities include internal staff labor associated with capturing energy efficiency project data from customers and vendors in the field and storing it in internal tracking systems, quarterly and annual reporting, maintaining benefit-cost models, updating the TRM, and other supporting efforts for program accountability.

Third-Party EM&V Studies. Independent third-party EM&V studies are used to ensure that program impacts reported to regulators and stakeholders are credible and sufficiently accurate for decision-making. Many EM&V studies are important to the electric utilities' continued compliance with ISO-NE's Market Rule 1, tied to FCM funding, which requires that energy efficiency capacity resources entered into commercial operation meet certain minimum statistical significance requirements.

In 2022, the EM&V Working Group hired third-party contractors through a competitive bidding process to conduct independent evaluations of the NHSaves programs. Recently completed and on-going studies from the 2022-2023 Strategic Evaluation Plan include:

- DNV (2023). Market Barriers to Energy Efficiency
- DNV (2023). Economic Impacts of the NHSaves Programs
- Guidehouse (2023). PY2022 Delivered Energy Insights Impact Evaluation
- DNV (on-going). Impact Evaluation of New Hampshire 2020 and 2021 PY Large Commercial and Industrial Program Custom Measures
- DNV (ongoing). Cross-State C&I Active Demand Reduction Initiative – Summer 2023 Evaluation
- Demand Side Analytics (on-going). Commercial and Industrial Existing Building Baselines Study
- NMR Group, Inc (on-going). New Hampshire Baseline Practices
- NMR Group, Inc (on-going). New Hampshire Residential Electric Efficiency Opportunities for Low- and Moderate-Income Customers

The NH Utilities, in consultation with the EM&V Working Group, identified a set of new priority evaluation efforts to be considered in 2024-2026, with the understanding that some of the studies may be completed in the next term and the scope of the studies may change based on evolving program needs and research priorities.

When determining which studies should be included in the SEP, the EM&V Working Group prioritizes those expected to have a significant impact on savings, address policy questions or fulfill regulatory requirements. The relative priority of a study can be determined by looking at the following factors:

- Magnitude of savings: Research questions on programs producing the greatest share of savings.

- Program design questions: Requests from program implementers to help inform program design.
- Regulatory requirements: Research questions stemming from orders or to fulfil other regulatory requirements.
- Age of recent studies: Outdated research still being cited will be prioritized for study.
- Availability of similar literature: Where possible, research conducted on similar programs will be leveraged.

Table 1 shows a list of the proposed studies for the 2024-2026 with brief descriptions, and Table 2 shows the tentative timing of each study.

Table 1. Proposed Studies for the 2024-2026 term

Research Area	Study Name	Brief Description
Residential	Energy Star Homes Impact and Process Evaluation	A two-phase study that will verify energy savings, study free-ridership and spillover and assess program processes, delivery, barriers and opportunities.
Residential	Energy Star Products Impact and Process Evaluation	A two-phase study that will verify energy savings, research freeridership and spillover and assess program processes, delivery, barriers and opportunities.
Residential	Home Performance Impact and Process Evaluation	A two-phase study that will verify energy savings, research free-ridership and spillover and assess program processes, delivery, barriers and opportunities.
Residential	Home Energy Assistance Impact and Process Evaluation	A two-phase study that will verify energy savings and assess program processes, delivery, barriers and opportunities.
Residential	Behavioral Program Impact Evaluation	This study will evaluate energy savings from Home Energy Reports Program.
C&I	Small Business Energy Solutions Program Impact and Process Evaluation	A two-phase study that will verify energy savings, research free-ridership and spillover and assess program processes, delivery, barriers, and opportunities.

Research Area	Study Name	Brief Description
C&I	C&I New Construction Impact and Market Assessment	This study will evaluate savings compared to code, determine share of new construction projects captured by program
Special & Cross-cutting	TRM Review	This study will review impact factors and savings assumptions for residential and C&I measures in the TRM
Special & Cross-cutting	NEI Research	This study will assess the current adder used in the Granite State Test for the HEA program
Special & Cross-cutting	Benefits and Impacts of Load Reduction	Evaluation of a pilot of peak load reductions throughout the year.

Table 2. Timeline of 2024-2026 Planned Studies:

		2024				2025				2026			
Sector	Study	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Residential	Energy Star Homes Impact and Process Evaluation												
Residential	Energy Star Products Impact and Process Evaluation												
Residential	Home Performance Impact and Process Evaluation												
Residential	Home Energy Assistance Impact and Process Evaluation												
Residential	Evaluation of Behavioral Program												
C&I	Small Business Energy Solutions Program Impact and Process Evaluation												
C&I	C&I New Construction Study												

S&CC	TRM Review												
S&CC	NEI Research												
S&CC	Benefits and Impacts of Load Reduction												

X Phase 1 (impact)

X Phase 2 (process)

Residential Studies:

1. Energy Star Homes / Codes Training Impact and Process Evaluation

Research Area:	Residential
Type of Study:	Impact/Process
Applicable Fuels:	Both
Program/ Initiative	ES Homes
Targeted Start Date:	Q3 2024

Description:

The Energy Star Homes program encourages New Hampshire builders and new home buyers to adopt energy efficient practices in new home design / building, as well as gut and rehab construction projects. The program uses cash incentives and significant technical assistance to offset the upfront costs and technical barriers associated with meeting Energy Star requirements. Separately, training is offered to building professionals and code officials on achieving energy efficient gains beyond those mandated by current NH energy code. Currently, no savings are planned for or claimed from this training, yet participants have consistently indicated that trainings lead to more efficient practices in the field.

This two-phased study will assess the overall administration of the program, the relationship of the beyond codes training and its impact and benefits on various stakeholders as well as investigate Freeridership and Spillover. In the first phase, evaluated savings will be determined through a billing analysis of participant homes compared to a control group of non-participant homes built during the same period, and or engineering analysis and building simulations The second phase will consist of a process evaluation and rely on in-depth interviews of utility staff, HERs raters, and both upstream actors (i.e., builders, designers, contractors) as well as downstream customers also involve onsite inspections to assess current delivery methods and participation trends. Completing the study in two phases will allow the impact evaluation to provide context and guide the research undertaken for the process evaluation. The process evaluation will be able to dig deeper on follow up issues that may be indicated by the quantitative work in the impact evaluation.

While the Energy Star Homes program only represents about 7% of annual kWh savings and 9% of MMBtu savings, and the beyond codes training currently claims no energy savings, this study is being prioritized given significant changes in the new construction sector and the recency of the latest study. The last study performed on the NH ES homes program was completed in 2017 using 2014-2015 program year data.

Study outcomes:

- Impact:
  - Gross Savings
  - Realization Rates
- Process
  - Participation Trends
  - Freeridership and Spillover

2. Energy Star Products Impact and Process Evaluation

Research Area:	Residential
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	ES Products
Targeted Start Date:	Q3 2024

Description:

This study's main objectives will be a) to update impact factors for the Energy Star Residential Products Program (ESRPP) and b) assess the effectiveness of program design and implementation now that lighting measures have been phased out. The ESRPP is designed to provide incentives for the adoption of readily available energy efficiency opportunities to residential customers at the point of sale. The ESRPP is a nationally coordinated program under the federal Energy Star label, administered by the US Environmental Protection Agency ("EPA") in coordination with thousands of manufacturers, retailers and program sponsors such as the NH Utilities. The program was established in 1992 and has been offered by the NH Utilities since the inception of the energy efficiency programs. The program is designed to increase the adoption of highly efficient appliances by changing retailer stocking, raising awareness of the benefits of energy efficiency, and reducing the incremental cost of purchase for customers. Equipment bearing the Energy Star label is by definition more energy efficient than the minimum efficiency standard allowed by law, and by pushing the market toward greater energy efficiency, minimum standards also progress over time.

The NHSaves program has increasingly utilized midstream incentives geared toward retailers and relied less on downstream incentives that require customers to take action to receive their rebate. The success of midstream approaches has not been well studied in New Hampshire to date, though a great deal of evaluation has been undertaken in other jurisdictions that shows the efficacy and efficiency of this approach.

The study will be split into two phases, impact, and process. Phase one, the impact study, will assess how claimed savings compare to evaluated savings. Phase two, the process study, will review the administration of the program and seek opportunities for improvement in program design, participation trends and customer satisfaction. First, the impact phase will verify the electric and gas energy savings, water savings, and electric demand reduction associated with measures offered under the program, potentially using tools such as onsite metering, reviews of algorithms used to estimate savings, and surveys of program participants.

The second phase of the study will rely on stakeholder interviews, including but not limited to program staff and vendor interviews. This portion of the study will also focus on identify trends in participation where possible and developing an understanding of freeridership and spillover of the program. This program has been prioritized for study as the most recent evaluation was completed in 2016, and the program represents a significant portion of residential kWh savings and 24% of residential MMBtu savings.

Study Outcomes:

- Impact:
    - In Service Rates
    - Realization Rates
- Process
    - Opportunities for improvement in program design
    - Participant satisfaction
    - Participation Trends of customers and vendors
    - Freeridership and Spillover

3. Home Performance Impact and Process Evaluation.

Research Area:	Residential
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	Home Performance
Targeted Start Date:	Q1 2024

Description:

The NH Saves Home Performance takes a whole home approach, offering participating customers a suite of weatherization measures to reduce energy usage, associated costs, and enhance durability and comfort of customers' homes. This evaluation will be undertaken in two phases. The first phase will consist of an impact study that will verify total gross energy savings (including MMBtus, kWh and kW), assess the accuracy of statewide modeling software that is used to estimate savings, compare evaluated savings to the reported savings, and describe the key contributors to differences. The impact phase will also look at free ridership and spillover. This first phase will rely on program tracking data, billing analysis, contractor and participant surveys and engineering analysis. The second phase of the study will consist of a process evaluation and rely on participant and non-participant surveys, staff interviews and contractor interviews to identify participant satisfaction, opportunities for improvement, and participation trends. Particularly, how the program and approach has evolved to include more than single family weatherization and other markets such as manufactured house, resident owned communities and other markets to identify what markets we have served and what markets may still be underserved. Where possible, the study will look to interview partial participants and non-participants. The Home Performance program is prioritized for evaluation as the impact factors currently in use are based on 2016-2017 data.

Study Outcomes:

- Impact:
  - Gross Savings by major end uses
  - Realization Rates by major end uses
  - Recommended measure life updates
  - Freeridership and Spillover
- Process
  - Opportunities for improvement in program design
  - Participant satisfaction
  - Participation trends

4. Home Energy Assistance Impact and Process Evaluation.

Research Area:	Residential
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	HEA
Targeted Start Date:	Q1 2024

Description:

The NH Saves Home Energy Assistance (“HEA”) program provides a comprehensive set of energy-saving measures to help income-qualified low income New Hampshire homeowners and renters reduce their energy costs and realize other non-energy impacts (NEIs), such as improved comfort, safety, and health outcomes. This evaluation will also be two phased and consist of an impact evaluation to review total reported gross energy savings (including MMBtus, kWh and kW), assess the accuracy of statewide modeling software that is used to estimate savings, compare the evaluated savings to the reported savings, and describe the key contributors to differences. This first phase of this study will rely on program tracking data, billing analysis, and engineering analysis to verify the gross savings and derive realization rates. The second phase of the study will consist of a process evaluation and involve working with the program delivery partners, including the NH Department of Energy staff, the Community Action Agencies and other vendors, as well as participants, utility implementation staff, and other low-income advocates and stakeholders. Where possible, the study will look to interview partial participants and non-participants. The HEA program is prioritized for evaluation as the impact factors currently in use are based on 2016-2017 data.

Study Outcomes:

- Impact:
    - Gross Savings by major end uses
    - Realization Rates by major end uses
- Process
    - Opportunities for improvement in program design
    - Participant satisfaction
    - Participation Trends of customers and vendors

5. Behavioral Program Impact Evaluation

Research Area:	Residential
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	Behavioral
Targeted Start Date:	Q2 2025

Description:

The Home Energy Reports (HER) Program is a well-established behavioral-based strategy offered across North America by utilities and energy efficiency program administrators to help customers better understand and control their energy use. The program sends personalized e-mails and printed communications that provide energy consumption information including a comparison to similar neighbors' energy use and energy-saving tips to raise awareness and encourage energy-saving behavior among residential customers.

This study will verify gross energy savings from the HER program and compare those savings to vendor-reported savings to derive realization rates. The study will also assess participation uptake in other NH energy efficiency programs because of receiving the home energy reports and account for savings generated through participation in other programs to avoid double counting of savings.

Study Outcomes:

- Impact:
    - Gross Savings
    - Realization Rates

Commercial and Industrial Studies

6. Small Business Energy Solutions Program Impact and Process Evaluation

Research Area:	C&I
Type of Study:	Impact/ process
Applicable Fuels:	Both
Program/ Initiative	SBES – retrofit / replace on failure
Targeted Start Date:	Q1 2024

Description:

The Small Business Energy Solution (SBES) program targets businesses under a certain usage threshold (200 kW of demand or 4,000 annual natural gas MMBtus) to help them reduce and otherwise manage their energy use and operating expenses by increasing the efficiency of their equipment and operations. Small businesses may own their buildings or lease their property from someone else, resulting in the potential for a split incentive in which the property owner gains nothing from the improvements made, and the lessor needs permission to make significant changes to the premises, which may not be recouped in a time frame that justifies the investment.

The major objective of this phased study will be to verify the gross energy savings, and to evaluate the program design and processes. The first phase will focus on deriving realization rates for various end uses (lighting, HVAC, refrigeration, etc.) and will rely on program tracking data, billing analysis and onsite visits. The second phase will focus on participation trends, program design and effectiveness not only of past performance but of a future in which the cost-effectiveness becomes a challenge for both lighting retrofits and replace on failure.

Because lighting has historically made up a majority of savings in this program for electric customers, the process portion of the evaluation will focus on future program delivery which encourages greater adoption of non-lighting measures. The study will rely on participant and non-participant surveys, contractor interviews, utility staff interviews and look at how other jurisdictions are designing and delivering effective programs to this customer segment post-lighting.

This study has been prioritized due to the age of recent evaluations, last conducted in 2012, and the importance of the programs and the customer sector to the portfolio. The SBES program accounts for 50% of commercial kWh savings in the electric portfolio, and 34% of commercial MMBtu savings in the gas portfolio.

Study Outcomes:

- Impact:
    - Gross Savings by major end uses
    - Realization Rates by major end uses
    - Freeridership and Spillover
- Process
    - Opportunities for to increase adoption of non-lighting measures
    - Participant satisfaction
    - Participation Trends of customers and vendors

7. C&I New Construction Study

Research Area:	C&I
Type of Study:	Impact/ Market assessment
Applicable Fuels:	Both
Program/ Initiative	C&I new construction (a component of Large, Small and Municipal Programs)
Targeted Start Date:	Q4 2024

Description:

This study will focus on the incremental savings achieved by participating commercial and industrial customers undertaking new construction relative to the new building code or industry standard practice baseline. What baseline to use will depend on the recommendations that result from the 2023 NMR Group Inc Baseline Practices Study. Baselines may differ by end use; for example, lighting baselines may be higher than code, whereas envelope baselines may be lower than code.

This new study will quantify the market for C&I new construction, identify the percentage of new construction projects that are being captured by the program, as well as the incremental savings achieved, and identify strategies for capturing additional energy efficiency savings. The study will identify program gaps and barriers and will compare the program with similar programs in other states to recommend program refinements. The study will also review the role of electrification in new C&I buildings and identify ways for the NHSaves programs to encourage and quantify savings from use of best practices and highest efficiency while maintaining consistency with the state policy focus on electric savings in the electric portfolio.

Study Outcomes:

- Incremental savings achieved
- Percent of new construction projects captured by program
- Opportunities for capturing additional savings
- Program gaps and Barriers

Special and Cross Cutting Studies:

8. TRM Review

Research Area:	S&CC
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	All
Targeted Start Date:	Q3 2025

Description:

Activity related to this research will include a review of savings estimation approaches, impact factors and other savings assumptions not being updated by formal evaluation. This review should be timed to allow for timely integration into the BC models to allow for filing revisions on or before July 1. New standards, codes, evaluation references, and other relevant information should be incorporated into measure descriptions and inform updates to algorithms and deemed values and be shared for consideration with the EM&V Working Group. The research will include review of TRMs and recent evaluation findings from other jurisdictions, codes and standards updates from state and federal sources, and other relevant information. If time and budget allow, primary research or more in-depth review could be conducted for priority measures or particularly out of date values.

Study outcomes:

- Recommendations to adopt various savings estimation approaches, savings values and impact factors based on a review of the current TRM.

9. Non-Energy Impact Research

Research Area:	S&CC
Type of Study:	Impact
Applicable Fuels:	Both
Program/ Initiative	All
Targeted Start Date:	Q3 2025

Description:

Non-Energy Impacts ("NEIs") include benefits and costs induced by the energy efficiency programs that are not directly related to avoiding energy use. As discussed with the NH Benefit/Cost Working Group, and per Commission Order[1] the NH Utilities are applying non-energy impacts (NEIs) in cost-effectiveness screening as follows:

- The **Primary Granite State Test** reflects low-income participant NEIs, based on New Hampshire-specific primary research on the Home Energy Assistance program.

[1] Docket No. DE 17-136, Order Approving Benefit Cost Working Group Recommendations, No. 26,322, December 30, 2019; Order Approving 2020 Update Plan, No. 26,323, December 31, 2019.

Specifically, based on the HEA evaluation[2],[2] a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project over its 15-year measure life. These NEIs are reflected in the measure chapters for insulation and air sealing.

- The **Secondary Granite State Test** reflects sector-level percentage adders for participant NEIs for the residential (non-low-income) and C&I sectors, based on a review of secondary NEI research from similar jurisdictions, adjusted for New Hampshire-specific economic and other factors and matched to New Hampshire's programs and measures[3]. The test also reflects environmental externality NEIs, based on non-embedded avoided cost values from the AESC. These NEI values are not reflected in the TRM measure chapters. For HEA, the same primary research NEI value is applied in the Secondary Granite State Test as in the Primary Granite State Test.
- Both the **Primary and Secondary Granite State Tests** reflect other resource impacts for water and delivered fuels, as reflected in the TRM measure chapters.

Under the Granite State Test, NEIs are an important component of the income eligible programs given the positive impacts of energy efficiency measures to vulnerable customers beyond the reduction in their energy bill. Improved health outcomes are the most obvious of these, but studies have shown a wide variety of monetizable impacts that can have positive impact on both participating and non-participating customers, including improved air quality, fewer missed days of work and school. In addition, the secondary Granite State Test includes

[2] Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf

[3] DNV-GL. New Hampshire Non-Energy Impacts Database Methodology Memo, April 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Final-NH-NEI-Methodology-Memo-20200409.pdf; New Hampshire Non-Energy Impacts Database, July 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200722-NH-NEI-Draft-Database-NHML-core.xlsm

NEIs related to other residential, commercial, industrial and municipal customers in the calculation of the benefits. Ensuring that the value of improved productivity, health outcomes, operational costs and maintenance are included in the primary and secondary tests leads to a more complete assessment of costs and benefits. This study will focus on the appropriateness of the current adder used in Granite State Test for the HEA program, which is based on weatherized homes only. As the HEA program expands to other measures and approaches, it may be appropriate to reconsider how NEIs are calculated. Additional review of the NEIs applied to all other residential and C&I programs may also be warranted to estimate the value of NEIs more accurately under the secondary Granite State Test.

Study outcome:

- Determine the appropriateness of the current adder used in the Granite state test for the HEA program.

10. Benefits of Load impact and Reduction

Research Area:	S&CC
Type of Study:	Impact / other
Applicable Fuels:	Both
Program/ Initiative	All
Targeted Start Date:	Q1 2024

Description:

Since 2019, Eversource and Unitil's electric divisions have piloted both residential and C&I active demand offerings in New Hampshire marketed under the 'Connected Solutions' name, in sync with their operations in Massachusetts (and for Eversource, in Connecticut, as well). These programs aim to reduce the demand during the annual system peak, which historically has been during the summer season when air conditioning load increases demand on the electric grid. To date, the utilities have not included any programs except those focused on the annual peak.

Avoided Energy Supply Components ("AESC") Studies undertaken every three years have identified only minimal benefits related to either active or passive reductions in winter demand (kW) or reductions in demand during other non-summer off-peak months. This is due to the fact that the development of new generating capacity, and transmission and distribution infrastructure are designed to meet demand for electricity during the summer peak. Given that the AESC study is the basis of vast majority of the avoided cost estimates underpinning the energy efficiency programs, including active demand pilots, and that pursuit of non-peak capacity reductions would not be cost-effective using the current benefit-cost framework, the utilities have designed demand reduction pilot programs to reduce the annual summer peak, and not off-peak or winter peak periods.

This study will attempt to identify more localized and appropriate estimates of cost savings related to demand reduction beyond the annual peak by investigating other NH dockets, as well as other jurisdictions, and ISO-NE forecasts. Identifying these savings may also require additional modeling that does not rely on the AESC study or the existing benefit cost model that supports all energy efficiency programs. By focusing on New Hampshire specific customer or distribution system cost reductions, additional benefits streams could be identified and integrated into the cost benefit analysis and allow for justification of demand reduction efforts beyond the annual peak in New Hampshire. Specifically, there may be opportunity to reduce the monthly cost allocations of Regional Network Service (RNS) and Local Network Service (LNS) for New Hampshire ratepayers, at least in the short term, which could justify deployment of demand management efforts during monthly peaks or other times, which in turn could open up avenues for active demand program expansion.

If there are opportunities found to quantify benefits for programs focused beyond the annual summer peak, the study will seek to determine whether the current offerings, or others that have not been included in the Connected Solutions framework, could be expanded or offered at lower cost than the benefits

Study outcome:

- Estimate cost savings related to peak curtailment beyond the annual summer peak by investigating other NH dockets, as well as other jurisdictions, ISO-NE forecasts or other applicable resources.
- Identify additional benefit streams to integrate into the cost benefit analysis

Emerging Issues:

The energy efficiency market is a fast-changing environment, and changes in purchasing behavior, new technologies and market dynamics influence estimated savings, program design, and program targets. As it is not possible to identify all the projects that will be needed in this term, the EM&V Working Group is reserving studies to address priority emerging issues. These topics may include:

- Research topics resulting from regulatory orders.
- Cross State Study Participation. Opportunities to join a study performed out of another state may arise and allow NH to participate in research for a lower cost. For example, NH is participating in the '2023 Summer C&I Active Demand Reduction Evaluation' with Massachusetts and Connecticut.
- NHSaves Market Assessment: The EM&V Working Group completed a market assessment in 2019 to gain deeper insights into residential customer attitudes and experience to determine whether marketing messaging and approaches were effective and to learn about customer awareness.

Attachment Q. ADR Supporting Details and EM&V Studies

C&I Load Curtailment Baseline Calculation

The baseline will be calculated for each non-holiday weekday interval during the summer cooling season, when the ISO-NE system peak generally occurs. The summer season for purposes of the Utilities' program will be June 1 through September 30th. The only weekday summer holidays are Independence Day and Labor Day. If Independence Day falls on a Saturday, the holiday is observed on Friday, July 3; if the holiday falls on a Sunday, the holiday is observed on Monday, July 5. A CSP or the C&I customer is restricted from taking any action to create or maintain a baseline that exceeds the typical electricity consumption levels that would be expected in the normal course of business for the customer. The program will be designed to minimize this risk and any customer/CSP found to be engaging in this practice will be removed from the program.

If the participating C&I customer produces net supply (i.e., pushes back energy at the retail delivery point) in an interval, that net supply will be used in the baseline calculations for that interval as representative of normal operating practice.

A non-holiday weekday baseline in each interval is equal to the average of the customer's meter data for the same interval from 10 prior non-holiday weekdays, as follows:

- For a customer without a non-holiday weekday baseline, the initial non-holiday weekday baseline will be created using meter data from the first 10 consecutive non-holiday weekdays with a complete set of interval meter data. This interval meter data will either be from a period just prior to the start of the customer's enrollment in the program or for the first 10 consecutive non-holiday weekdays once enrolled in the program. The customer is not permitted to participate in any activation until a baseline can be calculated. This includes activations from ISO-NE dispatch.

- For a customer that has established a non-holiday weekday baseline, the baseline is calculated each day using meter data from:

- the 10 most recent of the previous 30 non-holiday weekdays, excluding days during which: (1) the customer received an activation instruction or (2) the customer was on a facility scheduled shutdown (as described later);
- if there are fewer than 10 such days, then meter data from additional days will be used (until a total of 10 days have been identified) including, first, the most recent days during which the customer received an activation instruction and, second, the most recent days during which the customer was on a facility scheduled shutdown.

A facility scheduled shutdown is a reduction in demand resulting from a scheduled plant shutdown or scheduled maintenance of energy consuming equipment that would have normally responded to a demand response event during the activation period. A scheduled plant shutdown may be no shorter than a single calendar day and the total duration of the scheduled plant shutdown per summer cooling season or winter heating season may not exceed 14 calendar days. A facility in shutdown will not have those days counted toward baseline unless the requisite 10 days cannot be met with days with normal operations. Only the first day of a scheduled plant shutdown may be counted as performance during a program dispatch. Additional days in shutdown will not count towards positive performance.

List of ADR EM&V Studies

These studies assessed NH-specific initiatives and the results can be applied directly to inform program planning in NH.

- Cross State C&I Active Demand Impact – Summer 2019
  - This is a regional study of the C&I active demand reduction initiatives in Massachusetts, New Hampshire, and Connecticut. The key objectives are to assess program impact and identify process improvement opportunities. For NH, the study used NH specific data in Summer 2019 and provided load reduction estimates during event hours at the statewide and by PA (Eversource and Until). The study included participant surveys to assess customer satisfaction, challenges and customer experience. The survey results are also provided by state to understand customer experience and identify opportunities to improve program delivery.

- C&I Active Demand Impact – Summer 2023
  - This is a follow-up study to assess the impact generated by the ADR initiatives during Summer 2023 and includes NH ADR pilot. Study results will supplement learnings from the Summer 2019 ADR study. This study includes a process evaluation component to understand the customer experience, barriers to implementation, and PA and vendor

success in program delivery. The study is in progress and final report is expected on 2024 Q2

Studies in other New England states:

While the studies did not assess NH-specific programs, the studies document ADR performance, success and challenges seen in other states in New England. Several DR-enabled technologies like thermostats and EV chargers are being deployed in the same way across different states. NH can leverage experience and lessons learned from ADR studies in other states when designing ADR offerings. When applying results to NH, it is important to account for known similarities and differences between populations, programs, and implementation.

- MA Residential Thermostat DLC Impacts – 2019
    - The study assessed residential DR programs in MA and CT. NH has a similar initiative targeting customers with Wi-Fi thermostats and central ACs. This study provides insights on the following:
        - Customer experience/feedback to help improve program design
        - Motivations for participation
        - Opt-out rates and reasons for opting out of events
        - DR impacts
- MA C&I Demand Impact – Summer 2021
    - This is a C&I Active Demand Impact follow-up study to assess MA and CT ADR performance in Summer 2021. The key objectives are to assess program impact and identify process improvement opportunities.

- Other recent DR studies performed in MA and/or CT
    - CT DR Program summary – 2022
        - This study assessed a portfolio of DR initiatives offered by Avangrid (residential thermostat DR, Wi-Fi-enabled Heat Pump Water Heaters DR, C&I Auto RR) and Eversource (Wi-fi Air Conditioners DR) in Connecticut. NH can consider the study results when exploring other measures to include as part of its DR initiative.
    - Cost-Effectiveness of Active Demand Response for Residential End-Uses
        - This study assessed potential load reduction and cost-effectiveness of ADR for DR-enabled appliances (room AC, dehumidifier, heat pump water heater, electric resistance water heater and pool pump. NH can consider the study results when exploring other measures to include as part of its DR initiative.
    - MA Integrating DR and EE offerings – 2022
        - This study assessed how other PAs (outside of MA) are approaching DR and EE integration to help inform the strategy in MA.
    - MA EV Managed Charging Comparison Study – 2022
        - This study assessed EV managed charging offerings aimed to curtail EV charging during peak times. The managed charging initiatives includes Eversource EVSE DLC, National Grid's EV DLC and Eversource Off-Peak Charging offerings. The study provides a comparison of the designs, impacts, and customer acceptance and satisfaction between offerings. NH can consider the study when exploring other measures to include as part of its DR initiative.

- Eversource Electric Vehicle Supply Equipment Direct Load Control Demonstration Evaluation– 2022
  - This study assessed Eversource Off-Peak Charging offering. The study provided analysis and results on a variety of different topics such as customer experiences, charging characteristics, motivations for enrollment, and driving and charging behavior. This evaluation also included both CT and MA, which speaks to the applicability of providing findings and analysis across multiple states.

Avoided Energy Supply Components in New England: 2021 Report

Prepared for AESC 2021 Study Group

Released March 15, 2021
Amended May 14, 2021

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AMENDMENTS TO THE AESC 2021 STUDY

This is the second public release of the AESC 2021 Study. This document updates and amends the version originally released on March 15, 2021. The following text summarizes these changes.

- Text in Chapter 12: *Sensitivity Analysis* is now populated. Corresponding text was added to the executive summary (in the subsection titled "Sensitivities").
- We updated text in Chapter 2: *Avoided Natural Gas Costs* related to the calculation of the medium-term Henry Hub natural gas price forecast. Text in the March 15 edition referred to a methodology used in earlier drafts. This text has now been updated to reflect our final methodology. We also modified text in the natural gas section of the Executive Summary to reflect this update. We note that these are changes to the text only; all of the modeled avoided costs are unchanged.
- We clarified which avoided transmission and distribution (T&D) costs are included in summary tables like ES-Table 1. These tables only included avoided T&D costs related to pooled transmission facilities (PTF) and do not include non-PTF avoided T&D costs or avoided costs related to local T&D systems.
- We made a cosmetic correction to the Y-axis in Figure 17.
- In Section 8.1. *Non-embedded GHG costs*, the paragraph that begins with "In AESC 2018, the cost of avoided CO_2 was reported to be $68 per short ton…" was edited for clarity.
- We corrected a typographical error in Table 56 so that the "CES-E" program correctly refers to Massachusetts, rather than Maine.
- Numbering of figures, tables, footnotes, and pages has changed due to the inclusion of new text in Chapter 12: *Sensitivity Analysis* and other edits throughout the document.
- We have corrected a formula error in each of the AESC 2021 User Interface workbooks, on the sheet named "NonEmbedded_Calcs." In practical terms, this increases the non-embedded GHG cost for Vermont (assuming a New England marginal abatement cost-basis) by 1 percent. There are no other changes to other regions. No updates were required to tables or text in this document.

There are no further amendments, notes, or errata at this time.

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List of Acronyms

AESC	Avoided energy supply component/ cost
AEO	Annual Energy Outlook
Bcf	Billion cubic feet
CAGR	Compound annual growth rate
CEC	Clean Energy Certificate
CES	Clean Energy Standard
CCS	Carbon capture and sequestration
DOER	Massachusetts Department of Energy Resources
DRIPE	Demand reduction induced price effects
EIA	U.S. Energy Information Administration
FCA	Forward capacity auction
FCM	Forward capacity market
GWSA	Global Warming Solutions Act
HDD	Heating degree day
IPCC	Intergovernmental Panel on Climate Change
ISO	Independent system operator
LDC	Local distribution company
LMP	Locational marginal price
LNG	Liquefied natural gas
LSE	Load-serving entity
MMcf	Million cubic feet
Net ICR	Net installed capacity requirement
PTF	Pool transmission facilities
REC	Renewable energy certificate
RGGI	Regional Greenhouse Gas Initiative
RNG	Renewable natural gas
RPS	Renewable portfolio standard
VoLL	Value of lost load

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1. EXECUTIVE SUMMARY

This document is the 2021 Avoided Energy Supply Component (AESC) Study (AESC 2021). AESC 2021 contains cost streams of marginal energy supply components that can be avoided in future years due to reductions in the use of electricity, natural gas, and other fuels as a result of program-based energy efficiency or other demand-side measures across all six New England states.

The AESC Study provides estimates of avoided costs associated with energy efficiency measures for program administrators throughout New England states for purposes of both internal decision-making and regulatory filings. To determine the values of energy efficiency and other demand-side measures, avoided costs are calculated and provided for each New England state in a hypothetical future in which the New England program administrators do not install any new demand-side measures in 2021 or later years. New to this year's study, AESC 2021 features four different counterfactuals:

- **Counterfactual #1:** A future in which program administrators install no new energy efficiency, building electrification, or active demand management (demand response and energy storage) resources in 2021 or later years.
- **Counterfactual #2:** A future in which program administrators install no new building electrification resources in 2021 or later years. This future does model some amount of energy efficiency and active demand management resources installed by the program administrators.
- **Counterfactual #3:** A future in which program administrators install no new energy efficiency resources in 2021 or later years. This future does model some amount of building electrification and active demand management resources installed by the program administrators.
- **Counterfactual #4:** A future in which program administrators install no new energy efficiency resources in 2021 or later years. This future does model some amount of building electrification installed by the program administrators but does not include any active demand management resources installed by the program administrators.

Because each AESC counterfactual represents a hypothetical future that lacks some amount of anticipated demand-side measures, AESC 2021 should not be used to infer information about actual future market conditions, energy prices, or resource builds in New England. Furthermore, actual prices in the future will be different than the long-term prices calculated in this study since actual future prices will be subject to short-term variations in energy markets that are unknowable at this point in time. Note also that these caveats may also apply to sensitives modeled in the AESC 2021 Study (see Chapter 12 for more information).

As in previous AESC studies, this study examines avoided costs of energy, capacity, natural gas, fuel oil, other fuels, other environmental costs, and demand reduction induced price effects (DRIPE). Also, AESC 2021 relies upon a combination of models to estimate each one of these avoided costs for each future year. As in AESC 2018, this study provides avoided energy costs on an hourly basis. This allows users of the report to estimate avoided costs specific to a broad array of active demand response programs, including active load management and peak load shifting programs. Other avoided costs (e.g., natural gas, fuel oil) are provided at the time resolutions that are most appropriate for their markets (e.g., daily, seasonal, or annual).

On a 15-year levelized basis, in real 2021 dollars, the AESC 2021 Study estimates that direct avoided retail energy costs are approximately 4 cents per kWh for Counterfactual #1, and direct avoided gas costs are $6 per MMBtu, although these vary on the specific location and end-use. Compared to 2018 AESC, we find:

- Generally lower avoided costs of energy, due to sustained low natural gas prices at national hubs, lower estimated costs of complying with the Regional Greenhouse Gas Initiative (RGGI), and increased quantities of zero-marginal-cost renewables.
- Generally lower avoided costs of capacity due to a relatively flat supply curve based on observations of recent forward capacity auctions.
- Generally lower avoided costs of natural gas, based on lower long-term projections of wholesale natural gas prices. Avoided natural gas costs for retail end-users are also lower than in AESC 2018; but because incremental gas pipeline expansion costs are assumed to be higher, the change in avoided costs at the end-user level is not as large as the reduction in gas commodity prices.
- Generally higher avoided costs for fuel oil and other fuels, due to updates to recent historical data in the underlying sources in the sources used to calculate these values.
- Generally higher avoided costs for renewable portfolio standard (RPS) compliance. This is primarily due to recent (or anticipated) increases in RPS target obligations combined with expected increases in load due to electrification.
- Lower energy DRIPE and capacity DRIPE values, due to changes in utility long-term energy purchases, updated market data, and new commodity forecasts. Natural gas DRIPE and oil DRIPE values are also lower due to similar changes.
- Both higher and lower non-embedded costs for environmental regulations that are not otherwise included in the above projections (e.g., carbon dioxide, CO_2, and nitrogen oxides, NO_X) depending on the approach used to calculate this number. AESC 2021 presents a number of different non-embedded costs for use in different state policy contexts.
- Lower avoided costs for pooled transmission facility (PTF) costs, as a result of a switch to a forward-looking methodology (AESC 2018 utilized a historical methodology). AESC 2021 also presents additional methodologies for quantifying localized and non-PTF transmission and distribution avoided costs.
- Generally lower avoided costs for reliability, due to a flatter supply capacity market supply curve. This is in spite of a higher estimate for value of lost load (VoLL), determined through newly available data sources.

AESC 2021 provides detailed projections of avoided costs by year for an initial 15-year period based on modeling (2021 through 2035), and a second period based on extrapolation of values from this first period (2036 through 2055).[1] All values in this document are described in terms of real 2021 dollars, unless noted otherwise. In many cases, we provide 15-year (2021–2035) levelized values of avoided costs for ease of reporting and comparison with earlier AESC studies. See Appendix E: *Common Financial Parameters* for more information on financial parameters used in this analysis.

1.1. Background to the AESC Study

As in previous AESC studies, the AESC 2021 Study was sponsored by a group of electric and gas utilities and other efficiency program administrators (together, referred to as program administrators). The study sponsors, along with other parties (including representatives from state governments, consumer advocacy organizations, and environmental advocacy organizations and their consultants) formed a Study Group to oversee the design and production of the analysis and report.

Study sponsors for the AESC 2021 Study include: Berkshire Gas Company, Cape Light Compact, Liberty Utilities, National Grid USA, Eversource (Connecticut Light and Power, NSTAR Electric and Gas Company, Western Massachusetts Electric Company, Public Service Company of New Hampshire, and Yankee Gas), New Hampshire Electric Co-op, Columbia Gas of Massachusetts, Unitil (Fitchburg Gas and Electric Light Company, Unitil Energy Systems, Inc. and Northern Utilities), United Illuminating, Southern Connecticut Gas and Connecticut Natural Gas, Efficiency Maine, and the State of Vermont. Other parties represented in the Study Group include: Acadia Center, Connecticut Department of Energy and Environmental Protection, Connecticut Energy Efficiency Board, Maine Public Utilities Commission, Massachusetts Energy Efficiency Advisory Council, Massachusetts Clean Energy Center, Massachusetts Department of Public Utilities, Massachusetts Department of Energy Resources, Massachusetts Department of Environmental Protection, Massachusetts Attorney General, Massachusetts Low-Income Energy Affordability Network (LEAN), New Hampshire Office of Consumer Advocate, New Hampshire Public Utilities Commission, Rhode Island Division of Public Utilities and Carriers, Rhode Island Energy Efficiency and Resource Management Council, Rhode Island Office of Energy Resources, Vermont Department of Public Service, and Vermont Energy Investment Corporation / Efficiency Vermont.

After developing the scope for the 2021 study, the study sponsors selected Synapse Energy Economics (Synapse) as the lead contractor of the study. Synapse was joined by subcontractors Resource Insight, Sustainable Energy Advantage, Les Deman Consulting, and North Side Energy (together, the Synapse Team).

[1] This extrapolation is described in detail in Appendix A: *Usage Instructions*.

1.2. Summary of avoided costs

The following section provides a summary of the avoided costs for each category of costs calculated under the AESC 2021 Study. These categories include costs that can be applied to energy efficiency measures that avoid electricity (energy, capacity, DRIPE, RPS, etc.) while others are related to energy efficiency measures that avoid other types of energy consumption. ES-Table 1 provides an illustration of summer on-peak avoided cost components for electricity for the West/Central Massachusetts (WCMA) zone for Counterfactual #1, and how these components compare to the avoided costs from the previous AESC 2018 study for informational purposes. ES-Table 2, ES-Table 3, and ES-Table 4 provide analogous comparative information for Counterfactuals #2, #3, and #4, respectively.

In general, the Synapse Team finds that lower wholesale natural gas prices drive lower avoided energy costs, relative to AESC 2018. We also find that avoided cost of RPS compliance in AESC 2021 are generally higher than those projected in AESC 2018. This is primarily due to recent (or anticipated) increases in RPS target obligations combined with expected increases in load due to electrification). We find that projections of flatter supply curves in future years cause avoided capacity, energy DRIPE, and capacity DRIPE values to be lower.

Note that comparisons between 15-year levelized costs in AESC 2021 and AESC 2018 are not directly "apples-to-apples." While both calculations display levelized costs over 15 years (in real 2021 dollars), each levelization calculation is done over two different 15-year periods (2018 to 2032 for AESC 2018, and 2021 to 2035 for AESC 2021). Assumptions on prices and loads aside, the time periods spanned by each of these levelization calculations may contain fundamentally different data on the New England electric system, including differences in terms of online units and market rules.

ES-Table 1. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 Counterfactual #1 versus AESC 2018

	AESC 2018	AESC 2018	AESC 2021	AESC 2021, relative to AESC 2018		Notes
	2018 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	2.00	2.11	1.18	-0.93	-44%	*3,4,5,6*
Avoided Retail Energy Costs	5.05	5.32	3.85	-1.48	-28%	*5,7,8*
Avoided RPS Compliance	0.39	0.41	1.28	0.86	208%	*5,7,9*
Subtotal: Capacity and Energy	**7.48**	**7.85**	**6.30**	**-1.55**	**-20%**	
GHG non-embedded	**2.69**	**2.83**	**4.74**	**1.91**	**67%**	*5,10*
NO_X non-embedded	**0.18**	**0.19**	**0.08**	**-0.11**	**-55%**	*5*
Transmission & Distribution (PTF)	**2.26**	**2.38**	**2.02**	**-0.36**	**-15%**	*3,5,11*
Value of Reliability	**0.02**	**0.02**	**0.01**	**-0.01**	**-32%**	*3,5,6,12*
Electric capacity DRIPE	0.97	1.03	0.41	-0.62	-60%	*5,6*
Electric energy and cross-DRIPE	2.08	2.19	1.20	-0.99	-45%	*5,7,13*
Subtotal: DRIPE	**3.05**	**3.22**	**1.61**	**-1.60**	**-50%**	**-**
Total	**15.68**	**16.49**	**14.77**	**-1.72**	**-10%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars unless otherwise stated.
2. AESC 2018 data is from ES-Table 1 in AESC 2018. AESC 2018 values levelized (2018-2032) escalated with a factor of 1.05 to convert 2018 dollars to 2021 dollars. We observe that the total cost in AESC 2018 was 16.05 cents per kWh in 2018 dollars or 16.91 cents per kWh in 2021 dollars.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2018 cost (2018 $/kW-year) of $83/kW-year
AESC 2021 cost (2021 $/kW-year) of $49/kW-year
5. Includes T&D loss adjustments of:
9.0% for energy
16.0% for peak demand
These adjustments are also applied to AESC 2018 values, some of which used an 8% T&D loss factor in that study's ES-Table 1
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $33/MWh
9. Avoided RPS compliance cost of $12/MWh
10. Assumes non-embedded GHG cost based on New England MAC (electric sector)
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year. This value does not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.47/kW-year, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. In both AESC 2018 and AESC 2021, these DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.

ES-Table 2. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 Counterfactual #2 versus AESC 2018

	AESC 2018	AESC 2018	AESC 2021	AESC 2021, relative to AESC 2018		Notes
	2018 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	2.00	2.11	1.16	-0.95	-45%	*3,4,5,6*
Avoided Retail Energy Costs	5.05	5.32	3.63	-1.69	-32%	*5,7,8*
Avoided RPS Compliance	0.39	0.41	0.98	0.56	136%	*5,7,9*
Subtotal: Capacity and Energy	**7.48**	**7.85**	**5.77**	**-2.08**	**-26%**	
GHG non-embedded	**2.69**	**2.83**	**5.08**	**2.25**	**79%**	*5,10*
NO_X non-embedded	**0.18**	**0.19**	**0.08**	**-0.11**	**-55%**	*5*
Transmission & Distribution (PTF)	**2.26**	**2.38**	**2.02**	**-0.36**	**-15%**	*3,5,11*
Value of Reliability	**0.02**	**0.02**	**0.01**	**-0.01**	**-33%**	*3,5,6,12*
Electric capacity DRIPE	0.97	1.03	0.39	-0.64	-62%	*5,6*
Electric energy and cross-DRIPE	2.08	2.19	1.08	-1.11	-51%	*5,7,13*
Subtotal: DRIPE	**3.05**	**3.22**	**1.47**	**-1.75**	**-54%**	**-**
Total	**15.68**	**16.49**	**14.43**	**-2.05**	**-12%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars unless otherwise stated.
2. AESC 2018 data is from ES-Table 1 in AESC 2018. AESC 2018 values levelized (2018-2032) escalated with a factor of 1.05 to convert 2018 dollars to 2021 dollars. We observe that the total cost in AESC 2018 was 16.05 cents per kWh in 2018 dollars or 16.91 cents per kWh in 2021 dollars.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2018 cost (2018 $/kW-year) of $83/kW-year
AESC 2021 cost (2021 $/kW-year) of $48/kW-year
5. Includes T&D loss adjustments of:
9.0% for energy
16.0% for peak demand
These adjustments are also applied to AESC 2018 values, some of which used an 8% T&D loss factor in that study's ES-Table 1
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $31/MWh
9. Avoided RPS compliance cost of $9/MWh
10. Assumes non-embedded GHG cost based on New England MAC (electric sector)
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year. This value does not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.46/kW-year, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. In both AESC 2018 and AESC 2021, these DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.

ES-Table 3. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 Counterfactual #3 versus AESC 2018

	AESC 2018	AESC 2018	AESC 2021	AESC 2021, relative to AESC 2018		*Notes*
	2018 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	2.00	2.11	1.22	-0.88	-42%	*3,4,5,6*
Avoided Retail Energy Costs	5.05	5.32	3.92	-1.40	-26%	*5,7,8*
Avoided RPS Compliance	0.39	0.41	1.40	0.98	237%	*5,7,9*
Subtotal: Capacity and Energy	**7.48**	**7.85**	**6.54**	**-1.31**	**-17%**	
GHG non-embedded	**2.69**	**2.83**	**4.68**	**1.85**	**65%**	*5,10*
NO_X non-embedded	**0.18**	**0.19**	**0.08**	**-0.11**	**-55%**	*5*
Transmission & Distribution (PTF)	**2.26**	**2.38**	**2.02**	**-0.36**	**-15%**	*3,5,11*
Value of Reliability	**0.02**	**0.02**	**0.01**	**-0.01**	**-32%**	*3,5,6,12*
Electric capacity DRIPE	0.97	1.03	0.41	-0.62	-60%	*5,6*
Electric energy and cross-DRIPE	2.08	2.19	1.21	-0.98	-45%	*5,7,13*
Subtotal: DRIPE	**3.05**	**3.22**	**1.62**	**-1.60**	**-50%**	**-**
Total	**15.68**	**16.49**	**14.96**	**-1.52**	**-9%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars unless otherwise stated.
2. AESC 2018 data is from ES-Table 1 in AESC 2018. AESC 2018 values levelized (2018-2032) escalated with a factor of 1.05 to convert 2018 dollars to 2021 dollars. We observe that the total cost in AESC 2018 was 16.05 cents per kWh in 2018 dollars or 16.91 cents per kWh in 2021 dollars.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2018 cost (2018 $/kW-year) of $83/kW-year
AESC 2021 cost (2021 $/kW-year) of $51/kW-year
5. Includes T&D loss adjustments of:
9.0% for energy
16.0% for peak demand
These adjustments are also applied to AESC 2018 values, some of which used an 8% T&D loss factor in that study's ES-Table 1
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $33/MWh
9. Avoided RPS compliance cost of $13/MWh
10. Assumes non-embedded GHG cost based on New England MAC (electric sector)
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year. This value does not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.47/kW-year, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. In both AESC 2018 and AESC 2021, these DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.

ES-Table 4. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 Counterfactual #4 versus AESC 2018

	AESC 2018	**AESC 2018**	**AESC 2021**	**AESC 2021, relative to AESC 2018**		***Notes***
	2018 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	2.00	2.11	1.22	-0.89	-42%	*3,4,5,6*
Avoided Retail Energy Costs	5.05	5.32	3.90	-1.42	-27%	*5,7,8*
Avoided RPS Compliance	0.39	0.41	1.40	0.98	237%	*5,7,9*
Subtotal: Capacity and Energy	**7.48**	**7.85**	**6.52**	**-1.33**	**-17%**	
GHG non-embedded	**2.69**	**2.83**	**4.69**	**1.86**	**66%**	*5,10*
NO_X non-embedded	**0.18**	**0.19**	**0.08**	**-0.11**	**-55%**	*5*
Transmission & Distribution (PTF)	**2.26**	**2.38**	**2.02**	**-0.36**	**-15%**	*3,5,11*
Value of Reliability	**0.02**	**0.02**	**0.01**	**-0.01**	**-32%**	*3,5,6,12*
Electric capacity DRIPE	0.97	1.03	0.41	-0.62	-60%	*5,6*
Electric energy and cross-DRIPE	2.08	2.19	1.21	-0.98	-45%	*5,7,13*
Subtotal: DRIPE	**3.05**	**3.22**	**1.62**	**-1.60**	**-50%**	**-**
Total	**15.68**	**16.49**	**14.94**	**-1.54**	**-9%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars unless otherwise stated.
2. AESC 2018 data is from ES-Table 1 in AESC 2018. AESC 2018 values levelized (2018-2032) escalated with a factor of 1.05 to convert 2018 dollars to 2021 dollars. We observe that the total cost in AESC 2018 was 16.05 cents per kWh in 2018 dollars or 16.91 cents per kWh in 2021 dollars.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2018 cost (2018 $/kW-year) of $83/kW-year
AESC 2021 cost (2021 $/kW-year) of $50/kW-year
5. Includes T&D loss adjustments of:
9.0% for energy
16.0% for peak demand
These adjustments are also applied to AESC 2018 values, some of which used an 8% T&D loss factor in that study's ES-Table 1
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $33/MWh
9. Avoided RPS compliance cost of $13/MWh
10. Assumes non-embedded GHG cost based on New England MAC (electric sector)
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year. This value does not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.47/kW-year, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. In both AESC 2018 and AESC 2021, these DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.

Natural gas

At a high level, AESC 2021 assumes that Henry Hub natural gas prices are lower, and stay lower longer, relative to the assumptions used in AESC 2018. The levelized price basis for the New England market, as measured by the Algonquin Citygate price, is also lower.

On a 15-year levelized basis (see ES-Table 5), AESC 2021 projects a Henry Hub price of $3.15 per MMBtu (levelized over 2021 to 2035), 34.0 percent lower than the AESC 2018 value of $4.78 per MMBtu (levelized over 2018 to 2032). We attribute the decrease in Henry Hub prices to higher volumes of associated gas production and another downward adjustment in breakeven drilling and operating costs in the major shale and tight gas producing regions compared to AESC 2018.[2] Breakeven costs have been on a downward trend as a result of improvements in horizontal drilling technology and better information on the geology and geophysics of shale reservoirs.[3] Algonquin Citygate Hub prices show a slightly larger decline because the basis projections are lower in AESC 2021 (a smaller differential to Henry Hub) as a result of additional pipeline capacity and changing pricing dynamics between northeast and Gulf Coast gas markets.

ES-Table 5. Summary of 15-year levelized Henry Hub, Algonquin Citygate, and basis differentials for AESC 2021 and AESC 2018

	Units	Henry Hub	Algonquin Citygates	Basis
AESC 2018 (2018–2032)	2021 $/MMBtu	$4.78	$6.59	$1.24
AESC 2021 (2021–2035)	2021 $/MMBtu	$3.15	$4.20	$1.05
Percent change	%	-34.0%	-36.2%	-

Notes: All values are in 2021 $/MMBtu. AESC 2018 levelized costs are for 15 years (2018–2032) at a discount rate of 1.34 percent. AESC 2018 levelized costs are for 15 years (2021–2035) at a discount rate of 0.81 percent.

The avoided costs of natural gas for retail customers are summarized below (see ES-Table 6). For both southern New England and northern New England avoided natural gas costs are lower in AESC 2021 compared to AESC 2018, but because pipeline expansion costs are assumed to be higher, the change in avoided costs is not as large as the reduction in wholesale commodity prices. Northern New England avoided costs remain slightly lower relative to southern New England because natural gas delivered through Canada has become a significant marginal resource, as new pipeline capacity from the Marcellus Shale region has reduced the Dawn Hub price basis compared to the Henry Hub. Since the northern New England market is closer to this source of supply, the avoidable pipeline delivery cost is lower than it is for southern New England. For Vermont (not shown in ES-Table 6) avoided natural gas costs are also lower than in AESC 2018 because of lower projected natural gas prices at the Dawn Hub.

[2] Associated gas is essentially a byproduct in the production of crude oil. This gas will be produced (or flared) as long as oil production is economic, irrespective of the price of natural gas.

[3] U.S. Energy Information Administration (EIA). "Drilling Productivity Report." https://www.eia.gov/petroleum/drilling/. February 16, 2021.

ES-Table 6. Avoided costs of gas for all retail customers by end-use assuming no avoidable margin

	Units	Southern New England	Northern New England
AESC 2018 (2018–2032)	2021 $/MMBtu	$7.91	$7.57
AESC 2021 (2021–2035)	2021 $/MMBtu	$6.48	$6.39
Percent change	%	-18%	-16%

Note: AESC also calculates the avoided cost of gas for retail customers assuming some avoidable margin, and avoided costs for customers in Vermont. This additional detail is described in Chapter 0:

Avoided Natural Gas Costs.

ES-Table 8 compares the natural gas avoided costs described in ES-Table 6 with a non-embedded cost for GHGs. For consistency with ES-Table 1 and other similar tables, the non-embedded GHG cost shown here is the marginal abatement cost derived from the New England electric sector. We observe that the non-embedded GHG cost is roughly equal to the avoided cost of natural gas, which matches our observations in ES-Table 1, where the non-embedded cost is slightly greater than the avoided cost of energy.

ES-Table 7. Avoided costs of gas, with and without non-embedded GHG cost

	Units	Southern New England	Northern New England
Avoided cost (from ES-Table 6)	2021 $/MMBtu	$6.48	$6.39
Non-embedded GHG cost	2021 $/MMBtu	$7.32	$7.32
Avoided cost with non-embedded GHG cost	2021 $/MMBtu	$13.80	$13.71

Note: Avoided costs differ depending on region, and whether or not retail margins are included. The "non-embedded GHG cost" shown here is the marginal abatement cost derived from the New England electric sector.

Fuel oil and other fuels

In general, we find that avoided levelized costs for residential fuel oil and other fuels are generally higher than was estimated in AESC 2018, except for the levelized costs for commercial residual fuel oil and biofuels which are lower than was estimated in AESC 2018. The primary sources of these differences are changes in historical prices from the State Energy Data System (SEDS) and changes in the projected price of crude oil, which underlies many of the cost projections. ES-Table 8 displays the levelized avoided fuel costs for AESC 2021. New in AESC 2021 are avoided cost projections for motor gasoline and motor diesel.

ES-Table 8. Avoided costs of retail fuels (15-year levelized, 2021 $ per MMBtu)

	Residential						Commercial		Transportation	
	No. 2 Distill-ate	Pro-pane	Kero-sene	Bio-Fuel (B20)	Cord Wood	Wood Pellets	No. 2 Distillate	No. 6 Resid-ual	Motor Gasoline	Motor Diesel
AESC 2018	$23.36	$32.78	$20.95	$24.06	$14.12	$22.76	$19.46	$17.13	-	-
AESC 2021	$24.04	$38.79	$29.59	$21.64	$20.84	$22.47	$22.25	$15.74	$22.07	$22.76
Percent change	2.9%	18.3%	41.3%	-10.1%	47.6%	-1.3%	14.3%	-8.2%	-	-

The retail fuels avoided costs for AESC 2021 are similar to those of AESC 2018 for distillate fuels. The more significant differences between AESC 2021 and AESC 2018 observed in other fuels are primarily driven by changes in the starting prices based on recent historical data. There have been significant residential price increases for propane in recent years, perhaps associated with distribution costs. For non-wood products, AESC 2021 starts with the 2018 New England fuel prices in the U.S. Energy Information Administration (EIA) State Energy Data System (SEDS). It then makes adjustments to match the most recent national prices from the EIA Short Term Energy Outlook (STEO). For the near term, fuel oil prices follow the STEO's crude oil price forecast for 2021. Meanwhile, for 2022 and later years, we rely on projections in the AEO 2021 Reference case. For biofuels, the B20 blend shown in the table is discounted at about 10 percent below distillate. All sector propane prices are consistently higher than distillate prices for all years in SEDS.

For residential wood fuels, AESC 2021 surveyed various state energy sources, which gave much higher cord wood prices than those used in AESC 2018. Wood pellet prices were however about the same. Wood prices are then projected to increase in the future following the trend in crude oil prices reflecting competitive market factors.

Capacity

AESC 2021 develops capacity prices for annual commitment periods starting in June 2021 under each of the four counterfactuals (see ES-Table 9). The capacity prices (and resulting avoided capacity costs) are driven by actual and forecast clearing prices in ISO New England's Forward Capacity Market (FCM). The forecast capacity prices are based on the experience in recent auctions and expected changes in demand, supply, and market rules. These prices are applied differently for cleared resources, non-cleared energy efficiency, and non-cleared demand response.

On a 15-year levelized basis, Counterfactual #1 of the AESC 2021 forecast is 47 percent lower than what was estimated as a 15-year levelized price in the 2018 AESC study. Counterfactual #2 is 48 percent lower, while Counterfactual #3 and #4 are both 45 percent lower. In general, Counterfactual #2 has lower capacity prices due to a lower projection of load, while Counterfactuals #1, #3, and #4 feature relatively similar capacity prices, due to similar projections of annual loads. Market-clearing prices in the out-years are principally determined by future changes in supply (including additions of battery storage, solar, wind, and occasionally new natural gas-fired power plants; as well as and retirements of thermal generation) and future changes in demand. Small year-on-year variations are due to changes in load, new resources coming online, and other resources retiring.

ES-Table 9. AESC 2018 capacity prices (2021 $ per kW-month)

Commitment Period (June to May)	FCA	Actual	Actual but for post-2020 EE	AESC 2021				AESC 2018
				Counter-factual #1	Counter-factual #2	Counter-factual #3	Counter-factual #4	
2021/2022	12	$4.63	$4.77	$4.77	$4.63	$4.77	$4.77	$4.99
2022/2023	13	$3.73	$3.96	$3.96	$3.73	$3.96	$3.96	$5.10
2023/2024	14	$1.92	$2.47	$2.47	$1.92	$2.47	$2.47	$5.21
2024/2025	15	$2.46	$2.75	$2.75	$2.46	$2.75	$2.75	$5.50
2025/2026	16			$2.72	$2.69	$2.59	$2.59	$5.95
2026/2027	17			$2.88	$2.69	$2.75	$2.75	$6.46
2027/2028	18			$3.11	$3.33	$3.46	$3.43	$6.95
2028/2029	19			$3.30	$3.30	$3.65	$3.62	$7.45
2029/2030	20			$3.59	$3.41	$3.94	$3.92	$7.95
2030/2031	21			$3.42	$3.77	$3.97	$3.94	$6.95
2031/2032	22			$3.67	$3.81	$3.79	$3.77	$7.45
2032/2033	23			$3.90	$3.86	$4.02	$3.99	$7.95
2033/2034	24			$3.86	$4.02	$3.95	$3.92	$6.95
2034/2035	25			$4.67	$4.47	$5.09	$4.95	$7.45
2035/2036	26			$3.66	$3.86	$3.73	$3.71	$7.95
15-year levelized cost				**$3.51**	**$3.45**	**$3.65**	**$3.63**	**$6.63**
Percent difference				**-47%**	**-48%**	**-45%**	**-45%**	

Notes: Levelization periods are 2021/2022 to 2035/2036 for AESC 2021 2018/2019 to 2032/2033 for AESC 2018. Real discount rate is 0.81 percent for AESC 2021 and 1.34 percent for AESC 2018.

Energy

AESC 2021 modeling results feature a lower ratio of summer peak prices to the annual average compared to previous AESC studies. This difference can be attributed to: (1) increased levels of solar generation, which are largely coincident with this period and which have a marginal cost of zero dollars per MWh, (2) difference in month-to-month wholesale gas costs (which are driven by new recent historical data on month-to-month gas costs), and (3) higher levels of zero-marginal cost imports. These are the same factors that drove the change in energy prices in AESC 2015 and AESC 2018.

ES-Table 10 shows levelized costs (over 15 years) for the WCMA reporting region. Prices are shown for all hours, and for the four conventional AESC costing periods. On an annual average basis, the 15-year levelized prices in Counterfactual #1 of the AESC 2021 study are 20 percent lower than the prices modeled in the 2018 AESC study. Key drivers of these lower prices include lower Henry Hub natural gas prices, lower RGGI prices, more low- or zero-variable operating cost renewables (caused by changes to the RPS in states like Connecticut and Rhode Island), and the addition of a new transmission line from Canada. Note that these factors are not listed in a particular order. Energy prices observed in other counterfactuals are similar to Counterfactual #1. Counterfactual #2 features the largest divergence, as a result of its lower projection of load. This decrease is larger than the change in avoided energy costs observed between the 2015 AESC study and the 2018 AESC study.

ES-Table 10. Comparison of energy prices for WCMA region (2021 $ per MWh, 15-year levelized)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2018	$51.17	$58.66	$54.17	$45.22	$38.69
AESC 2021 Counterfactual 1	$40.85	$46.86	$45.20	$32.67	$29.86
AESC 2021 Counterfactual 2	$37.79	$42.98	$41.66	$30.87	$27.95
AESC 2021 Counterfactual 3	$41.34	$47.43	$45.63	$33.28	$29.93
AESC 2021 Counterfactual 4	$41.29	$47.40	$45.62	$33.17	$29.87
Pcnt Change: Counterfactual 1	-20%	-20%	-17%	-28%	-23%
Pcnt Change: Counterfactual 2	-26%	-27%	-23%	-32%	-28%
Pcnt Change: Counterfactual 3	-19%	-19%	-16%	-26%	-23%
Pcnt Change: Counterfactual 4	-19%	-19%	-16%	-27%	-23%

Notes: All prices have been converted to 2021 $ per MWh. Levelization periods are 2018–2032 for AESC 2018 and 2021–2035 for AESC 2021. The real discount rate is 1.34 percent for AESC 2018 and 0.81 percent for AESC 2021. Prices are wholesale.

ES-Table 11 compares 15-year levelized costs between AESC 2018 and AESC 2021 for each of the six New England states, for Counterfactual #1. These values incorporate the relevant costs of RPS compliance, as well as a wholesale risk premium.

ES-Table 11. Avoided energy costs, AESC 2021 vs. AESC 2018 (15-year levelized costs, 2021 $ per kWh)

			Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2021 Counterfactual 1	1	Connecticut	$0.059	$0.057	$0.043	$0.040
	2	Massachusetts	$0.062	$0.060	$0.047	$0.044
	3	Maine	$0.057	$0.056	$0.042	$0.039
	4	New Hampshire	$0.058	$0.057	$0.043	$0.040
	5	Rhode Island	$0.065	$0.064	$0.050	$0.047
	6	Vermont	$0.054	$0.053	$0.039	$0.036
AESC 2018	1	Connecticut	$0.063	$0.059	$0.049	$0.043
	2	Massachusetts	$0.062	$0.058	$0.049	$0.043
	3	Maine	$0.058	$0.054	$0.045	$0.039
	4	New Hampshire	$0.063	$0.060	$0.051	$0.044
	5	Rhode Island	$0.061	$0.057	$0.048	$0.042
	6	Vermont	$0.062	$0.058	$0.049	$0.042
Delta	1	Connecticut	-$0.005	-$0.002	-$0.006	-$0.003
	2	Massachusetts	-$0.001	$0.003	-$0.002	$0.001
	3	Maine	$0.000	$0.002	-$0.003	$0.000
	4	New Hampshire	-$0.005	-$0.003	-$0.008	-$0.004
	5	Rhode Island	$0.003	$0.007	$0.002	$0.005
	6	Vermont	-$0.008	-$0.005	-$0.010	-$0.006
Percent Change	1	Connecticut	-7%	-3%	-12%	-7%
	2	Massachusetts	-1%	5%	-4%	2%
	3	Maine	0%	4%	-6%	1%
	4	New Hampshire	-8%	-5%	-15%	-8%
	5	Rhode Island	6%	12%	5%	12%
	6	Vermont	-13%	-8%	-20%	-14%

Notes: These costs are the sum of wholesale energy costs and wholesale costs of RPS compliance, increased by a wholesale risk premium of 8 percent, except for Vermont, which uses a wholesale risk premium of 11.1 percent. All costs have been converted to 2021 dollars per kWh. Levelization periods are 2018–2032 for AESC 2018 and 2021–2035 for AESC 2021. The real discount rate is 1.34 percent for AESC 2018 and 0.81 percent for AESC 2021. Values do not include losses.

RPS compliance

Relative to AESC 2018, AESC 2021 sees much higher prices for meeting RPS compliance (see ES-Table 12). This difference is attributable to increased supply-demand tension in the near term, resulting in higher REC prices compared to AESC 2018, particularly for states that have recently adjusted their RPS policies. Even with higher prices, the remainder of the study period is characterized by surplus, with policy-mandated purchases exceeding incremental RPS demands. The cost of RPS compliance has also increased as a result of the addition of new RPS categories such as Clean Energy Standard-Existing (CES-E) and Clean Peak Energy Portfolio Standard (CPS) categories in Massachusetts. Increases in the cost of RPS compliance in states that have not increased RPS targets (e.g., New Hampshire) are due to an increase in REC demand in the New England-wide REC market, of which all six states are participants.

ES-Table 12. Avoided cost of RPS compliance (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
AESC 2018	$4.00	$0.55	$3.84	$5.25	$2.57	$2.12
AESC 2021 Counterfactual 1	$7.93	$7.37	$11.81	$8.10	$14.99	$3.90
AESC 2021 Counterfactual 2	$4.77	$3.55	$9.04	$6.41	$5.66	$2.67
AESC 2021 Counterfactual 3	$8.84	$8.56	$12.93	$8.67	$16.81	$4.44
AESC 2021 Counterfactual 4	$8.84	$8.56	$12.93	$8.67	$16.81	$4.44
Pcnt Change: Counterfactual 1	98%	1233%	208%	54%	482%	84%
Pcnt Change: Counterfactual 2	19%	541%	135%	22%	120%	26%
Pcnt Change: Counterfactual 3	121%	1448%	237%	65%	553%	110%
Pcnt Change: Counterfactual 4	121%	1448%	237%	65%	553%	110%

Note: Each state has multiple Classes or Tiers. For simplicity, we sum avoided costs for all non-Class I/New RPS policies together in the "all other classes" row. Levelization periods are 2018–2032 for AESC 2018 and 2021–2035 for AESC 2021. The real discount rate is 1.34 percent for AESC 2018 and 0.81 percent for AESC 2021. AESC 2018 values are from AESC 2018 Chapter 7, and have been converted into 2021 dollars. All values include a 9 percent loss factor.

Non-embedded environmental compliance

AESC 2021 provides several approaches to enable individual states to address specific policy directives regarding greenhouse gas (GHG) impacts. ES-Table 13 and ES-Table 14 compare these costs.

- A "damage cost" approximated by the social cost of carbon (SCC). There are many different options for a social cost of carbon. The Synapse Team recommends using a value that applies low discount rates, considers global damages, and considers the impact of high-risk situations. One source for this value is the December 2020 SCC Guidance published by the State of New York. Using a 2 percent discount rate (the one also recommended by New York for most decision-making), we recommend a 15-year levelized SCC of $128 per short ton in AESC 2021. We also recommend that program administrators continually review this value (e.g., for the purposes of mid-term modifications) as updates to the federally-recommended SCC are expected in early 2022.

- An approach based on global marginal abatement costs. In AESC 2021, we estimate a total environmental cost based on the cost of large-scale carbon capture and sequestration (CCS) equal to $92 per short ton of CO_2-eq. This is lower than the $105 per short ton of CO_2-eq value (in 2021 dollars) described in AESC 2018. This lower cost reflects the declining costs of this technology.

- An approach based on New England marginal abatement costs, assuming a cost derived from electric sector technologies. In AESC 2021, this is a total environmental cost of $125 per short ton of CO_2-eq emissions, based on a projection of future cost trajectories for offshore wind energy along the eastern seaboard. This compares to a cost of $72 per short ton of CO_2-eq emissions (in 2021 dollars) based on a projection of future costs of offshore wind energy, as described in AESC 2018. This increased cost reflects updated information on this technology in the United States, as well as lower energy costs in this edition of AESC.

- An approach based on New England marginal abatement costs, assuming a cost derived from multiple sectors. In AESC 2021, this is a total environmental cost of $493 per short ton of CO_2-eq emissions, based on a projection of future cost trajectories for renewable natural gas (RNG) derived from power-to-gas technology. This approach may be useful for policymakers who are considering more ambitious carbon reduction targets (e.g., 90 percent or 100 percent reductions by 2050).

ES-Table 13. Comparison of GHG costs under different approaches (2021 $ per short ton) in Counterfactual #1

	AESC 2018	AESC 2021	Difference	% Difference
Social cost of carbon (SCC or "damage cost") at 2% discount rate	Not quantified	$128	-	-
Global marginal abatement cost	$105	$92	-$13	-12%
New England-based marginal abatement cost, derived from the electric sector	$72	$125	$53	75%
New England-based marginal abatement cost, derived from multiple sectors	Not calculated	$493	-	-

Notes: All values shown are levelized over 15 years. All AESC 2021 values except the SCC are levelized using a 0.81 percent discount rate (SCC uses a 2.0 percent discount rate). All AESC 2018 values are levelized using a 1.34 percent discount rate, then converted into 2021 dollars. In AESC 2018, damage costs were discussed, but not quantified. AESC 2018 did not discuss or estimate a New England-based marginal abatement cost derived from multiple sectors. Values shown above remove energy prices, but not embedded costs. Values shown above do not include losses.

ES-Table 14. Comparison of GHG costs under different approaches (2021 cents per kWh) in Counterfactual #1

	AESC 2018	AESC 2021	Difference	% Difference
Social cost of carbon (SCC or "damage cost") at 2% discount rate	Not quantified	4.87	-	-
Global marginal abatement cost	4.64	3.41	-1.23	-26%
New England-based marginal abatement cost, derived from the electric sector	2.83	4.74	1.91	67%
New England-based marginal abatement cost, derived from multiple sectors	Not calculated	19.72	-	-

Notes: Values shown above remove embedded costs (e.g., RGGI, MA 310 7.74, MA 310 7.75. All values are quoted using a summer on-peak seasonal marginal emission rate, and include a 9 percent energy loss factor.

In addition, AESC 2021 establishes a non-embedded NO_X emission cost of $14,700 per short ton, based on a review of findings in the literature, which translates into an avoided wholesale cost for NO_X of $0.77 per MWh.

DRIPE

DRIPE refers to the reduction in prices in the wholesale markets for capacity and energy, relative to the prices forecast in the Reference case, resulting from the reduction in quantities of capacity and of energy required from those markets due to the impact of efficiency and/or demand response programs.

Thus, DRIPE is a measure of the value of efficiency in terms of the reductions in wholesale prices seen by all retail customers in a given period.

AESC 2021 models DRIPE benefits associated with reduced demand on electricity (energy and capacity), natural gas (supply and transportation), and oil markets. DRIPE results in AESC 2021 differ from those in AESC 2018 because of updated information changes in utility long-term energy purchases, updated market data, and new commodity forecasts. Generally speaking, we find (a) lower energy DRIPE and capacity DRIPE values, due to projections of flatter supply curves compared to AESC 2018, (b) lower natural gas DRIPE values due to lower commodity prices and flatter supply curves, and (c) lower oil DRIPE values, due to changes in the underlying projection of crude oil prices.

Transmission and distribution

In AESC 2021, we present four separate threads for analysis of avoided transmission and distribution (T&D) costs, building on the foundation established in the 2018 AESC and updating or expanding the analysis presented. The four aspects are:

1. Updating the avoided costs for PTF facilities based on future costs;
2. Reviewing utility approaches to generic avoided cost values for non-PTF transmission and distribution and evaluating these approaches on a common evaluation rubric to facilitate cross-comparison and learning;
3. Reviewing utility approaches to calculating geographically localized avoided costs, such as for non-wire alternatives (NWA); and
4. Developing an approach to the avoided cost of natural gas system T&D.

Of these items, only the first was performed in AESC 2018. In that study, we found the PTF cost to be $99 per kW-year (in 2021 dollars). In AESC 2021, we find the PTF value to be $84 per kW-year, a decrease of 15 percent. This change is due to a switch to a forward-looking methodology, versus the historical cost methodology used in AESC 2018.

Reliability

As in AESC 2018, AESC 2021 examines how changing electric load levels can change reliability in several ways, which differ among generation, transmission, and distribution. Our analysis addresses the effect of increased reserve margins based on generation reliability, the potential and obstacles in estimating the effect of load levels on T&D overloads and outages, and VoLL. We then develop estimates of the value of increased generation reliability per kilowatt of peak load reduction.

In AESC 2021, we find a default average VoLL value of $73 per kWh. This value is almost three times as large as the value derived in AESC 2018 ($26 per kWh in 2021 dollars). The change in the VoLL component is a result of updated information on VoLLs. This VoLL is then applied to the calculation of reliability benefits resulting from dynamics in New England's FCM to estimate cleared and uncleared benefits linked to improving generation reliability. In AESC 2021, we find 15-year levelized values of

$0.47 per kW-year for cleared benefits and $8.45 per kW-year for uncleared benefits. These are 32 percent lower and 21 percent higher, respectively, than the same values estimated in AESC 2018, after adjusting for inflation. For cleared reliability, despite a higher VoLL, overall benefits are lower as a result of flatter supply curve assumptions for the capacity market. Changes to the capacity market have less of an impact on uncleared resources, which exist outside the capacity market. As a result, an increase in the VoLL produces an increase in the uncleared reliability value.

New in AESC 2021, we provide an example methodology to estimate benefits related to T&D reliability This estimate is based on data for National Grid Massachusetts. This value would likely differ for each jurisdiction. As a result, the methodology provided can be interpreted as guidance for calculating avoided costs.

Sensitivities

The following sections detail the inputs and results of the sensitivity analysis. In AESC 2021, we evaluate avoided costs under three different sensitivities. These sensitivities include:

- A natural gas price sensitivity with higher gas prices than were used in Counterfactual #1 ("High Gas Price Sensitivity")
- A climate policy sensitivity, where avoided costs for energy efficiency are calculated under a hypothetical regional climate policy with increased levels of electrification and clean energy ("No New EE Climate Policy Sensitivity")
- A climate policy sensitivity which models energy efficiency along with increased levels of electrification and clean energy ("All-In Climate Policy Sensitivity")

For each of these sensitivity cases, we find the following:

- In the High Gas Price Sensitivity, energy prices are 27 percent higher, capacity prices are 2 percent lower, RPS compliance costs are 8 percent lower, and non-embedded GHG costs are 21 percent lower. All prices are compared to Counterfactual #1.[4]
- In the No New EE Climate Policy Sensitivity, energy prices are 4 percent lower, capacity prices are 52 percent higher, and RPS compliance costs are 12 percent higher. All prices are compared to Counterfactual #3. This sensitivity features a new avoided cost (the incremental regional clean energy policy compliance cost, or IRCEP), which captures the incremental cost of the region reaching 90 percent non-fossil generation by 2035. This category increases total levelized avoided costs by 0.9 percent
- In the All-In Climate Policy Sensitivity, energy prices are 4 percent lower, capacity prices are 42 percent higher, and RPS compliance costs are 11 percent higher. All prices are

[4] All of the summary costs described here are framed in terms of 15-year levelized costs for summer on-peak for the WCMA region.

compared to Counterfactual #2. The new IRCEP cost category increases total avoided costs by 0.4 percent, all else being equal.

In the High Gas Price Sensitivity, energy prices are higher due to higher gas prices, which is the fuel that powers the marginal resource in most hours. The non-embedded GHG cost is lower because one of the inputs to this value is the energy price (in situations like this one, where the non-embedded GHG cost is based on the New England-derived marginal abatement cost). Generally speaking, higher energy prices will produce lower non-embedded GHG costs.

In the climate policy sensitivities, we find that energy prices typically only have minor changes relative to the comparative counterfactual. Capacity prices tend to be much higher, and are largely caused by high capacity prices in the early- to mid-2030s. In these years, the system switches to winter peaking and demand increases quickly. Costs of RPS compliance are also higher due to increased demand for electricity. Finally, we find that the additional cost of compliance associated with the region reaching 90 percent non-fossil generation by 2035 is low, on a levelized basis. This is due to several factors, including the fact that many states in New England are already reaching very high non-fossil percentages by 2035, and because the cost of compliance is zero in the near term (as the policy does not come into effect until the mid-2020s).

2. AVOIDED NATURAL GAS COSTS

The following sections first discuss the drivers of natural gas commodity prices (i.e., the long-term price for natural gas at Henry Hub and other price points upstream of New England). The wholesale natural gas price is the market price of gas that is sold to local distribution companies (LDC), electricity generators, and other large end-users at interstate pipeline delivery points. The discussion then addresses factors impacting the price basis for natural gas sold in New England and ends with a discussion of the methodology used to quantify avoided costs of natural gas. The avoided cost of gas at a retail customer's meter has two components: (1) the avoided cost of gas delivered to the LDC (the "citygate cost"); and (2) the avoided cost of delivering gas on the LDC system (the "retail margin"). As with previous versions of AESC, natural gas avoided costs are presented with and without the retail margin.

Natural gas prices in AESC 2021 are significantly lower than in AESC 2018. Lower price forecasts have been a persistent trend over the past decade as a result of assumptions in the AEO Reference cases that were too conservative in terms of shale gas reserves, productivity, drilling costs, and production growth.

2.1. Introduction

The dampening effect of the COVID-19 pandemic on end-use consumer demand for natural gas and other fuels resulted in 2020 experiencing the lowest Henry Hub prices in over two decades. Producers reacted to this reduction in demand by shutting-in production and reducing drilling. However, low gas prices caused natural gas-fired generation to take market share from coal-fired electric generation and made liquified natural gas (LNG) exports from the United States highly attractive. As a result, total demand for natural gas in 2020 was nearly identical to 2019. As the supply-demand balance began to tighten in the fall of 2020, Henry Hub prices began to escalate, providing producers an incentive to increase drilling and production, but dampening the economics of gas-fired electric generation. Against this backdrop, the latest Annual Energy Outlook (AEO), published by the EIA in early February 2021, projects a slow return to "normal," indicating long-lasting effects on the energy sector from the COVID-19 pandemic. AEO projects that it will take until 2023 for natural gas production to return to its pre-pandemic peak, and that it will take until 2026 for domestic consumption to reach a new peak. Over the longer term, the projections for gas prices in AEO 2021 are not substantially different than prices projected in AEO 2020.

Responses to the pandemic in the physical natural gas market were not mimicked by the financial market or trading activity during 2020. This meant that trading was not substantially different from the prior year's record high activity.[5] AEO 2021 projects that prices will begin a sustained rebound in 2025 as

[5] While Federal Energy Regulatory Commission (FERC) Form 552 filings reported record volumes in 2019, Chicago Mercantile Exchange (CME) and Intercontinental Exchange (ICE) reported slightly lower trading volumes. Natural gas is also traded on other platforms, such as NASDAQ.

producers pursue less-economic reserves. Prices and financial trading volumes continue to indicate a very active market, anchored by NYMEX Henry Hub futures.[6] Although prices and outlooks fluctuate, there remains an active wholesale natural gas market in New England for gas that is sold to LDCs, electricity generators, and other large end-users at interstate pipeline delivery points. Note that recent energy market disruptions and macroeconomic impacts due to the COVID-19 pandemic widen the uncertainty band of any price forecast.[7]

2.2. Gas prices and commodity costs

The following sections provide an overview of historical natural gas prices and projected future wholesale natural gas prices.

Background

The U.S. fuel extraction industry appeared past its prime at the start of the 21st century, but early in the 2010s, shale gas and oil suddenly became an industry with significant growth potential. Order-of-magnitude drilling economics improvements have changed the market's perception of both natural gas and crude oil from increasing-cost commodities to flat-to-declining-cost commodities. Capital became widely available to small- and medium-sized companies willing to expand drilling in new shale and tight-sand formations, to build new processing and transport infrastructure, and to consume growing gas volumes in domestic sectors or export the surplus to growing overseas LNG markets. Indeed, in 2000 the United States consumed about 64 billion cubic feet per day (Bcfd) of natural gas, of which 10 Bcf per day was imported, while in 2020 consumption was about 83 Bcfd and over 7 Bcfd was exported.[8]

In the three years since the AESC 2018 analysis, these trends have been extended through significant production growth, mainly in Texas and Appalachia. This time period has also seen increasing domestic consumption, mainly through electric generation, and surging exports of LNG which are primarily from new terminals on the Gulf Coast and Eastern Seaboard. However, the upstream (production) side has seen a geographical shift. Natural gas in Appalachia had been in surplus for several years because of lags

[6] NYMEX Henry Hub futures prices are traded for 120 months out. There are also futures prices and price differentials (basis) for other regional natural gas hubs traded on the NYMEX or other organized exchanges. Cornerstone Research: *Characteristics of U.S. Natural Gas Transaction* (Jul 2020) reported that trading volumes during the first of this year indicate and increase in 2020; p. 10.

[7] Prices quoted on the NYMEX and other active futures exchanges represent a collective market view of supply and demand conditions in the future. However, there is a risk when using any price forecast in business decisions. Physical players such as LDCs and producers purchase or sell futures to hedge price risk. A futures contract provides insurance against price volatility. Buying and selling entities including traders know they run the risk that they will incur an opportunity cost—buying or selling at too low or too high a price. To many, this is an acceptable risk, giving up potential profits for a known price. Others may prefer purchasing derivative financial instruments that can be used to cover some of the opportunity cost risks; for example, protective collars can be purchased that provide additional downside or upside price protection, and the risk of purchasing too much or too little gas due to adverse weather can be hedged via weather derivatives.

[8] U.S. EIA, *Natural Gas Annual*, available at https://www.eia.gov/naturalgas/annual/. The 2019 edition was released on September 30, 2020. Historical data is published in the EIA's *Monthly Energy Review*.

in pipeline infrastructure, resulting in falling prices in the region. Simultaneously, high oil prices created a boom in shale oil plays, mainly in the Permian Basin. Surging oil production also resulted in a large increase in associated gas production.[9] Since the beginning of 2018, Permian gas production has more than doubled, compared to a 30 percent increase in Appalachian volumes. However, drilling activity dropped sharply in the second and third quarters of 2020 resulting in a decline in associated gas production and a flattening of Appalachian output.

All the primary gas markets were affected by these production shifts, by new infrastructure, and by new gas-fired electric generation. In New England, for example, gas-fired power now accounts for about half of the installed generating capacity in the six-state region, which is three times what it was 20 years ago. Volumes also increased at most gas trading hubs and the ability to arbitrage regional price differentials rose with additional pipeline capacity and new commodity trading platforms. Although a few small, incremental pipeline projects were added over the past few years, New England avoided large-scale investments in natural gas infrastructure; nonetheless, the region still exhibited a downward gas price trend over the past decade.

Over the past two years, the New England gas market has seen a small increase (see Section 2.3. *New England natural gas market*). However, the primary sources of gas supply to New England and the delivery pipelines are unchanged. As in prior AESC studies, we conclude that there are three main components to New England gas costs.

1. The natural gas price at the point of purchase at a market trading hub or at the production site (the "supply area" price or "commodity cost");
2. The pipeline transportation cost from the trading hub or supply area to the LDC citygate or electric generating plant; and
3. The retail distribution margin from the citygate to the end-user's burner tip.

Supply area natural gas prices

Natural gas consumed in New England is sourced from various points in the United States and Canada. These sources vary depending on the purchasing entity and contractual arrangements, as well as seasonal differences such as storage and LNG. Gas is purchased at hubs in New England, such as the Algonquin (AGT) Hub, or hubs further south, in Canada, or in other locations. As in the rest of North America, because of the integrated pipeline network, gas prices in New England are strongly correlated to the Henry Hub benchmark. Therefore, similar to previous AESC studies, Henry Hub serves as the foundation for developing price projections relevant to New England markets. The rationale for this choice is that Henry Hub has been the U.S. gas price benchmark since the early 1990s and is likely to continue that role in the foreseeable future. There are many reasons for choosing Henry Hub.

[9] Associated natural gas or associated-dissolved natural gas is natural gas that occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved gas).

1. Foremost, perhaps, is that it the most highly traded natural gas pricing point in the United States. According to the Chicago Mercantile Exchange (CME), the NYMEX Henry Hub contract (symbol “NG”) is the third-largest physical commodity futures contract in the world by volume.[10] The New York Mercantile Exchange (NYMEX) trades Henry Hub monthly gas with contracts extending for 120 months.

2. Many natural gas purchase and sales contracts for natural gas are tied to the NYMEX Henry Hub price because of transparency and liquidity. Moreover, they allow market participants the ability to hedge and to manage risk.

3. For many of the other trading points (hubs) throughout the United States, Henry Hub serves as the derivative pricing market in the form of basis trades, i.e., the difference between the Henry Hub price and the price at a different hub.

4. EIA (in the AEO) and many other organizations base their price forecasts on Henry Hub.

5. The burgeoning surplus of gas in Appalachia and other regions is being increasingly funneled to LNG export terminals along the Gulf Coast (Texas and Louisiana). From the end of 2017 through 2020, export capacity has increased from roughly 3 Bcfd to 10 Bcfd. Nearly 10 percent of U.S. gas demand now comes from LNG exports, with the bulk of that along the Gulf Coast. Pipelines have correspondingly increased capacity to meet this demand. Even more LNG export capacity is in the planning stage. The AEO and most other forecasts envision that LNG exports will be the marginal market for natural gas at least over the next decade and that the Henry Hub pricing point in Louisiana will be a primary signal in this new market dynamic.

Although natural gas prices quoted by the NYMEX are volatile, they represent the current collective wisdom of the gas market. Prices change daily as physical buyers and sellers and financial players continually assess new data and reformulate expectations about the future gas market. Near-term factors such as storage balances, weather, and demand and supply expectations have a larger influence in the front of the price curve. These prices influence decisions by producers, consumers, and investors that can affect the future demand and supply balance. Most NYMEX participants are “hedgers” who use the futures market to reduce the risk of financial losses from price changes, i.e., lock-in a price to buy or sell gas. With more hedging in the winter months when gas demand peaks, there is marked seasonality in natural gas trading. Most hedging is short-term, i.e., over the next 12 to 18 months, so there is more liquidity (larger volume of transactions) in the near months of the natural gas market). Liquidity falls significantly beyond 18 months. Thus, similar to previous AESC studies, the short-term natural gas price forecast relies entirely on NYMEX Henry Hub futures. In addition, we use the seasonality in monthly prices observed in the 2022–2023 NYMEX futures complex to develop long-term monthly trends for the Henry Hub gas price over the 2021–2035 study period.

[10] Details on the NYMEX Henry Hub Contract can be found on the CME website: http://www.cmegroup.com/trading/energy/nymex-natural-gas-futures.html. There is seasonality in the 12-year NYMEX Henry Hub futures complex and we are using that seasonality to convert the annual AEO forecasts to monthly forecasts. CME data was downloaded for use in the AESC 2021 Study on February 1, 2021.

As with previous AESC studies, we rely on AEO for longer-term Henry Hub price forecasts. The most recent current AEO was published in February 2021 (AEO 2021).[11] There are numerous reasons for choosing AEO for longer-term price forecasts; foremost is the extensive documentation and transparency of the inputs and models used by EIA. There are many companies, consultants, and other organizations that forecast natural gas and other prices. However, there is no way to evaluate them without complete datasets, assumptions, or documentation on model algorithms.[12] The EIA forecasts are public, transparent, and incorporate the long-term feedback mechanisms of energy prices upon supply, demand, and competition among various fuels. Previous AESC studies have relied on the AEO Reference Case, which generally assumes current legislation and environmental regulations. Specifically, AEO 2021 assumes government actions for which implementing regulations were available as of the end of September 2020 and macroeconomic assumptions based on third and fourth quarter 2020 assessments.[13] These macroeconomic assumptions include the effects of the COVID-19 pandemic on natural gas and other energy sectors.

EIA has recognized an increased level of uncertainty in its projections due to the impacts of the COVID-19 pandemic on energy markets and the wider economy.[14] The COVID-19 pandemic represents a novel forecasting challenge. As in previous outlooks, the Reference case for AEO 2021 is a projection rooted in experience to date and the current short- and medium-term economic outlook. But the influence of the pandemic in this forecast and the necessity of conjecturing what the recovery will look like means that the longer-term view may be particularly uncertain.

The Reference case in AEO 2021 anticipates that economywide demand for energy in the United States will not return to 2019 levels until 2029.[15] On average, the Henry Hub price forecast for the AEO 2021 reference case is approximately 2.6 percent lower than the corresponding forecast from AEO 2020. Meanwhile, alternative scenarios explored in AEO 2021 (“side cases”) consider the impacts of differing economic growth rates resulting in a return to pre-pandemic economic activity and energy consumption levels in shorter or longer order.

For AESC 2021, we use the current NYMEX Henry Hub futures forecast for short-term prices (through 2023) and AEO 2021 for medium- and long-term prices.[16] We believe that the current NYMEX Henry Hub

[11] U.S. EIA. 2021. Annual Energy Outlook (AEO) 2021. https://www.eia.gov/outlooks/aeo/.

[12] AESC 2021 differs from its predecessors in that the timing of this year’s study allows for the use of the most recent AEO projection. Previous AESC studies, by virtue of their study timeline, frequently used AEO projections that were a year or more out-of-date at the time of AESC’s publication.

[13] Assumptions are documented in several reports. See EIA’s AEO assumptions at https://www.eia.gov/outlooks/aeo/assumptions/.

[14] U.S. EIA, 2021. AEO 2021 narrative, p 4, at https://www.eia.gov/outlooks/aeo/pdf/AEO_Narrative_2021.pdf.

[15] Ibid.

[16] The gas price forecast methodology employed in AESC 2021 differs from that of AESC 2018 only in that we do not transition from the NYMEX futures value, used for the preliminary forecast years, to the AEO forecast series for the later forecast years

price forecast incorporates an independent and collective view of the market supply and demand balances over the next three years. It also incorporates current expectations on the effects and duration of the COVID-19 pandemic. Meanwhile, AEO 2021 represents a neutral, third-party projection of Henry Hub prices based on recent trends and expectations, accounting for the COVID-19 pandemic, but ultimately reflecting conventional trends outlasting the impacts of the pandemic.[17] Factors influencing the longer-term forecasts of energy demand beyond the period of uncertainty associated with the COVID-19 pandemic include economic and population growth; increasing reliance on renewables and consumption of natural gas and electricity; and technological, behavioral, and policy shifts.

The following section provides highlights of the AEO 2021 Reference case and other AEO cases.

AEO 2021 Reference case

Compared to the recent past, the AEO 2021 Reference case projects the U.S. natural gas industry growing more slowly in the decades ahead. Gas production in the United States (dry gas) increased by 57 percent from 2010 to 2019 while AEO 2021 has production growing by only 23 percent from 2024–2050.[18] Similarly, consumption slows markedly in all sectors. The decline is most pronounced in the residential sector, which sees flat-to-declining gas use in the future.

In AEO 2021, real Henry Hub prices (in 2021 dollars) are projected to fall from \$3.23 per MMBtu in 2021 to \$2.78 per MMBtu in 2023. Prices then increase by 2.4 percent per year, reaching a price of \$3.68 per MMBtu in 2035. Producers require higher prices to expand into less prolific and more expensive-to-produce areas to meet the growth in gas demand and LNG exports.

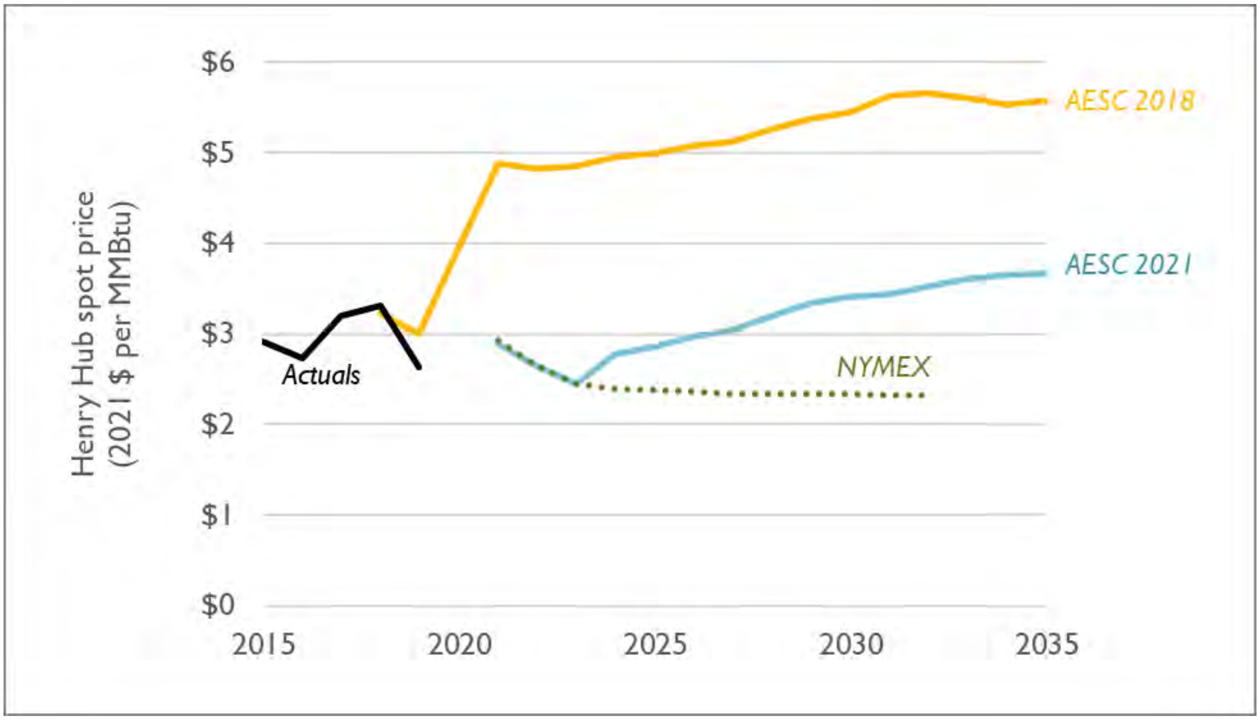
Figure 1 shows the forecast of Henry Hub prices used in AESC 2021. As described above, these rely on current NYMEX futures (dated February 1, 2021) for prices between 2021 and 2023. Prices in 2024 through 2035 are based on AEO 2021. Figure 1 also compares the Henry Hub price used in AESC 2021 with the price forecast used in AESC 2018 (in 2021 dollars).

with a bridge year calculated by averaging the two series. Instead, we transition directly from NYMEX futures (for 2021-2023) to the AEO forecast series (for 2024 and beyond).

[17] Ibid.

[18] "Dry" gas is consumer-grade natural gas. Basically, it is natural gas that that has been processed to remove hydrocarbon liquids and other impurities so that it has uniform properties that make it transportable and useable by all consumers. Dry natural gas production equals marketed production less extraction loss.

Figure 1. Henry Hub price forecasts (Actuals, NYMEX, AESC 2020, and AESC 2018)



As shown in Figure 1, Henry Hub natural gas prices average 34 percent lower in AESC 2021 compared to AESC 2018 over the 2021–2035 period. In general, forecasts of Henry Hub prices have continually declined over the past decade for several reasons.

1. Productivity in shale drilling has been increasing steadily. Average productivity (new well gas production per rig) as reported by EIA was about 1,284 Mcf at the beginning of 2014. Productivity was 3,570 Mcf in EIA's January 2018 report and 6,906 Mcf in the latest (2021) report.[19] This trend implies decreasing costs per unit of production, although AEO continues to assume that new supply will not be as productive as in the past, thus requiring higher prices to induce drilling.

2. A growing portion of gas production has been coming from oil wells (e.g., "associated natural gas"). For oil producers, drilling decisions are based on crude oil prices and any natural gas sold is considered a byproduct. Depending on gas pipeline availability and flaring regulations, this gas will be produced at any price as long as crude oil economics are positive. As new tranches of associated gas are marketed, they often displace existing gas production pressuring gas prices.

3. Realtime indicators are difficult to ignore. Since 2010, average gas prices have been on a downward trend—weekly, monthly, and annually. For example, the average Henry Hub spot price for two years prior to the initial 2015 AESC forecast was about $4.59 per MMBtu (in 2021 dollars), while for the 2018 report it was $2.96 per MMBtu. For the two years prior to AESC 2021 (2019 and 2020), the average price was $2.33 per MMBtu. The

[19] U.S. EIA. 2021. "Drilling and Productivity Report," January 19.

past decade has seen price spikes due to abnormal weather or short-term storage deficits, but projecting a sustained upward price surge is difficult to justify.

4. The COVID-19 pandemic initially exacerbated a bearish price cycle. The average Henry Hub spot price for the 12-months ending October 2020 was $2.00 per MMBtu, the lowest in over two decades. This price signal has led to near-record short-term production declines the second and third quarters of 2020. The market has recognized this, with NYMEX Henry Hub futures averaging closer to $3.00 per MMBtu beginning in the fourth quarter.

Natural gas prices at other upstream supply points

Although Henry Hub is the U.S. natural gas price benchmark, prices vary greatly across the nation. Conditions such as local production, pipeline capacities, storage availability, and demand variability are some of the many factors that cause this variation. Over the past few decades, most supply and consuming regions developed gas hubs, which are liquid pricing points where gas is bought and sold for immediate or future delivery. There are many hubs in the Northeast, but the critical question is which ones determine New England's natural gas prices?

Without indigenous production, New England continues to acquire gas from outside the region via:

1. Six pipeline systems including Tennessee Gas Pipeline (TGP) and Algonquin Gas Transmission (AGT) from the south; Iroquois Gas Transmission (IGTS) from the west through New York State; and Maritimes & Northeast Pipeline (MNP) along with Portland Natural Gas Transmission (PNGTS) from Canada via TransCanada Pipeline (TCPL). See below for a more detailed description of the six pipeline systems.

2. Two LNG import terminals in the Boston area including Excelerate Energy's Northeast Gateway Deepwater Port and Exelon Generation's Everett terminal. There is also the Canaport LNG import terminal in New Brunswick, from which regasified LNG can be piped down MNP into New England.

Pipeline shippers purchase natural gas at various supply or market hubs. This natural gas may be sourced from the U.S. Gulf Coast, Midwest, Appalachia, and both Eastern and Western Canada; however, production in the Marcellus/Utica has outstripped natural gas consumption in the Northeast. As a result, the physical source of New England pipeline gas is being increasingly supplied from this nearby basin even if shippers are notionally purchasing gas from distant supply basins (Gulf Coast, Western Canada, Permian Basin, etc.).[20] Thus the price at hubs that source Marcellus/Utica gas is increasingly relevant to New England.

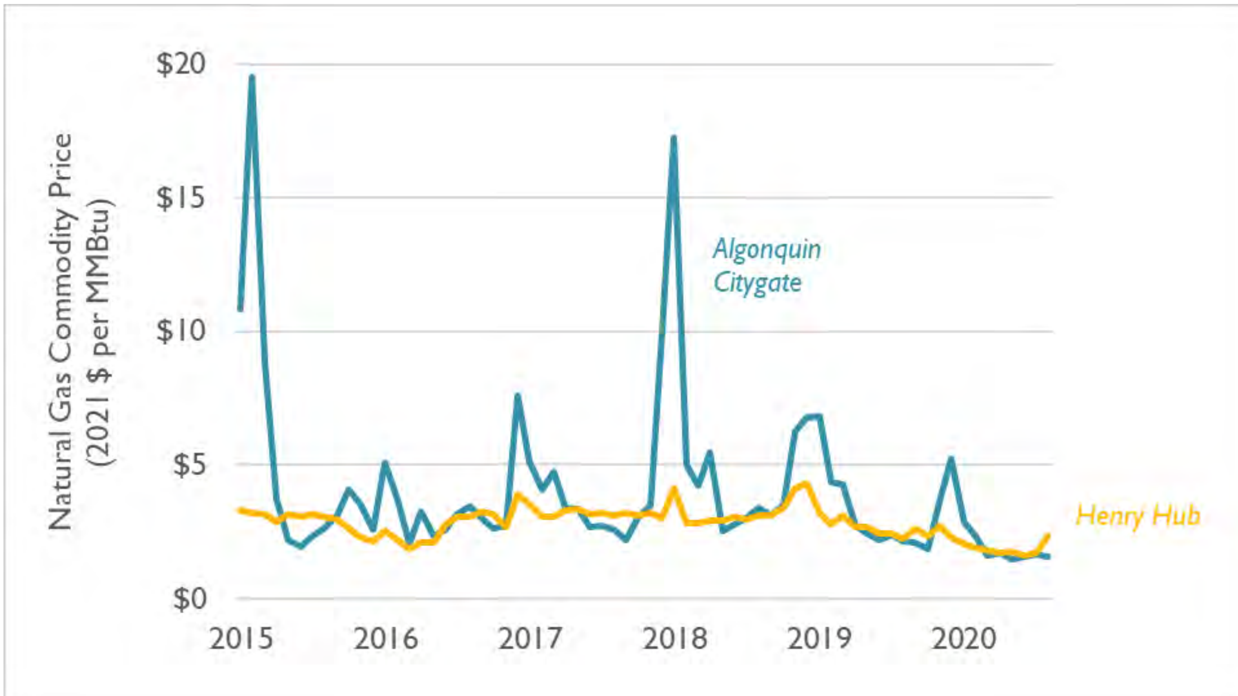
Although sourced from various upstream supply basins, a significant volume of New England gas is priced at the Algonquin Citygate Hub. AGT basis futures are traded on the Intercontinental Exchange

[20] Since natural gas is fungible, interstate pipelines can displace gas anywhere it enters or leaves the system.

(ICE) and there is a market up to 48 months out.[21] AGT spot prices are also quoted in several publications[22] and on the EIA website.[23] For 2024 and later years, to calculate the future monthly variation in prices for Henry Hub, Algonquin Citygate, and other and hubs upstream of New England, we average two years of projected monthly data (based on NYMEX) for the period 2022–2023.[24] For Henry Hub, the "shape" of this monthly variation is applied to the annual data from AEO 2021. For Algonquin Citygate and other hubs, we simply add the average monthly basis to the Henry Hub value.

We have also analyzed historical monthly basis data for these pricing points, allowing us to apply the seasonality in monthly prices to our longer-term projections. See Figure 2 for a historical comparison of gas prices at Algonquin Citygate and Henry Hub.

Figure 2. Historical comparison of natural gas prices at Algonquin Citygate Hub and Henry Hub



[21] Intercontinental Exchange (ICE). Last accessed March 9, 2021. "Algonquin Citygates Basis Future." *theICE.com*. Available at https://www.theice.com/products/6590124/Algonquin-Citygates-Basis-Future.

[22] Natural Gas Intelligence (NGI). Last accessed March 9, 2021. "Algonquin Citygate Daily Natural Gas Price Snapshot." *NaturalGasIntel.com*. Available at https://www.naturalgasintel.com/data-snapshot/daily-gpi/.

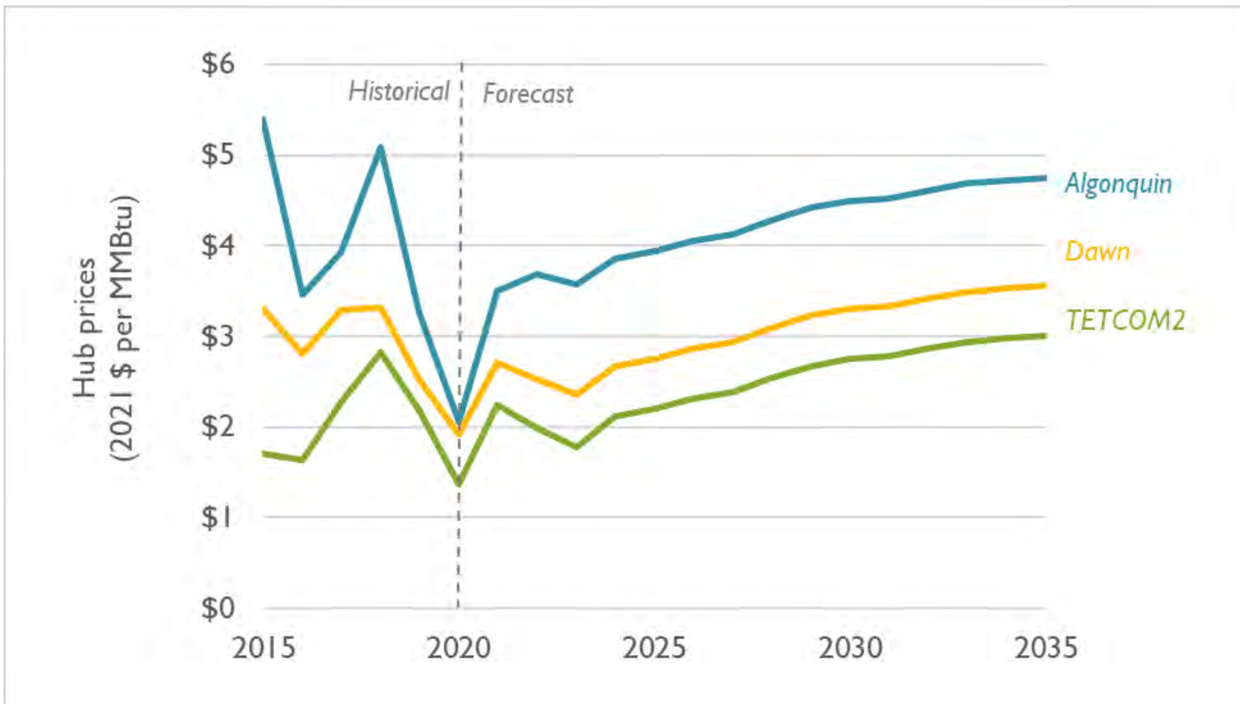
[23] U.S. EIA. Last accessed March 9, 2021. "Daily Prices." *Today in Energy*. Available at https://www.eia.gov/todayinenergy/prices.php.

[24] The term upstream generally refers to hubs and other points closer to the source of gas production.

In AESC 2021, we use the Texas Eastern Zone M-2 (TETCO M2) price, which is more representative of the actual prices paid by New England LDCs.[25] To cover the major gas supply sources, we model monthly prices at the Dawn Ontario Hub and TETCO M2 Hub using a similar methodology as our projection for the Algonquin Citygate basis (see Figure 3). The projected monthly basis values for these hubs are assumed to remain constant in real dollar terms over the modeling period.

While often correlated, natural gas prices at each hub will vary, depending on supply, demand and pipeline capacity, transport costs, and other conditions. There are trading platforms for these hubs: NYMEX trades (TETCO M2), and Natural Gas Intelligence (NGI) publishes prices for the Dawn Hub.[26] In most cases there is both a spot and a futures market of varying lengths at these hubs. Also note that these price forecasts implicitly assume no new large-scale pipeline expansion projects, other than ones under construction slated over the next year.[27] We believe the futures prices used in this analysis embed an unbiased estimate of the market's expected seasonal demand-supply pressures in the near term.

Figure 3. Historical and projected prices for AGT Hub, Dawn Hub, and TETCO M2 Hub



[25] In AESC 2018, we used the Dominion South Point (hub) index to measure gas prices in the Marcellus shale producing areas in and about Pennsylvania.

[26] NGI. Last accessed March 9, 2021. "Dawn Forward Fixed Natural Gas Price Snapshot." *NaturalGasIntel.com*. Available at http://www.naturalgasintel.com/data/data_products/forward-contracts?location_id=MCWDAWN&region_id=midwest.

[27] See Algonquin's "Atlantic Bridge Project" CP16-9.

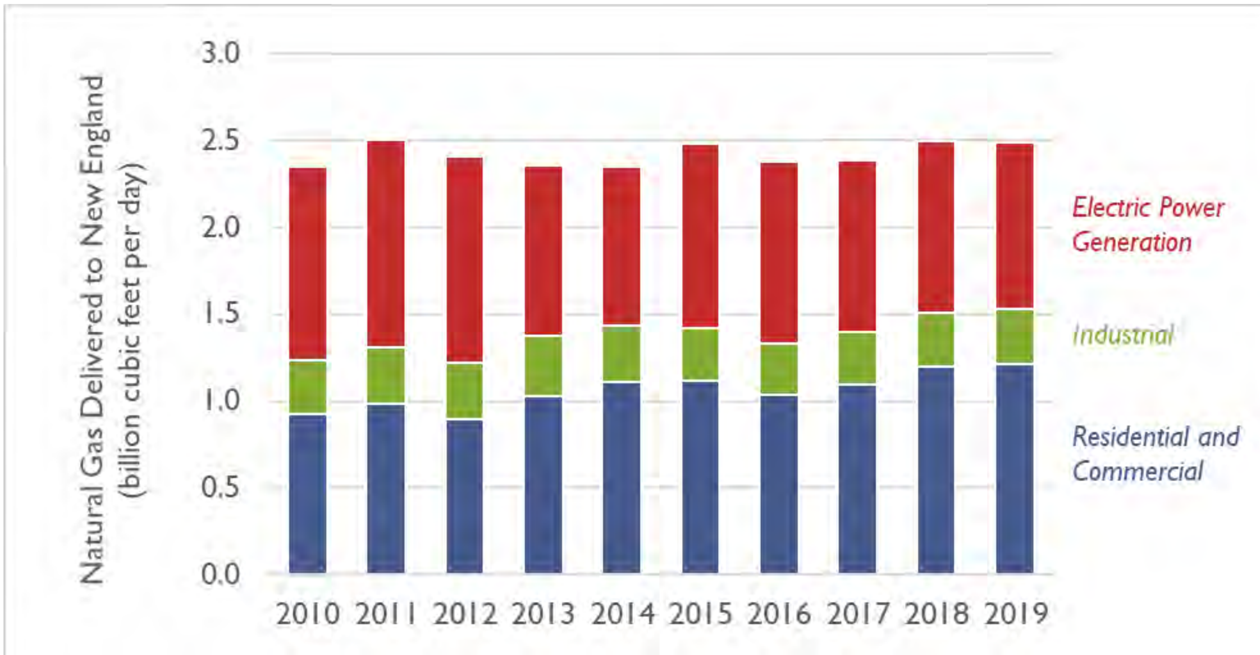
2.3. New England natural gas market

In addition to the commodity costs discussed above, natural gas avoided costs include the costs of transmission, storage, and peaking resources needed to make gas available where and when it is consumed. This section addresses the gas supply resource costs that would be avoided by reducing gas use and describes our methodology for calculating the avoided natural gas costs by end-use.

Natural gas consumption

Figure 4 shows the natural gas delivered to end-users in the six New England states for the years 2010 through 2019. Growth in residential and commercial consumption has been largely offset by lower gas use for electricity generation.

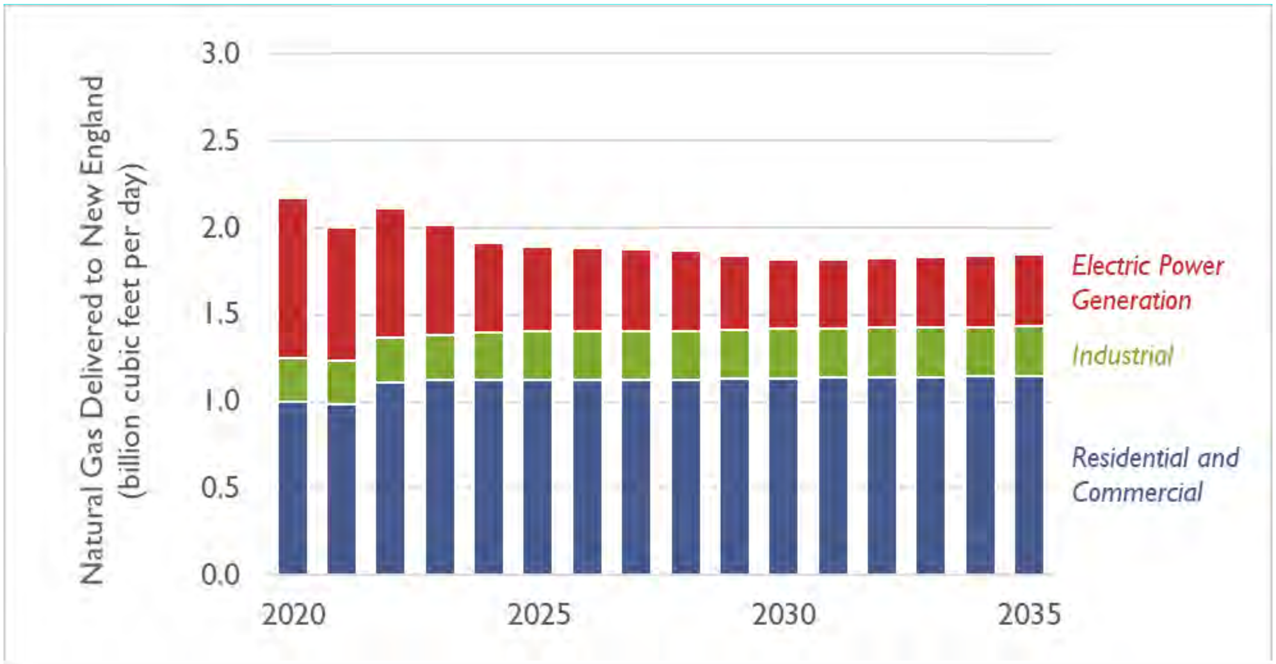
Figure 4. Historical natural gas deliveries in New England



Source: Energy Information Administration (EIA). Available at https://www.eia.gov/dnav/ng/ng_cons_sum_a_EPG0_vgt_mmcf_a.htm.

Going forward, the AEO 2021 Reference case forecast for New England shows a small near-term increase in consumption in the residential, commercial, and industrial sectors, then a flattening of gas consumption from the mid-2020s through the mid-2030s (see Figure 5). Meanwhile, EIA projects gas consumption in the electric power sector to be halved by 2025, then remain at a relatively consistent level through the mid-2030s.

Figure 5. AEO 2021 natural gas consumption forecast for New England



Source: Energy Information Administration (EIA). Available at *https://www.eia.gov/outlooks/aeo/supplement/excel/suptab_2.1.xlsx.*

Recent New England LDC forecasts show annual growth in customer requirements ranging from 0.2 percent to 2.3 percent per year (see Table 1). For the 13 LDC forecasts shown, the weighted average increase in requirements over a five-year period is just under 2 percent per year.[28]

There are several reasons why the LDC forecasts would be different from the EIA forecast:

- The LDC forecasts are "planning load" forecasts, not forecasts of total consumption. Planning load customers are sales customers that buy gas from the LDC, and transportation-only customers that buy gas from marketers that receive upstream capacity resources from the LDC under retail choice programs. "Capacity exempt" transportation customers that do not use LDC supply resources are excluded.
- LDC planning load excludes most gas used for electricity generation. Gas-fired power plants in New England typically receive gas supplies directly from an interstate pipeline or transport gas on an LDC under a special contract that makes them capacity-exempt.
- Some LDCs adjust their forecasts to include potential migration of existing capacity-exempt transportation customers to sales service or capacity-assigned transportation service. Shifting gas use by existing capacity-exempt transportation customers into

[28] Growth rates weighted by the annual planning load forecasts for 2020-21.

planning load causes the planning load growth rate to be higher than the actual growth in total consumption.

- Recent LDC forecasts reflect lower 2020 and 2021 gas use caused by COVID-19; they assume that consumption will bounce back later in the forecast period. This would cause the average annual growth rates for forecasts with a 2020 start date to be somewhat higher than pre-COVID forecasts, all else being equal.

- Finally, there are questions about the extent to which the econometric forecasts produced by New England LDCs reflect the future impacts of state initiatives to reduce GHG emissions. The Massachusetts Attorney General has suggested that LDCs should be required to submit forecasts for periods longer than five years in order to address the expected transition away from natural gas as a heating fuel.[29]

Table 1. New England LDC natural gas requirements forecasts

Utility	CAGR (%)	2020-2021 forecast (MMcf)		Forecast period	Case or Docket Number
		Annual	*Design Day*		
National Grid (MA)	2.3	136,633	1,425	2020 to 2025	MA DPU 20-132
Eversource Gas	0.8	48,660	522	2019 to 2024	MA DPU 19-135
NSTAR Gas	1.5	47,907	537	2019 to 2024	MA DPU 20-76
Liberty (MA)	1.0	6,452	77	2020 to 2025	MA DPU20-92
Berkshire Gas	0.5	6,472	66	2020 to 2025	MA DPU 20-139
Fitchburg Gas	0.2	2,314	23	2020 to 2025	MA DPU 21-10
CT Natural Gas	1.6	36,124	355	2020 to 2025	CT PURA 1820-10-02
Southern CT	1.2	33,167	325	2020 to 2025	CT PURA 1820-10-02
Yankee Gas	2.2	56,256	487	2020 to 2025	CT PURA 1820-10-02
National Grid (RI)	1.8	36,152	389	2019 to 2025	RI PUC 5043
EnergyNorth	2.3	15,650	165	2017 to 2022	NH PUC DG 17-152
Northern Utilities	1.5	15,628	143	2019 to 2024	NH PUC DG 19-126
Vermont Gas	0.2	7,162	72	2020 to 2025	VT PUC 20-1520
Total		**448,557**	**4,585**		

Gas supply resources

The natural gas consumed in New England comes from the natural gas pipelines that transport gas from producing areas in the United States and Canada, and import terminals in Massachusetts and New Brunswick that receive LNG by ship. A small, but growing amount of natural gas is transported into New England by truck as either LNG or compressed natural gas (CNG).

Gas transmission pipelines

Six major natural gas pipeline systems deliver gas to New England markets (see Figure 6).

Tennessee Gas Pipeline (TGP): Two branches of the TGP mainline deliver gas into New England. The "200 Line" enters Massachusetts from upstate New York and extends into the Boston area. The "300

[29] Massachusetts Office of the Attorney General's June 4, 2020 petition in Docket D.P.U. 20-80, pp. 12-13.

Line" enters southwestern Connecticut and connects to the 200 Line at Agawam, MA. Lateral pipelines transport gas into Rhode Island and New Hampshire.

Algonquin Gas Transmission (AGT): AGT is a regional pipeline that extends from central New Jersey to Boston. AGT receives gas from TGP at Mahwah, NJ and from Millennium Pipeline at Ramapo, NY. AGT delivers gas in Connecticut, Rhode Island, and Massachusetts. The AGT system also includes a 25-mile undersea pipeline (the "HubLine") that extends from Weymouth, MA to an interconnection with Maritimes & Northeast Pipeline (MNP) in Salem, MA.

Iroquois Gas Transmission System (IGTS): IGTS connects with the TransCanada PipeLines system (TCPL) at Waddington, NY. IGTS crosses the southwestern corner of Connecticut before terminating in Long Island and New York City. IGTS connects with TGP at Wright, NY, and with AGT at Brookfield, CT. Direct deliveries from IGTS into the New England are constrained by the capacity of Connecticut LDCs and power generators to receive gas at IGTS meters and competition from downstream markets in New York.

Portland Natural Gas Transmission System (PNGTS): PNGTS receives natural gas from TCPL at the New Hampshire-Quebec border. TCPL delivers this gas using capacity that it holds on TransCanada's (Trans Quebec and Maritimes) TQM pipeline. PNGTS connects with MNP at Westbrook, ME and delivers gas into TGP at Dracut, MA.

Maritimes & Northeast Pipeline (MNP): MNP was originally built to transport gas from offshore Nova Scotia to Canadian and U.S. markets.[30] The U.S. portion of the MNP system extends from the Maine-New Brunswick border to northeastern Massachusetts. MNP also receives gas from the Brunswick Pipeline, which is the outlet for the Canaport LNG terminal at St. John in New Brunswick. MNP connects with PNGTS at Westbrook, ME, with TGP at Dracut, MA, and with AGT at Salem, MA.

TransCanada PipeLines (TCPL): The TCPL mainline extends from Alberta to Quebec. TCPL receives gas in Alberta and from Enbridge Gas at the Parkway interconnect in southwestern Ontario.[31] TCPL connects directly to Vermont Gas System (VGS), and delivers gas into IGTS and PNGTS.

Liquefied natural gas (LNG) import terminals

Imported LNG is received at three terminals located in Massachusetts and New Brunswick.

Distrigas of Massachusetts: The Distrigas LNG terminal, located in Everett, MA, delivers gas to TGP, AGT, National Grid, and the Mystic Generating plant. Distrigas also delivers LNG into trucks that supply peaking gas facilities throughout the region.[32]

[30] Natural gas production in Nova Scotia ended in 2018.

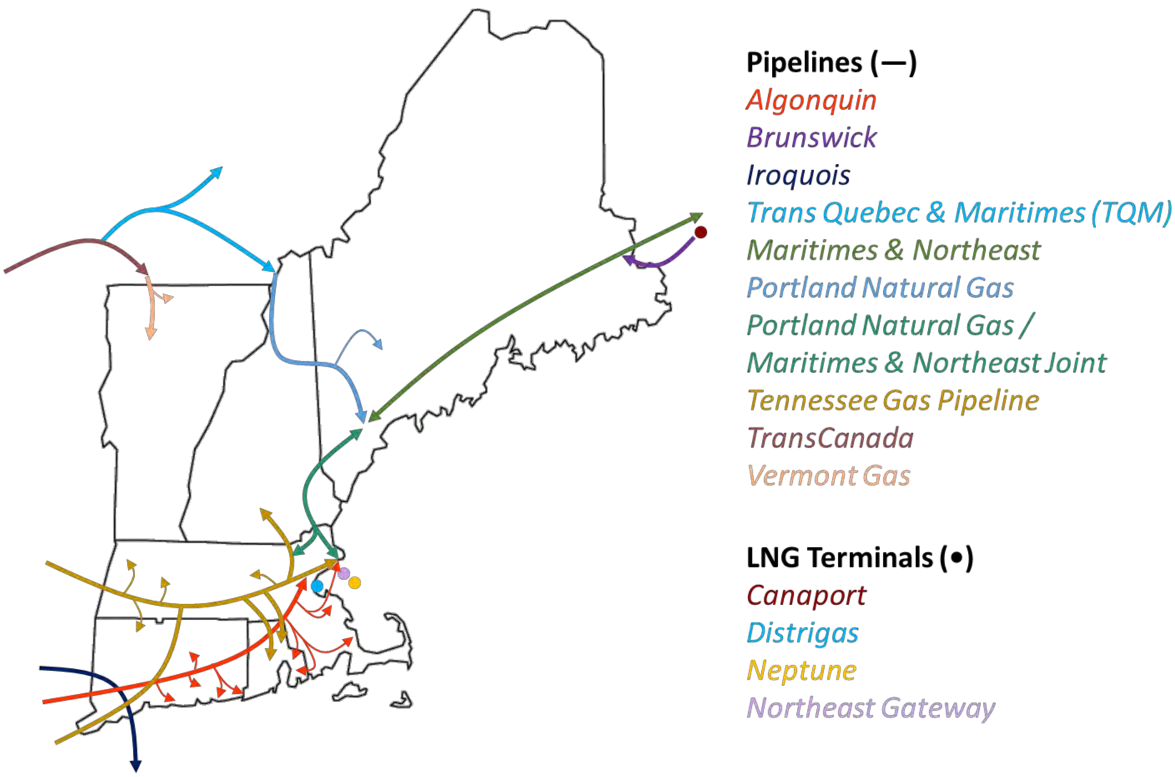
[31] Enbridge Gas (formerly Union Gas Limited) operates the Dawn Hub.

[32] The Distrigas terminal is owned by an Exelon Corporation subsidiary.

Northeast Gateway: Northeast Gateway is an offshore LNG receiving facility that connects to the AGT HubLine. Northeast Gateway began operating in 2008, but it has received only a few winter-season shipments in recent years.[33]

Canaport LNG: The Canaport LNG terminal has close to 10 Bcf of storage capacity and can send out approximately 1Bcfd. Repsol Energy North America, the Canaport operator, has a long-term contract for firm transportation service on MNP and uses this capacity to deliver gas at Dracut and Salem, and to markets in Maine.

Figure 6. Natural gas pipeline infrastructure in New England and nearby regions



Source: Synapse Energy Economics, 2021.

Natural gas delivery capacity

Total gas delivery capacity into New England increased by roughly 4 percent from 2018 to 2021 and is expected grow by another 1.5 percent from 2021 to 2024 (see Table 2). For AGT and TGP, we show the estimated west-to-east capacity to deliver gas into New England from New York. The IGTS capacity is an estimate of the amount of gas that can be received in Connecticut, and it excludes capacity used to transport gas through New England to downstream markets in New York. The "TCPL Direct" quantities are the receipt capacities of VGS and PNGTS at the U.S.-Canada border. The "LNG Dependent" quantities

[33] A second offshore LNG receiving terminal, Neptune, was built about the same time, but is now inactive.

show the certificated end-to-end capacity of the MNP pipeline and the estimated sendout capacity of the Distrigas facility, based on the take-away capacity of the interconnected pipelines. Note that the effective delivery capacity for MNP and Distrigas at any point in time is likely to be lower than shown in the table, since it will depend on the availability of LNG supply.

The supply of natural gas to the New England market is also reduced by exports to New Brunswick and Nova Scotia. EIA reports that 0.25 Bcfd of natural gas flowed into New Brunswick from Maine in 2019.[34] Canadian LDCs and end-users have contracted for pipeline capacity in the Atlantic Bridge, Portland XPress, and Westbrook XPress expansion projects.

Table 2. Historical and Projected Natural gas delivery capacity into New England (Bcfd)

	JAN 2018	JAN 2021	JAN 2024
AGT	1.82	1.91	1.91
TGP	1.39	1.39	1.42
IGTS	0.26	0.26	0.26
West-to-East	**3.47**	**3.56**	**3.59**
PNGTS	0.21	0.32	0.40
VGS	0.07	0.08	0.08
TCPL Direct	**0.28**	**0.40**	**0.48**
MNP	0.83	0.83	0.83
Distrigas	0.70	0.70	0.70
LNG Dependent	**1.53**	**1.53**	**1.53**
TOTAL	**5.28**	**5.49**	**5.60**

Table 3 provides details on recent and planned pipeline expansion projects that affect gas delivery capacity into the New England market.

[34] U.S. EIA. Last accessed March 9, 2021. "U.S. Natural Gas Exports and Re-Exports by Point of Exit." *eia.gov.* Available at https://www.eia.gov/dnav/ng/ng_move_poe2_a_EPG0_ENP_Mmcf_a.htm.

Table 3. Recent and planned New England pipeline expansions

Pipeline	Project	Capacity (Bcfd)	Description	Status
AGT	AIM	0.342	Expand from Ramapo, NY to New England citygates	Completed early 2017
TGP	CT Expansion	0.072	Expand from Wright, NY to CT citygates	Completed in 2017
AGT	Atlantic Bridge	0.133	Expand from Ramapo, NY to Salem, MA	Added 0.040 Bcfd in 2017, 0.093 Bcfd in 2019
TGP	261 Upgrades	0.027	Upgrade compression and expand Agawam, MA lateral	Lateral completed 2020. Compression planned for 2021
PNGTS	Portland XPress	0.064	Expand from Canadian border to Dracut, MA	Completed 2018, 2019, and 2020
PNGTS	Westbrook XPress	0.123	Expand from Canadian border to Westbrook, MA and Dracut	Added 0.043 Bcfd in 2020. Phases II and III in 2021 and 2022.
Total	**-**	**0.761**	**-**	**-**

Peaking facilities

Most New England LDCs operate on-system peaking facilities that inject either vaporized LNG or propane into the distribution system during periods of high gas demand (see Table 4). The total design-day production capacity for these facilities is approximately 1.5 Bcfd. Many of the LDC peaking facilities have on-site storage, but others are satellite facilities that require mid-winter refill by truck.

Table 4. New England LDC peaking facilities

Gas Utility	Type	Number of facilities	Aggregate Delivery Capacity (Bcf/day)	Aggregate Storage Capacity (Bcf)
National Grid (MA)	LNG	7	0.508	4.934
Eversource Gas	LNG	4	0.112	1.688
NSTAR Gas	LNG	2	0.210	3.650
Liberty (MA)	LNG	1	0.018	0.165
Berkshire Gas	LNG	1	0.003	0.010
Fitchburg Gas	LNG	1	0.003	0.003
CT Natural Gas	LNG	1	0.105	1.142
Southern CT	LNG	1	0.082	1.142
Yankee Gas	LNG	1	0.105	1.200
National Grid (RI)	LNG	2	0.174	2.462
EnergyNorth	LNG	3	0.013	0.013
Northern Utilities	LNG	1	0.006	0.012
Eversource Gas	Propane	4	0.058	0.137
Berkshire Gas	Propane	3	0.008	0.053
Fitchburg Gas	Propane	1	0.011	0.030
EnergyNorth	Propane	3	0.035	0.108
Vermont Gas	Propane	1	0.008	0.015
Total			**1.459**	**16.764**

Compressed natural gas

Several companies operate compression facilities in New England that fill large-capacity truck trailers with CNG.[35] The primary customers for trucked CNG are industrial and large commercial end-users that would not otherwise have access to natural gas. LDCs can also use CNG as a winter peaking resource, or as a source of gas supply for isolated market areas.[36]

CNG can expand the natural gas market by allowing large end-users to switch to gas from another fuel. However, the impact that CNG will have on the New England gas market will depend on where the CNG is produced. When CNG is produced locally, it can increase the need for pipeline capacity to deliver gas into the New England region. CNG facilities that are connected to LDCs (iNATGAS, for example, is a firm sales customer of EnergyNorth) can also increase the requirement for gas supply resources and distribution capacity. Alternatively, CNG that is transported into New England from compression facilities outside the region can be a source of gas supply that reduces the need for pipeline capacity and other sources of supply. For example, XNG has modified its Eliot, ME facility to also receive CNG and inject gas into the M&N/PNGTS joint facilities pipeline.

Renewable natural gas

RNG is pipeline-quality gas that is extracted from landfills, or produced from waste material using anaerobic digesters. Substituting RNG for natural gas is a means of reducing GHG emissions. See Section 8.1. *Non-embedded GHG costs* for a larger discussion on RNG costs and potentials.

Vermont Gas and Summit Natural Gas of Maine (SNGME) have implemented voluntary sales programs under which customers can choose to have a portion of their gas consumption backed by RNG.[37] Both programs currently use RNG that is produced outside of New England.[38]

Several projects are proposed or in development that would supply RNG to New England LDCs:

- An anaerobic digester facility under construction at a dairy farm in Salisbury, VT is expected to deliver 180,000 Mcf per year to Vermont Gas.[39]

[35] NG Advantage has facilities in Milton, VT and Pembroke, NH. Xpress Natural Gas (XNG) has facilities in Eliot, ME and Baileyville, ME. Innovative Natural Gas (iNATGAS) has facilities in Worcester, MA and Concord, NH.

[36] For example, XNG supplies CNG to EnergyNorth’s Keene, NH distribution system.

[37] Summit Natural Gas Maine. Last accessed March 10, 2021. “A Program to help Build a Sustainable Energy Future.” *summitnaturalgas.com.* Available at https://www.summitnaturalgasmaine.com/RenewableNaturalGas.

[38] RNG for the Vermont Gas program comes from a landfill in Quebec and a wastewater treatment plant in Iowa. SNGME is buying RNG attributes from a landfill in Oklahoma.

[39] Vanguard Renewables. Last accessed March 10,2021. "Goodrich Farm.” *Vanguardrenewables.com.* Available at https://vanguardrenewables.com/portfolio-items/goodrich-farm-salisbury-vt/.

- In August 2020 SNGME received Maine PUC approval to buy up to 146,000 Mcf of RNG per year from Peaks Renewables, Inc., which is developing an anaerobic digester facility at a dairy farm in Clinton, ME.[40]
- In 2018, EnergyNorth asked the New Hampshire PUC to approve an agreement to buy RNG that would be produced at a landfill in Bethlehem, NH. Because of the location of the landfill, the RNG would be compressed, and delivered to EnergyNorth by truck.[41]

2.4. Avoided natural gas cost methodology

AESC 2021 uses the same avoided cost methodology used for AESC 2018, as described below.

Avoidable gas supply costs

Gas supply resources are often categorized as baseload, intermediate, or peaking. Baseload resources, such as pipeline capacity that extends from outside the local market area, tend to have a relatively high fixed cost but a lower variable cost. This type of resource is best suited to supplying high-load-factor uses, where gas is consumed at a relatively constant rate throughout the year. Peaking resources, such as on-system LNG, typically have lower fixed costs but higher variable costs. These types of resources are a better fit for gas requirements that occur on a limited number of days per year. Intermediate resources, such as short-haul pipeline capacity or a winter season gas storage service, are often used to support winter heating requirements.

The avoided natural gas supply cost for an LDC will depend on the characteristics of the gas requirement reduced, and the cost of the marginal resource that would be used to supply each type of load. For example, if the load reduction is limited to commercial and industrial non-heating customers, the avoided cost will usually be the marginal cost of a baseload gas supply resource. For a change in residential heating load, the avoided cost is likely to involve a combination of resources, since the variable gas usage pattern of residential heating customers utilizes a wider range of gas supply resources.

Estimates of the gas supply costs that can be avoided by energy efficiency program savings are calculated for each state, by region, for each of the following end-use categories:

1. Electric generation
2. Commercial and industrial non-heating
3. Commercial and industrial heating

[40] ME PUC Docket No. 2020-00089. SNGME will buy the gas produced by the facility, but not the RNG Attributes. Peaks Renewables is an affiliate of SNGME.

[41] NH PUC Docket No. DG 18-140. EnergyNorth withdrew its application to the NH PUC in February 2020, but did not state that the project has been abandoned.

4. Residential heating
5. Residential water heating
6. Residential non-heating
7. All commercial and industrial
8. All residential
9. All retail end-uses

We provide avoided natural gas values by costing period, allowing readers of AESC to develop more specific avoided costs for other measures not listed above.

Our natural gas avoided cost methodology has three steps.

Step 1 is to identify the marginal gas supply resource for each load type (i.e., baseload, intermediate, or peaking). For electric generation, we assume the applicable natural gas cost is the New England wholesale market price. For the retail end-use categories, we examine the existing and potential gas supply resources that would potentially be the marginal source of supply.

For each resource that could potentially be increased or decreased in response to a change in gas requirements, we then estimate the total delivered cost of the resource for each costing period, expressed in $/MMBtu/year. We exclude unavoidable costs. The marginal resource for each costing period is assumed to be the resource with the lowest delivered cost over the forecast horizon.

Step 2 is to determine the percentage of load for each end-use type that corresponds to each costing period. For all states except Vermont, we use the same six costing periods used in AESC 2018 as detailed below:[42]

1. Highest 10 days
2. Highest 30 days
3. Highest 90 days
4. Winter (November-March)
5. Winter/Shoulder (All months except June-August)
6. Annual Baseload

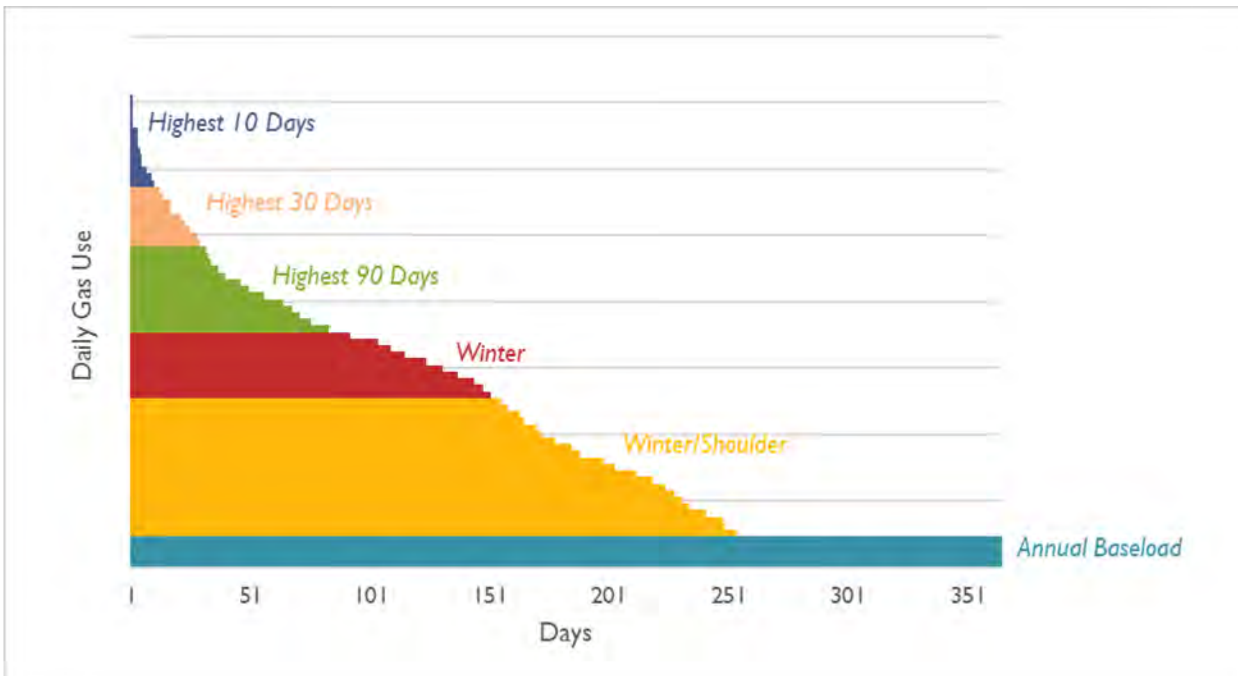
These costing periods generally correspond to the different types of gas supply resources that New England LDCs acquire to meet projected end-use requirements. Requirements that extend through the

[42] For Vermont, natural gas avoided costs are estimated for four time-of-use costing periods: peak day, next highest nine days, remaining winter (141 days), and summer/shoulder (214 days).

Annual Baseload and Winter/Shoulder periods are typically met with pipeline capacity from outside the region. Winter period requirements, and gas requirements that must be met at least 90 days per year, are often supplied using pipeline capacity from New England supply points or contracts for delivered gas. The shorter-duration requirements are typically supplied using on-system peaking resources and contracts for delivered peaking supplies.

The load shares for each end-use type are calculated from a load curve that combines a representative gas use equation (base use per day and use per heating degree day, or HDD) and a representative HDD distribution. This is illustrated by Figure 7, which shows a sample load curve for the Commercial and Industrial Heating end-use category. The load share for the Winter costing period, for example, is based on the amount of gas use that occurs at least 151 days per year, minus the gas use that only occurs on the highest 90 days. A resource that supplies planning load requirements during the Winter costing period would be used an average of 120 days per year, which corresponds to an annual load factor of 33 percent.

Figure 7. Illustrative commercial and industrial heating load shape



Step 3 is to multiply the marginal resource cost for each costing period by the corresponding load percentages. Summing the results over all costing periods gives the total annual avoided cost for each end-use. This calculation is repeated for each end-use type, for each year of the forecast period as illustrated in Table 5.

Table 5. Illustrative avoided cost calculation

Costing Period	Marginal Resource Cost ($/MMBtu)	Share of Annual Gas Use	Weighted Average ($/MMBtu)
	(A)	(B)	(A) x (B)
Annual	$4.00	-	-
Winter/Shoulder	$5.00	60%	$3.00
Winter	$6.00	25%	$1.50
Highest 90 Days	$8.50	10%	$0.85
Highest 30 Days	$15.00	4%	$0.60
Highest 10 days	$30.00	1%	$0.30
ILLUSTRATIVE AVOIDED COST FOR THIS END-USE TYPE →			**$6.25**

Assumptions and data sources

The following sections contain information about the assumptions and data sources used to construct avoided natural gas costs for New England.

New England regions

Natural gas avoided costs are estimated for three regions: (1) southern New England (Connecticut, Rhode Island, and Massachusetts); (2) northern New England (New Hampshire, Maine); and (3) Vermont.

Load shares

The load shares used for the avoided cost calculation are based on a representative HDD distribution, as well as base use per day and use per HDD factors by end-use category that were provided by study sponsors.[43] The same load share factors are used for all regions. The proportions of baseload and temperature-sensitive gas use for the five end-use categories are shown in Table 6.

Table 6. Base use and heating factors by end-use

End-use	Base use (Percent)	Temperature sensitive (Percent)
Residential Heating	-	100%
Residential Water Heating	69%	31%
Residential Non-Heating	100%	-
Commercial & Industrial Heating	21%	79%
Commercial & Industrial Non-Heating	68%	32%

Natural gas transmission costs

For AESC 2021, transmission costs are measured using the rates that New England LDCs pay to upstream pipelines for firm transportation services. These rates include a fixed reservation charge that is applied

[43] This assumes that the daily temperature distributions for the New England states are similar, even though the total annual HDDs are different in each state.

to the daily contract quantity and a variable charge that is applied to the quantity of gas transported. Pipelines also retain a percentage of the gas transported for compressor fuel and for "lost and unaccounted for" gas (see page 46).

Because the cost to build new pipeline facilities is generally higher than the costs of the depreciated assets that are used to set the pipelines' standard cost of service rates, interstate pipelines usually charge higher "incremental" rates for new services to avoid subsidization by the pipeline's other shippers. Shippers that participate in pipeline expansion projects often enter into negotiated rate agreements that set the transportation rate over the initial contract term.

The avoided cost estimates in AESC 2021 assume that LDCs can adjust the amount of transmission service they have under contract when customer requirements change. In a market such as New England, where natural gas use by LDC planning load customers is projected to increase, energy efficiency measures that reduce gas use should cause future pipeline expansions to be smaller.[44] For pipelines that price new capacity using incremental rates, the avoided transmission cost is the actual or proposed rate for the applicable pipeline's most current mainline expansion project. For the Canadian pipelines, which do not charge incremental rates for new capacity, the avoided cost is measured by the tariff rate.

Gas resource options for AESC 2021

Based on our review of New England LDC forecasts and resource plans, and other public material filed with state regulators, we assume that LDCs will obtain additional gas supplies using a combination of the representative gas resource options described here:

<u>Resource 1: Dawn Hub supply via TCPL</u>

This supply option includes Enbridge Gas transportation service from the Dawn Hub to TCPL, TCPL service to PNGTS, and service on PNGTS to Dracut. LDCs in southern New England also contract for TGP service to move gas Dracut to their city gates.

Vermont Gas currently obtains all pipeline-delivered gas supplies from the Dawn Hub and other Ontario points through its direct connection to TCPL. We assume that this will continue.

The costs for this option are based on Enbridge Gas and TCPL 2021 transportation rates and projected PNGTS expansion costs (see Table 7). Pipeline costs include the fixed reservation charge, shown as an average cost per MMBtu, the variable transportation charge, and the percentage of the natural gas transported that the pipeline retains for compressor fuel and unaccounted-for gas (see page 46). The gas commodity cost is the projected Dawn Hub price.

[44] See Table 3 for a list of recent and planned pipeline expansion projects.

Table 7. Transmission costs for the Dawn Hub capacity path

Transporter	Receipt	Delivery	Fixed Cost ($/MMBtu)	Variable Cost ($/MMBtu)	Fuel (Percent)
Enbridge Gas	Dawn Hub	Parkway	0.099	0.0	0.8%
TCPL	Parkway	VGS	0.446	0.0	0.9%
TCPL	Parkway	PNGTS	0.569	0.0	1.5%
PNGTS	TCPL	Dracut	0.854	0.0	0.7%
TGP	Dracut	TGP Zone 6	0.137	0.029	0.1%

Resource 2: Marcellus supply via AGT

This pipeline capacity path extends from the Marcellus shale gas producing areas in Western Pennsylvania to New England markets. The costs for this path include the Millennium Pipeline transportation costs from the Marcellus area to Ramapo, NY, and the incremental rates charged for Atlantic Bridge expansion project for transportation from Ramapo to New England. For northern New England, there are additional transportation costs on MNP to deliver gas from the end of the AGT system to markets in New Hampshire and Maine (see Table 8). The TETCO M2 index is used as the representative price for Marcellus-area gas supply received by Millennium Pipeline.

Table 8. Transmission costs for the Marcellus capacity path

Transporter	Receipt	Delivery	Fixed Cost ($/MMBtu)	Variable Cost ($/MMBtu)	Fuel (Percent)
Millennium	Marcellus	Ramapo	0.583	0.002	1.4%
AGT	Ramapo	Salem	1.805	0.0	2.6%
MNP	Salem	NH or ME	0.522	0.0	0.9%

Resource 3: Dracut supply via TGP (southern New England)

Gas is purchased at Dracut, where TGP connects with MNP and PNGTS, and is transported on TGP to the LDC city gate (see Table 9). LDCs are assumed to contract for winter season supply priced at the AGT Citygates index plus a fixed premium.

Table 9. Transmission costs for Dracut supply

Transporter	Receipt	Delivery	Fixed Cost ($/MMBtu)	Variable Cost ($/MMBtu)	Fuel (Percent)
TGP	Dracut	TGP Zone 6	0.137	0.029	0.1%

Resource 4: Delivered gas supplies (northern New England)

The northern New England LDCs that are connected to MNP and PNGTS contract for firm gas winter-season gas supply delivered at their citygates. We assume that the delivered gas cost is the AGT Citygates price plus a fixed premium.

Resource 5. On-system peaking resources (northern New England and Vermont)

The larger LDCs in northern New England (Northern Utilities and EnergyNorth) use LNG trucked to satellite peaking facilities to meet winter gas requirements. When peak-period requirements increase, these LDCs contract for additional LNG supplies to cycle their limited on-site LNG storage capacity. These

LDCs are also considering new LNG facilities to meet future increases in peak day demand. We assume that the cost of gas from an LNG peaking facility is the average AGT Citygates price for the peak winter months, plus a fixed premium. The peaking costs for Vermont are based on a forecast of propane prices.

Other sources of natural gas supply

There are other sources of natural gas supply that do not enter into the AESC 2021 avoided cost calculations.

Underground gas storage

Most New England LDCs hold contracts for seasonal storage service from underground gas storage facilities located in New York, Pennsylvania, and Ontario. With the growth of Marcellus shale gas production, underground storage is used less as a gas supply resource and more as a price hedging and operational balancing tool. Based on our review, LDC decisions to renew or terminate these contracts do not appear to be closely tied to changes in projected customer requirements. As with AESC 2018, we do not include storage service costs in the natural gas avoided cost estimates.

Compressed natural gas

Our review of New England LDC forecasts and supply plans found that several LDCs are considering CNG as a future gas supply resource, but we did not find evidence that CNG is expected to have a significant impact on these LDCs' gas supply costs.

Renewable natural gas

RNG is both a physical gas supply resource and a means of meeting GHG reduction goals. As a supply resource, several projects that would inject RNG into New England LDC distribution systems are proposed, or in active development (see Section 2.3. *New England natural gas market* for additional information). Connecticut LDCs are required to have standard RNG interconnection rules to facilitate future RNG production in that state.[45] However, because RNG is valued for its environmental benefits, RNG is not expected to be a marginal supply resource with production that varies with changes in gas consumption. For this reason, local RNG production is not included as a physical supply resource for the AESC 2021 avoided cost calculations.

There is also a market for RNG attributes. Vermont Gas recently began including the cost of purchasing RNG attributes in the cost of gas adjustment.[46] The VGS Climate Plan includes a goal of reducing GHGs by 30 percent by 2030. To reach this goal, VGS estimates that approximately 20 percent of its retail gas supply will need to be RNG. This includes RNG acquired for its voluntary sales program, and RNG attribute purchases that are included in system gas supply. Because VGS' RNG attribute purchases are

[45] CT PURA Docket No. 19-07-04.

[46] VT PUC Case No. 20-0431-TF, Direct Testimony of Todd Lawliss, p. 12.

tied to increases or decreases in customer requirements, RNG costs are included in the avoided costs for Vermont.

Lost and unaccounted for gas

The total quantity of gas measured at customer meters is generally lower than the measured quantity the LDC receives into its system because of lost and unaccounted for gas (LAUF). For New England LDCs, the difference between measured receipts and deliveries is typically between 1 and 2 percent. LAUF causes the gas requirement at the LDC citygate to be slightly greater than the amount delivered to customers, which increases gas supply costs. We use a LAUF factor of 1.75 percent for all regions outside of Vermont, and a 1.0 percent LAUF factor for VGS.

Natural gas distribution margin

Natural gas distribution systems are designed to meet the projected peak hourly requirements of the LDC's firm customers. When gas use is increasing, LDCs expand capacity by adding new mains, by replacing existing mains with larger-diameter pipe, or by replacing older mains with pipe that can be operated at a higher pressure. Efficiency measures that lower peak gas use avoid the cost of new facilities and associated increases in operation and maintenance (O&M) costs.[47]

LDC marginal cost studies use econometric analysis and engineering estimates to calculate the relationship between expenditures for plant and O&M and changes in peak day demand. The results from these studies are used to design rates and to set floors for the rates charged under special contracts. For AESC 2021 we use the results from recent marginal cost studies prepared by New England LDCs. These are presented in Table 10, which also shows the avoidable LDC margins for southern New England that were used for AESC 2018.[48]

[47] Some mains-replacement projects reduce leakage risk and hence maintenance costs; it is not clear to what extent load growth results in more mains replacement, as opposed to changes in the order of replacements.

[48] AESC 2018 used marginal costs from a recent LDC rate case to estimate the portion of the distribution rate for each class of customer that was related to changes in system capacity. These percentages were then applied to average distribution margins for each New England region. Average distribution margins were calculated by subtracting the citygate natural gas price from the residential, commercial, and industrial prices that are reported by EIA for each state.

Table 10. Marginal distribution capacity cost by customer class (2021 $ per MMBtu)

Company	Docket Number	Residential		Commercial / Industrial		Annual Use (Bcf)
		Non-Heating	*Heating*	*High Load Factor*	*Low Load Factor*	
National Grid (Boston Gas)	17-170	0.960	1.327	0.861	1.391	95.4
National Grid (Colonial Gas)	17-170	1.000	1.418	0.960	1.511	23.8
Berkshire Gas	18-40	0.959	1.518	0.661	1.531	7.6
Eversource Gas	18-45	0.453	0.694	0.387	0.744	51.8
NSTAR Gas	19-120	1.521	2.205	1.128	2.122	51.7
EnergyNorth	DG 20-105	0.937	1.607	0.544	1.597	15.7
Northern - Maine	2019-00092	0.635	0.817	0.301	0.708	10.8
Weighted Average		0.96	1.39	0.78	1.41	
AESC 2018 (2018 $/MMBtu)		0.33	1.09	0.42	0.75	
AESC 2018 (2021 $/MMBtu)		0.35	1.15	0.44	0.79	

2.5. Avoided natural gas costs by end-use

A summary of the natural gas avoided cost estimates is shown in Table 11, Table 12, and Table 13. Avoided costs are developed for three regions: southern New England (Connecticut, Massachusetts, Rhode Island), northern New England (Maine, New Hampshire), and Vermont. Vermont is shown separately because it uses a different avoided gas cost methodology. The results are shown with and without the avoided LDC margin and are compared to the values from AESC 2018.

Table 11. Avoided costs of gas for retail customers by end-use assuming no avoidable margin (2021 $ per MMBtu)

	Residential				Commercial & Industrial			All retail end-uses
	Non Heating	*Hot Water*	*Heating*	*All*	*Non Heating*	*Heating*	*All*	
Southern New England								
AESC 2018	$6.16	$8.09	$8.64	$8.16	$6.98	$8.12	$7.62	$7.91
AESC 2021	$4.67	$5.52	$7.42	$6.63	$5.60	$6.86	$6.31	$6.48
2018 to 2021 change	*-24%*	*-32%*	*-14%*	*-19%*	*-20%*	*-15%*	*-17%*	*-18%*
Northern New England								
AESC 2018	$5.95	$7.74	$8.24	$7.80	$6.71	$7.77	$7.31	$7.57
AESC 2021	$4.51	$5.39	$7.38	$6.55	$5.48	$6.79	$6.22	$6.39
2018 to 2021 change	*-24%*	*-30%*	*-11%*	*-16%*	*-18%*	*-13%*	*-15%*	*-16%*

Notes: AESC 2018 levelized costs are for 15 years (2018–2032) at a discount rate of 1.34 percent. AESC 2021 levelized costs are for 15 years (2021–2035) at a discount rate of 0.81 percent.

Table 12. Avoided costs of gas for retail customers by end-use assuming some avoidable margin (2021 $ per MMBtu)

	Residential				Commercial & Industrial			All retail end-uses
	Non Heating	*Hot Water*	*Heating*	*All*	*Non Heating*	*Heating*	*All*	
Southern New England								
AESC 2018	$6.51	$8.31	$9.66	$9.04	$7.37	$8.79	$8.17	$8.61
AESC 2021	$5.63	$6.48	$8.81	$7.86	$6.38	$8.27	$7.45	$7.67
2018 to 2021 change	*-14%*	*-22%*	*-9%*	*-13%*	*-13%*	*-6%*	*-9%*	*-11%*
Northern New England								
AESC 2018	$6.28	$8.06	$9.30	$8.73	$7.01	$8.30	$7.73	$8.06
AESC 2021	$5.47	$6.35	$8.76	$7.79	$6.26	$8.19	$7.35	$7.58
2018 to 2021 change	*-13%*	*-21%*	*-6%*	*-11%*	*-11%*	*-1%*	*-5%*	*-6%*

Notes: AESC 2018 levelized costs are for 15 years (2018–2032) at a discount rate of 1.34 percent. AESC 2021 levelized costs are for 15 years (2021–2035) at a discount rate of 0.81 percent.

Table 13. Avoided costs of gas for retail customers by end-use for Vermont (2021 $ per MMBtu)

	All sectors			
	Design Day	*Peak Days*	*Remaining Winter*	*Shoulder/ Summer*
Vermont				
AESC 2018	$591.58	$27.68	$5.15	$4.72
AESC 2021	$556.10	$17.08	$5.11	$4.75
2018 to 2021 change	*-6%*	*-38%*	*-1%*	*1%*

Notes: AESC 2018 levelized costs are for 15 years (2018–2032) at a discount rate of 1.34 percent. AESC 2021 levelized costs are for 15 years (2021–2035) at a discount rate of 0.81 percent.

Southern New England and Northern New England

The AESC 2021 avoided cost estimates are lower than the AESC 2018 estimates, but the change in the avoided costs is not as large as the change in the Henry Hub and Algonquin Citygate commodity price forecasts. The main reason is that the cost of expanding natural gas pipeline capacity into New England continues to rise. For AESC 2021, the incremental cost to expand capacity on PNGTS is assumed to be $0.85 per MMBtu, which is 40 percent higher than the transportation charge that was used for AESC 2018. The final rates charged for AGT's Atlantic Bridge expansion project are 14 percent higher than the previous estimate. Because pipeline operators recover capital costs and most operating costs through a fixed monthly charge, the impact of the higher incremental pipeline charges is amplified for lower load factor end-uses, such as residential heating.

Comparing the two Southern New England and Northern New England regions, because the marginal gas transmission path used to calculate the avoided costs for both northern New England and southern New England runs from the Dawn Hub in Ontario through northern New Hampshire, additional gas pipeline charges cause the avoided costs for southern New England to be slightly higher. However, the difference in avoided costs between southern New England and northern New England is smaller for AESC 2021 than for AESC 2018.

Vermont

The natural gas avoided cost estimates for Vermont use the end-use costing periods and methodology developed for previous AESC studies. The Design Day avoided cost is the marginal upstream supply and delivery cost, plus the marginal LDC transmission cost. The Canadian pipeline tolls that set the upstream delivery costs for VGS are slightly lower for AESC 2021 than for AESC 2018, due in part to the change in the Canadian dollar exchange rate. The avoided cost for the remaining nine Peak Days reflects the lower delivered cost of propane for the VGS peaking facility.

3. FUEL OIL AND OTHER FUEL COSTS

In this chapter, we present the avoided fuel oil and other fuel costs used for AESC 2021, compare those estimates with AESC 2018, and identify the data sources used.

This section analyzes oil prices in $/MMBtu for the four sectors: electric generation, residential, commercial, and industrial. Prices are developed for the following grades: distillate fuel oils (No.2 and No. 4), residual fuel oils (No. 6), and biofuel blends.[49] Also included are cord wood, wood pellets, kerosene, and propane in the residential heating applications. New to AESC 2021, we also investigate avoided costs for motor gasoline and diesel used for transportation.

In general, we find that avoided levelized costs for all fuels considered in this category are moderately higher than what was estimated in AESC 2018. In AESC 2021 we follow the EIA Short Term Energy Outlook (STEO) for one year and then directly transition to the 2021 AEO forecast. We chose these data sources for the near term to represent current market conditions and to capture the effects of the COVID-19 pandemic. In contrast, in AESC 2018 we followed the STEO and NYMEX market futures for two years and then transitioned over several years to the most recent AEO forecast.

3.1. Results and comparison with AESC 2018

Table 14 compares the levelized avoided fuel costs for AESC 2021 with those used for AESC 2018. Annual avoided fuel costs are detailed in Appendix D: *Detailed Oil and Other Fuels Outputs*. The Synapse Team based the results for the oil-based fuels on the most recent New England State Energy Data System (SEDS) prices. We then adjusted the results based on the crude oil price trends as discussed above and the AEO 2020 Reference Case projections for New England. Residential distillate prices are 2.9 percent greater, while Commercial distillate prices are 14.3 percent higher and commercial residual prices are 8.2 percent lower (this decrease is due to a drop in recent historical prices for this fuel product). Propane prices are higher, representing recent increases in the SEDS price data. Kerosene, a fuel with a very modest market share, shows a significant increase based on the most recent SEDS data with a price midway between that of distillate and propane.

Wood pellet prices are about the same, reflecting current market conditions. Cord wood, whose price and quality can vary widely, shows a significant price increase based on recent prices. However, these prices are below those of wood pellets. Note that all these prices reflect the fuel heat content and do not adjust for relative efficiencies and delivered energy. This analysis uses SEDS values for the starting points, adjusted for current and near-term national prices from STEO. The prices then follow the trajectory of the AEO 2021 Reference case prices going forward.[50]

[49] For the purposes of AESC 2021, biofuels blended in heating oil include B5 and B20.

[50] See https://www.eia.gov/state/seds/ for more information about the EIA State Energy Data System (SEDS).

Table 14. Comparison of avoided costs of retail fuels (15-year levelized, 2021 $ per MMBtu)

	Residential						Commercial		Transportation	
	No. 2 Distill-ate	Pro-pane	Kero-sene	Bio-Fuel (B20)	Cord Wood	Wood Pellets	No. 2 Distillate	No. 6 Resid-ual	Motor Gasoline	Motor Diesel
AESC 2018	$23.36	$32.78	$20.95	$24.06	$14.12	$22.76	$19.46	$17.13	-	-
AESC 2021	$24.04	$38.79	$29.59	$21.64	$20.84	$22.47	$22.25	$15.74	$22.07	$22.76
Percent change	2.9%	18.3%	41.3%	-10.1%	47.6%	-1.3%	14.3%	-8.2%	-	-

3.2. Forecast of crude oil prices

The primary factor driving avoided fuel oil costs and fuel oil prices is the price of crude oil. For AESC 2021, we rely on EIA's STEO and projections from the 2021 AEO Reference case (see Chapter 0:

Avoided Natural Gas Costs for more information about the analogous gas price forecast). This is a similar methodology to that used in the 2018 AESC study.

For near-term projections in AESC 2021, we rely on data from the most recent STEO forecast for West Texas Intermediate (WTI) crude oil. We then transition to the AEO 2021 Reference case price projections in 2022. The approach is similar to that used for the natural gas price forecast, but it differs in that the markets have different sources of production and distribution. The oil markets are much more global and fluid than those for natural gas.

The COVID-19 pandemic has reduced fossil fuel consumption world-wide and prices have fallen as supply exceeds demand. In the January 2021 edition of the STEO, the oil price forecast is about $45 per barrel through 2022. However, the uncertainty is quite large, as shown in Figure 8. We also reviewed the NYMEX oil futures for WTI (see Figure 9), which were occasionally used in past AESC studies to adjust or to verify the forecast. These values are similar to the January 2021 STEO in the near term, but then decline in both nominal and real dollar terms. This is odd market behavior and probably not indicative of likely future prices. Thus we make no use of this information in AESC 2021. For short-term prices, we ultimately rely on the STEO forecast because that incorporates an informed analysis of a wide variety of data, including the futures.[51]

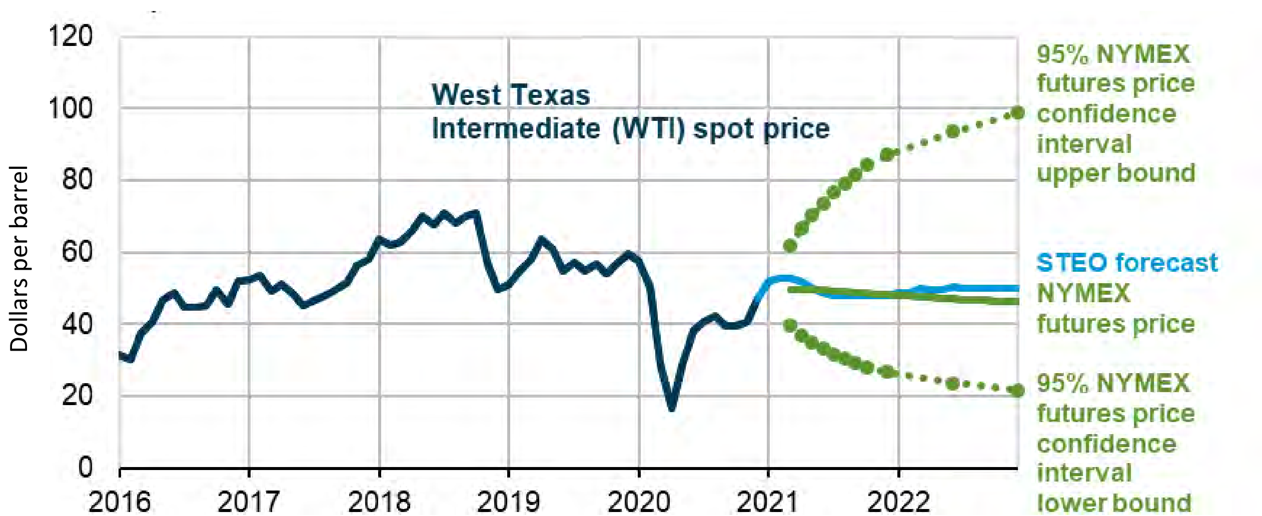
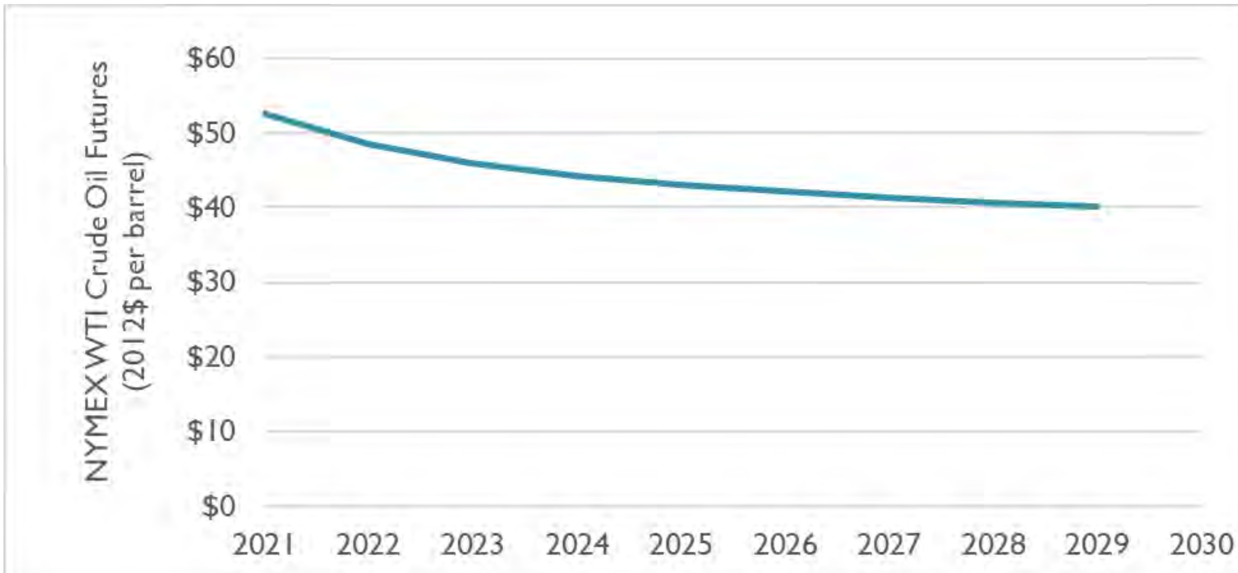


Figure 8. Forecast for West Texas Intermediate crude oil with NYMEX confidence intervals

Source: Reproduced from the January 2021 edition of EIA's Short-Term Energy Outlook. Available at *https://www.eia.gov/outlooks/steo/* *Retrieved January 30, 2021. EIA note: "Confidence interval derived from options market information for the five trading days ending Jan 7, 2021. Intervals not calculated for months with sparse trading in near-the-money options contracts."*

[51] U.S. EIA. Last accessed March 10, 2021. "Short Term Energy Outlooks" *eia.gov.* Available at https://www.eia.gov/outlooks/steo/marketreview/crude.php.

Figure 9. NYMEX oil futures for West Texas Intermediate (WTI) crude oil

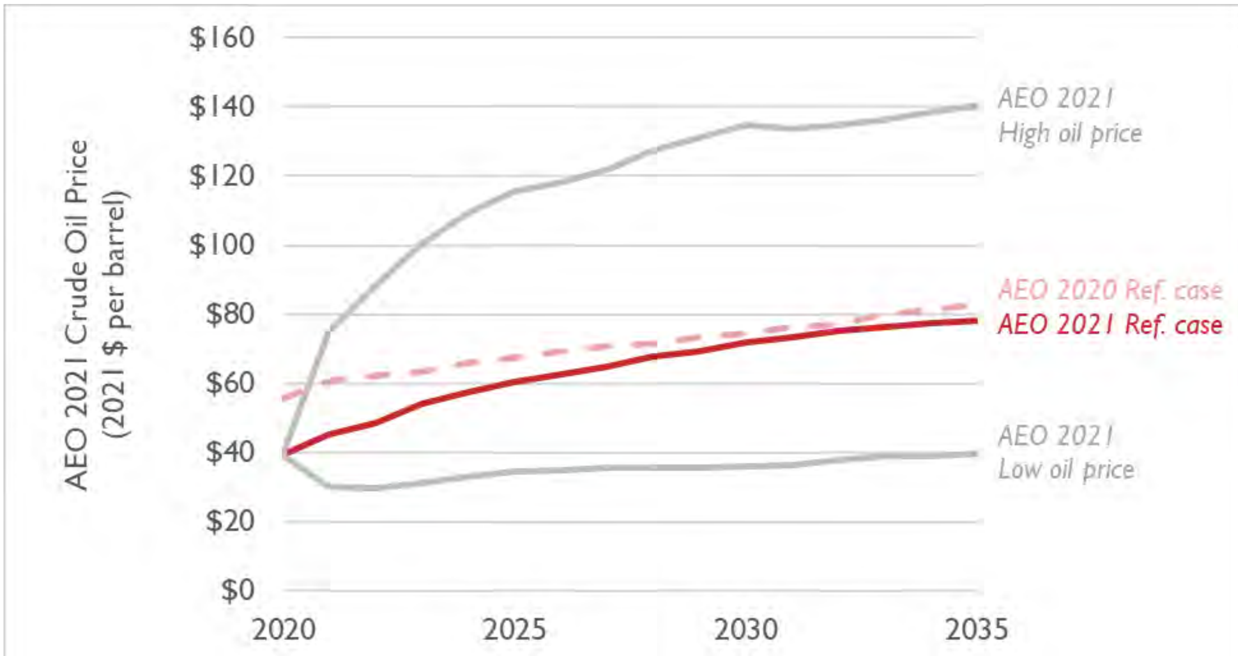


Source: CME Group, https://www.cmegroup.com/market-data/settlements.html?redirect=/market-data/settlements/index.html, Retrieved February 2, 2021.

Figure 10 shows prices for WTI crude oil from a number of scenarios in AEO 2021.[52] Oil prices rise modestly in the Reference case but differ substantially in the High and Low Oil Price scenarios. This represents the uncertainty about future oil prices. The 2020 price of oil in AEO 2021 (about $40 per barrel) is about two-thirds the price projected in AEO 2020 but increases up to similar levels by 2030.

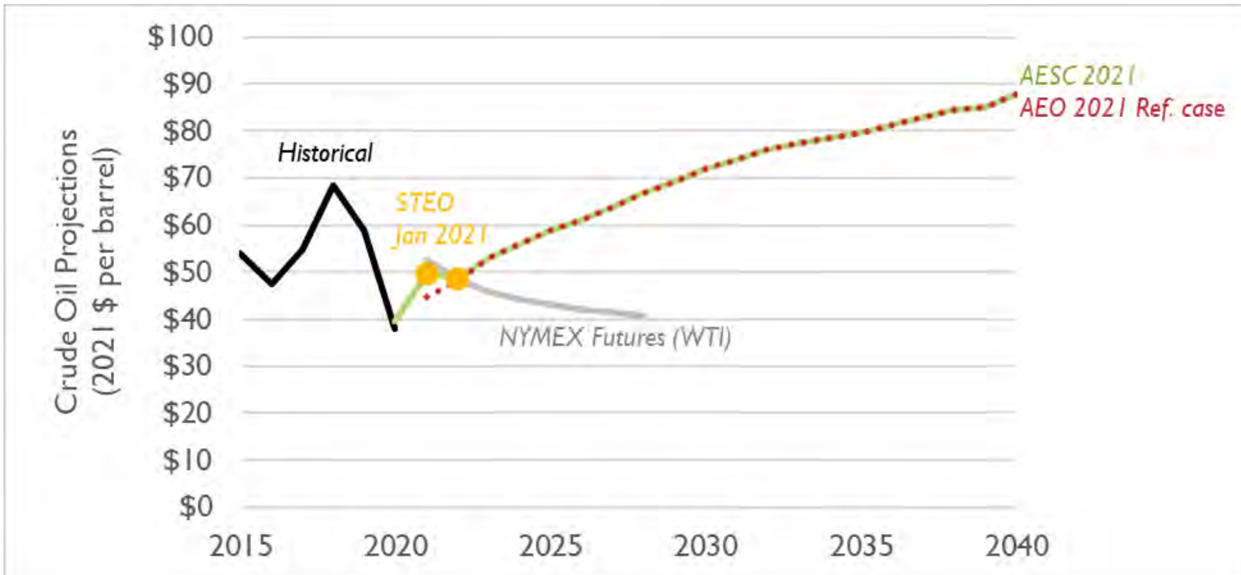
[52] AEO 2020 does not present WTI crude oil prices. Price shown for AEO 2020 is for Brent.

Figure 10. Oil prices projected in various AEO 2021 scenarios



The current short-term forecasts and futures markets do not indicate much increase in crude oil prices over the next several years. However, AEO projections are based on fundamental resource base analyses, and thus it is reasonable to expect higher future oil prices in the medium to long term. For AESC 2021, we use STEO for the near term (2021) and AEO 2021 for the medium and long terms (2022 and all subsequent years) (see Figure 11). The annual real rate of price increase is about 2 percent per year. This forecast is not meant to predict the actual price in any given year, but rather to represent a mid-point average of fluctuating prices.

Figure 11. Crude oil prices, historical, forecast, and AESC 2021



3.3. Forecast of fuel prices

For AESC 2021, starting prices for fuel prices for electric generation and other end-uses are based on historical prices for the various fuels and sectors from SEDS (see Table 15). SEDS represents a comprehensive compilation of the actual prices and consumption. For the electric sector, we verify this with the EIA database of fuel costs for electric generation. Investigation of recent wood prices found delivered wood pellets to be in the range of $18 per MMBtu.[53] Prices for cord wood and wood chips at the residential level are not readily available and vary widely both in cost and heat value.

Data in EIA's SEDS database is provided at the state level. We looked at nine years (2010–2018) of historical data to determine if there are significant variations between the New England states. No consistent and significant state variations are apparent, and except for propane, prices in New England closely resemble national average prices.

[53] New Hampshire Office of Strategic Initiatives. "Fuel Prices," accessed August 31, 2020. Available at: https://www.nh.gov/osi/energy/energy-nh/fuel-prices/index.htm.

Table 15. SEDS New England fuel prices in 2018 by end-use sector in 2018 (2021 $ per MMBtu)

Fuel	Residential	Commercial	Industrial	Transportation	Electric
Distillate fuel oil	20.8	20.2	19.0	24.8	16.6
Kerosene	25.6	25.6	16.0	-	-
LPG (Propane)	36.8	19.0	20.2	19.8	-
Residual fuel oil	-	11.6	13.9	-	7.9
Motor Gasoline	-	24.4	24.4	24.4	-
Wood	17.9	-	-	-	-
Wood & Waste	-	22.4	22.4	-	-

AEO 2021 and other EIA documents do not generally make a distinction between state-level prices for specific grades of fuel oil. Instead, they simply report on high-level categories of Distillate Fuel Oil and Residual Fuel Oil. However, the grade mix between sectors does vary and is reflected to some degree in the prices for those sectors.

In terms of the AESC grade categories, we use the following mapping: No. 2 grade is distillate fuel oil used in the residential sector; No. 4 is distillate fuel oil used in the other sectors; and No. 6 is residual fuel oil used in the commercial, industrial, and electric sectors. Definitions of the EIA fuel oil categories can be found on the EIA website.[54] This is the same mapping applied in the 2018 AESC Study.

AEO 2021 does not provide a forecast of New England regional prices for biofuel B5 and B20 blends, as these blends represent a small portion of the New England market. Both B5 and B20 are mixes of a petroleum product, such as distillate oil or diesel, and an oil-like product derived from an agricultural source (e.g., soybeans). The number in their name is the percent of agricultural-derived component. Thus “B5” and “B20” represent products with a 5 percent and a 20 percent agricultural-derived component, respectively. They are both similar to No. 2 fuel oil and are used primarily for heating. Each of these fuels has both advantages and disadvantages relative to No. 2 fuel oil. Their advantages include lower GHG emissions per MMBtu of fuel consumed,[55] more efficient operation of furnaces, and less reliance on imported crude oil. Their disadvantages include somewhat lower heat contents, equipment effects, and concerns about the long-term supply of agricultural source feedstocks.

Per ASTM D396, fuel oils for home heating and boiler applications may be blended with up to 5 percent biodiesel below the rack.[56, 57] Marketers are not required to disclose information on biodiesel content below these levels. While the AEO forecast for fuel oil does not reflect any inherent biodiesel content, the current price premium for B99-B100 biodiesel is $0.90 per gallon, or an implied 7 cents per gallon for

[54] EIA Fuel oil definitions: https://www.eia.gov/tools/glossary/index.php?id=N.

[55] The CO_2 emissions from the bio component of the fuel are not counted as contributing to global climate change.

[56] ASTM International. “ASTM Sets the Standard for Biodiesel.” Jan 2009. Available at: http://www.astm.org/SNEWS/JF_2009/nelson_jf09.html.

[57] “Below the rack” refers to blending at the refinery, before fuel is sold to wholesalers.

the B5 blend. However, the current price for B20 is $0.25 per gallon below diesel ($2.36 vs. $2.61).[58] B20 prices have been below diesel prices by similar levels since 2018. We thus project that B20 prices will be 10 percent below diesel prices in the future, and that B5 prices will have neither a discount nor a premium.

The SEDS data show no differences in residential wood prices between the New England states. As the starting basis for wood prices, AESC 2021 uses recent data from New Hampshire.[59] Actual wood prices and wood quality can vary widely, and we recommend that anyone interested in this issue carry out an independent investigation of local wood prices. In previous AESC studies, we linked the future wood fuel price changes to that of distillate oil and we do so again here.

Because recent oil prices have changed so much since the 2018 SEDS data, we adjusted those prices to represent the changes in oil prices since then. The AESC 2021 starting prices are shown in the following table.

Table 16. New England fuel prices in 2021 by end-use sector (2021 $ per MMBtu)

Fuel	Residential	Commercial	Industrial	Transportation	Electric
Distillate fuel oil	19.1	20.9	20.0	20.0	18.5
Kerosene	23.6	26.4	16.8		
LPG (Propane)	33.9	19.7	21.2	15.9	
Residual fuel oil	-	12.0	14.6		8.8
Motor Gasoline	-	25.3	25.6	19.7	
Wood	17.9				
Wood & Waste	-	23.2	23.6		

Prices in future years start with the base year prices as indicated above and then increase following the trajectory for the oil price forecast, as shown in Figure 11. They then follow that same relative trajectory and match the AEO 2021 New England price projections and trends in 2022 and future years. The AESC 2021 starting prices are based on 2018 SEDS historical data and actual 2020 prices, but the changes over the analysis period are based on the AEO projections.[60]

Since fuel oil prices do not show meaningful variations by month or season, we have not developed monthly or seasonal price variations for petroleum products. Storage for petroleum products is relatively inexpensive and this also tends to smooth out variations in costs relative to market prices. For these reasons, our forecast does not address volatility in the prices of these fuels.

[58] U.S. Department of Energy Alternative Fuels Data Center, April 2020 prices. https://www.afdc.energy.gov/fuels/prices.html.

[59] New Hampshire Office of Strategic Initiative, "Fuel Prices." Available at https://www.nh.gov/osi/energy/energy-nh/fuel-prices/index.htm. Accessed August 31, 2020.

[60] In cases where there are noticeable differences between the SEDS and the AEO prices we have relied on the SEDS prices, as these represent actual reported costs.

3.4. Avoided costs

For the avoided costs for fuel oil products and other fuels by end-use, we used the prices as discussed above and the consumption as projected in AEO 2021. The consumption of these fuels is not expected to increase significantly over the study period. Moreover, the supply systems are flexible and diverse, and they are not subject to the capacity- or time-based constraints associated with electricity and natural gas. Thus, we believe the market prices provide an appropriate representation of the avoided costs.

For petroleum-related fuels, we started with the costs of those fuels by sector by multiplying our projected regional prices for each fuel and sector by the relative quantities of each petroleum-related fuel that AEO projects will be used in that sector. We estimated that the crude oil price component of these projected prices is the portion that can be avoided through demand-side management (DSM) programs. For other fuels, we used the projected regional prices multiplied by the consumption of those fuels as projected by AEO, with appropriate fractional adjustments based on the SEDS historical data. Consistent with prior AESC studies, we model the full cost of those fuels as avoidable.

3.5. Greenhouse gas and criteria pollutant emissions

Table 17 provides carbon dioxide (CO_2) emission rates for the various fuels analyzed in this chapter. This table defines the CO_2 emission rate for wood fuels as zero. This essentially a placeholder value, as there are differing views about the GHG impacts of wood fuels. Additional information on emissions rates can be found in Appendix G: *Marginal Emission Rates and Non-embedded Environmental Cost Detail*.

Table 17. CO_2 emission rates for non-electric fuels (lb per MMBtu)

Fuel	CO_2 Emission Rate
Distillate fuel oil	161
B5 Biofuel	153
B20 Biofuel	129
Kerosene	159
LPG	139
RFO	173
Transportation Diesel	161
Gasoline	157
Wood	zero
Wood & Waste	zero

Note: Biofuel rates are based on the fossil fuel fraction. The direct CO_2 emission rate for wood combustion depends strongly on wood type and moisture content, but a rough range would be 200–250 lbs/MMBtu. Version February 2016.
Sources: Emission rates for petroleum products from EIA https://www.eia.gov/environment/emissions/co2_vol_mass.php.

Combustion of these fuels also produces sulfur dioxide (SO_2) and nitrogen oxides (NO_X) emissions. Most of the available emission data is quite old and the impacts are very small. However, for reference we provide the emission rates from AESC 2018 (see Table 18). Most of the Northeast has switched to Ultra-

Low Sulfur Diesel (ULSD) fuel oil, which consists of only 50 or 15 parts per million (ppm) of sulfur.[61] By contrast, 1 percent sulfur oil—historically in wide use in New England—contains 10,000 ppm of sulfur. The shift to ULSD reduces the SO_2 emissions by a factor of over 600. Distillate oil at 15 ppm sulfur is equivalent to 0.0016 lb SO_2 per MMBtu, which rounds to the 0.002 lb SO_2 per MMBtu, shown in Table 18. Heavier oils will likely have higher sulfur content and the emission rates should be adjusted accordingly based on their actual characteristics.

Table 18. SO_2 and NO_X emission factors (lb per MMBtu)

Emission Rates of Significant Pollutants from Fuel Oil Sector and Fuel	SO_2	NO_X	*Notes*
#2 Fuel Oil			*(a)*
Residential, #2 oil	0.002	0.129	
Commercial, #2 oil	0.002	0.171	
Industrial, #2 oil	0.002	0.171	
Kerosene—Residential heating	0.152	0.129	*(b)*
Wood—Residential heating	0.020	0.341	*(c)*

Notes: For fuel oil, we assumed sulfur content of 15 ppm.
Sources: Table originally from AESC 2015, Exhibit 4-15. Page 4-93. Embedded sources include (a) Environmental Protection Agency, AP-42, Volume I, Fifth Edition, January 1995, Chapter 1, External Combustion Sources. http://www.epa.gov/ttnchie1/ap42/ (for SO_2 and NO_X); (b) AESC 2013; (c) James Houck and Brian Eagle, OMNI Environmental Services, Inc., Control Analysis and Document for Residential Wood Combustion in the MANE-VU Region, December 19, 2006. http://www.marama.org/publications_folder/ResWoodCombustion/RWC_FinalReport_121906.pdf.

The table below provides emission assumptions for gasoline and diesel used in transportation. Note that criteria pollutants from the transportation sector can vary substantially based on vehicle type and age. These numbers are based on national averages for vehicles on the road in 2018 and may change as new vehicle emission standards are implemented in the future and older vehicles are retired.

Table 19. Transportation fuel emission factors (lb per MMBtu)

Fuel	NO_x	HC	CO	PM2.5 (Exhaust)	PM2.5 (Brake and Tire)
Gasoline	0.124	0.137	1.620	0.003	0.001
Diesel	0.717	0.077	0.239	0.026	0.002

Notes: NO_X = nitrogen oxides; HC = hydrocarbons; CO = carbon monoxide; PM2.5 = particulate matter with diameter <= 2.5 micrometers. Gasoline includes light-duty vehicles, light-duty trucks, and motorcycles. Diesel includes trucks of six tires or more. combination trucks, and buses.
Sources: Derived from the National Transportation Statistics tables of the Bureau of Transportation Statistics of the U.S. Department of Transportation. Available at https://www.bts.gov/product/national-transportation-statistics. See Tables 1-35, 4-43, and 4-6M.

[61] U.S. EIA. April 18, 2012. "Sulfur Content of Heating Oil to be Reduced in Northeastern States." *eia.gov.* Available at https://www.eia.gov/todayinenergy/detail.php?id=5890.

Vehicle emission rates vary at the state level for a variety of factors including vehicle mix and inspection programs (for example, see the data in Table 20).[62] U.S. Department of Transportation does not publish state emission data, but this data may be available from state transportation or environmental agencies.[63]

Table 20. Transportation fuel 2018 emission factors (grams per mile)

Pollutant	Gasoline: *Light-duty vehicles*	Gasoline: *Light-duty trucks*	Gasoline: *Heavy-duty vehicles*	Gasoline: *Motor-cycles*	Diesel: *Light-duty vehicles*	Diesel: *Light-duty trucks*	Diesel: *Heavy-duty vehicles*
HC	0.350	0.421	1.160	2.544	0.183	0.324	0.645
CO	3.941	5.655	21.352	13.58	2.663	2.754	1.994
NO_X	0.289	0.478	1.416	0.719	0.153	1.321	5.971
Exhaust $PM_{2.5}$	0.008	0.010	0.030	0.024	0.004	0.045	0.213
Brakewear $PM_{2.5}$	0.003	0.003	0.009	0.001	0.003	0.003	0.013
Tirewear $PM_{2.5}$	0.001	0.001	0.002	0.001	0.001	0.002	0.004

Sources: Derived from the National Transportation Statistics tables of the Bureau of Transportation Statistics of the U.S. Department of Transportation. Available at https://www.bts.gov/product/national-transportation-statistics*. Table, 4-43.*

[62] In addition, there may be volatile organic compound (VOC) emissions from fuel oil handling and from wood fuel combustion. These emissions are not quantified as part of the AESC 2021 study.

[63] U.S. Environmental Protection Agency's (EPA) MOVES model is one example of such a resource. https://www.epa.gov/moves.

4. COMMON ELECTRIC ASSUMPTIONS

The following section contains input assumptions which are common to the calculations of avoided electric energy, avoided electric capacity, and avoided RPS compliance.

One of the main tasks of the AESC 2021 study is to estimate the electricity supply costs that would be avoided by reducing retail sales of electricity through energy efficiency initiatives or other emerging DSM programs. It includes methodologies, assumptions, and sources relating to the modeling frameworks, electricity demand, transmission, renewable policies, generic resource additions, known and anticipated resource additions, and known and anticipated resource retirements.

In addition to differences in underlying natural gas prices and fuel oil prices (discussed in Chapter 0 and Chapter 3, respectively) modeling assumptions in AESC 2021 differ from those used in AESC 2018 in terms of the following:

- Examination of different load trajectories under four counterfactual scenarios
- Lower projections for annual sales (not including impacts associated with building or transportation electrification)
- Inclusion of impacts of transportation electrification in all four counterfactual scenarios
- Updated assumptions on clean energy additions, including substantial updates to new long-term contracting requirements (e.g., for offshore wind and other renewables), modifications to online dates for certain clean energy projects, and updates of other renewable policies including RPS
- Updated assumptions for known and estimated unit retirements as well as unit additions
- Lower projections for compliance prices under RGGI

4.1. AESC 2021 modeling framework

The wholesale energy markets in New England are managed by ISO New England. There are two primary energy markets: (1) the Day-Ahead Market (where the majority of transactions occur) and (2) the Real-Time Market, in which ISO New England balances the remaining differences in energy supplies and demand.[64] On average, prices in these two markets are typically close to one another, although there is a tendency for greater volatility in the Real-Time Market. ISO New England also manages a capacity market, which is an auction-based system that ensures the New England power system has sufficient resources to meet future demand for electricity. Forward Capacity Auctions (FCA) are held each year,

[64] See ISO New England's *2019 Annual Markets Report* for more information at https://www.iso-ne.com/static-assets/documents/2020/06/a6_2019_annual_markets_report.pdf.

three years in advance of a specified future operating period. ISO New England also manages other ancillary markets, including regulation and reserve markets.

AESC 2021 uses three models to concurrently forecast avoided energy market and capacity costs. These models include:

The EnCompass Model

Developed by Anchor Power Solutions, EnCompass is a single, fully integrated power system platform that allows for utility-scale generation planning and operations analysis. EnCompass is an optimization model that covers all facets of power system planning, including the following:

- Short-term scheduling, including detailed unit commitment and economic dispatch
- Mid-term energy budgeting analysis, including maintenance scheduling and risk analysis
- Long-term integrated resource planning, including capital project optimization and environmental compliance
- Market price forecasting for energy, ancillary services, capacity, and environmental programs

EnCompass provides unit-specific, detailed forecasts of the composition, operations, and costs of the regional generation fleet given the assumptions described in this document. Synapse has populated the model using the *EnCompass National Database*, created by Horizons Energy. Horizons Energy benchmarked its comprehensive dataset across the 21 North American Electric Reliability Corporation (NERC) Assessment Areas and it incorporates market rules and transmission constructs across 76 distinct zonal pricing points. Synapse uses EnCompass to optimize the generation mix in New England and to estimate the costs of a changing energy system over time, absent any incremental energy efficiency or DSM measures. More information on EnCompass and the Horizons dataset is available at www.anchor-power.com.

EnCompass modeling topology

EnCompass, like other production-cost and capacity-expansion models, represents load and generation by mapping regional projections for system demand and specific generating units to aggregated geographical regions. These load and generation areas are then linked by transmission areas to create an aggregated balancing area. Table 21 shows load and generation areas to be reported on in AESC 2021 and Table 22 details modeled load and generation areas. This is the same modeling topology as that used in AESC 2018. For AESC 2021, we use load-weighted averages to translate modeling zones into reporting zones. While some zones under each topology are close matches, other reporting zones are made up of a number of different modeling zones. The percentages for weighting percentages are based on locations of pnodes in specific states and modeling zones (see Table 23).[65] These weighting percentages are updated with 2019 nodal data that are similar, but not identical to, the weightings used in AESC 2018 (which was based on 2016 nodal data).

Table 21. Reporting zones in AESC 2021

	AESC Reporting Zones
1	Maine
2	Vermont
3	New Hampshire
4	Connecticut
4a	Southwest Connecticut (including Norwalk-Stamford)
4b	Rest of Connecticut (Northeast)
5	Rhode Island
6	Massachusetts
6a	SEMA (Southeastern Massachusetts)
6b	WCMA (West-Central Massachusetts)
6c	NEMA (Northeastern Massachusetts)

Table 22. Modeled load zones in AESC 2021

EnCompass Region	ISO New England sub-area
NE Maine Northeast	BHE
NE Maine West Central	ME
NE Maine Southeast	SME
NE New Hampshire	NH
NE Vermont	VT
NE Boston	Boston
NE Massachusetts Central	CMA/NEMA
NE Massachusetts West	WMA
NE Massachusetts Southeast	SEMA
NE Rhode Island	RI
NE Connecticut Northeast	CT
NE Connecticut Southwest	SWCT
NE Norwalk Stamford	NOR

[65] Pnode load factors for 2019 are available on the ISO New England website at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/nodal-load-wgts.

Table 23. Translation between EnCompass modeling zones (vertical) and AESC 2021 reporting zones (horizontal)

		ME	NH	RI	VT	All CT	SW CT	NE CT	All MA	SE MA	NE MA	WC MA
NE Maine Northeast	BHE	15%	-	-	-	-	-	-	-	-	-	-
NE Maine West Central	ME	50%	-	-	-	-	-	-	-	-	-	-
NE Maine Southeast	SME	35%	-	-	-	-	-	-	-	-	-	-
NE New Hampshire	NH	-	82%	-	3%	-	-	-	-	-	-	-
NE Vermont	VT	-	16%	-	91%	-	-	-	-	-	-	-
NE Boston	Boston	-	-	-	-	-	-	-	46%	-	100%	1%
NE Mass. Central	CMA/ NEMA	-	3%	-	-	-	-	-	13%	-	-	46%
NE Mass. West	WMA	-	-	-	6%	1%	-	2%	15%	-	-	53%
NE Mass. Southeast	SEMA	-	-	10%	-	-	-	-	20%	77%	-	-
NE Rhode Island	RI	-	-	90%	-	-	-	-	6%	23%	-	-
NE Connecticut Northeast	CT	-	-	-	-	50%	-	98%	-	-	-	-
NE Connecticut Southwest	SWCT	-	-	-	-	32%	66%	-	-	-	-	-
NE Norwalk Stamford	NOR	-	-	-	-	17%	34%	-	-	-	-	-

Notes: Totals may not add due to rounding.

Neighboring regions modeled in this study are New York, Quebec, and the Maritime Provinces. These regions are not represented with unit-specific resolution. Instead, they are represented as a source or sink of import-export flows across existing interfaces in order to reduce modeling run time.[66]

[66] In this analysis, the Maritimes zone includes Emera Maine and Eastern Maine Electric Cooperative (EMEC) which are not part of ISO New England and, therefore, are not included in any of the New England pricing zones used in this study. These regions are not modeled as part of the Maine pricing zone and were modeled as part of the New Brunswick transmission area.

The Renewable Energy Market Outlook Model

In addition to EnCompass, AESC 2021 uses Sustainable Energy Advantage's New England Renewable Energy Market Outlook (REMO), a set of models developed by Sustainable Energy Advantage that estimate forecasts of scenario-specific renewable energy build-outs, as well as REC and clean energy certificate (CEC) price forecasts. Within REMO, Sustainable Energy Advantage can define forecasts for both near-term and long-term project buildout and REC pricing.

Near-term renewable builds are defined as projects under development that are in the advanced stages of permitting and have either identified long-term power purchasers or an alternative path to securing financing. These projects are subject to customized, probabilistic adjustments to account for deployment timing and likelihood of achieving commercial operation. The near-term REC price forecasts are a function of existing, RPS-certified renewable energy supplies, near-term renewable builds, regional RPS demand, alternative compliance payment (ACP) levels in each market, and other dynamic factors. Such factors include banking, borrowing, imports, and discretional curtailment of renewable energy.

The long-term REC price forecasts are based on a supply curve analysis taking into account technical potential, resource cost, and market value of production over the study period. These factors are used to identify the marginal, REC price-setting resource for each year in which new renewable energy builds are called upon. The long-term REC price forecast is estimated to be the marginal cost of entry for each year, meaning the premium requirement for the most expensive renewable generation unit deployed for a given year.

The FCM Model

The AESC 2021 study uses a spreadsheet model to develop FCM auction prices for power years from June 2021 onwards. We coordinate the major input assumptions regarding the forecasts of peak load and available capacity in each power year with the input assumptions used in the Encompass energy market simulation model. General assumptions for this model include the assumption that resources generally continue to bid FCM capacity in a manner similar to their bidding in FCA 12 through FCA 15, the assumption that FCM prices will be to a large degree determined by the price of new peaking units, and the assumption that the supply curve in future FCAs feature similar slopes to FCA 15. See Chapter 5: *Avoided Capacity Costs* for more detail on the methodology.

Modeled market rules

The EnCompass model approximates the market rules used in ISO New England. The following sections provide an overview of the model's approach to these rules.

Marginal-cost bidding

In deregulated markets, generation units are assumed to bid marginal cost (opportunity cost of fuel plus variable O&M costs plus opportunity cost of tradable permits). The model prices are based on such representative marginal costs. Notably, the model calculates bid adders to close any gap between energy market revenues and submitted bids. The resulting energy-price outputs are benchmarked against historical and future prices.

Installed capacity

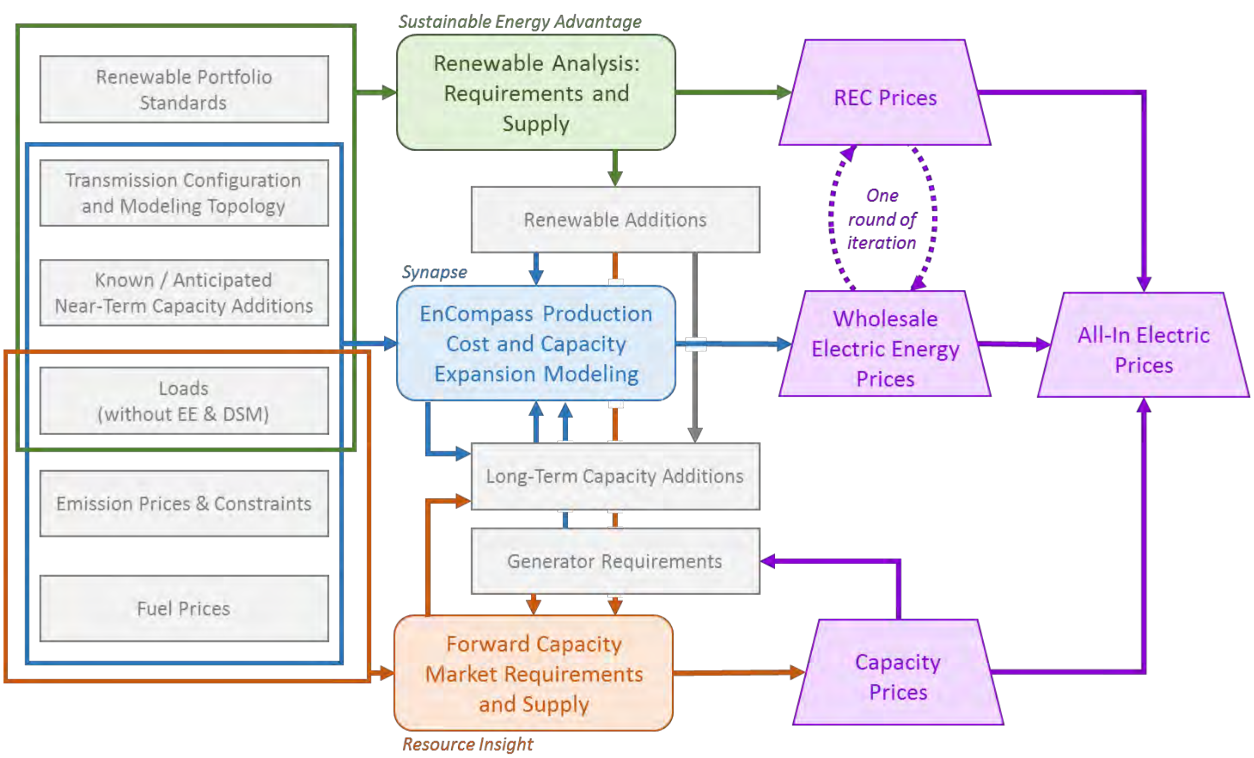
Installed-capacity requirements for the EnCompass model include reserve requirements established by ISO New England on an annual basis. Current estimates of the reserve-margin and installed-capacity requirement (with and without the Hydro Quebec installed-capacity credits) are described in Chapter 5: *Avoided Capacity Costs.* Installed capacity for the energy model in each model year is consistent with the values assumed in the FCA analysis, although the values are not necessarily the same due to imports and exports.

Ancillary services

EnCompass allows users to define generating units based on each unit's ability to participate in various ancillary services markets including Regulation, Spinning Reserves, and Non-Spinning Reserves. The model allows users to specify these abilities for each unit, at varying levels of granularity. EnCompass allows units to contribute to contingency and reserves requirements, and it considers applicable costs when determining bids.

Figure 12 highlights the interactions between the models used in AESC 2021.

Figure 12. AESC 2021 modeling schematic



Energy Security Initiative

ISO New England proposed a package of new day-ahead reserve products through its *Energy Security Improvements* (ESI) proposal to address concerns over fuel security in the winter. The proposal utilized call options on energy, which have not been used in other regional transmission organizations, to address what the ISO describes as a "misaligned incentives problem" under the current market rules. The Federal Energy Regulatory Commission (FERC) rejected ISO New England's proposal on October 30, 2020 due to concerns about the impact it would have on energy security as measured by metrics such as reserve shortage hours and loss of load, as well as the costs the proposal would impose on consumers.[67] FERC was particularly concerned that ESI would produce reserves on a one-day-ahead timeframe that would not provide resource owners enough time to procure firm fuel supplies. The New England Power Pool (NEPOOL) offered an alternative version of ESI that adjusted some of the reserve products the ISO would procure and reduced the total quantity of reserve product purchases, particularly in the non-winter months. The NEPOOL alternative was projected to be less costly to consumers but was also rejected by FERC because it did not address FERC's concerns with the timing of the reserve procurement and the expected limited impact on reserve shortage hours.[68] ISO New England is reviewing FERC's decision and will be discussing next steps with stakeholders. As of November 2020, timing for next steps was uncertain. We recommend that any impacts attributed to ESI be incorporated in a future AESC study or study update.

Modeling timescale

In EnCompass, REMO, and the FCM Model, we explicitly model 15 years from 2021 through 2035. In order to develop 30-year levelized avoided costs, AESC 2021 continues the trajectory of each avoided cost component through 2050.[69]

For each modeled year, we use the temporal resolutions described below.

For avoided energy costs:

- Each year is first modeled in EnCompass' capacity-expansion construct. In this construct, EnCompass optimizes to determine the most cost-effective capacity additions.[70] We run EnCompass at the resolution of a typical week. This means that EnCompass represents each year from 2021 to 2035 as an aggregation of 12 months, each of which is represented by a typical week, each week of which is represented by five "on peak" days and two "off peak days," and each day of which is represented by a 24-hour chronological dispatch period.

[67] *ISO New England Inc.*, 173 FERC ¶ 61,106 (2020).

[68] 173 FERC ¶ 61,106.

[69] In all cases, this involves extrapolating values through 2055. See Appendix A: *Usage Instructions* for the methodology used.

[70] Note that these capacity additions are limited to generic resource types (described below). Note that we enter other capacity as exogenous additions.

- After running EnCompass in the capacity-expansion construct, we next run it in production-cost mode for a subset of years. EnCompass' production-cost mode uses the capacity-expansion outputs as "seed" data, and it allows the model to better approximate unit commitment over the course of a year. In this construct, we use an 8,760-hour resolution for each year between 2021 and 2035.

- Hourly 8,760 data are then aggregated using load-weighted averages to the four time periods used for reporting in previous AESC studies (summer on-peak, summer off-peak, winter on-peak, and winter off-peak).[71]

For avoided capacity costs:

- Program administrators can claim avoided capacity by either bidding capacity (cleared) into the FCAs, or by reducing peak summer loads through non-bid capacity (uncleared) (which then becomes phased-in load forecasts for subsequent FCAs). Hence, all avoided capacity will be stated per kW of peak load reduction. The effect of uncleared capacity for demand response will vary with the number days each summer for which peak load is reduced and the number of years for which the load reduction continues (see Appendix J: for more information).

- The capacity value of passive demand resource (such as an energy efficiency program) or an active demand resource cleared in the capacity market will be determined by the capacity value accepted by the ISO. The user of the model will need to estimate how much capacity value will be recognized by the ISO for each resource that will be bid into the market. The capacity value of energy efficiency that is not cleared in the capacity market will be approximately the load reduction of the measure at the ISO's normal peak conditions.[72]

- ISO New England models peak load by regressing daily peak in each day of July and August on a number of variables, including monthly energy, WTHI,[2] a time trend × WTHI, and dummies for weekends and holidays (also × WTHI). While it is difficult to determine exactly how load reductions in various summer conditions will affect the peak forecast, an energy efficiency measure that reduces load throughout the summer or in the days with above-average WTHI should fully affect the load forecast. Load management that affects only a few summer days would have a much smaller impact on the load forecast.

[71] These time periods are defined by ISO New England as follows: Winter on-peak is October through May, weekdays from 7am to 11pm; winter off-peak is October through May, weekdays from 11 p.m. to 7 a.m., plus weekends and holidays; summer on-peak is June through September, weekdays from 7 a.m. to 11 p.m.; and summer off-peak is June through September, weekdays from 11 p.m. to 7 a.m., plus weekends and holidays.

[72] The normal peak conditions are defined as a weighted temperature-humidity index (WTHI) for the day of 79.9°, where the weighting is (10 × the current day's THI, plus 5 × the previous day's THI, plus 2 × the THI two days earlier) ÷ 17. The daily THI is 0.5 × temperature +0.3 × dewpoint +15. The THIs are computed for eight cities (Boston, Hartford, Providence, Portland, Manchester NH, Burlington VT, Springfield, and Worcester) and weighted by zonal loads.

For DRIPE:

- Energy DRIPE is estimated as proportional to avoided energy cost. Thus, energy DRIPE can be applied to any level of disaggregated avoided energy cost.
- Capacity DRIPE is stated per kW of peak load reduction, for bid resources and for non-bid load reductions. Those values can be attributed to programs in the same manner as the avoided capacity costs, and with the same computations for demand response.
- Natural gas supply DRIPE and oil DRIPE are intrinsically annual values.
- Natural gas basis DRIPE is associated with high-load days in the winter, for both electric and natural gas loads.

Model calibration

Because one of the main outputs of the AESC 2021 study is the estimation of avoided electric energy costs, it is essential that modeling outputs for wholesale energy prices are in line with actual, recent historical wholesale energy prices. In this analysis, we compare the model's projected regional hourly price forecasts to 2019 prices in the ISO New England's "SMD" dataset.[73] See Section 6.2: *Benchmarking the EnCompass energy model* for more information on the results of the model calibration for energy costs.

Note that because several of the AESC counterfactuals project futures that lack any incremental energy efficiency installed beyond 2020, prices in future years are likely to substantially diverge from recent historical prices.

4.2. Modeling counterfactuals

The *AESC 2021 User Interface* (a separate Excel workbook) includes hourly values in addition to the four traditional energy costing periods (summer on-peak, summer off-peak, winter on-peak, and winter off-peak).[74] These 8,760 avoided cost values may help refine the quantification of traditional DSM programs that have relied upon avoided cost values from previous AESC studies.

New to the AESC 2021 study is the development of four different counterfactual scenarios for our analysis. Table 24 details the DSM components modeled in each of the counterfactuals. Generally speaking, each of the avoided cost streams is the "but for" costs attributed to the counterfactual scenario, so those specific DSM components are excluded in the specified scenario. For purposes of simplification and comparison, Counterfactual #1 is the counterfactual used for the discussion of many

[73] "SMD" is a legacy acronym referring to "Standard Market Design." Currently, the primary application of this term is in the naming of this dataset. The SMD dataset containing hourly data for 2019 can be found at on the ISO New England website at https://www.iso-ne.com/static-assets/documents/2019/02/2019_smd_hourly.xlsx.

[74] Appendix B: *Detailed Electric Outputs* contains the cost streams associated with the four costing periods consistent with previous AESC studies.

high-level findings and comparisons with previous AESC study results throughout this report. The following two sections on system demand and renewable energy policies describe the assumptions used for each of the DSM components.

Table 24. Modeled counterfactual scenarios in AESC 2021

DSM component included?	Counterfactual #1 *AESC for EE, ADM and building electrification*	Counterfactual #2 *AESC for building electrification only*	Counterfactual #3 *AESC for EE only*	Counterfactual #4 *AESC for EE and ADM only*
Energy Efficiency (EE)	*No*	Yes	*No*	*No*
Active Demand Management (ADM)	*No*	Yes	Yes	*No*
Building electrification	*No*	*No*	Yes	Yes
Transportation electrification	Yes	Yes	Yes	Yes
Distributed generation	Yes	Yes	Yes	Yes

Notes: A "Yes" indicates that the relevant DSM component is included (e.g., modeled) within that counterfactual. A "No" indicates that the DSM component is not incorporated into the modeling in 2021 or any future year. A "No" only removes the programmatic resources associated with each DSM component (e.g., energy efficiency associated with codes and standards is modeled in all scenarios, as is storage or demand response owned or funded by entities other than program administrators).

4.3. New England system demand

Forecasts of annual peak demand and energy used in each of the AESC 2021 models are in large part based on the 50/50 values published by ISO New England in the 2020 *Forecast Report of Capacity, Energy, Loads and Transmission* (CELT) study.[75] However, our forecast includes modifications and enhancements to this forecast. Specifically, our load forecast covers the following components:

- Econometric forecast: This is a projection of energy consumption (in MWh) and peak demand (in MW) related to traditional electric end-uses, based on data provided in ISO New England's 2020 CELT forecast. It also includes historical energy efficiency installed through 2020, but does not include any energy efficiency installed in 2021 or later years. It also does not include impacts from any of the categories discussed below.

- Energy efficiency: This is a projection of energy efficiency measures for 2021 and later years, for all New England states based on data provided in ISO New England's 2020

[75] The "50/50" forecast contains ISO New England's statistically most-likely estimate of future demand. ISO New England also publishes other forecasts for demand, including a 90/10 and a 10/90 forecast, which represent high and low ranges of estimates for demand.

CELT forecast. It is used in counterfactuals that estimate avoided costs for measures *other than* energy efficiency.

- Building electrification: This is a projection of the impacts from residential heat pumps, based on data provided in ISO New England's 2020 CELT forecast. It is used in counterfactuals that estimate avoided costs for measures *other than* building electrification.
- Active demand management: This is a projection of the impacts from demand response and behind-the-meter (BTM) energy storage, based on data in ISO New England's FCM and program data reported by states and utilities. It is used in counterfactuals that estimate avoided costs for measures *other than* active demand management.
- Transportation electrification: This is a projection of the impacts from light-, medium-, and heavy-duty electric vehicles, based on data from Bloomberg New Energy Finance's (BNEF) Electric Vehicle Outlook 2020. It is used in all counterfactuals.
- Distributed generation: This is a projection of the impacts from distributed solar, based on the implied quantities resulting from state renewable policy. It is used in all counterfactuals. See Section 4.4: *Renewable energy* for more information on this topic.

Econometric forecast

The following sections focus on the "econometric" forecast for electricity demand. Generally speaking, this forecast includes futures impacts of measures (such as energy efficiency) installed in past years, as well as future impacts of "traditional" electric end-uses (e.g., not transportation electrification or building electrification).

Annual energy demand

In May 2020, ISO New England released its newest electricity demand forecast, CELT 2020.[76] As in the CELT forecasts before it, in CELT 2020 ISO New England developed a forecast of annual energy for New England as a whole and for each individual state and load zone. These forecasts are based on regression models that integrate inputs on previous annual consumption, real electricity price, real personal income, gross state product, and heating and cooling degree days with data from 1990 through 2019.

To calculate the econometric component of electricity demand in AESC 2021 (e.g., the component of electricity demand driven by factors like population, gross domestic product, and weather—rather than energy efficiency or electrification).[77] We do not rely on the specific MWh demand quantities articulated

[76] Further information about the CELT forecast can be found at ISO New England's website at https://www.iso-ne.com/system-planning/system-plans-studies/celt, https://www.iso-ne.com/system-planning/system-forecasting/load-forecast/ and https://www.iso-ne.com/static-assets/documents/2020/04/modeling_procedure_2020.pdf.

[77] Note that ISO New England's econometric forecast can be impacted by the effects of federal energy efficiency standards and other non-programmatic energy efficiency.

in the 2020 CELT study, as these quantities start with a projected level of 2020 demand that will likely exceed actual 2020 demand in part due to the COVID-19 pandemic.

Instead, we examined monthly actual versus projected system demand through July 2020 (see Figure 13).[78] From January through July, actual regionwide system demand was, on average, 7 percent lower than system demand as projected in CELT 2020. These monthly differences range from a high of 12 percent lower than projected in May to a low of 3 percent *greater* than projected in July. These monthly differences are not solely attributable to the COVID-19 pandemic; instead, differences in projections and observed system demand in January, February, and (at least part of) March are likely mostly due to differences in projected versus actual weather.[79]

Assuming that system demand returns to projected levels in August through December 2020 (as the June and July data points suggest it may) we find that, for the year as a whole, actual 2020 system demand would be 4 percent lower than projected by CELT 2020. We apply this scaling factor to ISO New England's projection of 2020 Gross Demand (less electrification and incremental energy efficiency) as it is defined in ISO New England's 2020 CELT study to determine a new, adjusted starting point for the AESC 2021 forecast. To create system load values for 2021 through 2029, we apply the compound annual growth rate (CAGR) for 2020 through 2029, as estimated for each of the 13 modeling regions in CELT 2020. To calculate system demands for 2030 through 2035, we apply the CAGR calculated for each region in CELT 2020 for the last five years (2025 through 2029) and compared to AESC 2018 (see Figure 14).[80]

[78] Monthly actual system demand for 2020 is available on ISO New England's website at https://www.iso-ne.com/static-assets/documents/2020/02/2020_smd_monthly.xlsx.

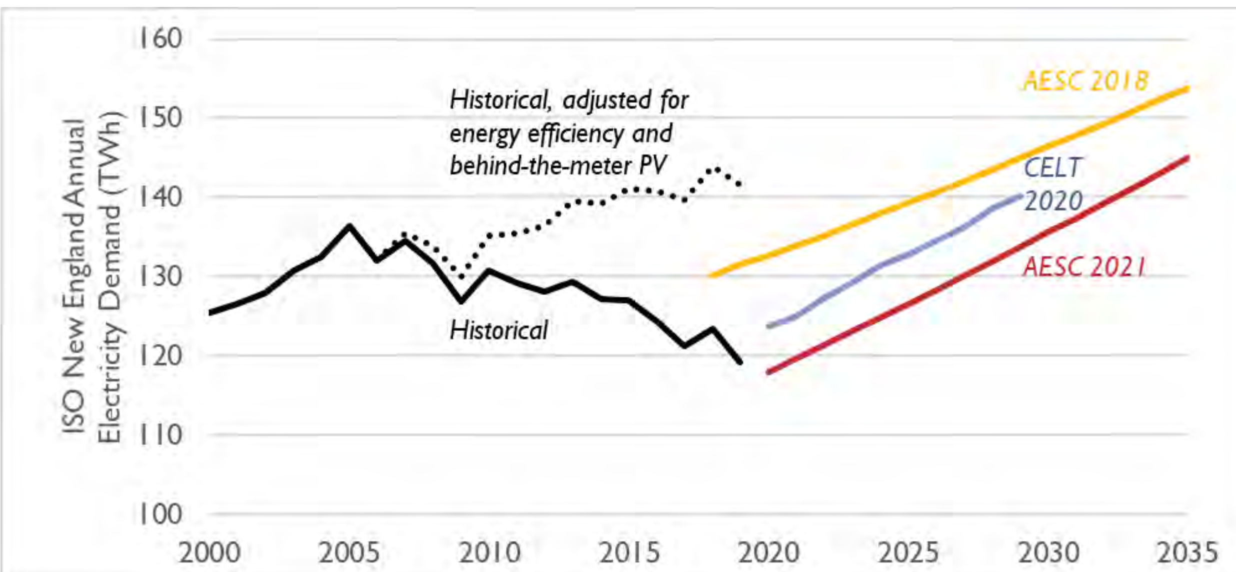
[79] Note that this comparative analysis does not distinguish between shifts in system demand (e.g., commercial versus residential air conditioning).

[80] Note that the regionwide CAGR calculated for gross demand in each of the CELT forecasts from CELT 2015 to CELT 2019 have ranged from 0.9 percent to 1.1 percent.

Figure 13. Actual versus projected system demand for 2020, ISO New England

Notes: All trajectories are inclusive of the effects of energy efficiency, BTM solar, and electrification.

Figure 14. Historical and projected annual energy forecasts for all of ISO New England



Notes: In both the "CELT 2020" and "AESC 2021" trajectories, all data points are decreased to reflect the energy efficiency installed in 2020 (see following section on "Programmatic Energy Efficiency"). No other impacts from energy efficiency, active demand management, building electrification, transportation electrification, or distributed solar are included.

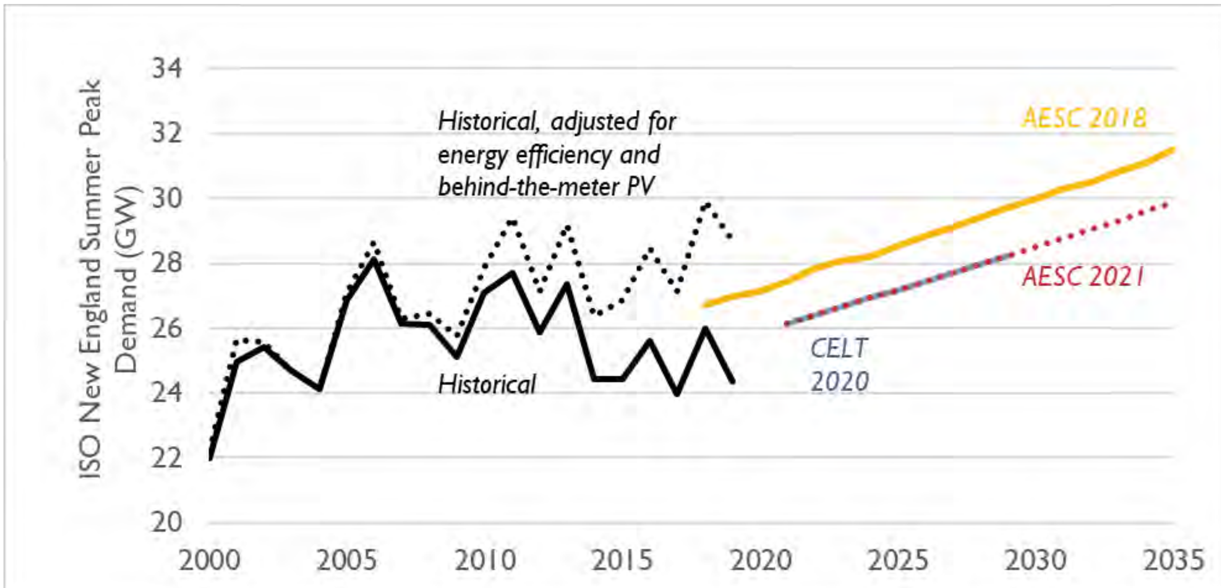
In order to develop hourly system energy demand, we apply hourly load shapes developed for each load zone published by ISO New England in the 2020 CELT study.[81] Note that while it is possible that load shapes may change over time, the scale and shape of these changes are uncertain. As a result, we rely on ISO New England's load shapes for purposes of simplification. Load shapes for other components of system load (e.g., energy efficiency, transportation electrification) are discussed in the *Other System Demand Components* section, below.

Peak demand forecasts and capacity requirements

To calculate peak demand, we compare projected summer peak demand from CELT 2020 with actual historical data. Per CELT 2020, the projected 50/50 net summer peak for ISO New England in 2020 (inclusive of impacts from energy efficiency, distributed solar, building electrification, and transportation electrification) was 25,125 MW. Through July 2020, the actual observed system peak was 25,054 MW (about 0.3 percent lower than projected). Based on the available data, it appears as though the COVID-19 pandemic has not had a substantial impact on summer peak in New England. As a result, we rely on the gross summer peak as specified in CELT 2020 (see Figure 15).

[81] Hourly load shapes developed by ISO New England for the CELT 2020 forecast can be found on the ISO New England website at https://www.iso-ne.com/static-assets/documents/2020/04/hourly_sa_fcst_eei2020.txt.

Figure 15. Historical and projected summer peak demand forecasts for ISO New England

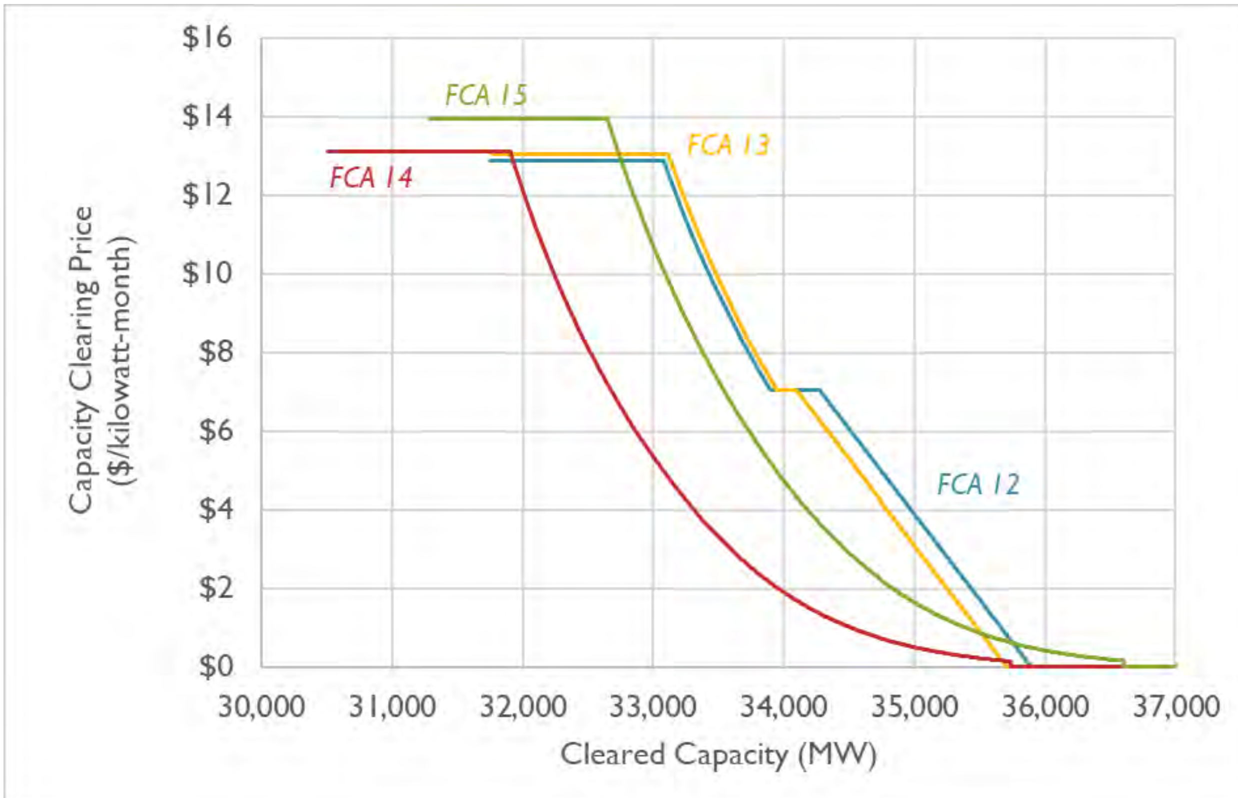


Note: The "AESC 2021" projection shown in this chart differs from the peak demand created in our EnCompass modeling as this value is calculated based on annual data available in ISO New England's CELT forecast, whereas the modeled values are calculated dynamically based on hourly, regional load shapes. For Counterfactual #1, this illustrative projection matches the modeled projection within +/-5 percent in all years.

The load forecast in one year is used in the forward capacity auction early in the next year to set the installed-capacity requirement for the capacity period starting three years after that. For example, the peak forecast for the summer of 2021 (released in May 2020) will be used to set the installed-capacity requirement for FCA 15 (held in February 2021) which sets the capacity obligations and prices for the period June 2024 to May 2025.

The actual capacity requirement is determined by the intersection of the supply curve (determined by resource bids) and a sloped "demand curve" set by ISO New England. Figure 16 shows the demand curve used in FCAs 12 through 15. ISO New England has transitioned from demand curves that partly followed the marginal reliability index (MRI) and were partially linear, with a flat part in between, to all-MRI curves in FCA 14 and 15.

Figure 16. Sloped demand curves, FCAs 11 to 15



Other system demand components

The following sections describe our other modifications to system demand. Some of these components are incorporated in all AESC 2021 counterfactual scenarios, while other components may only be used in a single counterfactual.

Programmatic energy efficiency

Since 2008, ISO New England has sought to compensate for these "embedded energy efficiency" effects by explicitly accounting for "passive demand resources" (PDR).[82] Thus, programmatic energy efficiency is excluded from the main ISO New England econometric forecasts, producing a "gross" forecast for annual energy and peak demand that is higher than it would be without the impact of PDRs. Starting in 2008, ISO New England has put forth a separate PDR forecast for energy efficiency resources, and since 2015, it has published a third forecast for distributed solar (PV). ISO New England then subtracts the forecasted quantities of PDRs and distributed PV from its gross forecast to estimate a "net" forecast, a lower number that reflects the actual estimated demand for each modeled year.

[82] Prior to 2008, ISO New England's forecast implicitly contained some level of reductions from efficiency programs because the programs were in effect during the historical period.

During the development of each CELT forecast, ISO New England works with the Energy Efficiency Forecast Working Group (EEFWG), which produces an estimate for future energy efficiency based on expected future energy efficiency expenditures and program performance. ISO New England estimates future energy efficiency impacts first based on levels of capacity that have cleared in the FCM, and then on future estimated levels of resource addition and attrition. Like other components of the 2020 CELT forecast, this forecast contains estimates of energy efficiency through 2029.

For an energy efficiency trajectory in AESC 2021, we rely on a modified version of the energy efficiency forecast described in CELT 2020. [83] This modified forecast includes three major differences relative to CELT 2020:

- First, this forecast removes the use of ISO New England's production cost escalator, which causes costs-per-MWh of energy efficiency to be roughly 10 percent larger in 2029 than in 2021. The Study Group requested this escalator be removed in order to develop a forecast that is more consistent with the program administrators' internal energy efficiency plans.
- Second, this forecast assumes that all energy efficiency budgets assumed by ISO New England for 2029 remain constant through 2035. This forecast also assumes that all end-use shares for energy efficiency measures (i.e., how much of a state's energy efficiency budget is dedicated to HVAC, or lighting, or other measures) remains constant from 2029 through 2035.
- Third, this forecast utilizes an energy efficiency forecast for Vermont provided by Vermont Department of Public Service, rather than the ISO New England forecast for energy efficiency in Vermont developed in the above steps.

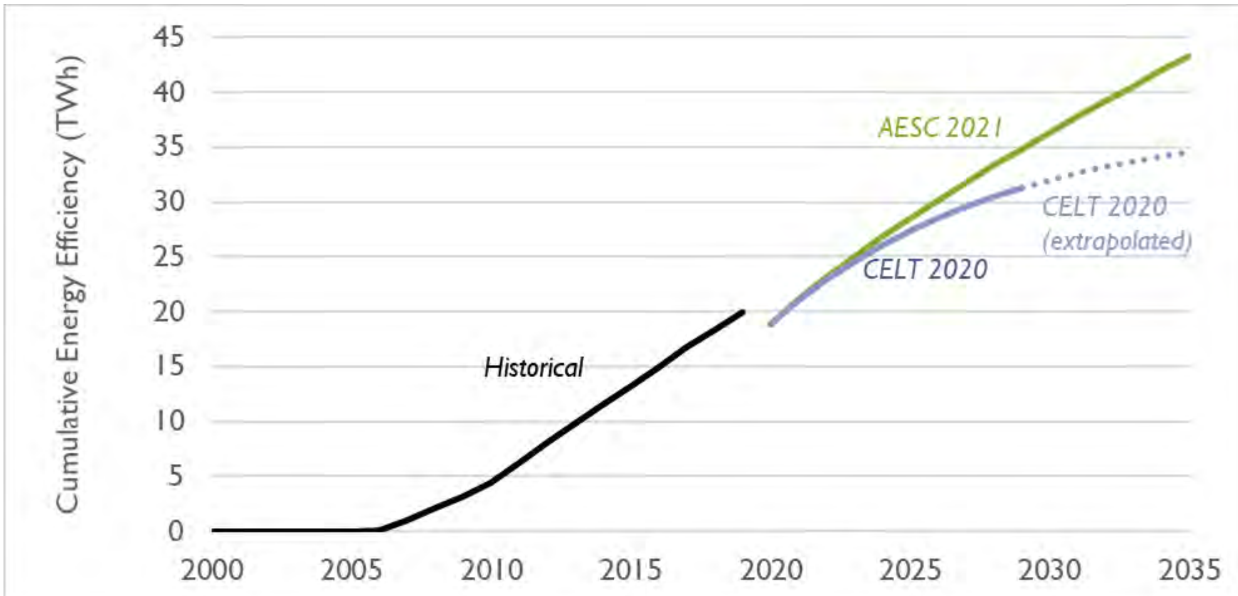
Figure 17 illustrates the difference in this modified forecast relative to the energy efficiency forecast provided in CELT 2020.

Generally speaking, past AESC studies have not considered scenarios that include forward-going levels of energy efficiency. This is the case in AESC 2021 for Counterfactual #1 and Counterfactual #3.[84] However, Counterfactual #2 requires a projection of energy efficiency.

[83] Another alternative considered by the Synapse Team would have extended recent historical levels of incremental savings through 2035. This forecast produced cumulative savings that were 15–20 percent higher than the CELT 2020 forecast through 2025, with greater differences in savings in later years.

[84] Note that, as in AESC 2018 but unlike AESC 2015, we do not decrease demand in future years to reflect energy efficiency for which program administrators are financially committed, but have not yet delivered (i.e., resources with capacity supply obligations in the 8th Forward Capacity Auction and later years, See AESC 2015, pages 5–14). Although these resources do have a financial commitment to be implemented, we believe that embedding them in the load forecast would prohibit users of the AESC 2021 from evaluating these resources' cost-effectiveness because of double-counting.

Figure 17. Historical and projected cumulative regionwide energy efficiency impacts used in Counterfactual #2



For Counterfactual #2, Synapse uses the same load shape for energy efficiency that is used for the econometric component of the energy forecast. This will effectively reduce the econometric component in every hour by the fraction of modeled energy efficiency (in MWh) relative to the system demand. While in reality, different energy efficiency measures have different load profiles, this simplified approach is meant to approximate the implementation of a portfolio of energy efficiency measures. Peak impacts of energy efficiency, and energy efficiency's contribution to the capacity requirement, will be determined by estimating the peak hour for energy efficiency in each year, based on the annual regionwide energy efficiency amount and annual system demand impact.

Active demand management

For the purposes of AESC 2021, active demand management includes both demand response measures as well as BTM energy storage measures. We modeled both resources as supply-side resources in the EnCompass model. Impacts of both types of resources are applied to peak demand calculations in the relevant counterfactuals.

This component is included in the modeling of Counterfactual #2 and Counterfactual #3, but not Counterfactual #1.

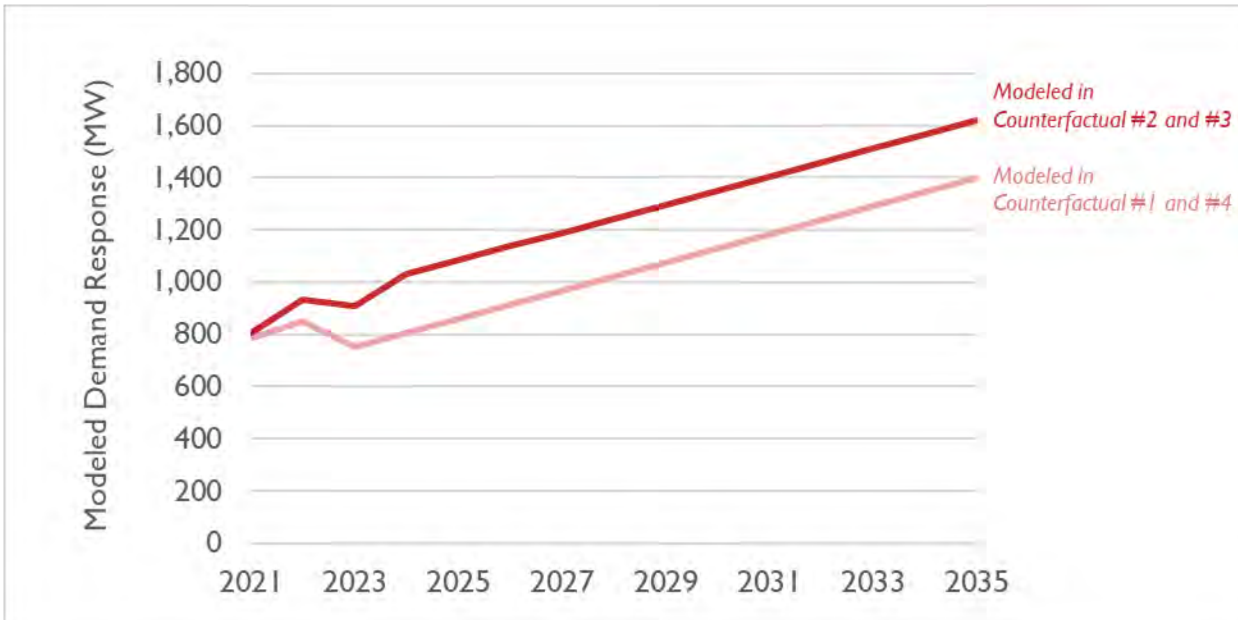
<u>Demand Response</u>

Demand response participates in ISO New England's FCM and serves as a peak demand resource. Demand response participation in the FCM has grown steadily for several years. To forecast demand response impacts in future years, we have extended the trend observed between capacity compliance periods between the summers of 2019 and 2023 linearly through 2035 (see Figure 18). In FCA 14, 592 MW of demand response capacity cleared the market and received a capacity supply obligation. We assume that all demand response that has cleared in the FCM so far is non-programmatic and is modeled in all counterfactuals.

In addition, we assume that under the current draft planning numbers for demand response Massachusetts is planning to install roughly 160 MW of measures capable of demand response in 2020 and perhaps double that quantity by 2024. This is the programmatic quantity assumed to be modeled in Counterfactual #2 and Counterfactual #3.

Based on recent historical behavior in the energy market, we assume that 10 percent of the entire demand response resource dispatches when prices are greater than $30 per MWh (in 2019 dollars) while 90 percent of this resource dispatches when prices exceed $900 per MWh (e.g., a stand-in for rare, very high price events).

Figure 18. Demand response forecast for New England



<u>Energy Storage</u>

There is currently no regional projection of BTM storage for New England. Furthermore, there is no data on existing BTM installations publicly available, although this data may be available to individual utilities. To establish a baseline of existing and projected BTM storage installation in New England, we have assembled data and projections from policy mandates and incentives for BTM storage for every state and New England. We then aggregated these projections to forecast total BTM storage capacity through 2035.

- Connecticut: In Connecticut, Eversource administers the Connected Solutions program which provides residential customers incentives for supplying their own batteries.[85] Under this program, customers can receive incentive payments of up to $225 per average kW used from their demand response resources over a three-hour period in certain seasons. The program supports only three battery vendors, including Sonnen, Generac, and Tesla.

- Maine: In December 2019, the Maine PUC was tasked with considering "bring your own device" (BYOD) programs for BTM energy storage in the state.[86] While there is no official BTM storage target or policy incentive, movement on this topic is forthcoming.

- Massachusetts: The first major incentive for storage is an adder as part of the Solar Massachusetts Renewable Target (SMART) program. As of February 2021, this program had approved about 40 MW of BTM storage in Massachusetts.[87] In April 2020, the state doubled the program target for solar from 16 GW to 32 GW. Though there is no specific target for BTM storage in this expansion; for the purposes of AESC 2021, we assume the capacity for BTM is doubled to reflect this update.

  Second, as in Connecticut, Eversource and National Grid deploy the Connected Solutions program through Mass Save, which provides residential customers an incentive for supplying their own batteries.[88, 89]

  Third, there are other programmatic BTM storage initiatives currently ongoing in Massachusetts, including the Daily Dispatch program and the Cape and Vineyard Electrification Offering (CVEO) program.[90] However, data on expected projections of BTM storage was not available at the time of our analysis.

[85] Eversource. Accessed March 10,2021. *Program Materials for Connected Solutions for Commercial/Industrial Customers*. Available at https://www.eversource.com/content/docs/default-source/save-money-energy/program-materials-demand-response.pdf?sfvrsn=695bd362_0.

[86] Maine 127th Legislature. December 2019. "Commissions to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry." Available at: https://legislature.maine.gov/doc/3710.

[87] Massachusetts Department of Energy Resources (DOER). "SMART Qualified Units." Accessed February 5, 2021. Available at: https://www.mass.gov/doc/smart-qualified-units-0.

[88] MassSave. Last Accessed March 10,2021. "Use Your Battery Storage Device to Make the Grid More Sustainable." *Massave.com.* Available at https://www.masssave.com/saving/residential-rebates/connectedsolutions-batteries.

[89] Members of the Study Group provided information on recently installed measures in Massachusetts' Connected Solutions program. For purposes of simplification and to avoid double-counting, we assume that all measures in this program are either also participating as demand response in the FCM or in the SMART program and are already accounted for in either one of the two projections.

Mass Save. February 11, 2020. *Energy Efficiency Program Administrators Quarterly Report*. Available at https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2019-Q4-2-11-20-1.pdf.

Mass Save. August 12, 2020. *Massachusetts Energy Efficiency Program Administrators Quarterly Report.* Available at https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q2-Final.pdf.

[90] Winter, D. March 16, 2016. *D.P.U. 20-33 – Fitchburg Gas and Electric Company d/b/a Until (Electric Division)*. Keegan Werlin LLP prepared for Department of Public Utilities. Available at https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/11942570.

Finally, the newly launched Clean Peak Standard (CPS) may also serve as an incentive for BTM storage in the state. The CPS went into effect in June 2020. Qualified resources under the CPS include new renewable resources that also meet eligibility under Massachusetts' Class I and Class II RPS program.[91] Existing renewable resources in both programs are eligible, so long as these resources are paired with a new energy storage system. Furthermore, both standalone energy storage systems and demand response resources are eligible to meet the CPS. Modeling published by Massachusetts Department of Energy Resources describes the estimated benefits under the CPS, which are projected to reach over 120,000 metric tons by 2030.[92] Assuming that all of these benefits are provided by BTM storage, and that storage is able to provide a benefit of 60 metric tons per MW, this implies a 2030 capacity of about 2.0 GW.[93] This is substantially larger than the Commonwealth's current storage target of 500 MW in 2025.[94]

Based on recommendations from the AESC Study Group, we assume an exogenous 500 MW of storage in Massachusetts in 2025 and all later years.[95] Of this quantity, we assume that 70 percent is funded through the current energy efficiency programs, due to the size of the incentives offered in that program versus others (e.g., SMART, CPS). This 350 MW is the programmatic portion of storage assumed in Massachusetts. The remaining 150 MW non-programmatic portion is met through other programs, including SMART and CPS.

- New Hampshire: The New Hampshire Public Utilities Commission (PUC) is currently examining whether and how BTM storage can or should be incentivized. In January 2019, the NH PUC approved a BTM pilot project for Liberty Utilities' customers. Liberty partnered with Tesla to install 500 Tesla Powerwall batteries and 500 other private company batteries (totaling 1,000 BTM batteries) to be used for demand response.[96]

[91] Massachusetts Department of Energy Resources. October 26, 2020. *Clean Peak Energy Resource Eligibility Guide.* Available at https://www.mass.gov/doc/clean-peak-resource-eligibility-guidelines/download.

[92] Massachusetts Department of Energy Resources. August 7, 2019. *The Clean Peak Energy Standard.* Available at https://www.mass.gov/doc/drafts-cps-reg-summary-presentation/download . Slide 39.

[93] Per members of the Study Group, this metric tons per MW value is the avoided emissions value that has been applied for use in discussions regarding CPS.

State of Charge. 2017. *Massachusetts Energy Storage Initiative Study.* Prepared for Massachusetts Department of Energy Resources. Available at https://www.mass.gov/files/2017-07/state-of-charge-report.pdf. P. 95

[94] Massachusetts' energy storage goal is 1,000 MWh of storage by 2025 Per data available from *the* SMART program, the average duration of storage installed to date is 2 hours, which yields a storage target of 500 MW.

Massachusetts Department of Energy Resources. Last accessed March 11, 2021. "ESI Goals & Storage Target." *Massgov.com*. Available at https://www.mass.gov/info-details/esi-goals-storage-target.

[95] We note that the model is "allowed" to build more storage if it is economic to do so in any of the counterfactuals, states, or years. See Section 4.5: *Anticipated non-renewable resource additions and retirements* for more information on the assumptions used for this endogenous storage resource.

[96] Gheorghiu, Iulia. 2019. "Designing Liberty Utilities' New Hampshire residential storage program." *Green Tech Media (GTM)*. Available at: https://www.utilitydive.com/news/designing-liberty-utilities-new-hampshire-residential-storage-program/548940/

This program will put an estimated 5 MW of BTM storage in New Hampshire.[97] The program estimates roughly 100 batteries, equivalent to 500 kW of battery storage, will become operational per year.[98]

- Rhode Island: As in Massachusetts and Connecticut, National Grid administers the Connected Solutions program which provides residential customers incentives for supplying their own batteries.[99]
- Vermont: The main service provider for the state of Vermont, Green Mountain Power (GMP), has partnered with Tesla to pilot a BTM storage program for the state. This program, coupled with a provision that allows customers to “bring your own device” (BYOD), has incentivized between 13 and 14 MW of BTM storage installed in the state in 2019.[100] The program has been expanded and is projected to add up to 5 MW per year for the next 15 years.

The storage forecast from 2019 through 2035 for the entire New England region is shown in Figure 19.

[97] State of New Hampshire Public Utility Commission. Order No. 26,209. January 2019. Available at: https://www.clf.org/wp-content/uploads/2019/01/26-209.pdf

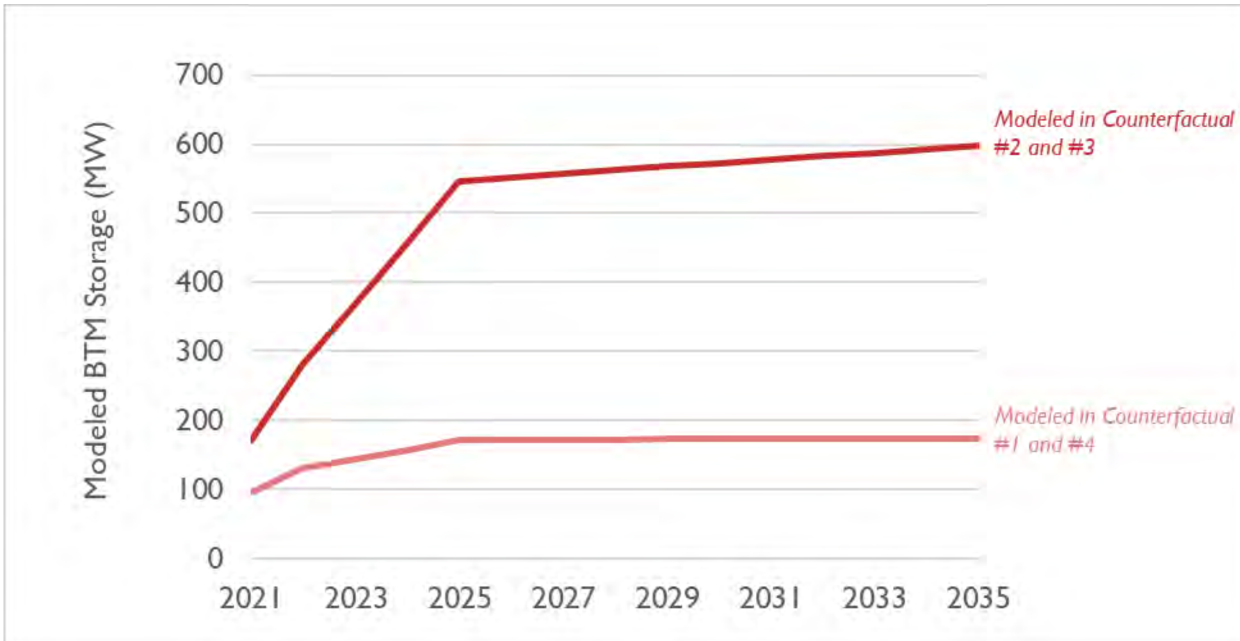
[98] Members of the Study Group provided information on recently installed measures in New Hampshire’s C&I Active Demand Response Program. This includes 7.5 MW of existing capacity. However, demand response and BTM storage programs are not differentiated in this document. For purposes of simplification and to avoid double-counting, we assume that all measures in this program are accounted for in the demand response projection described in the section above (see Figure 18).

New Hampshire’s Electric and Natural Gas Utilities. January 15, 2020. *New Hampshire Statewide Energy Efficiency Plan 2020 Update.* Prepared for NH Saves. Available at https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2020-01-15_EVERSOURCE_UPDATED_EE_PLAN.PDF.

[99] National Grid. Accessed August 27, 2020. “Use Your Battery Device to Make the Grid More Sustainable.” National Grid website. Available at: https://www.nationalgridus.com/RI-Home/ConnectedSolutions/BatteryProgram.

[100] Gheorghiu, Iulia. 2020. “Green Mountain Power expands PYOD and Tesla battery programs as it targets fossil peakers.” *Utility Dive.* Available at: https://www.utilitydive.com/news/green-mountain-power-to-roll-out-byod-and-tesla-battery-programs-as-it-targ/578573/.

Figure 19. BTM storage forecast for New England



Our modeling uses the same battery dispatch profile for all BTM storage in New England. Given the predominance of the CPS in this forecast, we assume that storage will dispatch according to the CPS seasonal peak periods: Winter (December 1 through February 28) 4 p.m. to 8 p.m., Spring (March 1 through May 14) 5 p.m. to 9 p.m., Summer (May 15 through September 14) 3 p.m. to 7 p.m. and Fall (September 15 through November 30) 4 p.m. to 8 p.m.[101] Under the CPS, systems may only get CPS credits for discharging within these daily hours of hours per day, so we assume each system is limited to discharging once per day (or 365 cycles per year).

Our BTM storage modeling assumes a round trip efficiency (RTE) of 85 percent for all storage systems as is consistent with field tests of battery storage performance.[102] We calculate MWh from capacity assuming a 2-hour duration.

Given the lack of data on BTM storage projections, it is challenging to determine what portion of the above programs might be deployed as part of an active demand management program managed by one of the AESC 2021 Sponsors, and what portion may be deployed regardless of actions taken by the AESC 2021 Sponsors. Table 25 describes what category each of the above programs appears to fall into. For the purposes of AESC 2021, we assume that only policies marked as "Programmatic" are programmatic; all other policies are modeled in all counterfactuals.

[101] Massachusetts Department of Energy Resources (DOER). August 7, 2019. *The Clean Peak Energy Standard.* Available at https://www.mass.gov/doc/drafts-cps-reg-summary-presentation/download. Slides 15 and 19.

[102] Deline, Chris, et al. July 2019. *Field-Aging Test Bed for Behind-the-Meter PV + Energy Storage*. National Renewable Energy Laboratory (NREL). Available at: https://www.nrel.gov/docs/fy19osti/74003.pdf.

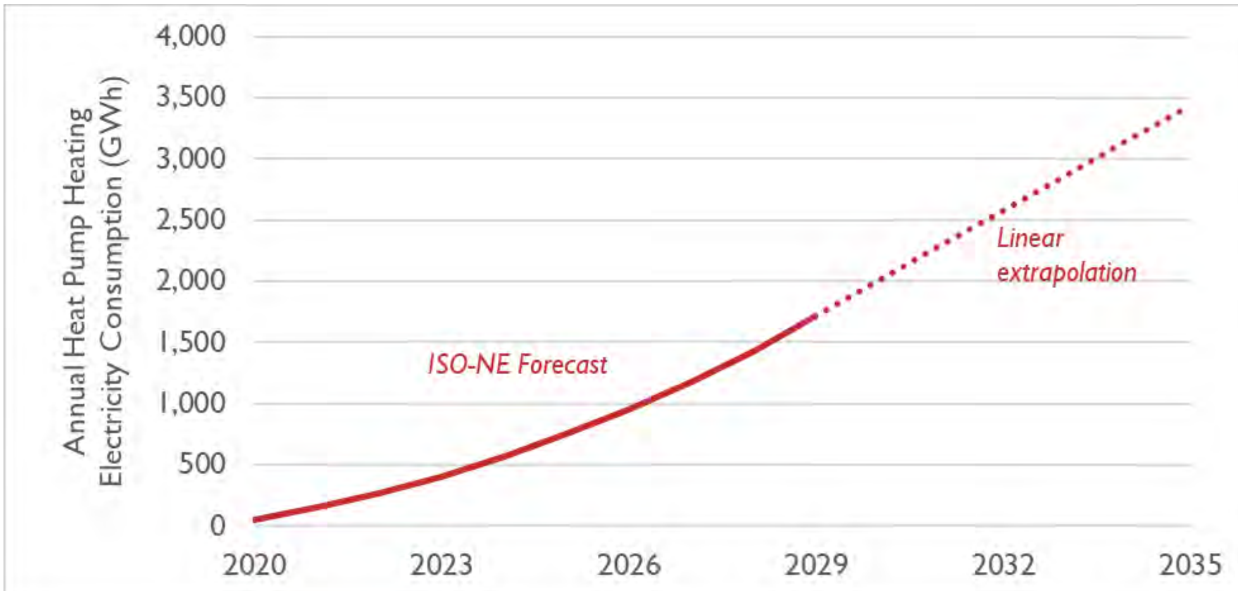
Table 25. Behind-the-meter storage categorization

State	Policy	Categorization
CT	Connected Solutions	**Programmatic**. Program entirely administered by Eversource; no data available
ME	*No known BTM storage policies*	-
MA	SMART program	**Unclear.** Project may overlap with other Massachusetts BTM storage policies. Measures assumed to be counted in the CPS program.
MA	Clean Peak Standard	**Unclear.** Project may overlap with other Massachusetts BTM storage policies.
MA	Connected Solutions	**Programmatic**. Program entirely administered by National Grid but assumed to be counted within the CPS program
MA	Daily Dispatch	**Programmatic**. Program entirely administered by PAs
MA	CVEO	**Programmatic**. Program entirely administered by CLC; no data available
NH	BTM Pilot (Liberty)	**Programmatic**. Program entirely administered by Liberty Utilities
RI	Connected Solutions	**Programmatic**. Program entirely administered by National Grid; no data available
VT	BTM Pilot (GMP)	**Programmatic**. Program entirely administered by Green Mountain Power

Building electrification

The adoption of electric air source heat pumps is projected to be a significant source of load growth over the study period, in certain counterfactuals. ISO New England developed a forecast of residential heat pump load as part of its CELT 2020 report to examine the winter electricity consumption of heat pumps (see Figure 20). ISO New England developed its forecast in collaboration with regional stakeholders who provided information about heat pump programs, incentives, and policy targets across the New England states. Heat pump adoption was modeled at the state level based on specific heat pump incentive programs.

Figure 20. Heat pump wholesale electricity impacts on heating for Counterfactual #3

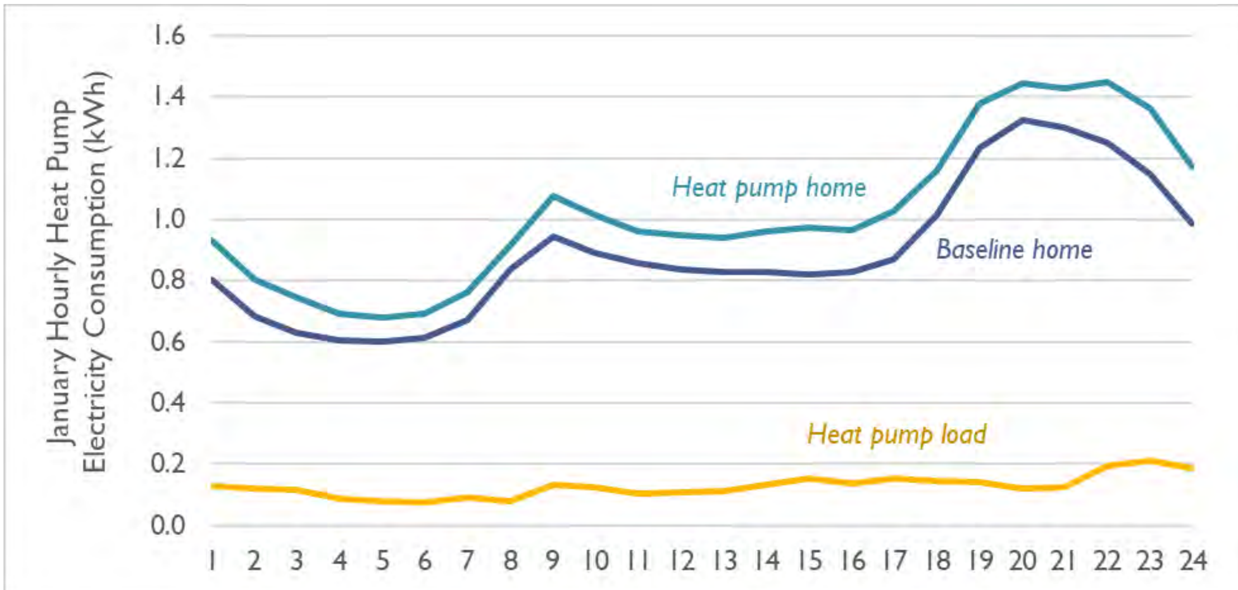


To develop hourly impacts, ISO New England combined its forecast for residential heat pump installations with advanced metering infrastructure load profile data for 18 residential heat pump installations in northeastern Massachusetts. ISO New England noted that this is a small sample size and that it may not be reflective of the entire region.[103] As more heat pumps are installed and additional studies become available, it is likely that this data will be refined. Currently, data availability for load profiles based on recent heat pump installations is limited.

ISO New England presented load shapes for homes with and without heat pumps in the advanced metering infrastructure data it acquired. This dataset included 33 homes with heat pumps and more than 400 homes without heat pumps. We calculated the hourly load profile of a heat pump by subtracting the baseline home load profile from a heat pump home load profile. The January load profiles (used for the winter season) are shown in Figure 21.

[103] ISO New England. 2019. "Draft 2020 Heating Electrification Forecast." *Load Forecast Committee.* Available at: https://www.iso-ne.com/committees/reliability/load-forecast/. Page 3.

Figure 21. Hourly heat pump load profiles for January



As in the CELT 2020 forecast, we assume that summer impacts of residential heat pump adoption will be small. As a result, we do not explicitly adjust summer loads. To inform this decision, we examined several different sources. First, a 2019 evaluation study of Connecticut heat pump installations reports the increased electricity loads resulting from heat pump installations in homes that previously lacked air conditioning, as well as the decreased electricity loads in homes that had central or window air conditioning prior to heat pumps.[104] The Connecticut study concludes (based on a weighted average of cooling systems prevalent in the state and average summer conditions) that heat pump installations summer savings are about 47 kWh per ton.

However, for several reasons, we believe that the expected long-term, New England-wide impact on cooling would be significantly smaller. First, some of the other New England states (particularly Vermont, New Hampshire, and Maine) would be expected to have lower penetrations of existing cooling systems and would therefore see more summer load growth and fewer cooling savings as a result of heat pump adoption. Second, the Connecticut study reports that heat pumps consume 26 percent as much electricity for cooling as they do for heating. Based on cooling and heating degree data for Massachusetts, we expect the long-term ratio of cooling to heating energy consumption to be significantly lower, as data for recent years suggests that the number of cooling degree days is only about 10 percent of the number of heating degree days.[105] This difference suggests that the heat pumps evaluated in the study may not have been sized to meet the full heating loads of the households, and

[104] DNV GL. June 20, 2019. *R1617 Connecticut Residential Ductless Heat Pumps Market Characterization Study – Final Report*. Available at: https://www.energizect.com/sites/default/files/R1617_CT%20Residential%20DHP%20Market%20Characterization%20Study_Final%20Report_6.20.19.pdf.

[105] Mass.gov. Accessed September 15, 2020. "Mass. Home Heating Profile Background." Available at: https://www.mass.gov/service-details/mass-home-heating-profile-background.

that incremental heat pump installations in these households (or future heat pumps installed without backup heating systems) would provide additional heat but not displace any additional cooling. Finally, heat pump energy savings in the summer may be included in the energy efficiency forecast, and thus not including additional savings here avoids potential double-counting. Additional data would improve the precision with which heat pump summer impacts could be quantified, but we believe these impacts are likely to be small and we have not quantified them in AESC 2021.

For the purposes of AESC 2021, all residential heat pump impacts are assumed to be programmatic.[106]

At this time, we do not have information to develop a forecast for other types of building electrification, including commercial or industrial heat pumps or variable refrigerant flow (VRF) systems, or other types of industrial electrification. The Study Group identified several studies that examine pilot programs aimed at these technology types in Massachusetts, Rhode Island, and Vermont; but projections that mirror the trajectories modeled for residential heat pumps, energy efficiency, and transportation electrification (for example) are currently unavailable.[107]

This component is included in the modeling of Counterfactual #1 and Counterfactual #3, but not Counterfactual #2. While some non-program heat pump adoption would be expected even in Counterfactual #2, we do not include any specific heat pump load forecast. ISO New England's general load forecast methodology includes a regression over historical load data that includes some amount of heat pump load. Thus, the general forecast implicitly includes a small amount of heat pump adoption, which is appropriate for a case in which no heat pump programs are implemented.

Transportation electrification

Over the study period of AESC 2021, vehicle electrification is projected to increase demand for electricity. In CELT 2020, ISO New England developed a forecast for electric vehicle (EV) electricity consumption as part of its CELT 2020 report. The CELT forecast uses a projection of the number of EVs sold in New England from AEO 2019. Among projections of EV adoption, AEO 2019 has one of the lowest forecasts, with EV sales projected to largely plateau after a limited increase in the 2020s. In place of this, Synapse has developed its own forecast to reflect the likelihood of continued growth in the EV market in the medium to long term. We use an EV sales forecast from Bloomberg New Energy Finance's (BNEF) *Electric Vehicle Outlook 2020*.[108] The Transportation and Climate Initiative's (TCI) reference case forecast was also considered, but ultimately not chosen due to its high short-term EV sales forecast, which is not

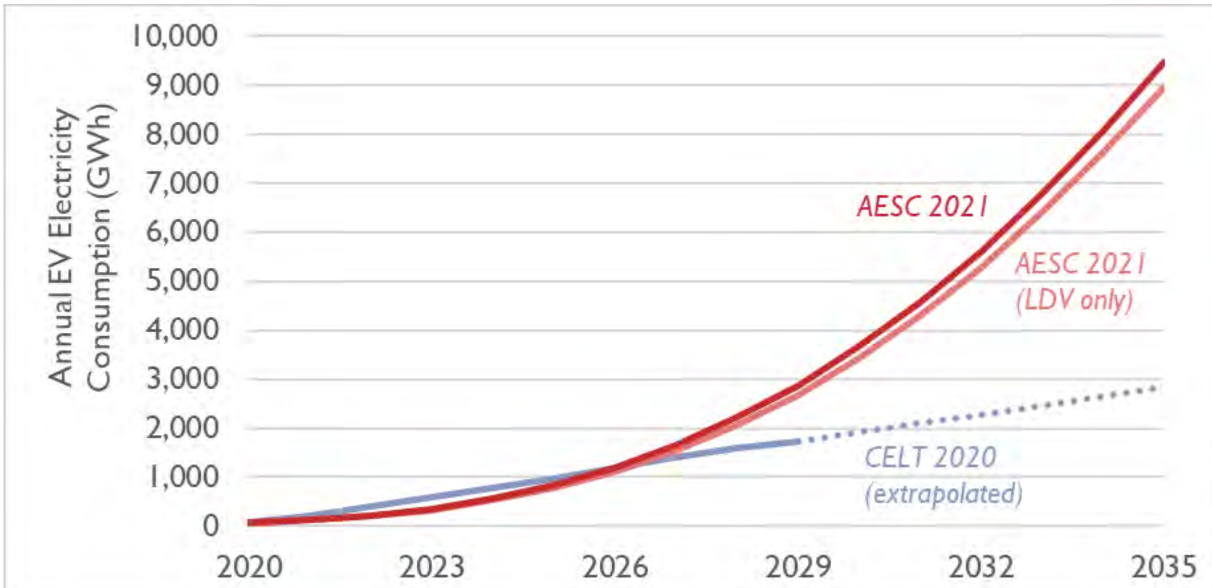
[106] Note that historically, a small amount of heat pump load growth has been implicitly projected in the CELT forecast through ISO New England's regression model.

[107] Synapse also examined deployment of commercial heat pumps in the 2020 edition of the AEO. According to underlying modeling data provided by EIA, commercial heat pumps currently make up less than 0.5 percent of New England's electricity demand; they are not projected to have any change in electricity consumption between 2018 and 2040, under the baseline conditions modeled in the 2020 AEO Reference case.

[108] Bloomberg New Energy Finance. 2020. *Electric Vehicle Outlook 2020*. Available at: https://about.bnef.com/electric-vehicle-outlook/.

in line with the most recent sales data.[109, 110, 111] Both the BNEF and TCI forecasts show similar levels of EV sales in the medium to long term. The Synapse forecast uses the Electric Vehicle Regional Emissions and Demand Impacts (EV-REDI) model to evaluate how long EVs remain on the road, how many miles EVs are driven, and how much electricity they consume.[112] One advantage of this methodology is that it eliminates the need to extrapolate the CELT forecast beyond 2029. We also use BNEF's global forecast for medium- and heavy-duty vehicle electrification to project electrification load associated with medium- and heavy-duty trucks (including buses). The CELT and Synapse load forecasts are shown in Figure 22 and peak demand impacts are shown in Figure 24.

Figure 22. Projected wholesale electricity consumption from EVs in ISO New England for all Counterfactuals



CELT 2020 also includes an hourly EV charging profile based on data acquired from the EV charging station company ChargePoint. This dataset includes a sample of charges located at both residential and commercial locations. ISO New England narrowed the dataset to include a greater fraction of residential charging, reflecting ISO New England's view that most EV charging occurs at homes. The CELT 2020 daily charging profiles are shown in Figure 23. These same EV load profiles are also used in the AESC 2021

[109] Transportation and Climate Initiative. August 8, 2019. Reference Case Results Webinar. Available at: https://www.transportationandclimate.org/sites/default/files/20190808%20-%20TCI%20Webinar%20-%20Reference%20Case%20Results.pdf.

[110] TCI is a regional collaboration of 12 states and the District of Columbia to improve clean transportation. Participating states include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia. States will choose individually whether to adopt the final proposed policy framework.

[111] Note that we have used BNEF's forecast for passenger vehicles to forecast EV adoption for all light-duty vehicles, which includes both passenger vehicles and light commercial vehicles.

[112] See Synapse's website at https://synapse-energy.com/tools/electric-vehicle-regional-emissions-and-demand-impacts-tool-ev-redi for more information on the EV-REDI model.

Study for both light-duty vehicles (LDV) and medium- and heavy-duty (MHD) vehicles.[113] The summer peak impact resulting from this EV adoption and load shape is shown in Figure 24.

Figure 23. Seasonal, hourly EV load profiles assumed by ISO New England in CELT 2020

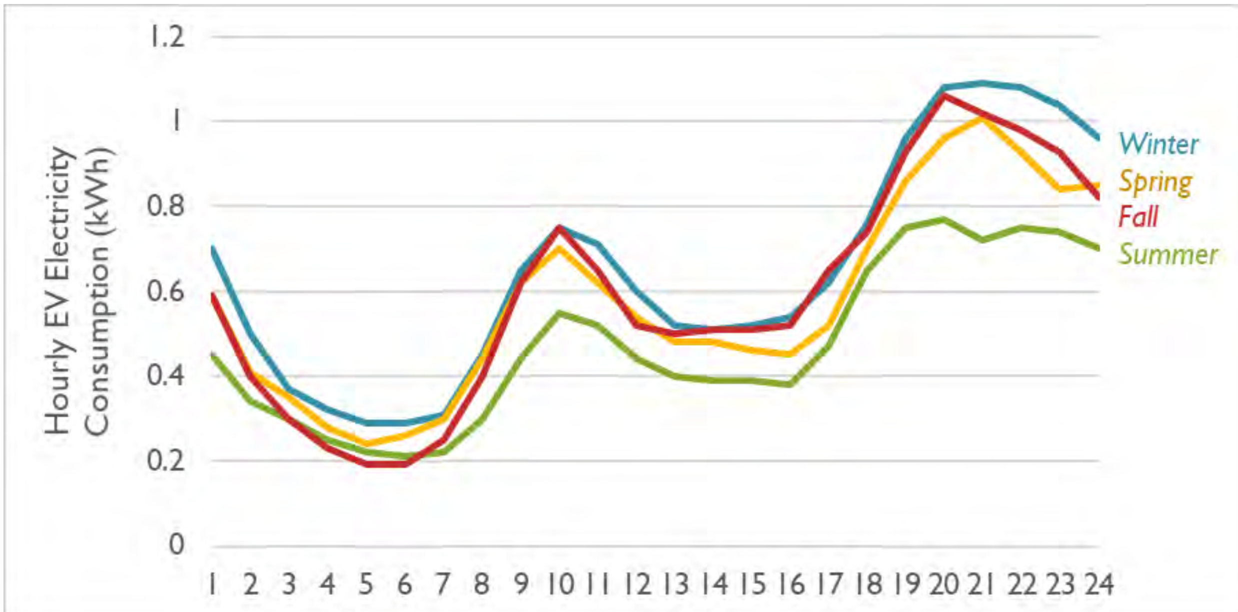
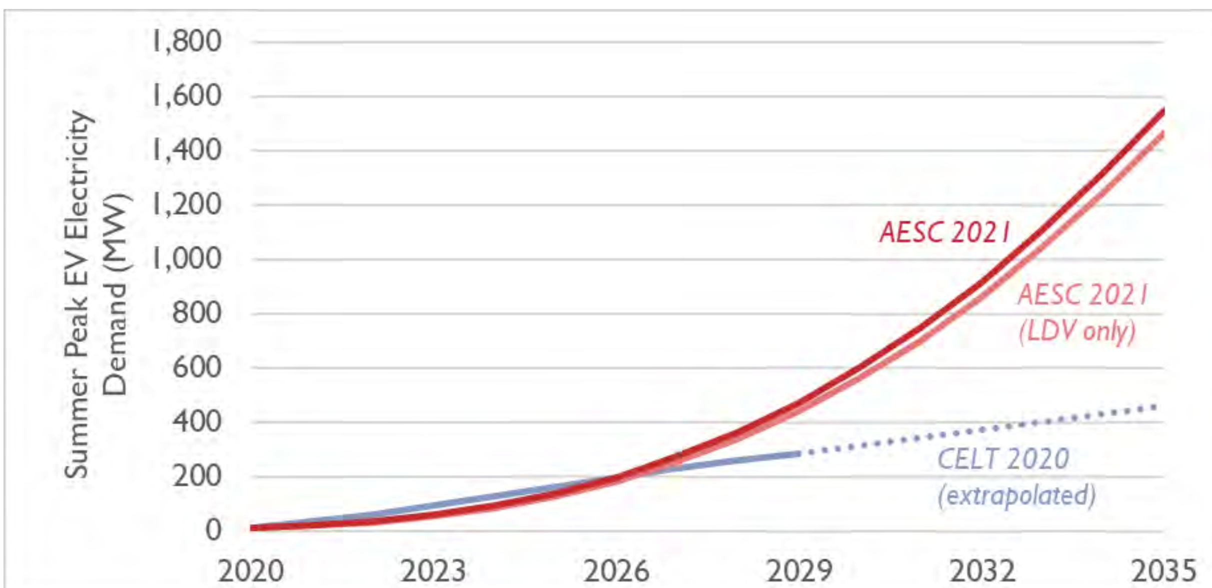


Figure 24. Summer EV wholesale peak demand impacts in ISO New England for all Counterfactuals



[113] In reality, MHD vehicles are likely to differ in terms of daily charging profiles. However, given the diversity of MHD end-uses and the early stage of MHD EV adoption, there is little data available for a reasonable alternative. Finally, since most EV charging load modeled in AESC 2021 is associated with LDVs, it is unlikely that a different charging profile would substantially impact avoided costs.

Importantly, the ChargePoint data represents how EV charging has occurred historically. As EV load grows, there will be greater benefits associated with implementing managed charging programs and shifting more charging to off-peak periods. Limited managed charging programs are currently in place in New England. While the ChargePoint data is the best available source for historical charging patterns, it may misrepresent future charging behavior and may overstate peak impacts.

While the COVID-19 pandemic has affected the LDV market during 2020, we do not anticipate significant medium- or long-term impacts to the rate of EV adoption, in line with recent projections from other analyses. For example, an August 2020 EV projection published by Wood Mackenzie suggests that the impact of the COVID-19 pandemic on mid- to long-term EV adoption is likely to be limited.[114] As a result, we have not explicitly adjusted the EV load forecast to account for the COVID-19 pandemic. However, the EV sales forecast described above does have short-term sales projections in agreement with the most recent sales data that has been released during the pandemic.

This component is included in all counterfactuals and does not differentiate between programmatic or non-programmatic components.

Distributed generation

For the purposes of AESC 2021, "distributed generation" is assumed to include only distributed solar. Like active demand management, distributed generation is modeled as a supply-side resource in the EnCompass model. Impacts from distributed generation is applied to peak demand calculations in each counterfactual.

The 2020 CELT forecast contains a projection of BTM solar. This forecast applies material discount factors (35 to 50 percent) to post-policy distributed PV installation to reflect uncertainty associated with future policies and/or market conditions. This approach, which yields lower PV load reductions than what may be realistic, is appropriate for reliable planning and operation of the system. For the purpose of the AESC 2021 study, we used a distributed PV forecast that is more representative of expected solar installation under existing policies and future policies (if applicable) and / or market conditions, based on research and market analysis. For more information on the Synapse Team's methodology for modeling distributed solar, including policies modeled and load profiles, see Section 4.4: *Renewable energy* .

This component is included in all counterfactuals and does not differentiate between programmatic or non-programmatic components.

[114] Chandrasekaran, R. August 26, 2020. "Electric Vehicles Market to Get Back on Track Post-COVID-19." *Wood MacKenzie*. Available at: https://www.woodmac.com/news/opinion/electric-vehicles-market-to-get-back-on-track-post-covid-19/.

Other resources not modeled in AESC 2021

There are other emerging DSM programs (see Table 26) that may be modeled using the 8,760 avoided cost values. These resources are not modeled in any AESC 2021 counterfactuals.

Table 26. Current status of emerging DSM technologies

Technology	Other Components or Considerations
Conservation Voltage Reduction (CVR)	The traditional avoided costs streams may be applied for CVR programs. CVR occurs in front of the customer meter. Some feeders, such as those with high motor load, may not be appropriate for CVR. CVR factors for feeders would need to be quantified. Utilities must maintain service quality requirements, which may limit applicability. Distribution planning personnel from program administrators should weigh in on the matter.
Volt-Var Control (VVO)	The traditional avoided costs streams may be applied for VVO programs. VVO occurs in front of the customer meter. Hourly data for real and reactive power will determine hourly line losses, and the difference between baseline and impact losses yields energy savings. Distribution planning personnel from program administrators should weigh in on the matter.

Energy losses

Electric systems incur energy losses when delivering power from power plants to customer's sites through T&D wires. T&D losses are developed in AESC 2021 for two main reasons:

- First, the development of certain categories of load forecast components requires the conversion between retail electricity consumption and wholesale electricity impacts. In this case, T&D losses are inputs into the avoided costs.
- Second, readers of AESC 2021 may wish to apply a T&D loss factor to convert the wholesale avoided costs calculated in AESC into retail avoided costs. In this case, T&D loss factors are applied to modeling outputs.

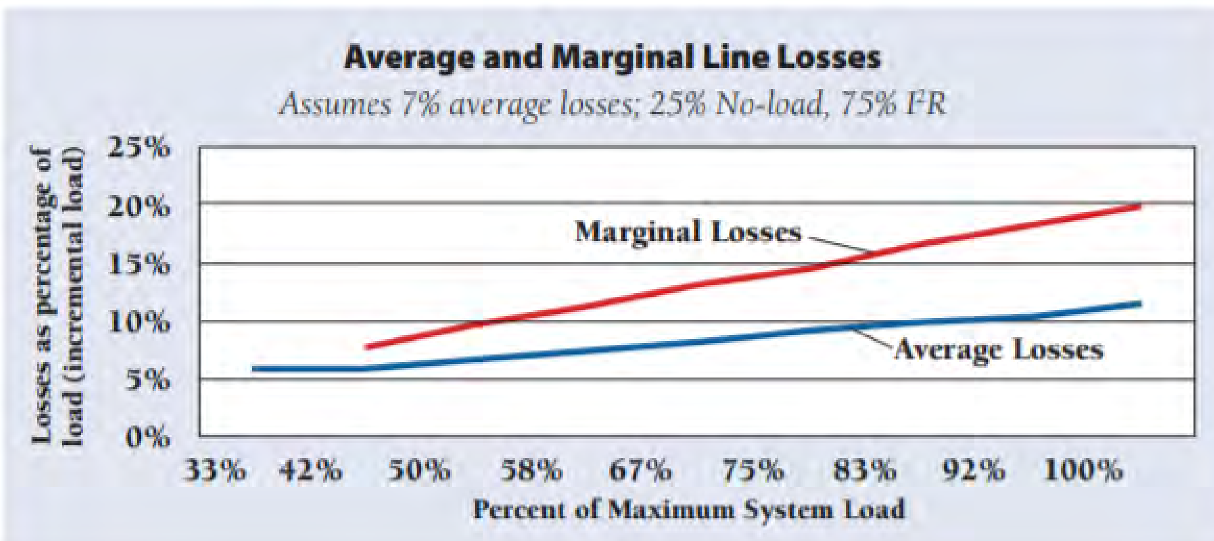
The following section is primarily concerned with the development of the T&D losses under the first category, as it is our understanding that each program administrator calculates and applies (or uses a T&D loss factor based on state precedent). However, readers may wish to review the following section to help inform their selection of loss factors.

Marginal loss factors

The amount of energy loss is affected by a number of factors including resistance in wires, system utilization rates, and weather conditions. Energy losses are generally higher when loads are higher and significantly higher during peak periods because resistive losses in wires increase with the square of the load (loss power = I^2R). This means that line losses for incremental loads ("marginal losses") that would be avoided by DSM programs are likely higher than average line losses. On the other hand, a certain amount of loss, ranging from 20 percent to 30 percent of the entire loss, are "no-load losses" that do not increase with the square of the current, unlike resistive losses. These losses incur to energize the system (i.e., create a voltage available to serve a load).[115] This means that the influence of resistive losses is greater at higher load levels because the impact of the no-load losses is fixed and relatively smaller at higher load levels.

A 2011 Regulatory Assistant Project (RAP) paper, "Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements," discusses in detail line loss factors. This paper presents an example of line loss factors and demonstrates how marginal and average losses vary at different system load levels as shown in Figure 25. This figure shows that the increases in marginal losses are greater than the increases in average losses as the system load levels increase. For example, when the system is loaded at 50 percent of the capacity, average and marginal losses are approximately 6 percent and 8 percent respectively, and when the load is near its capacity, average and marginal losses are approximately 12 percent and 20 percent respectively.

Figure 25. Average and marginal line loss factors from Lazar and Baldwin (2011)



Source: Reproduced from Figure 4 in "Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements." (2011) Regulatory Assistance Project (RAP). Available at https://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf.

In order to accurately estimate annual average marginal losses, we need to know detailed load data and system utilization rates for each hour of a year. However, details on system utilization rates are not readily available for ISO New England. The RAP paper suggests a rule of thumb value that marginal losses are about 1.5 times average losses. Thus, we use a factor of 1.5 to convert annual average line losses to marginal line losses. This value is also the value recommended by some stakeholders including one local utility in New Jersey and recently adopted by New Jersey Board of Public Utilities for

[115] RAP. 2011. Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements. Available at http://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf.

establishing the New Jersey Cost Test.[116] In AESC 2021, we apply a marginal loss factor to any incremental load added in a given year; all other portions of the load (i.e., the quantity that is less than or equal to the total load in the previous year) utilize an average loss factor. We use an average loss factor of 6 percent and a marginal loss factor of 9 percent (calculated by multiplying 6 percent by 1.5).[117]

For estimating marginal losses associated with capacity, we would need to know the system utilization factor at peak hours, or in other words, the degree to which the T&D system is stressed. While the utilization rates at the peak hours are by definition higher than the average rate for an entire year, detailed data for system utilization rates for the entire ISO New England grid for peak hours is not readily available. Thus, we rely on a larger factor than used for annual energy. Based on the data in Figure 25, factors for marginal losses over average losses range from 1.4 at a 50 percent system utilization factor to 2.6 at a 92 percent system utilization factor. Based on this range, we rely on a simple factor of 2.0. For the purposes of calculating the wholesale impact of load components (see above), we apply a marginal loss factor of 16 percent (calculated by multiplying 8 percent by a factor of 2.0) and an average loss factor of 8 percent to any existing demand (e.g., the quantity of demand in a year that is equal to or less than the previous year's demand).[118]

For more on applying energy losses to wholesale avoided costs, see Appendix B: *Detailed Electric Outputs*.

4.4. Renewable energy assumptions

See Chapter 7: *Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies* for more information on the assumptions used for renewable energy in AESC 2021's energy and capacity modeling. We describe additional assumptions on offshore wind interconnections below.

Offshore wind interconnection

The REMO Model provides information on projected offshore wind capacity and generation but does not specify where these facilities interconnect with New England's electric grid. We assume that all offshore wind that is built in southern New England is built in the U.S. Bureau of Ocean Energy Management's designated lease zones (see Figure 26). However, there is ongoing discussion on where these offshore wind facilities will interconnect. Options include locations on or near Cape Cod; New London or further west in Connecticut; Quonset, RI; Brayton Point, MA; or in the Greater Boston region.

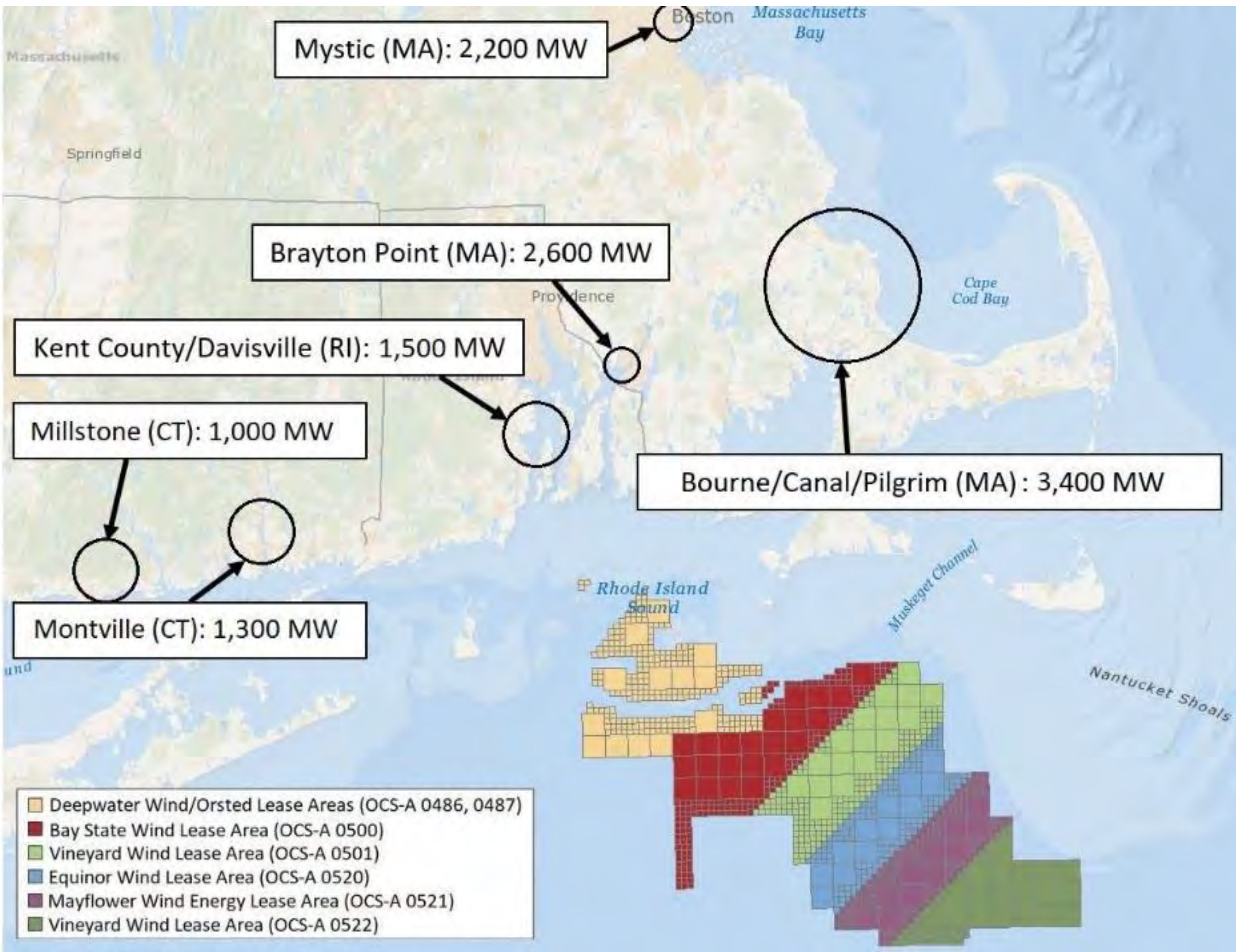
[116] New Jersey Board of Public Utilities. 2020. Order Adopting the First New Jersey Cost Test. Docket No. QO19010040 and QO20060389.

[117] Note that 6 percent is the average T&D loss factor assumed by ISO New England for long-term energy forecast. ISO New England. November 18, 2019. *Update on the 2020 Transportation Electrification Forecast.* Available at https://www.iso-ne.com/static-assets/documents/2019/11/p2_transp_elect_fx_update.pdf.

[118] See ISO New England Market Rules, Section III.13.1.4.1.1.6.(a).

In order to minimize price anomalies, we distribute the offshore wind interconnection points throughout southern New England.[119] Although there is uncertainty about which interconnection points will be used, to what degree, and when, we rely on a simplified "cycling" methodology to allocate the offshore wind throughout various modeling zones. Using 800 MW blocks, we change the interconnection point of offshore wind projects as they are built, moving from Southeast Massachusetts, to Rhode Island, to Connecticut Northeast, to Boston, and back through again. By 2035, this produces interconnected quantities that are largely consistent with those described in two separate recent modeling studies by Anbaric and NESCOE.[120]

Figure 26. Bureau of Ocean Energy Management (BOEM) lease zones in southern New England and potential interconnection points



Source: Figure reproduced from https://www.iso-ne.com/static-assets/documents/2020/03/a8_anbaric_2019_economic_study_prelim_results_marpac.pdf*, slide 9.*

[119] Through exploratory analysis in AESC 2021, we discovered that interconnecting all the offshore wind builds in the Southeast Massachusetts modeling zone produced very low energy prices in that zone and Rhode Island.

[120] ISO New England. "Anbaric 2019 Economic Study – Offshore Wind Results." March 18, 2020. Available at https://www.iso-ne.com/static-assets/documents/2020/03/a8_anbaric_2019_economic_study_prelim_results_marpac.pdf. Page 51.

4.5. Anticipated non-renewable resource additions and retirements

The following section highlights key input assumptions regarding retirements of existing units as well as anticipated additions of new generating units. This section is not meant to be a comprehensive census of all existing generators; instead, it is meant to provide an overview of the significant changes to non-renewable capacity expected to occur during the analysis period.[121]

Nuclear units

There are two remaining nuclear plants in New England: Seabrook (located in New Hampshire) and Millstone (located in Connecticut). Seabrook has one unit, and Millstone has two (see Table 27). None of the three units have announced a retirement date within the AESC 2021 analysis period. In the recent past, the Nuclear Regulatory Commission (NRC) relicensed Pilgrim 1 (previously located in Massachusetts and retired in May 2019), Millstone 2, and Millstone 3—along with many other reactors outside New England—without denying a single extension.[122] Based on this track record and the lack of evidence suggesting that the NRC would deny license renewals for any of these plants, we assume that all three nuclear units continue to operate throughout the entire modeling period.[123]

Table 27. Nuclear unit detail

Unit	State	Capacity (MW)	Announced Retirement Date	Current License Expiration Date
Seabrook 1	NH	1,242.0	None	March 2050
Millstone 2	CT	909.9	None	July 2035
Millstone 3	CT	1,253.0	None	November 2045

We do not model any incremental nuclear unit additions during the study period.

Coal units

As of August 2020, there are three coal units operating in New England, spread across two power plants (see Table 28). Other recently retired plants include Brayton Point (retired June 2017), Mount Tom (retired June 2014), Salem Harbor (retired June 2014), and Schiller (retired July 2020).

[121] Note that we are not proposing to include any incremental demand response resources in our analysis, in line with our assumptions for conventional energy efficiency resources.

[122] NEI. Last accessed March 10.2021. “Nuclear Energy in the U.S.” *Nei.org*. Available at https://www.nei.org/resources/statistics.

[123] These assumptions are consistent with those assumed by ISO New England in its 2019 Regional System Plan (see https://www.iso-ne.com/static-assets/documents/2019/10/rsp19_final.docx, page 152), with the addition of an assumed license extension for Seabrook 1.

Of the remaining units, Bridgeport Station 3 has already announced a retirement date. The Merrimack units have undergone substantial environmental retrofits in recent years. In this analysis, we make the below assumptions for these units' future operation.

Merrimack

The Merrimack power plant consists of two coal-fired units, and two 19-MW gas-fired combustion turbines. The two coal units at Merrimack were built in 1960 and 1968, making the units 52 and 60 years old, respectively, as of 2020. Both Merrimack coal units feature a wet fluidized gas desulphurization (FGD) system to control for SO_2, a selective catalytic reduction (SCR) system to control for NO_X, and an electrostatic precipitator (ESP) to control for particulate matter. Merrimack 1 operated at a capacity factor of 7 percent in 2019 and 2 percent in the first six months of 2020; Merrimack 2 operated at 8 percent and 3 percent in those same periods. All four Merrimack units have capacity commitments through FCA-14 (i.e., through May 31, 2024). Consistent with AESC 2018, we assume that both Merrimack 1 and Merrimack 2 retire on January 1, 2025, and that the other two (gas-fired) Merrimack units are operational throughout the analysis period.

Table 28. Coal unit detail

Unit	State	Capacity (MW)	Announced Retirement Date	Modeled Retirement Date
Bridgeport Station 3	CT	400.0	June 2021	June 2021
Merrimack 1	NH	113.6	None	January 2025
Merrimack 2	NH	345.6	None	January 2025

We do not model any incremental coal unit additions during the study period.

Natural gas and oil units

Throughout the study period, we assume over 40 MW of new capacity additions from natural gas or oil resources. Table 29 lists the units added exogenously during the study period. Data on capacities and online dates are from EIA's Form 860 and the FCM. These resources are assumed to be primarily natural gas-fired.

Table 29. Incremental natural gas and oil additions

Unit	State	Capacity (MW)	Modeled Online Date	Unit Type
MIT Central Utilities/Cogen Plant GT200	MA	21.7	Feb 2021	Combustion Turbine
MIT Central Utilities/Cogen Plant GT300	MA	21.7	Feb 2021	Combustion Turbine
Killingly	CT	632	Oct 2023	Combined Cycle

In addition, there are a number of major natural gas- and oil-fired units which are assumed to retire during the study period (see Table 30). Unit retirements are based on announcements by the unit owners. We do not assume any additional exogenous natural gas- or oil-fired unit retirements beyond those detailed in this table.

Table 30. Major natural gas and oil retirements

Unit	State	Capacity (MW)	Announced / Modeled Retirement Date	Unit Type	Notes
Mystic Generating Station 7	MA	617.0	June 2021	Steam Turbine	-
Mystic Generating Station GT1	MA	14.2	June 2021	Combustion Turbine	-
Mystic Generating Station GT81	MA	278.6	June 2024	Combined Cycle	-
Mystic Generating Station GT82	MA	278.6	June 2024	Combined Cycle	-
Mystic Generating Station GT93	MA	278.6	June 2024	Combined Cycle	-
Mystic Generating Station GT94	MA	278.6	June 2024	Combined Cycle	-
Mystic Generating Station ST85	MA	315.0	June 2024	Combined Cycle	-
Mystic Generating Station ST96	MA	315.0	June 2024	Combined Cycle	-
Cleary Flood 8	MA	28.3	June 2023	Steam Turbine	-
Pawtucket Power Associates GEN1	MA	41.8	June 2022	Combined Cycle	-
Pawtucket Power Associates GEN2	MA	27.0	June 2022	Combined Cycle	-
Mass Inst Tech Cntrl Utilities/Cogen Plt CTG1	MA	21.2	Feb 2021	Combustion Turbine	-
Cape Gas Turbine GT4	MA	17.5	June 2022	Combustion Turbine	No FCA oblig. in Jun 2022
Cape Gas Turbine GT5	MA	17.5	June 2022	Combustion Turbine	No FCA oblig. in Jun 2022
William F Wyman Hybrid (Yarmouth) 1	ME	50.0	June 2020	Steam Turbine	No FCA oblig. in Jun 2020
William F Wyman Hybrid (Yarmouth) 2	ME	50.0	June 2020	Steam Turbine	No FCA oblig. in Jun 2020
William F Wyman Hybrid (Yarmouth) 3	ME	113.6	June 2022	Steam Turbine	No FCA oblig. in Jun 2022
William F Wyman Hybrid (Yarmouth) 4	ME	632.4	June 2022	Steam Turbine	No FCA oblig. in Jun 2022
Middletown 2	CT	113.6	June 2022	Steam Turbine	No FCA oblig. in Jun 2022
Middletown 4	CT	414.9	June 2023	Steam Turbine	No FCA oblig. in Jun 2023

Unit	State	Capacity (MW)	Announced / Modeled Retirement Date	Unit Type	Notes
Middletown 10	CT	18.5	June 2023	Steam Turbine	No FCA oblig. in Jun 2023
Essential Power Massachusetts LLC (West Springfield) 3	MA	113.6	June 2023	Steam Turbine	No FCA oblig. in Jun 2023
Maine Independence Station GEN1	ME	177.8	June 2023	Combined Cycle	No FCA oblig. in Jun 2023
Maine Independence Station GEN2	ME	177.8	June 2023	Combined Cycle	No FCA oblig. in Jun 2023
Maine Independence Station GEN3	ME	194.6	June 2023	Combined Cycle	No FCA oblig. in Jun 2023
Capitol District Energy Center (CDECCA) GTG	CT	39.8	June 2023	Combined Cycle	No FCA oblig. in Jun 2023
Capitol District Energy Center (CDECCA) STG	CT	30.7	June 2023	Combined Cycle	No FCA oblig. in Jun 2023

We note that after the modeling phase of this project had concluded, ISO New England posted detailed data on resource additions and retirements identified through FCA 15.[124] Large, notable additions include a 60 MW capacity addition at Ocean State Power in RI, 150 MW of new battery storage at Cranberry Point Battery Energy Storage in MA, 250 MW of new battery storage at Medway Grid in MA, 175 MW of new battery storage at Resource Cross Town in ME, and 20 MW of new battery storage at Great Lakes Millinocket in ME. Large notable addition include a 95 MW retirement at West Springfield 3 in MA. We expect that the inclusion of these changes would likely have limited impacts on projections of avoided energy costs, avoided capacity costs, and other avoided cost categories. We note that there are numerous uncertainties in any projection of the future as new resources are announced and others are retired and that future modeling efforts should endeavor to include the impacts of these resource changes.

Other resources

Note that our analysis also includes several other existing resources not discussed in the above sections. These include conventional hydroelectric resources, pumped-storage hydroelectric resources, and other natural gas-fired and oil-fired resources that are not assumed to exogenously retire during the study period.

[124] ISO New England. Last Accessed March 10, 2021. *FCA Obligations.* Available at https://www.iso-ne.com/static-assets/documents/2018/02/fca_obligations.xlsx.

Other resources (e.g., biomass, wind) may have specific retirement dates.[125] These retirements and additions are accounted for in Section 4.4: *Renewable energy* .

Generic non-renewable resource additions

In addition to known and anticipated capacity additions, we allow the EnCompass model to construct generic unit additions of the types represented in Table 31 if it is determined there is a peak demand need. These parameters are similar, but not identical, to the parameters assumed in the 2018 AESC Study. Note that there are two types of each of these generic additions: one type that is built in Massachusetts load zones (and therefore subject to Mass DEP 310 CMR 7.74) and one type that is built in any of the other New England load zones.[126]

Table 31. Characteristics of generic conventional resources assumed in the EnCompass model

		Natural gas-fired combined cycle	Natural gas-fired combustion turbine
Maximum size	*MW*	702	237
Minimum size	*MW*	225	120
Heat rate	*Btu/kWh*	7,408	9,800
Variable O&M costs	*2021 $/MWh*	3.80	3.84
Fixed O&M costs	*2021 $/kW-yr*	11.93	19.16
NO_X emissions rate	*lb/MMBtu*	0.0075	0.0300
SO_2 emissions rate	*lb/MMBtu*	0	0
CO_2 emissions rate	*lb/MMBtu*	119	119

Note: Each type of generic resource may be fueled either with natural gas or fuel oil.
Source: Anchor Power Solutions New England database.

In addition to the exogenous storage builds described above, EnCompass can build out two- and four-hour duration storage resources if it determines it is optimal to do so. For these additional storage resources, we rely on capital expenditure data from the National Renewable Energy Laboratory's (NREL) 2020 Annual Technology Baseline (ATB).[127] NREL's 2020 ATB assumes that two-hour duration storage resources have capital expenditures of $963 per kW in 2018 before declining to $607 per kW in 2030 and thereafter increasing slightly to $647 per kW in 2040 (all values in nominal dollars). It assumes that four-hour duration storage resources have capital expenditures of $1,633 per kW in 2018 before declining to $1,029 per kW in 2030 and thereafter increasing slightly to $1,098 per kW in 2040 (all values in nominal dollars).

In general, the model builds new storage resources to meet reserve margin requirements as peak demand increases. As the model optimizes to meet a region's reserve margin requirement, it often finds

[125] These retirements include Pinetree Power (MA) in June 2022.

[126] More information on this environmental regulation can be found in the subsequent section on electricity commodities.

[127] National Renewable Energy Laboratory. Last accessed March 10, 2021. "Battery Storage." *Atb.nrel.gov.* Available at https://atb.nrel.gov/electricity/2020/index.php?t=st.

that storage resources are the most cost-effective resource available. In AESC 2021, we use a five-year optimization horizon, wherein the EnCompass model looks over the next five years to evaluate reliability requirements and costs in order to retire or build capacity as necessary.[128]

4.6. Transmission, imports, and exports

This section describes the existing, under construction, and planned intra-regional transmission modeled in the AESC 2021 study. It also describes our assumptions on new transmission between New England and other adjacent balancing authorities, and how we model imports over these inter-regional transmission lines in the analysis.

Intra-regional transmission

The interface limits used in the AESC 2021 study reflect both the existing system and the ongoing transmission upgrades discussed in ISO New England's Regional System Plan.[129] The transmission paths that link each of the 13 modeled regions in New England are based on transmission limits published by ISO New England (see Table 32).[130]

[128] Earlier AESC studies typically used one-year optimization horizons, largely because of computing power limitations. We have selected a five-year optimization horizon because this is roughly the horizon used to conceptualize and build large power plant projects (the FCM has a three-year horizon, but projects are conceptualized and qualified in the market before each auction at least one year and possibly more). When comparing resulting avoided costs in AESC 2021 with earlier studies, the most likely impact of this change in optimization horizon is to reduce "noise." In other words, this change is unlikely to cause avoided costs to be lower or higher but is more likely to reduce the year-on-year variation in costs.

[129] Regional System Plan documents can be found on ISO New England's website at https://www.iso-ne.com/system-planning/system-plans-studies/rsp.

[130] Note that recent analysis by Synapse which examines large amounts of renewable construction has found that, depending on where and how much renewable capacity is built, at a certain point, additional transmission capacity is required to facilitate the movement of renewable generation in northern New England (i.e., areas with favorable wind capacity factors) to southern New England (i.e., areas of high customer load). In response to this, we model a new 600 MW transmission line between Maine West Central and Massachusetts Central beginning in 2023. The transmission line is intended to help limit issues of curtailment in Massachusetts.

Table 32. Group transmission limits

Transmission Limit	Path	A to B (MW)	B to A (MW)	Notes
NE East-West	NE Massachusetts Central - NE Massachusetts West	3,500	3,000	
	NE New Hampshire - NE Vermont			
	NE Rhode Island - NE Connecticut Northeast			
NE North-South	NE New Hampshire - NE Boston	2,725	2,725	
	NE New Hampshire - NE Massachusetts Central			
	NE Vermont - NE Massachusetts West			
	Hydro Quebec - NE Massachusetts Central			
NE SEMA/RI	NE Massachusetts Southeast - NE Boston	1,800	3,400	
	NE Rhode Island - NE Boston			
	NE Rhode Island - NE Connecticut Northeast			
	NE Rhode Island - NE Massachusetts Central			
NE Southeast	NE New Hampshire - NE Boston	5,150		
	NE Massachusetts Central - NE Boston			
	NE Rhode Island - NE Connecticut Northeast			
	NE Rhode Island - NE Massachusetts Central			
NE SW CT	NY K Long Island - NE Norwalk Stamford	2,800		
	NE Connecticut Northeast - NE Connecticut Southwest			
NE Connecticut	NE Connecticut Northeast - NY K Long Island	3,400	3,400	
	NY K Long Island - NE Norwalk Stamford			
	NE Massachusetts West - NE Connecticut Northeast			
	NE Rhode Island - NE Connecticut Northeast			
	NY G Hudson Valley - NE Connecticut Northeast			
New Brunswick	New Brunswick - NE Maine Northeast	variable	variable	-249 to 989
NY to NE	NY F Capital - NE Massachusetts West	variable	variable	-1,400 to 1,875
	NY D North - NE Vermont			
	NY G Hudson Valley - NE Connecticut Northeast			
Northport	NY K Long Island - NE Norwalk Stamford	variable	variable	-246 to 213
Quebec	Hydro Quebec - NE Vermont	2,000	2,000	
	Hydro Quebec – NE Massachusetts Central	217	100	
Cross Sound	NE Connecticut Northeast - NY K Long Island	variable	variable	-177 to 333

Inter-regional transmission

In addition, we model transmission between subregions of New England and adjacent balancing authorities in New York, Québec, and New Brunswick. As with intra-regional transmission, transmission lines between these regions are typically grouped into aggregate links with aggregate transfer capacities. These transmission links were developed by Anchor Power Solutions and updated by Synapse to ensure consistency with ISO New England's census of transmission lines. Imports and export quantities between New England and adjacent balancing areas are represented as fixed, based on recent historical quantities. Anchor Power Solutions has calibrated transfers on these lines such that transfers in historical years match actual historical transfers (see Table 33).

Table 33. Single pathway transmission limits with regions adjoining ISO New England

Zone A	Zone B	A to B Capacity (MW)	B to A Capacity (MW)
NE Connecticut Northeast	NY G Hudson Valley	600	600
NE Connecticut Northeast	NY K Long Island	330	330
NE Maine Northeast	NE Maine West Central	1,325	
NE Maine Northeast	New Brunswick	1,000	1,000
NE Maine Southeast	NE Maine West Central		1,500
NE Maine Southeast	NE New Hampshire	1,900	
NE Massachusetts Central	Hydro Quebec	217	217
NE Massachusetts West	NY F Capital	700	700
NE Norwalk Stamford	NY K Long Island	100	100
NE Vermont	Hydro Quebec	2,000	2,000

In addition, we model an incremental 1,200 MW transmission line from Québec to southeast Maine, per the topology of the New England Clean Energy Connect (NECEC) project.[131] This line is modeled as providing 9.45 TWh per year. This transmission line represents compliance with Massachusetts' 2017 Act to Promote Energy Diversity, and the associated long-term contracts signed per that legislation. Under Massachusetts Chapter 188 Section 83D, any contracts selected from the 83D solicitation process must be executed by no later than December 31, 2022. Per the latest data available, we assume that this line will instead be energized on July 1, 2023. Because this cost is assumed to be unavoidable to Massachusetts ratepayers, we do not develop or incorporate a price for this resource at this time.

4.7. Operating unit characteristics

Under the production cost modeling framework, EnCompass represents the detailed operations of individual generating units. This representation includes detail on following operational characteristics for dispatch data:

- Unit type (steam-cycle, combined-cycle, simple-cycle, cogeneration, etc.)

[131] See the New England Clean Energy Connect website at https://www.necleanenergyconnect.org/ for more information.

- Fuel type (including dual-fuel capabilities, startup fuel usage, and fuel delivery point or basin of origin)
- Heat rate values and curve
- Seasonal capacity ratings (maximum and minimum)
- Variable operation and maintenance costs
- Commitment bid adders and multipliers
- Forced outage rates and planned outage rates and schedules
- Minimum up and down times, including maximum hours for warm and hot start scenarios
- Quick start, regulation, and spinning reserves capabilities
- Startup costs
- Ramp rates
- Emission rates (SO_2, NO_X, and CO_2) with options for fixed, linear, quadratic, cubic, and quartic rates
- Seasonal and/or hourly capacity factor profiles for hydro, wind, and solar resources
- Acceptable curtailment levels for hydro, wind, and solar resources
- Storage charge and discharge rates (in MW), maximum energy-stored levels (in MWh), and payback rates for pumped hydropower and battery storage

Unit operational restraints (for example, minimum up times and ramp rates) are used to simulate unit commitment for hourly, chronological model runs. During unit operations, units incur costs based on fuel usage, variable O&M costs, and emission costs. Operational units also receive revenue based on their provision of grid services, including energy, regulation, and reserve services. Every model run produces an estimate of each unit's profitability given a dispatch pattern optimized to produce the lowest overall electric system costs for the region.

O&M costs for existing conventional generation are based on unit-specific data contained in EnCompass. Capital, operating, and maintenance costs and heat rate for new conventional generation are based on data from the 2017 AEO.

4.8. Embedded emissions regulations

This section contains detail on the emission regulations embedded in the electric commodity forecast.

The Regional Greenhouse Gas Initiative

All six New England states are founding members of RGGI. Under the current program design, the six states (along with New York, Maryland, Delaware, and New Jersey) conduct four auctions in each year in which CO_2 allowances are sold to emitters and other entities.

In August 2017, the RGGI states announced a set of proposed program changes for Years 2021 through 2030.[132] Under this extended program design, the RGGI states will continue to reduce CO_2 emissions through 2030, eventually achieving a CO_2 emissions level 30 percent below 2020 levels. This new program design has also put forth a number of changes to the "Cost Containment Reserve" (a mechanism that allows for the release of more allowances in an auction if the price exceeds a certain threshold) and the creation of an "Emissions Containment Reserve" (a mechanism which withholds a number of available allowances if the allowance price remains below a certain threshold). Together, these triggers effectively act as a floor and ceiling on RGGI prices.[133]

In addition, in recent years, the RGGI region has begun to expand. The first new state to join RGGI was New Jersey in January 2020 (rejoining the program after leaving it in 2012).[134] Later in 2020, Virginia finalized its rulemaking to join RGGI, effective January 1, 2021.[135] Finally, Pennsylvania is also developing a draft regulatory proposal to join RGGI (with the state slated to on January 1, 2023), though this rulemaking remains ongoing.[136]

Starting in April 2020, Pennsylvania Department of Environmental Protection tasked ICF International with developing RGGI price projections under a base case and a case where Pennsylvania joins the 11-state RGGI region. ICF International is the same firm that typically creates RGGI price forecasts on behalf of RGGI, Inc. This includes the RGGI price modeling generated in the 2016 RGGI Program Design, which served as the basis for RGGI prices in the 2018 AESC Study.[137]

Figure 27 displays the recent prices for RGGI allowances from auctions in 2010 through 2020. The figure includes a trajectory through 2030 where Pennsylvania does not join RGGI, plus a trajectory where

[132] The official announcement ca be found on the RGGI website at http://rggi.org/docs/ProgramReview/2017/08-23-17/Announcement_Proposed_Program_Changes.pdf.

[133] Regional Greenhouse Gas Initiative. December 19, 2017. "RGGi 2016 Program Review: Principles to Accompany Model Rule Amendments" *Rggi.org.* Available at rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Principles_Accompanying_Model_Rule.pdf.

[134] New Jersey Department of Environmental Protection. Last accessed March 10, 2021. "Regional Greenhouse Gas Initiative." *state.ny.us.* Available at https://www.state.nj.us/dep/aqes/rggi.html.

[135] Virginia Department of Environmental Quality. Last accessed March 10, 2021. "Carbon Trading." *Deq.virginia.gov.* Available at https://www.deq.virginia.gov/air/greenhouse-gases/carbon-trading.

[136] Pennsylvania Department of Environmental Protection. Last accessed March 10, 2021. "Regional Greenhouse Gas Initiative." *Dep.pa.gov.* Available at https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx.

[137] Regional Greenhouse Gas Initiative. Last accessed March 10. 2021. "Program Review." *Rggi.org.* Available at https://www.rggi.org/program-overview-and-design/program-review.

Pennsylvania does join RGGI. The RGGI price trajectory used in AESC 2018 is also shown, for reference. This figure also shows the prices associated with the emissions containment reserve (ECR) and cost containment reserve (CCR). Although two states (Maine and New Hampshire) do not use the ECR (the floor price), emissions from these two states make up a small fraction of RGGI-wide emissions and are unlikely to have a substantial effect on the price.

Because the RGGI region includes states not modeled in the AESC 2021 study (New York, Delaware, Maryland, New Jersey, Virginia, and Pennsylvania) and is in fact dominated by emissions outside of New England (see Figure 28), we model the effects of RGGI as an exogenous price rather than a strict cap on emissions. Note that neither of the scenarios recently modeled by ICF International displayed in Figure 27 exactly represent the assumptions used for the New England electricity system throughout this report (for example, they do not include any assumptions about transportation electrification, and both assume some amount of energy efficiency persists through 2030). Both of them indicate prices lower than what is implied by the ECR, in at least some years. Prices lower than the ECR are possible in situations where the full ECR (e.g., 10 percent of the allowances sold in any given auction) is withheld and there is still not enough demand at the trigger price for the remaining allowances. If only some of the ECR needs to be withheld, then the price will match the ECR trigger price.

The RGGI price modeled in AESC 2021 follows the ECR price (and follows a trajectory that extends the ECR’s 2020 to 2030 CAGR to 2031 to 2035). This trajectory reflects a future in which reductions in the RGGI cap are continued after the current compliance period ends in 2030, and a future in which New England electricity demand is higher than recently modeled by ICF International.

Figure 27. Historical RGGI allowance prices, recently modeled RGGI allowance prices, the prices associated with the cost containment reserve (CCR) and emissions containment reserve (ECR), and RGGI price used in AESC 2021

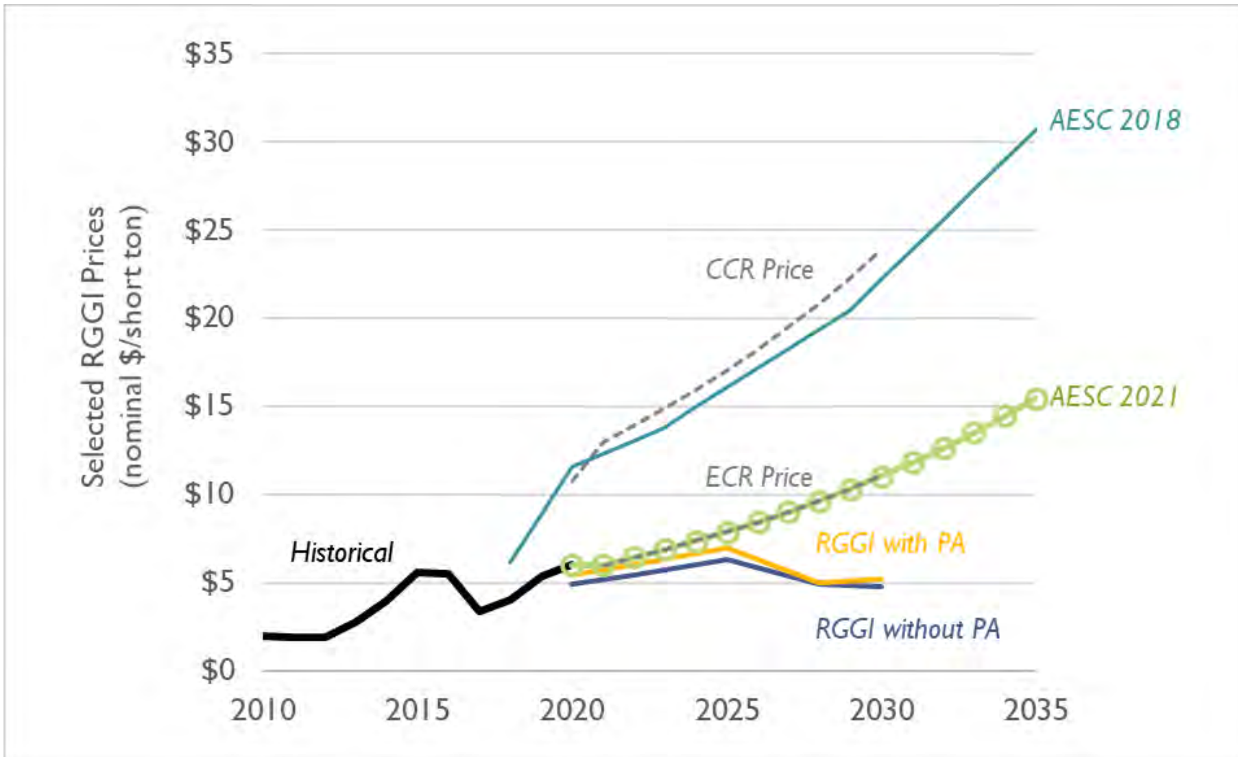
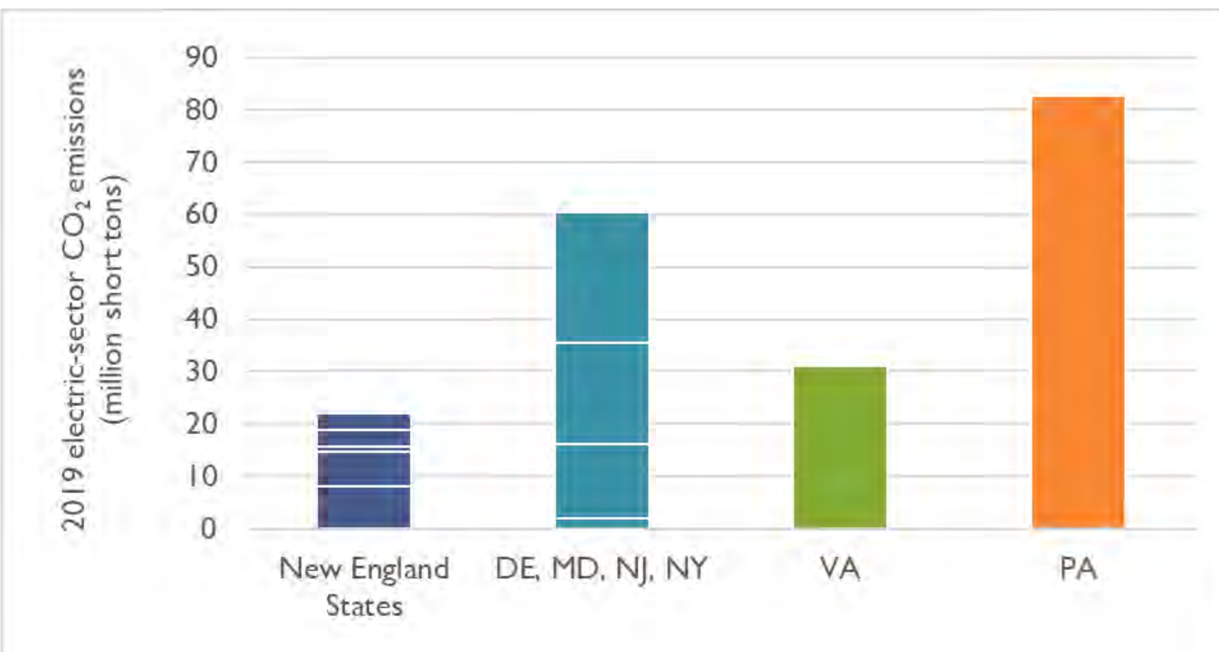


Figure 28. Electric sector CO_2 emissions in existing and proposed RGGI states, 2019



Source: EPA Air Market Programs dataset, available at ampd.epa.gov.

Massachusetts Global Warming Solutions Act and MassDEP regulations

AESC 2021 models the GHG regulations finalized by the Massachusetts Department of Environmental Protection (MassDEP) in 2017 in accordance with the Massachusetts Global Warming Solutions Act (GWSA). Under this finalized rule, MassDEP established two regulations that impact the electric sector: 310 CMR 7.74, which establishes a state-specific cap on CO_2 emissions from emitting generators in Massachusetts and 310 CMR 7.75, which establishes a Clean Energy Standard for Massachusetts load-serving entities (LSE). Impacts of these policies in $-per-metric-ton terms are available in Appendix G: .

310 CMR 7.74: Mass-based emissions limit on in-state power plants

310 CMR 7.74 assigns declining limits on total annual GHG emissions from identified emitting power plants within Massachusetts. Table 34 lists the affected power plants under this regulation. In the AESC 2021 study, we model this regulation as a state-wide limit through which plants receive CO_2 allowances pursuant to 310 CMR 7.74 at the start of each year.[138] The emissions limit starts at 9.1 million metric tons in 2018. It then declines by 2.5 percent of the 2018 emissions limit to 8.7 million metric tons in 2020, and 6.4 million metric tons in 2030 (see Table 24).[139]

In this analysis, we assume that both new and existing units fall under the same aggregate limit, as was done in the 2018 AESC study. We modeled all new and existing units as able to fully trade allowances pursuant to 310 CMR 7.74 throughout each compliance year. To simplify computation, we do not model ACPs or banking of CO_2 allowances pursuant to 310 CMR 7.74.

[138] We understand that allowances may be distributed through free allocation, through an auction, or through some combination thereof. We do not plan to make a distinction between these approaches in the 2018 AESC study, as the approach is unlikely to substantially impact allowance prices.

[139] Under the regulation, the emissions cap continues through 2050.

Figure 29. Analyzed electric sector CO_2 limits under 310 CMR 7.74

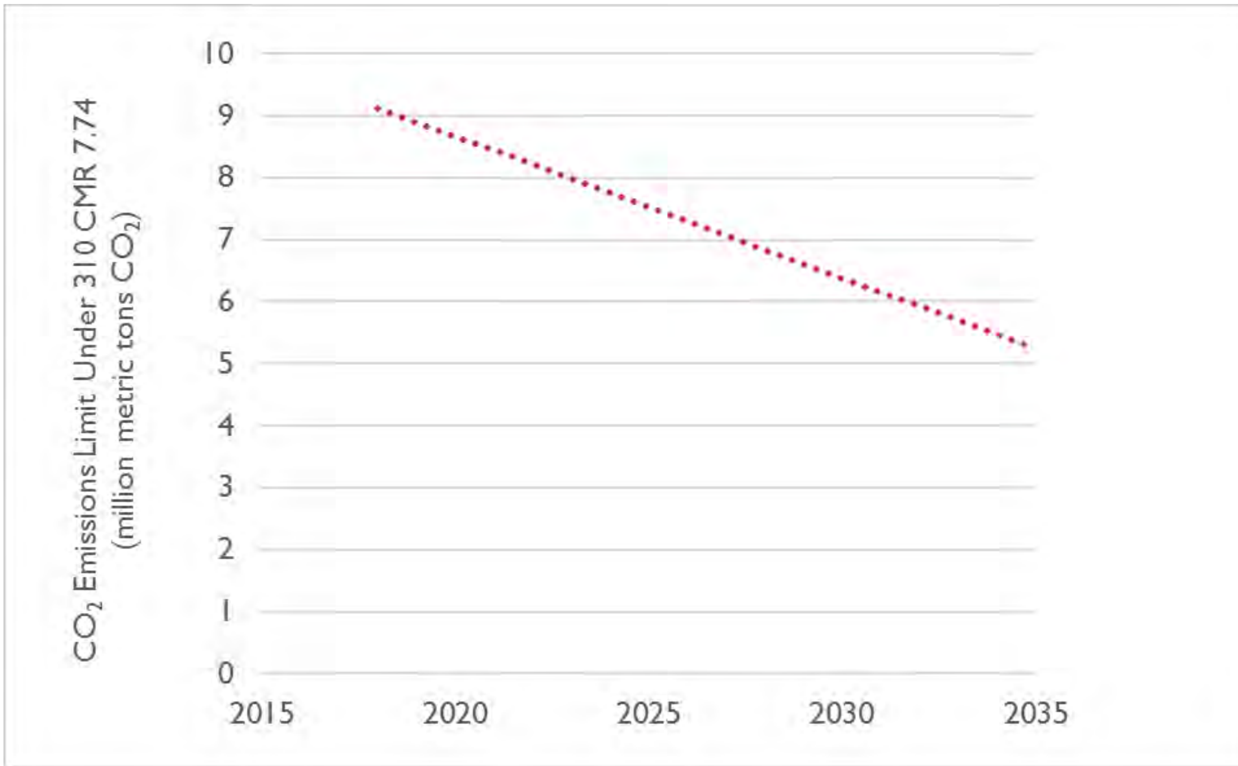


Table 34. List of generating units modeled as subject to 310 CMR 7.74

ORSPL	Facility	Unit Type	Fuel Type	Online Year (if recent)	EnCompass Unit Name
1588	Mystic	ST	Natural Gas	-	Mystic 7
1588	Mystic	CC	Natural Gas	-	Mystic CC
1592	Medway Station	GT	Oil	-	West Medway Jet
1595	Kendall Green Energy LLC	ST	Natural Gas	-	Kendall Square Jet
1595	Kendall Green Energy LLC	CC	Natural Gas	-	Kendall Square CC
1599	Canal Station	ST	Oil	-	Canal 1
1599	Canal Station	ST	Oil	-	Canal 2
1642	West Springfield	ST	Oil	-	West Springfield 3
1642	West Springfield	GT	Natural Gas	-	West Springfield 10
1642	West Springfield	GT	Natural Gas	-	West Springfield 1-2
1660	Potter	CC	Natural Gas	-	Potter Station 2
1660	Potter	GT	Natural Gas	-	Potter Station 2 GT
1678	Waters River	GT	Natural Gas	-	Waters River 1
1678	Waters River	GT	Natural Gas	-	Waters River 2
1682	Cleary Flood	ST	Oil	-	Cleary-Flood
1682	Cleary Flood	OT	Natural Gas	-	Cleary-Flood CC
6081	Stony Brook	CC	Oil	-	Stony Brook CC
6081	Stony Brook	GT	Oil	-	Stony Brook GT
10307	Bellingham	CC	Natural Gas	-	Bellingham Cogen
10726	MASSPOWER	CC	Natural Gas	-	Masspower
50002	Pittsfield Generating	CC	Natural Gas	-	Pittsfield
52026	Dartmouth Power	CC	Natural Gas	-	Dartmouth Power CC
52026	Dartmouth Power	GT	Natural Gas	-	Dartmouth Power GT
54586	Tanner Street Generation, LLC	CC	Natural Gas	-	L'Energia Energy Center
54805	Milford Power, LLC	CC	Natural Gas	-	Milford Power (MA)
55026	Dighton	CC	Natural Gas	-	Dighton Power
55041	Berkshire Power	CC	Natural Gas	-	Berkshire Power
55079	Millennium Power Partners	CC	Natural Gas	-	Millennium Power
55211	ANP Bellingham Energy Company, LLC	CC	Natural Gas	-	ANP Bellingham
55212	ANP Blackstone Energy Company, LLC	CC	Natural Gas	-	ANP Blackstone
55317	Fore River Energy Center	CC	Natural Gas	-	Fore River
1626	Footprint (Salem Harbor)	CC	Natural Gas	2017	Salem Harbor CC
1599	Canal 3	GT	Natural Gas	2019	Canal GT
59882	Exelon West Medway II LLC	GT	Natural Gas	2018	West Medway II

Note: This list includes some units that are modeled as retiring at some point in the study period.

310 CMR 7.75: Clean Energy Standard

This regulation establishes additional tranches of clean energy that are eligible to qualify for Clean Energy Certificates. More information on how we modeled this regulation (along with recent regulations for existing energy that were finalized in 2020) can be found in Section 4.4: *Renewable energy* .

Other environmental regulations

Several other environmental regulations are modeled in EnCompass and are thus embedded in the avoided energy costs. Other environmental regulations not included in the avoided energy costs include the following.

Sulfur dioxide (SO_2) and nitrogen oxides (NO_X)

Allowance prices are applied for annual SO_2 emissions covered under the Cross-State Air Pollution Rule (CSAPR) and the Acid Rain Program (ARP). Actual weighted average allowance prices from the 2020 SO_2 spot auction ($0.02 per short ton) for SO_2 are escalated at the rate of inflation through the study period, where SO_2 allowances are trading at a transaction cost.[140] These assumed prices are lower than the prices assumed in AESC 2018 ($0.52 per short ton, in 2018 dollars).

In AESC 2021 we assume no embedded NO_X prices. This assumption stems from three factors: the New England states being exempt from the CSAPR program; an assumption that currently proposed state-specific regulations in Massachusetts and Connecticut on ozone-season-NO_X are unlikely to be binding; and NO_X prices having been excluded from being modeled in previous AESC studies.

Mercury

As in past AESC studies, we assumed no trading of mercury and no allowance prices.

Other state-specific CO_2 policies

Similar to Massachusetts GWSA, all other New England states have specified a goal or target for reducing CO_2 emissions (see Table 35). Unlike Massachusetts, no other state has currently issued specific electric-sector regulations aimed at requiring that electric-sector emissions remain under a specified cap in some future year. In the AESC 2021 analysis, we do not include any embedded costs of GHG reduction compliance from states other than Massachusetts, and we assume no additional electric-sector regulations to those put forth under 310 CMR 7.74 and 7.75.[141]

[140] U.S. EPA. Last accessed March 10,2021. “2020 SO_2 Allowance Auction.” *EPA.gov*. Available at https://www.epa.gov/airmarkets/2020-so2-allowance-auction#tab-2.

[141] Note that AESC 2021 does not assume that the full costs of the Massachusetts GWSA—or any other states’ climate goals—are embedded in the energy prices and CES compliance prices. AESC 2021 only models the cost of compliance associated with regulations promulgated by MassDEP, including 310 CMR 7.74 and 310 CMR 7.75. In reality, the full cost of the Massachusetts GWSA and similar goals, targets, and requirements, will also be driven by (a) other, modeled impacts to the electric sector (i.e., new unit retirements, unit additions, natural gas prices, load forecasts) and (b) explicitly non-modeled impacts to the electric sector (i.e., energy efficiency and other DSM programs), (e) emission-reducing actions that occur outside the electric sector, and will be bounded by (c), the interim targets for specific milestone dates, which are in many cases, not yet established.

Table 35. State-specific GHG emission reduction targets 2050

State	2050 Target	Category	Sources	Interim Targets / Notes
CT	80% below 2001 levels	Statutory Target	Substitute House Bill No. 5600 Public Act 08-98: "An Act Concerning Global Warming Solutions" (Global Warming Solutions Act, or GWSA). See https://www.cga.ct.gov/2008/ACT/PA/2008PA-00098-R00HB-05600-PA.htm	Senate Bill No. 7 Public Act No. 18-82 An Act Concerning Climate Change Planning and Resiliency. This 2018 Act established an interim goal of 45% below 2001's GHG emissions level by January 1, 2030. Available at https://www.cga.ct.gov/2018/act/pa/pdf/2018PA-00082-R00SB-00007-PA.pdf
ME	80% below 1990 levels by January 1, 2050	Statutory Target	38 MRSA §576-A. Greenhouse gas emissions reductions. See http://www.mainelegislature.org/legis/statutes/38/title38sec576-A.html	The legislation has the following interim goals: (a) Reduce GHG emissions by 45 percent by January 1, 2030 and (b) by January 1, 2040, the gross annual GHG emissions level must, at a minimum, be on an annual trajectory sufficient to achieve the 2050 annual emissions level.
MA	Net zero emission by 2050; gross emissions must be at least 85% below 1990 levels	Statutory Target	2008, Chapter 298 An Act Establishing the Global Warming Solutions Act. See https://malegislature.gov/laws/sessionlaws/acts/2008/chapter298 and https://www.mass.gov/doc/final-signed-letter-of-determination-for-2050-emissions-limit/download	Statutory target set at 80% below 1990 levels by 2050; GWSA requires the Executive Office of Energy and Environmental Affairs to set economy-wide GHG emission reduction goals for 2020, 2030, 2040, and 2050.
NH	80% below 1990 levels	Executive Target	2009 New Hampshire Climate Action Plan. See https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/documents/nhcap_final.pdf	n/a
RI	80% below 1990 levels	Statutory Target	TITLE 42, State Affairs and Government, Chapter 42-6.2 Resilient Rhode Island Act of 2014 – Climate Change Coordinating Council, Section 42-6.2-2. See http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-6.2/42-6.2-2.HTM	Interim targets below 1990 levels include: (a) 10 percent below 1990 levels by 2020 and (b) 45 percent below 1990 levels by 2035;
VT	75% below 1990 levels	Statutory Target	Title 10 V.S.A. § 578 Conservation And Development Chapter 023: Air Pollution Control. See https://legislature.vermont.gov/statutes/section/10/023/00578	Interim targets below 1990 levels include: (a) 25 percent by January 1, 2012 and 50 percent by January 1, 2028.

Note: "Category" uses definitions from https://www.c2es.org/document/greenhouse-gas-emissions-targets/.

Federal CO_2 policies

In August 2018, the U.S. Environmental Protection Agency (EPA) announced a successor policy to the Clean Power Plan in the form of the Affordable Clean Energy (ACE) rule.[142] In January 2021, the D.C. Circuit vacated the ACE Rule and remanded it to EPA.[143] While other plans for federal action on CO_2 have been discussed in recent years, there are currently no regulations or policies in federal rulemaking. AESC 2021 models no other federal CO_2 policies.

[142] Synapse has written a short summary of an earlier ACE proposal at https://www.synapse-energy.com/about-us/blog/ace-whats-cards-emissions-reductions-0.

U.S. EPA. Last accessed March 11, 2021. "Affordable Clean Energy Rule." Epa.gov. Available at https://www.epa.gov/stationary-sources-air-pollution/affordable-clean-energy-rule.

[143] United States Court of Appeals USCA Case #19-1140. October 8, 2020. *American lung Association and American Public Health Association V. Environmental Protection Agency and Andrew Wheeler, Administrator, Respondents.* Available at https://statepowerproject.files.wordpress.com/2021/01/american-lung-assn-v.-epa-dc-cir.-no.-19-1140-per-curiam-decision.pdf.

5. AVOIDED CAPACITY COSTS

AESC 2021 develops avoided capacity prices for annual commitment periods starting in June 2021. The avoided capacity costs are driven by actual and forecasted clearing prices in ISO New England's FCM. The AESC 2021 forecast prices are based on observations made in recent auctions as well as expected future changes in demand, supply, and market rules. These prices are applied differently for cleared measures (i.e., measures that participate in the capacity market) and uncleared measures (i.e., measures that do not participate in the capacity market).[144]

We find that in Counterfactual #1, capacity prices range from $2.80 per kW-month to $4.34 per kW-month in 2021 dollars. Market-clearing prices in the out-years are principally determined by future changes in supply (including additions of battery storage, solar, wind, and occasionally new natural gas-fired power plants; as well as and retirements of thermal generation) and future changes in demand. Small year-on-year variations are due to changes in load, new resources coming online, and other resources retiring.

Compared to AESC 2018, capacity prices in AESC 2021 are about half as large on a 15-year levelized basis. In general, Counterfactual #2 has lower capacity prices due to a lower projection of load, while prices in Counterfactual #1, Counterfactual #3, and Counterfactual #4 are relatively similar due to similar projections of annual loads. Small year-on-year observed differences are due to changes in load, new resources coming online, and other resources retiring.

5.1. Wholesale electric capacity market inputs and cleared capacity calculations

The following section provides a description of the analysis used to develop avoided capacity prices from the FCM auctions, as well as key input assumptions.

Description of Forward Capacity Market analysis

AESC 2021 develops avoided capacity prices from the FCM auction prices for power-years from June 2020 onward, using the actual results in auctions for delivery years 2021/22 through 2024/25 (FCAs 12 through 15) and extrapolating the historical results for the rest of the analysis period. The major assumptions used to simulate the future operation of the FCM include*:*

- ISO New England will continue to operate the FCM in a manner similar to recent years, including using a similarly shaped demand curve.

[144] "Uncleared resources" includes resources that qualify for the FCM but do not receive an obligation, as well as resources that simply do not participate in the market at all. They can also be thought of as "non-market" resources.

- Resources generally continue to bid FCM capacity in a manner similar to their bidding in FCA 9 through FCA 15. Most existing resources (renewables, nuclear, hydro, combined-cycle and modern combustion turbines) continue to bid in as price-takers, at or below likely FCM clearing prices.

- The build-out of the transmission system and additions of capacity in southern New England, as well as restrictions on the shifting of resources among zones in the *Competitive Auctions with Sponsored Resources* (CASPR) program, will minimize the risk of separation of capacity prices among the internal ISO capacity zones. The location of future potential zonal price spikes is difficult to assess; since the start of the FCM, ISO New England has observed or anticipated capacity-price separation for Maine, Connecticut, NEMA, northern New England (Vermont and New Hampshire), SEMA, SEMA-RI, and southeastern New England (NEMA, SEMA and Rhode Island). The transmission and ISO New England have made great efforts to eliminate binding capacity constraints between zones and have been successful since FCA 10.[145] We observed relatively minimal price separation in FCA 15, but we do assume no price separation in future years. Although it is possible that prices separation could occur in some future years, there is much uncertainty in terms of when this separation could occur, where it could occur, what level of price spread occurs, and how long the effect lasts. Thus, for purposes of simplicity, we assume a single regional clearing price in all modeled years.

- Retirements and additions of resources will change the amount of capacity in the low-price section of the supply curve, but the shape of the demand curve around the market-clearing point will remain similar to the shape of the supply curve in FCA 15.

- Due to retirements and load growth, FCM prices in the out-years are likely to be determined by the price of new resources, net of energy profits and operating-reserve revenues. Those new resources may be combustion turbines, combined-cycle units, or battery storage.

- The capacity price is set in the primary FCA based on the bids of existing resources, new unsubsidized resources, subsidized resources that could clear without the subsidy, and imports. New state-mandated resources, such as purchases of Canadian hydro power and offshore wind, are assumed to continue to participate in a substitution auction under the CASPR program, in which they can contract to take over the capacity supply obligation (CSO) of a generation resource that clears in the primary FCA and elects to permanently retire, giving up its transmission rights.[146] Once a sponsored resource has cleared in the CASPR market, it is then considered an existing resource and is able to participate in the primary auction. The existence of the CASPR market should encourage uneconomic generators (including a large amount of fossil steam capacity) to bid low to

[145] The abrupt non-price retirement of the entire Brayton Point station and Vermont Yankee in FCA 8 resulted in insufficient competition in the entire ISO in FCA 8 and in SEMA/RI in FCA 9.

[146] The retiring resource may pay the sponsored resource to take over the obligation (at a price less than the FCA clearing price) or the sponsored resource may pay the retiring resource for the right to become an existing resource in future FCAs.

clear the FCA, with the intent of offloading their CSOs to sponsored resources.[147] Once they are recognized as existing resources, sponsored resources are likely to bid largely as price-takers, since they will not want to shut down. A detailed discussion of the CASPR market is found below in subsection titled *ISO New England's Competitive Auctions with Sponsored Resources initiative*.

- For purposes of simplification, we assume that all resources are paid a single-year price, rather than a multi-year price. The option to elect a multi-year price will no longer be allowed beginning in FCA 16.[148]

AESC 2021 incorporates these assumptions to estimate FCM prices for power years from June 2025 onward.

Input assumptions to FCM analysis

The analysis of future capacity prices utilizes the results of the four most recent forward capacity auctions (FCA 12 through FCA 15), which are among the only ISO New England FCAs to clear at bid prices, rather than an administrative limit.[149] Table 36 shows the Rest of Pool (ROP) results for each round of each auctions. As the price falls in each round, the ISO increases the level of "demand," i.e., the amount of capacity it deems appropriate to procure. Simultaneously, the amount of supply that would clear falls with the price, and the excess of supply over demand falls even faster.

[147] ISO New England requires that an existing capacity resource which seeks to participate in the substitution auction offer a Test Price that indicates its estimate of a price at which it would not earn enough revenues to cover its going-forward costs. This document is reviewed by ISO New England's Internal Market Monitor. It is not yet apparent that this mechanism will preclude many existing resources from clearing.

[148] U.S. Federal Energy Regulatory Commission. December 2, 2020. *Order on Paper Hearing 173 FERC ¶ 61,198.* Available at https://www.iso-ne.com/static-assets/documents/2020/12/el20-54-000_12-2-20_order_new_entrant_rules.pdf.

[149] FCA 9 and FCA 10 also cleared at bid prices.

Table 36. FCA price results by round (rest-of-pool results only)

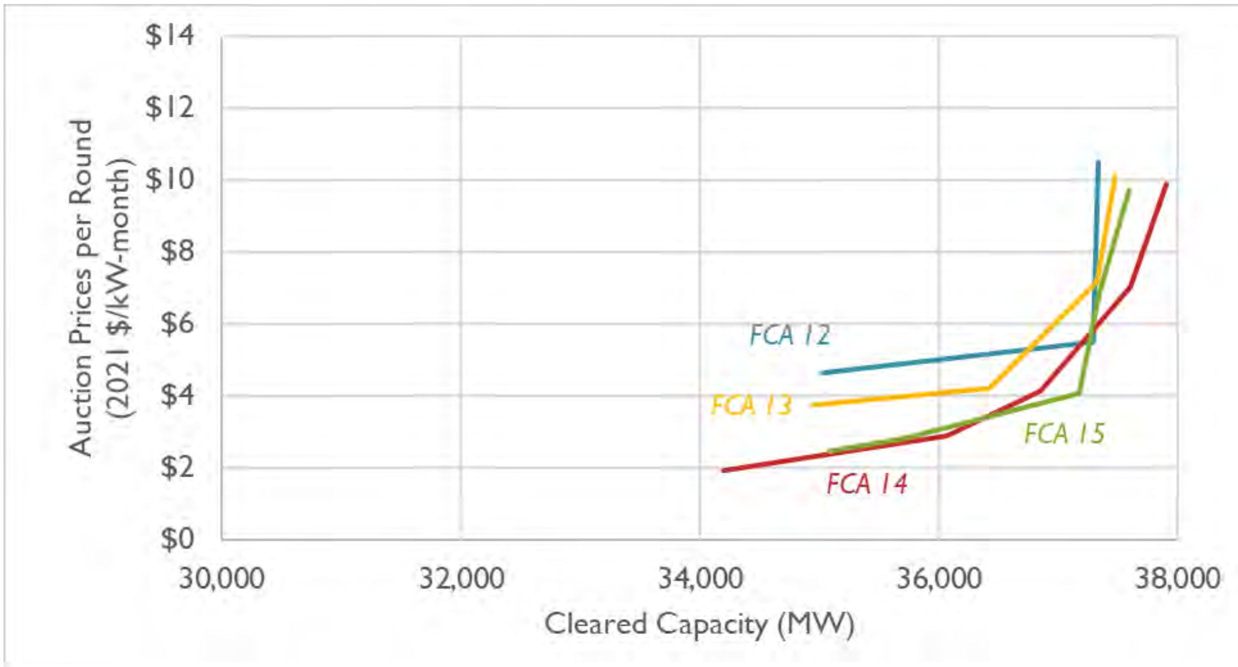
			CONE	Net CONE	Round 1	2	3	4	5
FCA 12	Price	*2021 $/kW-month*	$11.35	$8.04	$10.50	$8.00	$5.50	$4.63	
	Demand	*MW*			33,362	33,732	34,626	35,030	
	Excess	*MW*			3,972	3,589	2,669	0	
	Supply	*MW*			37,334	37,321	37,295	35,030	
FCA 13	Price	*2021 $/kW-month*	$11.07	$8.00	$10.30	$7.30	$4.30	$3.80	
	Demand	*MW*			33,437	33,897	34,724	34,954	
	Excess	*MW*			4,039	3,431	1,696	0	
	Supply	*MW*			37,476	37,328	36,421	34,954	
FCA 14	Price	*2021 $/kW-month*	$11.03	$7.87	$10.30	$7.30	$4.30	$3.00	$2.00
	Demand	*MW*			32,204	32,631	33,237	33,591	34,194
	Excess	*MW*			5,704	4,973	3,612	2,480	0
	Supply	*MW*			37,908	37,604	36,849	36,071	34,194
FCA 15	Price	*2021 $/kW-month*	$11.26	$8.20	$9.71	$6.88	$4.05	$2.83	$2.46
	Demand	*MW*			33,049	33,493	34,102	34,464	35,081
	Excess	*MW*			4,547	3,857	3,078	1,246	0
	Supply	*MW*			37,596	37,350	37,179	35,710	35,081

Notes: All prices have been converted to 2021 dollars.
Sources: See https://www.iso-ne.com/static-assets/documents/2016/12/summary_of_historical_icr_values.xlsx and https://www.iso-ne.com/static-assets/documents/2018/05/fca-results-report.pdf.

Historical supply curves

Figure 30 shows the price results of the auction rounds, as a function of the supply available at that price. These are effectively the supply curves for capacity in each of these auctions. Each year, the market has been able to provide more capacity at a given price, or provide a given capacity at a lower price. The price curves for the last four auctions are relatively closely clustered and guide the AESC 2021 projection for future pricing. For future years, we move the FCA 15 supply curve right or left to reflect changes in capacity additions and retirements under each counterfactual.

Figure 30. FCA price results by round (effective supply curves)



Note: All prices have been converted into 2021 dollars.

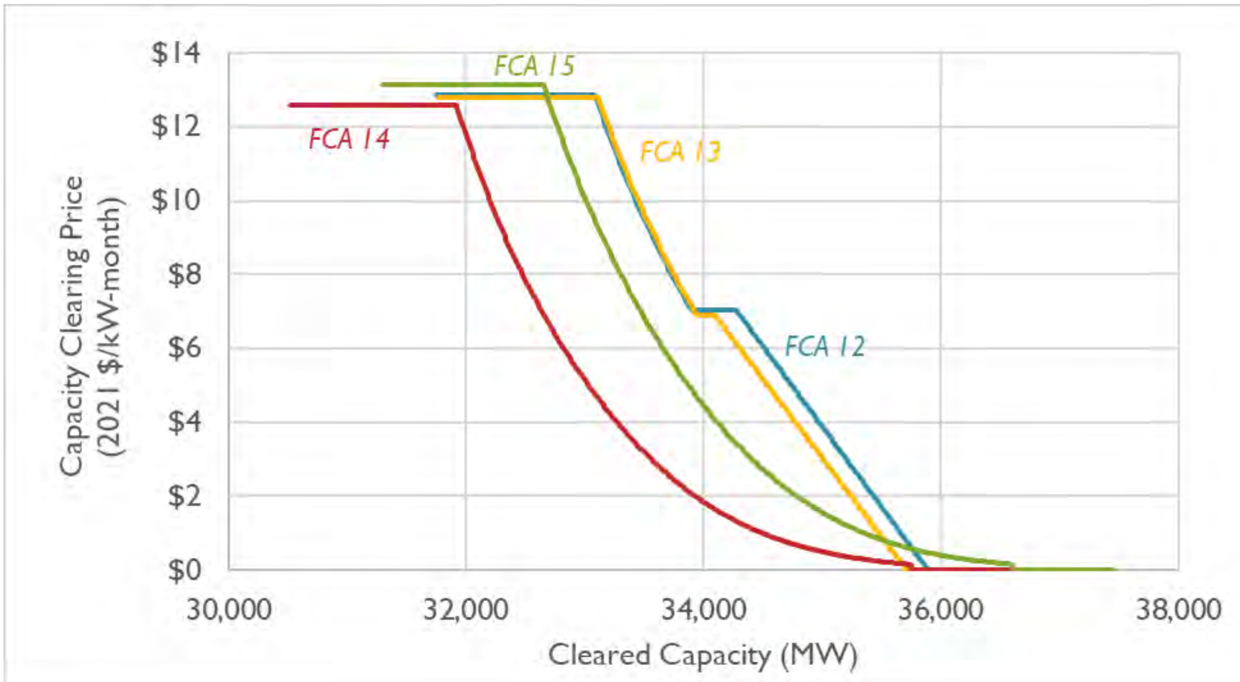
Historical demand curves

ISO New England has used the administrative demand curve for several years to provide greater stability in capacity prices and acquire additional resources when prices are low. Starting with FCA 14, the demand curve has been a smooth curve, shaped to mimic the change in loss-of-load expectation. The demand curve is scaled so that the capacity price equals ISO New England's estimate of cost of new entry (CONE) at the net installed capacity requirement (Net ICR).

Figure 31 shows the FCA 12 and FCA 13 demand curves, the last two auctions featuring a stepped demand curves, and the two more recent auctions that have used fully smoothed demand curves. Note that the curve for FCA 14 moved considerably lower relative to FCA 13, while the curve for FCA 15 moved back up.

To model FCA 16 and future years, we rely on the demand curve for FCA 15, shifted according to projected changes in demand in each counterfactual.

Figure 31. Recent FCA demand curves



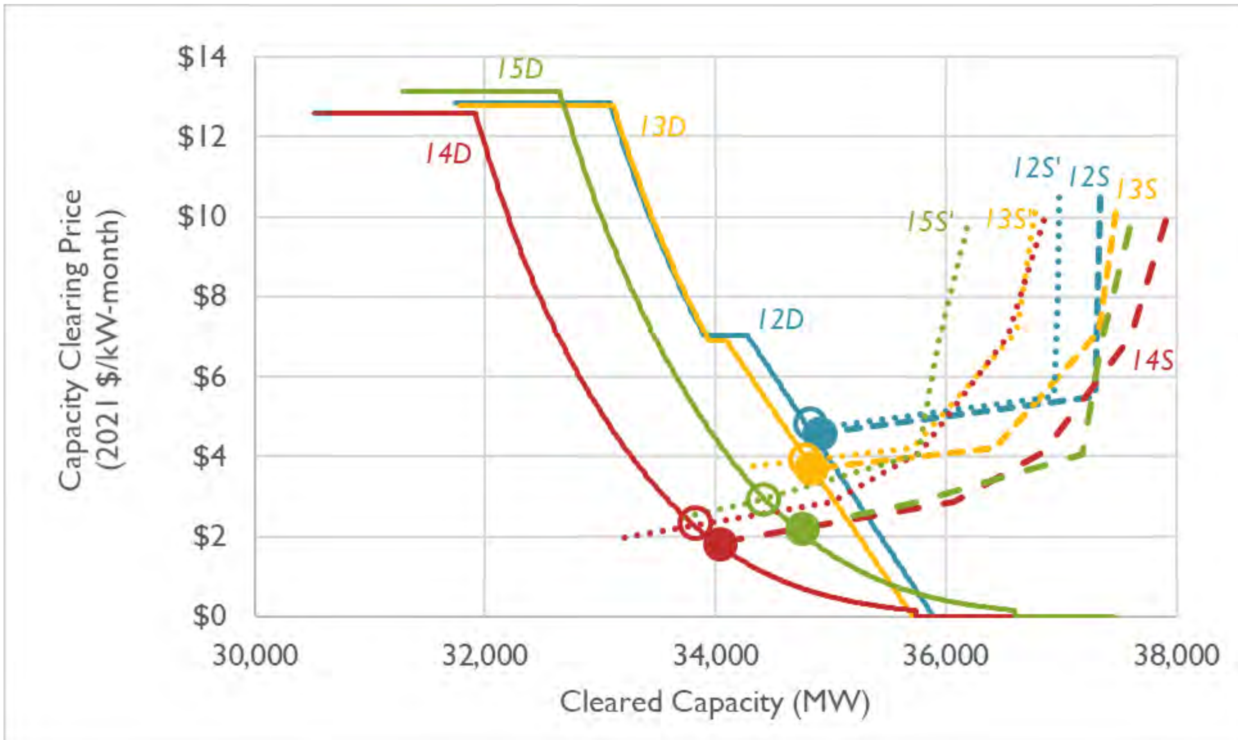
Note: All prices have been converted into 2021 dollars.

Historical capacity price results

Figure 32 shows the result of matching the demand and supply curves for FCA 12 through FCA 15. The figure shows each FCA represented by a distinct color. The figure then is further differentiated with:

- A solid line representing the demand curve for each FCA
- A dashed line representing the supply curve for each FCA
- A dotted line for the supply curve for Counterfactual #1 that excludes the post-2020 energy efficiency for each FCA
- A solid circle that shows the actual market clearing price for each auction
- An empty circle that indicates what the clearing price would have been if not for energy efficiency that was installed in 2021 and later years

Figure 32. Market clearing capacity prices for FCA 12 through FCA 15



Notes: Solid lines marked "D" are demand curves, dashed lines marked "S" are actual supply curves, and dotted lines marked "S'" are supply curves absent post-2020 energy efficiency. Solid circles denote the clearing price under actual conditions while empty circles denote what the clearing price would have been but for post-2020 energy efficiency. Only results for rest-of-pool are shown.

The exact clearing price in each auction depends on the size of the marginal unit, since ISO New England accepts entire units rather than individual megawatts. Hence, the actual FCA supply curve does not quite intersect with the demand curve, especially for FCA 12 and FCA 14; these clearing prices must have been set by large units. Table 37 summarizes the clearing prices for the actual and hypothetical "without post-2020 EE" cases described in Figure 32.

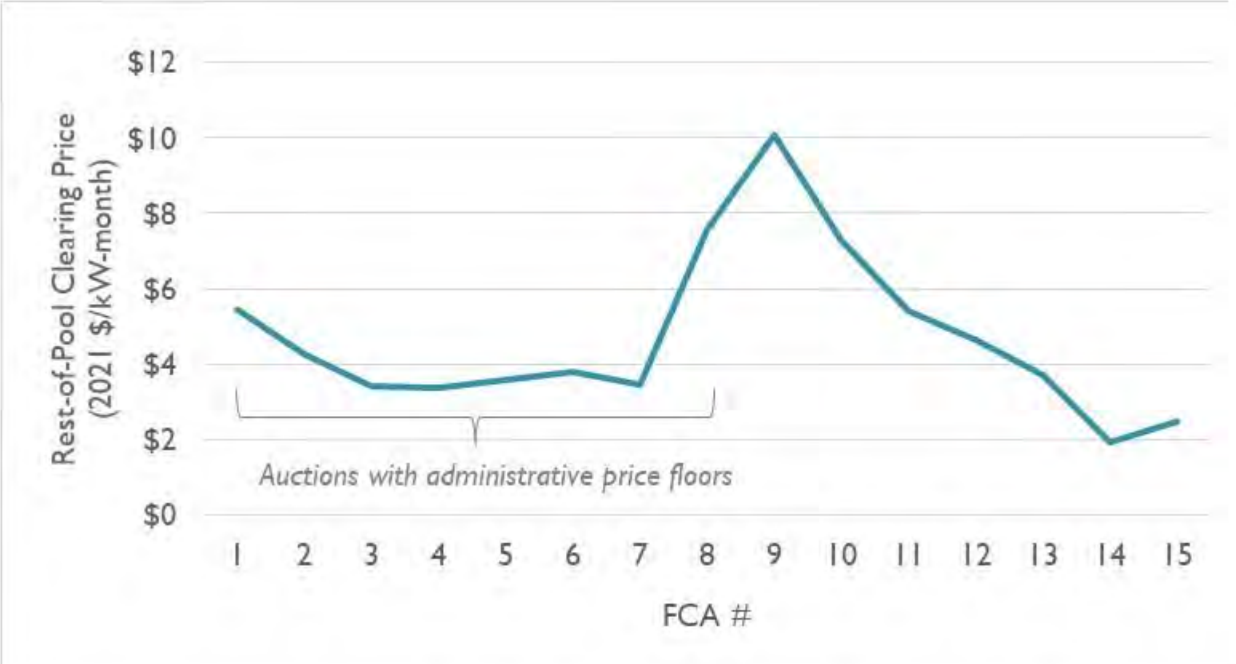
Table 37. Capacity prices for recent and pending FCAs (2021 $ per kW-month)

Commitment Period (June to May)	**FCA**	**Actual Clearing Price** *2021 $*	**Actual Clearing Price Without post-2020 EE** *2021 $*
2021/2022	12	$4.63	$4.77
2022/2023	13	$3.73	$3.96
2023/2024	14	$1.92	$2.47
2024/2025	15	$2.46	$3.29

Note: Rest-of-pool prices only.

As a point of reference, Figure 33 illustrates the actual clearing prices since the start of the FCM. The average rest-of-pool clearing prices over the four most recent auctions is $3.19 kW-month.

Figure 33. Forward capacity auction clearing prices for all past auctions (rest-of-pool prices only)



Note: All prices have been converted into 2021 dollars.

Projecting future capacity prices

For each subsequent auction after FCA 15, we estimate both the demand curve and the supply curve, using the steps described above. The demand curve shifts to the right as the forecasted peak increases. The supply curve shifts left or right, depending on the extent of resource retirements and additions.[150] The intersection of these two curves indicates the capacity price.

Table 38 depicts the estimated peak demand under each counterfactual in the future years where prices are simulated (as opposed to 2021 through 2024, where capacity prices are based on actual observations). We calculated peak demand based on the aggregate hourly peak load from the drivers described in Section 4.3: *New England system demand*. Peak demand for Counterfactuals #1, #3, and #4 are relatively similar due to the similarity of their underlying assumptions. Peak demand for Counterfactual #2 is substantially lower, as this counterfactual incorporates incremental energy efficiency after 2020.

[150] The supply curve will also change with the economics of continued operation of resources, the operators' bidding strategies, the availability of imports, ISO New England's rules for resource eligibility, and other factors. We have not estimated those changes, which will be driven by factors that are difficult to forecast.

Table 38. Projected cumulative change in demand (GW), relative to FCA 15

		Counterfactual #1	Counterfactual #2	Counterfactual #3	Counterfactual #4
FCA 16	2025	0.5	0.1	0.5	0.5
FCA 17	2026	0.8	0.1	0.8	0.8
FCA 18	2027	1.2	0.2	1.2	1.2
FCA 19	2028	1.6	0.2	1.6	1.6
FCA 20	2029	2.1	0.4	2.1	2.1
FCA 21	2030	2.5	0.5	2.5	2.5
FCA 22	2031	2.9	0.6	2.9	2.9
FCA 23	2032	3.3	0.8	3.3	3.3
FCA 24	2033	3.9	1.0	3.9	3.9
FCA 25	2034	4.4	1.3	4.4	4.4
FCA 26	2035	4.9	1.5	4.9	4.9

Table 39 depicts the available supply under each counterfactual in the future years where prices are simulated (as opposed to 2021–2024, where capacity prices are based on actual observations). Projected supply is based on the impacts from the drivers described in Chapter 4. *Common Electric Assumptions*, Chapter 7. *Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies*, and the dynamics of the CASPR auction described below in the subsection titled *ISO New England's Competitive Auctions with Sponsored Resources initiative*. The supply depicted here is the net cumulative supply relative to FCA 15, after accounting for conventional plant retirements and additions, as well as CASPR-eligible plant additions.

Projected supply for Counterfactuals #1, #3, and #4 are relatively similar due to the similarity of their underlying assumptions. Projected supply for Counterfactual #2 is substantially lower, as this Counterfactual incorporates incremental energy efficiency after 2020. See Chapter 6. *Avoided Energy Costs* for more discussion on these results.

Table 39. Projected cumulative change in supply (GW), relative to FCA 15

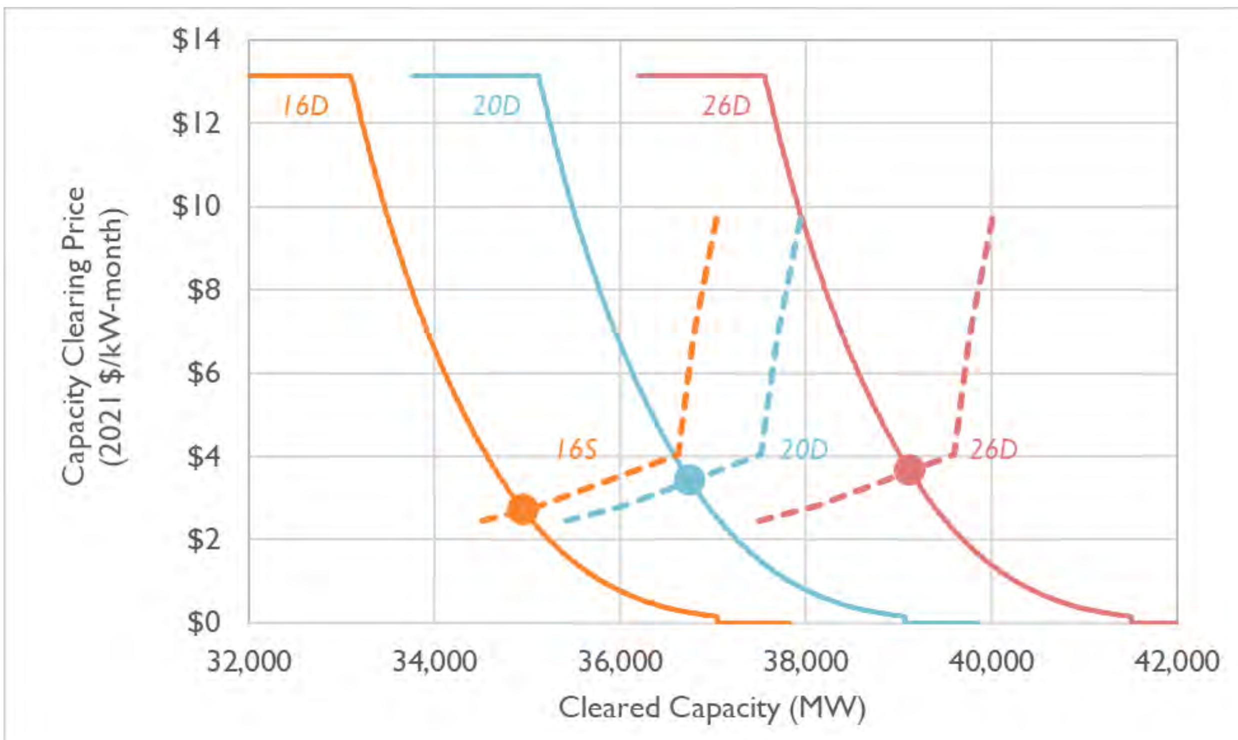
		Counterfactual #1	Counterfactual #2	Counterfactual #3	Counterfactual #4
FCA 16	2025	-0.6	-0.9	-0.3	-0.3
FCA 17	2026	-0.5	-0.8	-0.2	-0.2
FCA 18	2027	-0.4	-1.8	-1.0	-0.9
FCA 19	2028	-0.4	-1.7	-0.9	-0.9
FCA 20	2029	-0.3	-1.7	-0.9	-0.8
FCA 21	2030	0.3	-2.1	-0.5	-0.4
FCA 22	2031	0.4	-2.1	0.2	0.3
FCA 23	2032	0.4	-2.0	0.3	0.3
FCA 24	2033	1.1	-2.0	0.9	1.0
FCA 25	2034	1.1	-1.9	1.0	1.0
FCA 26	2035	2.4	-1.3	2.3	2.3

As described above, our simplified capacity market model does not estimate geographic price separation in any years after FCA 15. We observed relatively minimal price separation in FCA 15, but we do assume no price separation in future years. Although it is possible that prices separation could occur in some future years, there is much uncertainty in terms of when this separation could occur, where it could occur, what level of price spread occurs, and how long the effect lasts. Thus, for purposes of simplicity, we assume a single regional clearing price in all modeled years.

Results

As described above, for each year and each counterfactual, MW differences in demand (relative to FCA 15) are added to or subtracted from the FCA 15 demand curve to create a new future demand curve. A similar operation is performed for the FCA 15 supply curve using the changes in supply. Figure 34 illustrates the resulting market clearing prices in Counterfactual #1 for a selection of years. In this counterfactual, capacity prices in FCA 16 and later range from $2.72 per kW-month to $4.67 per kW-month in 2021 dollars. The market-clearing prices in the out-years are principally determined by whether the balance of the qualified and cleared capacity additions, primarily from battery storage and offshore wind, and retirements of thermal generation (fossil steam, combustion turbines, some older combined-cycle units, and some biomass), and how the resulting supply compares to the change in demand.

Figure 34. Forecast of selected FCA prices in Counterfactual #1 (2021 $ per kW-month) in rest-of-pool region



Notes: Solid lines marked "D" are demand curves while dotted lines marked "S" are supply curves. Empty circles denote estimated clearing prices. Several supply curves are not marked on this figure, but lie in between 16S and 26S. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

These capacity prices, projected for 2025 and later years, are then appended to actual capacity prices for 2021–2024 (in the case of Counterfactual #2) and capacity price projections for these same years but for the impact of post-2020 energy efficiency (in the case of Counterfactuals #1, #3, and #4). Table 40 and Figure 35 compare the complete capacity price projections for each counterfactual. In general, Counterfactual #2 has lower capacity prices due to a lower projection of load, while Counterfactual #1, Counterfactual #3, and Counterfactual #4 are relatively similar due to similar projections of annual loads. Small year-on-year differences are due to changes in load, new resources coming online, and other resources retiring. These are the avoided capacity costs used for cleared resources.

Compared to AESC 2018, the AESC 2021 capacity prices are about half as large on a 15-year levelized basis. Prices tend to be lower and remain low because the amount of demand and supply resources modeled in future years is expected to produce clearing prices that occur in a relatively low and shallow part of both the supply and demand curves.[151]

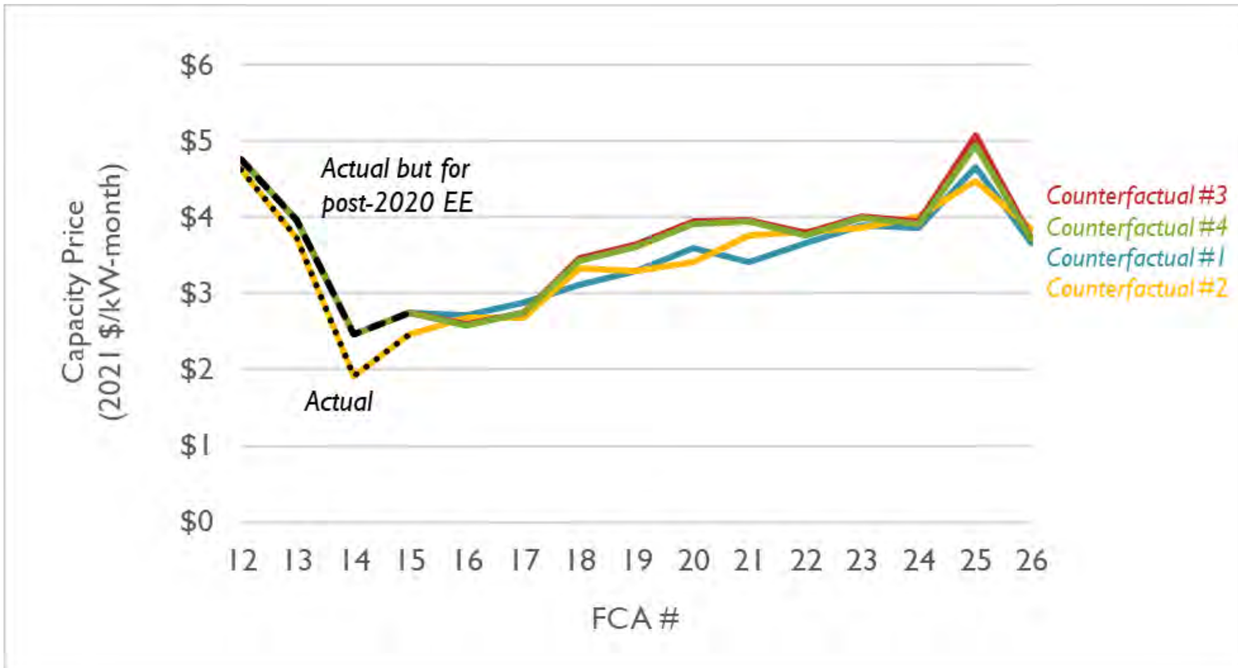
Table 40. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Commitment Period (June to May)	FCA	Actual	Actual but for post-2020 EE	AESC 2021				AESC 2018
				Counter-factual #1	Counter-factual #2	Counter-factual #3	Counter-factual #4	
2021/2022	12	$4.63	$4.77	$4.77	$4.63	$4.77	$4.77	$4.99
2022/2023	13	$3.73	$3.96	$3.96	$3.73	$3.96	$3.96	$5.10
2023/2024	14	$1.92	$2.47	$2.47	$1.92	$2.47	$2.47	$5.21
2024/2025	15	$2.46	$2.75	$2.75	$2.46	$2.75	$2.75	$5.50
2025/2026	16			$2.72	$2.69	$2.59	$2.59	$5.95
2026/2027	17			$2.88	$2.69	$2.75	$2.75	$6.46
2027/2028	18			$3.11	$3.33	$3.46	$3.43	$6.95
2028/2029	19			$3.30	$3.30	$3.65	$3.62	$7.45
2029/2030	20			$3.59	$3.41	$3.94	$3.92	$7.95
2030/2031	21			$3.42	$3.77	$3.97	$3.94	$6.95
2031/2032	22			$3.67	$3.81	$3.79	$3.77	$7.45
2032/2033	23			$3.90	$3.86	$4.02	$3.99	$7.95
2033/2034	24			$3.86	$4.02	$3.95	$3.92	$6.95
2034/2035	25			$4.67	$4.47	$5.09	$4.95	$7.45
2035/2036	26			$3.66	$3.86	$3.73	$3.71	$7.95
15-year levelized cost				**$3.51**	**$3.45**	**$3.65**	**$3.63**	**$6.63**
Percent difference				**-47%**	**-48%**	**-45%**	**-45%**	

Notes: Levelization periods are 2021/2022 to 2035/2036 for AESC 2021 2018/2019 to 2032/2033 for AESC 2018. Real discount rate is 0.81 percent for AESC 2021 and 1.34 percent for AESC 2018. Values for "Actual" and "Actual but for post-2020 EE" are calculated based on rest-of-pool. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

[151] The shapes of both of these curves are determined by data published by ISO New England, either directly through a publication by ISO New England (in the case of the FCA 15 demand curve) or indirectly via auction results (in the case of the FCA 15 supply curve).

Figure 35. Comparison of capacity prices in AESC 2021 across different counterfactuals



Note: Values for "Actual" and "Actual but for post-2020 EE" are shown based on rest-of-pool. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

5.2. Uncleared capacity calculations

Any load reduction that clears provides avoided capacity costs in the year that the resource participates in the capacity auction. For example, if a program administrator has bid 1 MW into FCA 15 and expects to deliver that 1 MW starting in the summer of 2024 (the beginning of the FCA 15 commitment period), that benefit will receive the full avoided capacity cost benefit starting in 2024. Likewise, if this measure is re-bid into each subsequent auction for the duration of its life, it will receive an avoided capacity cost equal to the market clearing price for all future years.

But not all resources are bid into the FCA. Program administrators may choose to claim lower savings from new installations until the program is approved, funding is more certain, or the rate of installation is better known. Thus, a program administrator may bid some (or only a portion) of the anticipated capacity into the FCA.[152]

This remaining capacity is known as "uncleared" capacity. Unlike cleared capacity, the benefit associated with this resource is not simply the capacity price multiplied by the resource's capacity. Instead,

[152] As long as it is "qualified" to participate in auctions (per ISO New England's definition and rules), the uncleared portion of the resource may be later bid into monthly annual reconciliation auctions (MRA), annual reconciliation auctions (ARA), as well as for the FCAs for later commitment periods. In general, ARA prices are lower than FCA prices; for the ARAs completed for the commitment periods ending in 2018 to 2021, the first ARA averaged about 76 percent of the FCA price, the second ARA averaged 37 percent, and the third ARA averaged 31 percent.

uncleared capacity utilizes a "phase-in" and "phase-out" schedule that approximates how the impacts of these resources are indirectly captured in the development of inputs to ISO New England's FCM.

Phase-in

Each year, ISO New England generates a demand forecast using a complex regression analysis of load, weather, and a time trend over 15 years of historical summer (primarily July and August) daily peak loads. As load reductions from uncleared efficiency programs appear in the model's data, forecasts of capacity requirements (i.e., load) are reduced.[153] Because each annual capacity auction is performed three years in advance of a commitment period, and because there is a lag in terms of when changes to load appear in the load forecast used for a capacity auction, we assume that benefits from uncleared capacity do not start until 5 years after their installation date. Table 41 describes a hypothetical timeline where a measure is installed in 2019, but does not produce an impact on the capacity market for another five years.

Table 41. Illustration of when uncleared capacity begins to have an effect

Year	Event
2019	Measure is installed and begins to reduce load.
2020	ISO New England publishes a load forecast that is partially impacted by the load reductions installed in the previous year.
2021	An annual capacity auction occurs (effective three years from now in 2024). The demand curve in this auction is based on the load forecast made in the previous year.
2022	-
2023	-
2024	The year the prices from the capacity auction take place. The uncleared measure now begins to have an impact.

Phase-out

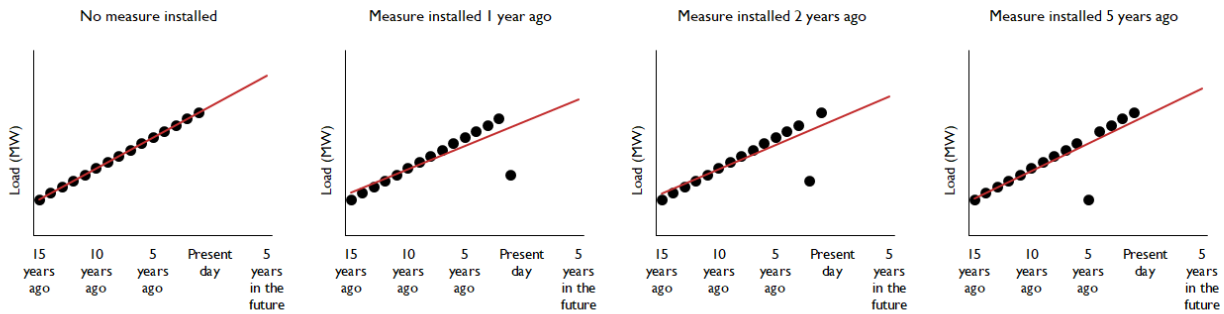
However, once impacts begin (in year N+5), they are discounted to some degree. The phase-in of these impacts is non-linear, depending on the duration of load reductions and when in the 15-year dataset the reductions occur. The following paragraphs illustrate two examples of this phenomenon.

Figure 36 illustrates how a measure with a one-year measure life may impact the load forecast used in the FCM In each panel, the black dots illustrate historical load data, with the right-most dot representing data from the most recent historical year. The red line is a simple best-fit linear regression continuing for several years into the future. The first panel shows a base case with 15 years of data and no reduction in load. The second panel shows the effect of a one-year load reduction on a linear regression when that load reduction occurs in the most recent historical year. The third panel shows an alternate situation, where the one-year load reduction occurred two years in the past. The final panel shows a situation

[153] The effect of the load reduction on the coefficients of the weather variables is less predictable and depends on the weather conditions on the days affected by the program.

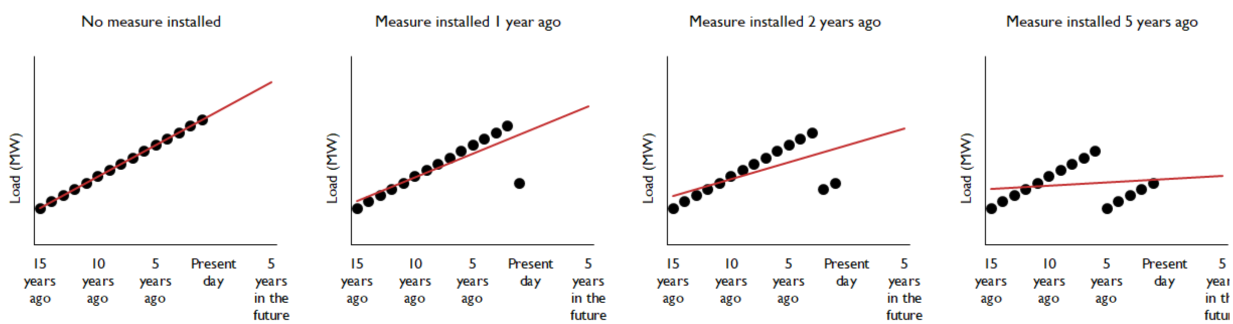
where the one-year load reduction has occurred five years in the past. These examples show that the single-year load reduction has the largest impact on the forecast when it is at the end of the data, in the most recent past year. When the reduction has aged, the impact on the forecast is more modest. This is because the critical point is more towards the center of the 15-year time series rather than on the edge.

Figure 36. Illustrative impacts of a single-year load reduction on the peak forecast



In a second example, Figure 37 depicts the impact of a load reduction with a five-year measure life. This measure is illustrated at having been installed at various times: not at all in the first panel, one year ago in the second panel, two years ago in the third panel, and five years ago in the final panel. The program's effect on the load forecast (the red line) increases with multiple years of operation. The longer a measure is in effect, the flatter the resulting trend line.

Figure 37. Illustrative impacts of a five-year load reduction on the peak forecast



Load forecast effect (LFE) schedule

The above observations lead us to a set of conclusions:

In reality, we would expect the capacity market to respond to the cumulative effect of each program on the load forecast (and hence the demand curve used in the auction). Because of the complexity associated with these forecast reductions, we approximate the incremental phase-in schedule using simplified blocks (see Table 42). We assume that the first year a one-year measure produces an impact on the load forecast, the uncleared capacity benefit is scaled by 30 percent. In the following three years, the benefit is scaled by 20 percent. In the fourth year, the benefit is scaled by 10 percent, and by the fifth year, we assume the benefit is erased completely.

Table 42. LFE schedule for a measure with a one-year lifetime installed in 2021

	Percent of uncleared capacity impact in place
2021	0%
2022	0%
2023	0%
2024	0%
2025	0%
2026	30%
2027	20%
2028	20%
2029	20%
2030	10%
2031	0%
2032	0%
2033	0%
2034	0%
2035	0%

However, because these effects are assumed to be driven by the cumulative impact of a measure, if a measure produces savings for multiple years, it will have a greater and more sustained price effect. Table 43 shows the schedule assumed for measures with lifetimes varying from one to ten years.[154] Each successive phase-in column has the same series of values (equal to the effect of a one-year program), offset by one year. The percentage of the actual load reduction integrated into the forecast is the sum of the effect from each program year.[155] For example, in 2027, the assumed effect is equal to 50 percent, or the sum of the 2026 impact from a one-year program and the 2027 impact from a one-year program.

[154] See the *AESC 2021 User Interface* for a detailed schedule of uncleared capacity DRIPE effects for measures lasting one through 35 years. We note that AESC 2018 described there being two separate LFE schedules for long-duration and short-duration measures. This is because for measure lives 10 years or greater, the LFE schedule is effectively same for the first 15 years of a measure lifetime (see the last column in Table 43). In the *AESC 2021 User Interface*, we explicitly calculate the uncleared resource effects for 35 different measure lives for the entire study period (2021 through 2055) and thus no longer need to make this simplifying assumption.

[155] This modeling is a simplification to facilitate screening. In some simple trend-line examples, the forecast can actually fall by slightly more than the full load reduction in some years. Given the effects of other variables on the regression equation, and the uncertainties in the decay schedule, greater complexity in modeling the capacity DRIPE effect does not seem warranted.

Table 43. LFE schedule for uncleared capacity value for measures with L lifetimes installed in 2021

	L=1	L=2	L=3	L=4	L=5	L=6	L=7	L=8	L=9	L=10
2021	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2022	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2023	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2024	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2025	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2026	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
2027	20%	50%	50%	50%	50%	50%	50%	50%	50%	50%
2028	20%	40%	70%	70%	70%	70%	70%	70%	70%	70%
2029	20%	40%	60%	90%	90%	90%	90%	90%	90%	90%
2030	10%	30%	50%	70%	100%	100%	100%	100%	100%	100%
2031	0%	10%	30%	50%	70%	100%	100%	100%	100%	100%
2032	0%	0%	10%	30%	50%	70%	100%	100%	100%	100%
2033	0%	0%	0%	10%	30%	50%	70%	100%	100%	100%
2034	0%	0%	0%	0%	10%	30%	50%	70%	100%	100%
2035	0%	0%	0%	0%	0%	10%	30%	50%	70%	100%

Note: Measures installed in subsequent years utilize the same schedule, but shifted by an appropriate number of years (e.g., a measure installed in year 2022 would see effects beginning in year 2027). Note that effects for measures with measure lives of six years or greater continue to phase out after 2035. Because of this, the AESC 2021 User Interface calculates these effects through 2050 for each individual year, rather than extrapolating values.

Reserve margin requirements

Each year ISO New England calculates a net installed capacity requirement (Net ICR) that represents the target amount of capacity to be purchased in the Forward Capacity Auction in order to plan for a system that meets the accepted standard for resource adequacy. While the actual amount of capacity procured depends upon many factors, the percentage by which the Net ICR exceeds the projected system peak is the planning reserve margin. Over the last four auctions, the reserve margin has averaged 14.2 percent (see Table 44). We assume this average value persists from 2025 through 2035 for all counterfactuals. AESC 2021 estimates reserve margins independently of clearing prices. This is because the planning reserve margins are based upon the target amount to be procured, and actual capacity purchased is often much higher as incumbent generation owners are willing to accept very low capacity payments dictated by a downward sloping demand curve.

Table 44. Calculated reserve margins

Summer	FCA #	Calculated reserve margin
2021	12	15%
2022	13	16%
2023	14	13%
2024	15	14%
Average	**-**	**14%**

The reserve margin is particularly relevant to the calculation of uncleared capacity benefits. Uncleared measures are effectively “counted” on the demand side of the capacity auction (i.e., within the load forecast). In contrast, cleared measures are effectively treated the same as conventional power plants (i.e., supply), and through the auction effectively require the purchase of some extra amount of capacity to act as a reserve margin. As a result, we increase the uncleared capacity benefit by a value equal to one plus the reserve margin.

Calculating the benefit from uncleared capacity

Finally, to calculate the benefit from uncleared capacity in any particular year, we calculate the product of:

- The capacity price (e.g., the values in Table 40)
- The effect schedule that matches the measure's lifetime (e.g., the values in Table 43)
- One plus the reserve margin (e.g., the values in Table 44)

Table 45 describes the uncleared capacity benefit in Counterfactual #1. This table describes benefits for measures installed in 2021, with measure lives ranging from one to ten years.

Table 45. Uncleared capacity value for measures with L lifetimes installed in 2021 in Counterfactual #1 in rest-of-pool region

	L=1	L=2	L=3	L=4	L=5	L=6	L=7	L=8	L=9	L=10
2021	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2022	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2023	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2024	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2025	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2026	$11.67	$11.67	$11.67	$11.67	$11.67	$11.67	$11.67	$11.67	$11.67	$11.67
2027	$8.47	$21.17	$21.17	$21.17	$21.17	$21.17	$21.17	$21.17	$21.17	$21.17
2028	$9.02	$18.05	$31.58	$31.58	$31.58	$31.58	$31.58	$31.58	$31.58	$31.58
2029	$9.83	$19.66	$29.49	$44.23	$44.23	$44.23	$44.23	$44.23	$44.23	$44.23
2030	$4.68	$14.03	$23.39	$32.74	$46.77	$46.77	$46.77	$46.77	$46.77	$46.77
2031	$0.00	$5.02	$15.07	$25.12	$35.17	$50.24	$50.24	$50.24	$50.24	$50.24
2032	$0.00	$0.00	$5.34	$16.01	$26.69	$37.36	$53.38	$53.38	$53.38	$53.38
2033	$0.00	$0.00	$0.00	$5.28	$15.85	$26.42	$36.98	$52.83	$52.83	$52.83
2034	$0.00	$0.00	$0.00	$0.00	$6.39	$19.17	$31.95	$44.73	$63.90	$63.90
2035	$0.00	$0.00	$0.00	$0.00	$0.00	$5.01	$15.02	$25.03	$35.04	$50.06
15-year levelized	**$2.92**	**$5.96**	**$9.12**	**$12.39**	**$15.74**	**$19.21**	**$22.36**	**$24.82**	**$26.66**	**$27.61**

Note: Note that effects for measures with measure lives of six years or greater continue to phase out after 2035. Because of this, the AESC 2021 User Interface (tab "Appdx J") calculates these effects through 2050 for each individual year, rather than extrapolating values. See the AESC 2021 User Interface for benefits in other counterfactuals, other regions, and benefits for measures with longer lifetimes.

Important caveats for applying uncleared capacity values

Uncleared capacity is different than many other avoided cost categories. Because uncleared capacity describes an effect that fades out over time due to the market's responses to that effect, users should sum avoided costs over the entire study period, regardless of any one measure's lifetime. For example, the avoided costs of a 1 MW measured installed in 2021 would be equal to the sum of the values from

2021 through 2055, regardless of whether that measure had a 1-year measure life or a 30-year measure life.[156]

Uncleared resources affect the load forecast only to the degree that these resources provide load reductions on the hours used in the load forecast regression. Some resources—such as demand response resources—may be active only on one or some of the hours used in the load forecast. As a result, these resources would provide a diminished uncleared capacity benefit. We recommend that program administrators apply a scaling factor to the benefits detailed in Table 45 to account for this effect. See Appendix K: *Scaling Factor for Uncleared Resources* for more information on how this scaling factor is calculated and how it can be applied.

5.3. Other considerations

The following sections provide greater detail on other aspects of the capacity market assessed in AESC 2021.

ISO New England's Competitive Auctions with Sponsored Resources initiative

This section describes ISO New England's CASPR rule and how it is modeled in AESC 2021. This modeling is integral to the calculation of projected capacity supply, described above.

ISO New England has run two capacity auctions using a new method to allow some new resources sponsored by state policy to acquire capacity supply obligations without swamping the FCM. ISO New England's CASPR rule does not allow a new resource to bid into the capacity auctions at a price below its estimated cost, net of expected revenues from the ISO energy, capacity, and ancillary markets, plus revenues from RECs that are available to resources from a broad geographic and technology range. Any additional targeted revenues cannot be used to justify a lower bid price. This may include revenue from Massachusetts's SMART program for distributed solar; the Multi-State Clean Energy RFP (which has selected 246 MW of solar and 126 MW of wind projects to be divided among Massachusetts, Connecticut, and Rhode Island); or state-mandated contracts for purchases from Canada, offshore wind, or other renewables. As a result of CASPR, sponsored resources will often be unable to bid low enough to clear in the main auction, especially at the low prices observed in recent FCAs.

The CASPR solution treats the existing FCA as the first stage of a two-stage process. After the capacity supply obligations are determined in the primary auction, without participation of the sponsored resources, the ISO runs a substitution auction in which cleared generation resources can retire and buy out of their capacity supply obligations, by paying the sponsored renewable or green resources. For example, if an FCA clears at $4 per kW-month, a cleared generator might offer to pay up to $3 per kW-month to get out of a capacity supply obligation. The substitution auction may clear at $1 per kW-

[156] We note that this is the same approach used for summing avoided costs for uncleared capacity and uncleared capacity DRIPE, but no other avoided cost categories.

month, in which case the retiring generator will be paid $4–$1 = $3 per kW-month for doing nothing in the delivery year. The substitution auction could even clear at a negative price, in which case the retiring resource would be paid more for not performing in the delivery year than for delivering capacity. The ISO considers the gain to the retiring generator a “severance payment” for giving up its place in the ISO markets.

The retiring resource must then give up its transmission interconnection rights and permanently retire from all ISO markets.[157] The substituted sponsored resource will be treated in the future as though it had cleared in the FCA, and it will be able to bid into future FCAs as an existing resource. The prospect of receiving capacity revenues for many years into the future may result in the sponsored resource bidding a substantial negative price in the substitution auction, such as paying $5/kW-month for one year to receive future market prices indefinitely.

One effect of the CASPR rules will be to create incentives for marginally viable existing generators to bid in the FCA with the intention of selling the capacity supply obligation in the substitution auction. As a result, most existing capacity supply obligations from transmission-connected generators may never retire, since they can be profitably transferred to sponsored resources.

Through FCA 14, sponsored renewables were able to qualify under a temporary exception to the minimum bid limits, known as the Renewable Technology Rule. The exception was removed in FCA 15, after which new sponsored resources with need to acquire capacity obligations in the CASPR secondary auction.

We model CASPR by treating CASPR-eligible resources (such as wind and solar) separately within our capacity model. We first assess the incremental year-on-year firm capacity of these resources, then determine whether or not there is sufficient retiring capacity in that same year. If yes, capacity from these resources is deemed eligible for the main capacity market and is added to the overall calculation of supply.

Other capacity-related avoided costs

In addition to the locational marginal energy prices and capacity prices, ISO New England’s monthly *Wholesale Load Cost Report* includes the following cost components:

- First-Contingency Net Commitment Period Compensation (NCPC)
- Second-Contingency NCPC
- Regulation (automatic generator control)
- Forward Reserves

[157] Only existing generation resources with transmission interconnection rights are able to discharge their capacity supply obligations in the substitution auction.

- Real-Time Reserves
- Inadvertent Energy
- Marginal Loss Revenue Fund
- Auction Revenue Rights revenues
- Price Responsive Demand Cost
- ISO Tariff Schedule 2 Expenses
- ISO Tariff Schedule 3 Expenses
- NEPOOL Expenses

These cost components are described in more detail in the *Wholesale Load Cost Reports*.[158] For 2019, ISO New England's estimates of costs to load (a load with 100 percent load factor) for most zones comprised energy (about 70 percent of the total) and capacity costs (about 26 percent) as well as a few percent for all of the NCPC, reserves, and regulation put together. These ratios will change over time, for example, as capacity prices fall.

None of the components listed below vary clearly enough with the level of load to warrant inclusion in the avoided-cost computation. More specifically:

- The **NCPC costs** (by far the largest of these categories, although much smaller than forward capacity charges) are compensation to generators that comply with ISO instructions to warm up their boilers, ramp up to operating levels, remain available for dispatch, possibly generate some energy, and then shut down without earning enough energy- or reserve-market revenue to cover their bid costs. Older boiler plants may take many hours to reach full load and have minimum run-times and shut-down periods, requiring plants to continue running at minimum levels overnight. Lower on-peak loads would tend to reduce the need for bringing these plants into warm reserve, thus reducing NCPC costs. On the other hand, lower energy prices (especially off-peak) would tend to increase the net compensation due to these units when they were required, since they would earn less when they actually operated. Hence, while energy efficiency may affect NCPC costs, the direction and magnitude of the effects are not clear.

- **Regulation costs** are associated with units that follow variations in load and supply in the range of seconds to a few minutes. Reduced load due to efficiency is likely to result in reduced variation in load (in megawatts per minute), reducing regulation costs. On the other hand, some controls may increase regulation costs if end-use equipment responds more quickly to changing ambient conditions. Overall, energy efficiency

[158] ISO New England. Last accessed March 11, 2021. "Energy, load, and Demand Reports." *EPA.gov.* Available at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/mthly-whl-load-cost-rpt.

programs will probably reduce regulation costs, but we cannot estimate the magnitude of the effect.

- **Forward and real-time reserve requirements** should decrease slightly with energy efficiency, for two reasons. First, lower load will tend to leave more available capacity on transmission lines, which will tend to reduce the need for local reserves. Second, a portion of real-time reserves are priced to recover forgone energy for units that remain in reserve; lower energy prices will tend to depress reserve prices. We expect that these effects would be small and difficult to measure.

- **Inadvertent energy exchanges** with other system operators (NYISO, Hydro Québec, and New Brunswick) are small and probably not affected by energy efficiency.

- The **Marginal Loss Revenue Fund** returns to load the difference between marginal losses included in locational energy prices and the average losses actually experienced over the pool transmission facilities. That fund is—by definition—generated by infra-marginal usage, and it will not be affected by reduction of loads at the margin.

- **Auction Revenue Right** revenues are generated by the sale of Financial Transmission Rights (FTR), to return to load the value of transfers on the ISO transmission facilities. To the extent that efficiency programs reduce energy congestion, the value of these rights will tend to decrease.

- **Price Responsive Demand** charges recover a portion of the ISO's payments for those demand resources. The use of those resources would tend to fall as peak prices fall, but so would their compensation from the energy markets, potentially increasing this charge. This category is miniscule.

Expenses (ISO Tariff Schedules 2 and 3 and NEPOOL) are largely fixed for the pool as a whole, although a portion of the ISO tariffs are recovered on a per-MWh basis. Some of the ISO costs may decrease slightly as energy loads decline, if that leads to a reduction in the number of energy transactions, dispatch decisions, and other ISO actions required. Any such effect is likely to be small and slow to occur, and energy efficiency programs add their own costs in load forecasting, resource-adequacy planning, and operation of the FCM.

6. AVOIDED ENERGY COSTS

This chapter describes the findings associated with avoided energy costs. As a point of comparison, we compare the electric energy prices for the West Central Massachusetts zone between AESC 2021 and AESC 2018.[159] On a levelized basis, the 15-year AESC 2021 annual all-hours price for Counterfactual #1 is $41 per MWh, compared to the equivalent value of $51 per MWh from AESC 2018. This represents a reduction of 20 percent. For Counterfactual #2, the 15-year AESC 2021 annual all-hours price is $38 per MWh, representing a reduction of 26 percent relative to the value from AESC 2018. Counterfactual #3 and #4 both feature 15-year AESC 2021 annual all-hours prices of $41 per MWh, a 19 percent reduction relative to AESC 2018.[160] The decrease in energy prices observed in AESC 2021 is primarily due to a lower estimate of wholesale natural gas prices in New England and a lower estimate of RGGI prices.

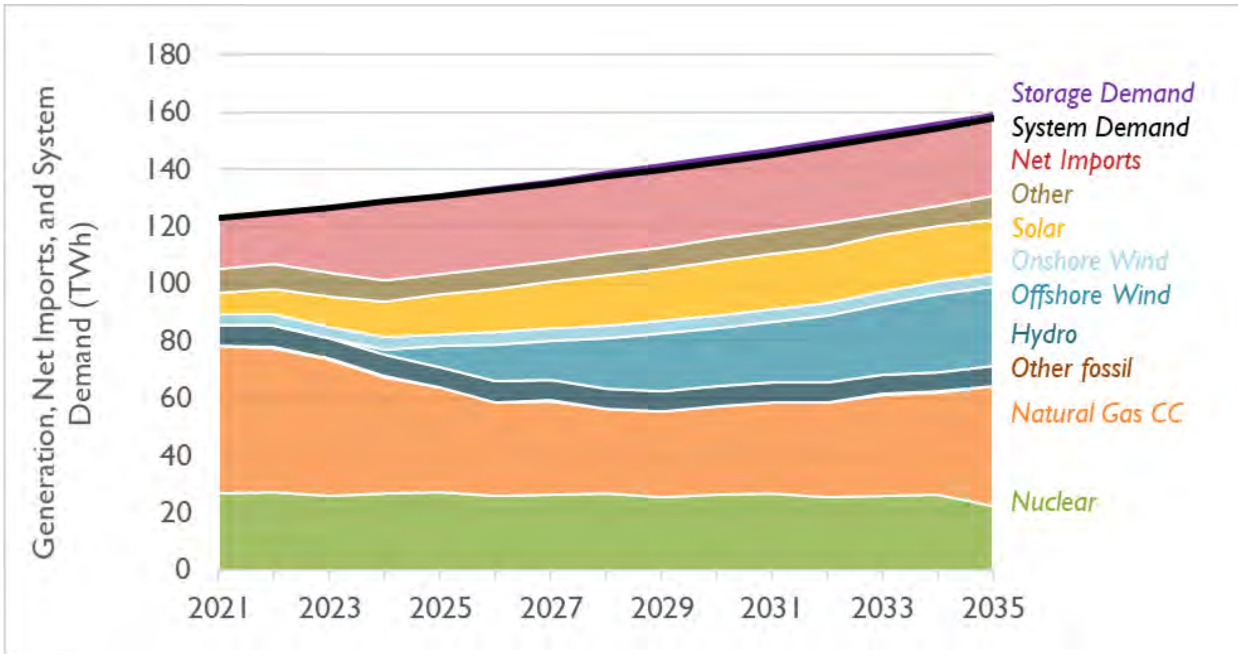
6.1. Forecast of energy and energy prices

Figure 38 presents the projected level of New England electric system energy from 2021 to 2035. These energy levels are estimated by the EnCompass model given the capacities specified in Figure 39, fuel prices, availability factors, heat rates, and other unit attributes. Figure 38 assumes a future in which no new energy efficiency is added in 2021 or later years, and other assumptions are consistent with Counterfactual #1. This figure includes an accounting of energy imports over both existing and new transmission lines from electric regions adjacent to New England. Note that all prices discussed in this chapter are wholesale prices, not retail prices.

[159] This WCMA price is intended to represent the ISO New England Control Area price, which is within this zone.

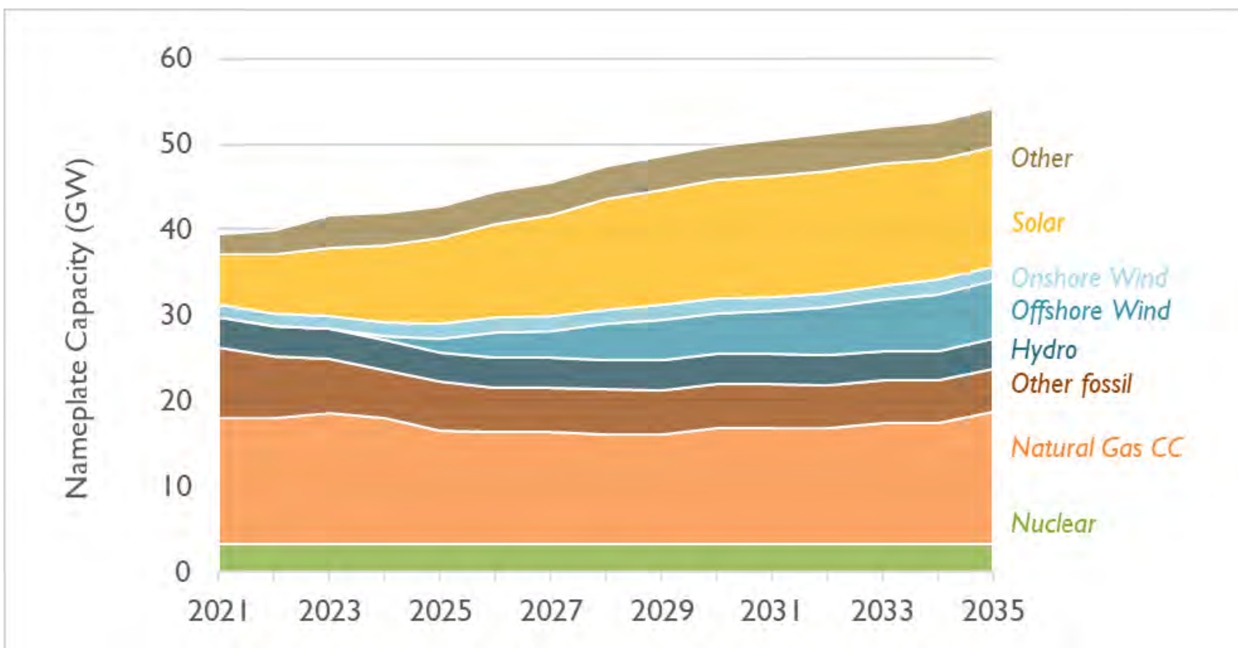
[160] The difference in percentage change relative to Counterfactual #1 is a result of rounding.

Figure 38. AESC 2021 New England-wide generation, imports, and system demand in Counterfactual #1



Notes: "Other Fossil" contains generation from steam turbines (including coal), combustion turbines, fuel cells, and other miscellaneous fossil fuel-fired power plants. "Other" contains generation from energy storage, demand response, municipal solid waste, landfill gas, and other miscellaneous fuel types.

Figure 39. New England-wide capacity modeled in EnCompass in Counterfactual #1



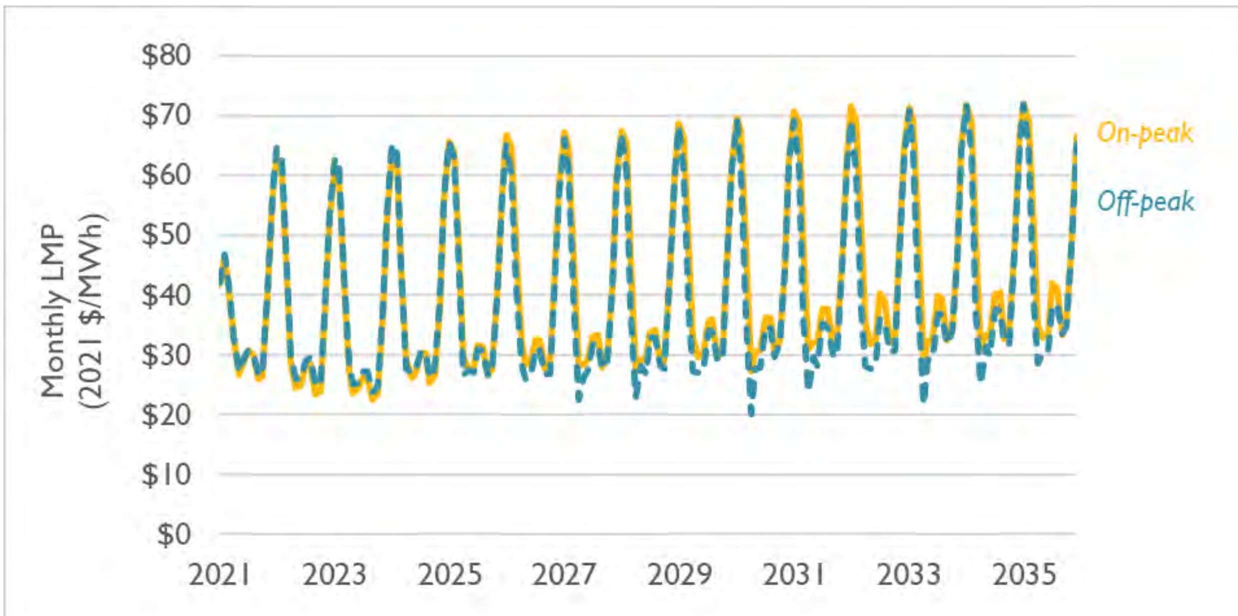
Notes: "Other Fossil" contains capacity associated with steam turbines (including coal), combustion turbines, fuel cells, and other miscellaneous fossil fuel-fired power plants. "Other" contains capacity associated with energy storage, demand response, municipal solid waste, landfill gas, and other miscellaneous fuel types. Capacity is included in the above chart in a given year if a resource is existing on January 1 of that year.

Forecast of wholesale energy prices

In addition to modeling the generation shown in Figure 39, the EnCompass model also produces wholesale energy prices (see Figure 40 and Table 46).[161] These modeled prices change over time (and on a peak and off-peak basis) depending on the system demand, available units, transmission constraints, fuel prices, and other attributes. This trend is caused by (a) increasing amounts of renewable and imported generation which increasingly displaces higher-cost fossil units, and (b) a lower future Algonquin basis in real-dollar terms, in some months. Year-to-year variations in prices can be traced to impacts associated with the new transmission line from Canada in the early 2020s, large quantities of offshore wind in the mid to late 2020s, a flattening of assumed Henry Hub prices in real-dollar terms through the 2030s, and lower RGGI prices.[162]

Note that these energy prices are not inclusive of RECs, but they are inclusive of modeled environmental regulations that impose a price on traditional generators, including RGGI and 310 CMR 7.74.

Figure 40. AESC 2021 wholesale energy price projection for WCMA in Counterfactual #1



Note: As elsewhere in this report, in this figure, on-peak and off-peak are defined according to ISO New England's definitions, and may not match popular conceptions of on-peak or off-peak. See Appendix B: Detailed Electric Outputs for more information on this topic.

[161] Note that all summarized energy prices are calculated using a load-weighted average.

[162] Note that modeled energy prices described here do not include impacts from ISO New England's proposed Energy Security Initiative (ESI) which was rejected by FERC in October 2020.

Table 46. AESC 2021 wholesale energy price projection for WCMA region in Counterfactual #1 (2021 $ per MWh)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
2021	$36.05	$42.85	$36.72	$31.93	$26.26
2022	$37.61	$45.03	$41.65	$28.79	$25.30
2023	$36.61	$43.18	$42.03	$26.19	$25.06
2024	$39.05	$45.30	$44.19	$29.39	$27.84
2025	$39.56	$45.69	$44.61	$30.23	$28.35
2026	$39.94	$46.69	$44.26	$31.50	$27.97
2027	$40.12	$47.43	$43.35	$32.90	$27.77
2028	$40.49	$45.79	$45.45	$31.62	$30.45
2029	$41.80	$46.95	$47.18	$32.77	$31.46
2030	$41.99	$46.97	$47.04	$33.46	$31.98
2031	$42.86	$47.91	$47.92	$34.52	$32.47
2032	$43.74	$50.30	$47.22	$37.19	$31.48
2033	$44.04	$49.72	$47.97	$36.93	$33.15
2034	$44.73	$49.65	$49.59	$36.57	$34.69
2035	$45.57	$50.49	$50.43	$37.52	$35.35

Comparison to AESC 2018

Table 47 shows a comparison between AESC 2018 and AESC 2021 for the 15-year levelized costs for the WCMA reporting region. Prices are shown for all hours, and for the four periods analyzed in previous AESC studies. On an annual average basis, the Counterfactual #1 15-year levelized prices in the AESC 2021 Study are 20 percent lower than the prices modeled in the AESC 2018 Study, while the Counterfactual #2 15-year levelized prices are 26 percent lower. Counterfactual #3 and #4 both show levelized prices that are 19 percent lower than the prices modeled in the AESC 2018 Study. Key drivers of these lower prices include lower overall demand for electricity (even in a future with no incremental energy efficiency), lower Henry Hub natural gas prices, lower RGGI prices, more renewables (caused by changes to renewable policies in several states), and the addition of a new transmission line from Canada.[163] This decrease is larger than the change in avoided energy costs observed between the AESC 2015 Study and the AESC 2018 Study.

In particular, AESC 2021 modeling results feature a lower ratio of summer peak prices to the annual average than observed in previous AESC studies. This difference can be attributed to: (1) increased levels of solar generation, which is largely coincident with this period and which have a marginal cost of zero dollars per MWh, (2) difference in summer wholesale gas costs (which are driven by new recent historical data on month-to-month gas costs), and (3) higher levels of zero-marginal cost imports. These are the same factors that drove the change in energy prices from AESC 2015 and AESC 2018. Meanwhile, the ratio of winter peak prices to annual average prices are largely unchanged, relative to AESC 2018.

[163] Other factors, including the Massachusetts-specific emissions cap under MA DEP 310 CMR 7.74 and a lower discount rate, push the avoided costs observed in AESC 2018 up, but not enough to overcome the impact of the other factors mentioned above.

This is due to largely consistent assumptions on winter gas costs (relative to annual averages) and similar load shapes.

Among the counterfactuals, prices are generally similar due to the relatively flat supply curve for energy in New England. In other words, the region has a large number of relatively new, similar, natural gas-fired combined cycle units that are frequently marginal in any future year, in any future counterfactual. That said, Counterfactual #2 does feature lower prices compared to the other two counterfactuals due to lower system loads and lower peak demand.[164]

Table 47. Comparison of energy prices for WCMA region (2021 $ per MWh, 15-year levelized)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2018	$51.17	$58.66	$54.17	$45.22	$38.69
AESC 2021 Counterfactual 1	$40.85	$46.86	$45.20	$32.67	$29.86
AESC 2021 Counterfactual 2	$37.79	$42.98	$41.66	$30.87	$27.95
AESC 2021 Counterfactual 3	$41.34	$47.43	$45.63	$33.28	$29.93
AESC 2021 Counterfactual 4	$41.29	$47.40	$45.62	$33.17	$29.87
% Change: Counterfactual 1	-20%	-20%	-17%	-28%	-23%
% Change: Counterfactual 2	-26%	-27%	-23%	-32%	-28%
% Change: Counterfactual 3	-19%	-19%	-16%	-26%	-23%
% Change: Counterfactual 4	-19%	-19%	-16%	-27%	-23%

Notes: All prices have been converted to 2021 $ per MWh. Levelization periods are 2018–2032 for AESC 2018 and 2021–2035 for AESC 2021. The real discount rate is 1.34 percent for AESC 2018 and 0.81 percent for AESC 2021. AESC 2018 values are from AESC 2018 Chapter 5 and the AESC 2021 User Interface.

Table 48 compares 15-year levelized costs between AESC 2018 and AESC 2021 for each of the six New England states. These values incorporate the relevant costs of RPS compliance, as well as the impact of wholesale risk premiums. Avoided energy costs for each reporting region are detailed in Appendix B: *Detailed Electric Outputs*.

[164] These results are consistent with the "With EE" sensitivity modeled in AESC 2018.

Table 48. Avoided energy costs, AESC 2021 vs. AESC 2018 (15-year levelized costs, 2021 $ per kWh)

			Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2021 Counterfactual 1	1	Connecticut	$0.059	$0.057	$0.043	$0.040
	2	Massachusetts	$0.062	$0.060	$0.047	$0.044
	3	Maine	$0.057	$0.056	$0.042	$0.039
	4	New Hampshire	$0.058	$0.057	$0.043	$0.040
	5	Rhode Island	$0.065	$0.064	$0.050	$0.047
	6	Vermont	$0.054	$0.053	$0.039	$0.036
AESC 2018	1	Connecticut	$0.063	$0.059	$0.049	$0.043
	2	Massachusetts	$0.062	$0.058	$0.049	$0.043
	3	Maine	$0.058	$0.054	$0.045	$0.039
	4	New Hampshire	$0.063	$0.060	$0.051	$0.044
	5	Rhode Island	$0.061	$0.057	$0.048	$0.042
	6	Vermont	$0.062	$0.058	$0.049	$0.042
Delta	1	Connecticut	-$0.005	-$0.002	-$0.006	-$0.003
	2	Massachusetts	-$0.001	$0.003	-$0.002	$0.001
	3	Maine	$0.000	$0.002	-$0.003	$0.000
	4	New Hampshire	-$0.005	-$0.003	-$0.008	-$0.004
	5	Rhode Island	$0.003	$0.007	$0.002	$0.005
	6	Vermont	-$0.008	-$0.005	-$0.010	-$0.006
Percent Difference	1	Connecticut	-7%	-3%	-12%	-7%
	2	Massachusetts	-1%	5%	-4%	2%
	3	Maine	0%	4%	-6%	1%
	4	New Hampshire	-8%	-5%	-15%	-8%
	5	Rhode Island	6%	12%	5%	12%
	6	Vermont	-13%	-8%	-20%	-14%

Notes: These costs are the sum of wholesale energy costs and wholesale costs of RPS compliance, increased by a wholesale risk premium of 8 percent, except for Vermont, which uses a wholesale risk premium of 11.1 percent. All costs have been converted to 2021 dollars per kWh. Levelization periods are 2018–2032 for AESC 2018 and 2021–2035 for AESC 2018. The real discount rate is 1.34 percent for AESC 2018 and 0.81 percent for AESC 2021. Values do not include losses.

6.2. Benchmarking the EnCompass energy model

The AESC 2021 Study Group required a calibration of the dispatch model used with actual, historical data. To complete this, the Synapse Team developed modeling inputs that reflect our best understanding of electric system market operations in 2019. This included assumptions relating to available generating units, fuel prices, and system demand.

Figure 41 compares actual day-ahead locational marginal prices (LMP) for each New England region reported on by ISO New England against the same prices modeled in EnCompass for 2019.[165] This figure also details the percent difference between actual and modeled LMPs for each region. For the WCMA region, for example, average modeled LMPs for 2019 are 3 percent higher than actual historical LMPs. For all regions, modeled 2019 LMPs range from 1 percent higher to 3 percent higher than actual 2019 LMPs.

Figure 41. Comparison of 2019 historical and simulated 2019 locational marginal prices

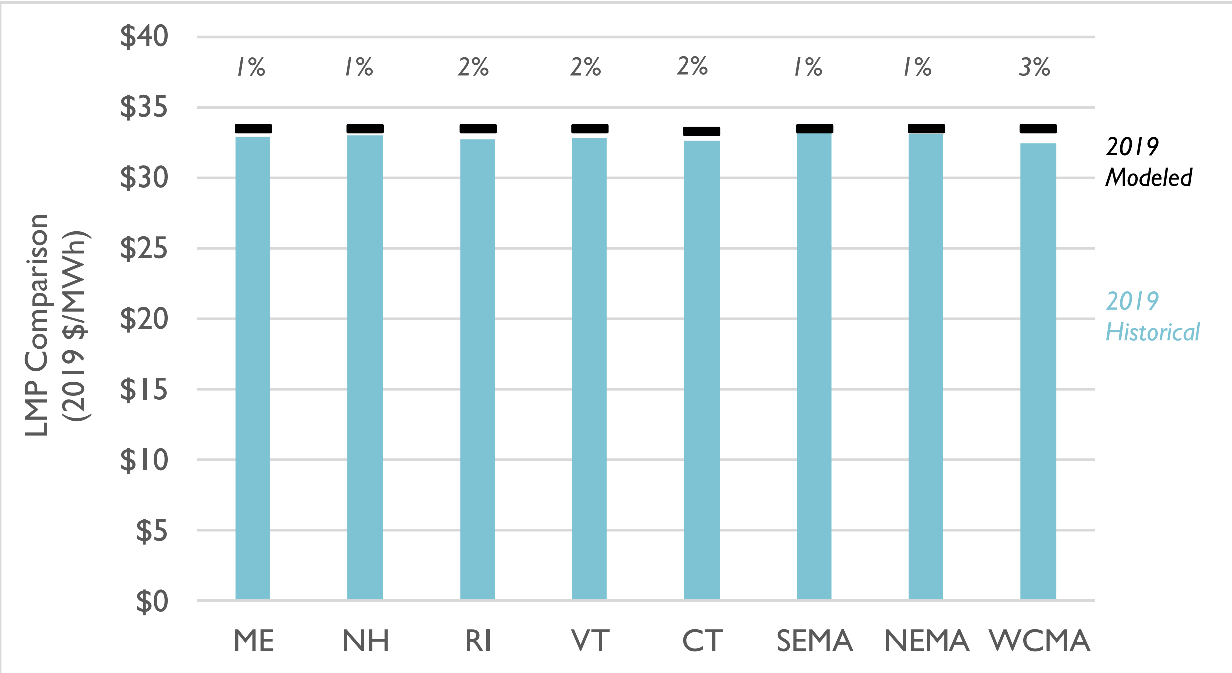


Figure 42 compares the monthly modeled LMPs for 2019 in the WCMA region against actual 2019 LMPs for the same region, and Figure 43 compares hourly modeled New England-wide average LMPs for 2019 against actual hourly 2019 LMPs for New England.[166] Our calibration for 2019 produces differences between modeled results and actual historical prices in line with the differences observed between a calibrated 2016 year from the 2018 AESC study. The scale of these differences indicates that the EnCompass model is accurately capturing the magnitude and differential spread of LMPs around New England during 2019. As in previous AESC studies, differences between price on a regional or temporal basis—for both the annual, monthly, and hourly calibrations—are likely related to differences between actual anomalies in the electric system (which are challenging to represent in an electric system dispatch

[165] Actual LMP data is available from the ISO New England website at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/zone-info.

[166] Note that the prices modeled in EnCompass most closely approximate day-ahead, rather than real-time prices. The day-ahead market is where most of the generating fleet is committed and compensated, whereas the real-time market mostly represents transfer payments for over-performance and under-performance; they do not necessarily approximate the price implied by the hour-by-hour demand.

model) and the production cost model's best-estimate rendering of a historical year. These "anomalies" may include actual and assumed generator and transmission outages (for which hourly data is unavailable or difficult to access), maintenance schedules (which are plant-specific and typically unknown), and operator discretion (which is often masked by ISO New England for confidentiality purposes). These differences may imply that depending on variations in future years, some hourly avoided costs may be underestimated while some others will be overestimated.

Figure 42. Comparison of 2019 historical and simulated 2019 locational marginal prices for the WCMA region (monthly)

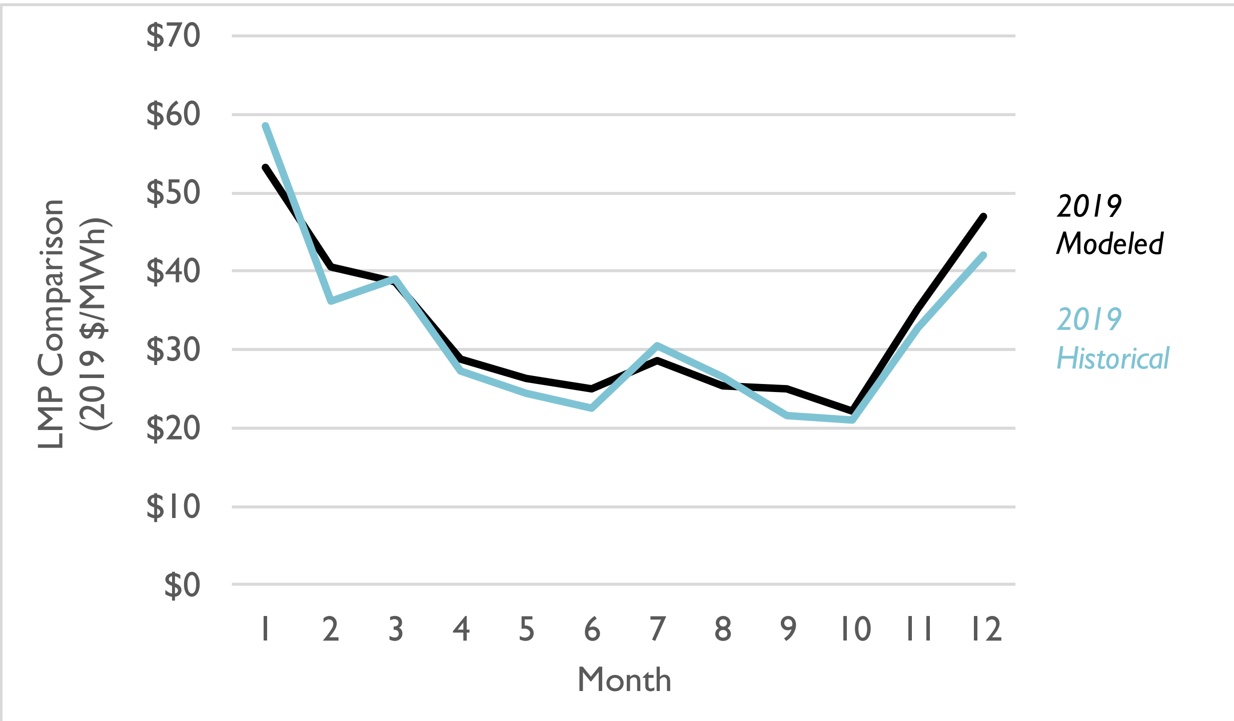
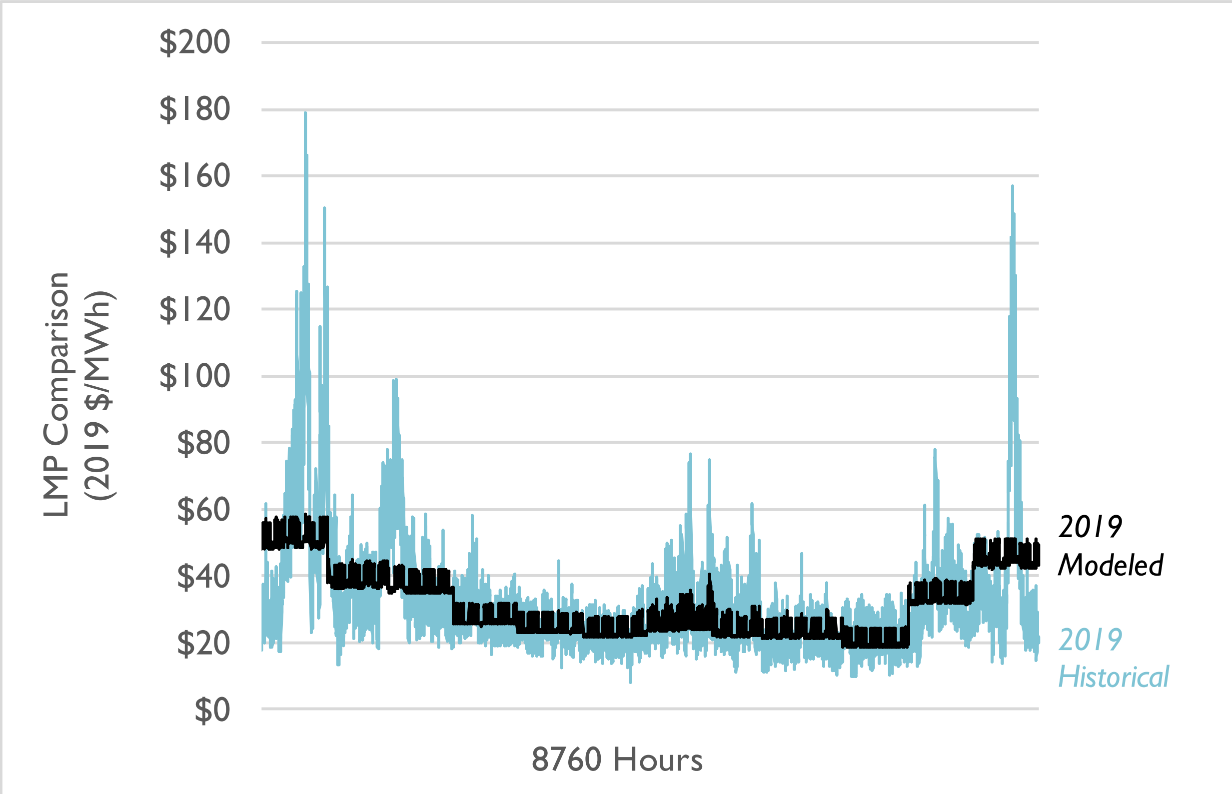


Figure 43. Comparison of 2019 historical and simulated 2019 locational marginal prices for New England (hourly)



7. Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies

Energy efficiency programs reduce the cost of compliance with RPS requirements by reducing total LSE load. Reduction in load due to energy efficiency or other demand-side resources will therefore reduce the RPS obligations of LSEs and the associated compliance costs recovered from consumers. This estimate of avoided costs includes the expected impact of avoiding each class or tier[167] of RPS[168] or Renewable Energy Standards[169] (RES) within each of the six New England states. Table 49, Table 50, Table 51, and Table 52 list the avoided costs of compliance for Counterfactuals #1, #2, #3, and #4, respectively.[170] Generally speaking, avoided costs are lowest in Counterfactual #2. Avoided costs are higher in Counterfactual #1 as a result of increased load and increased demand for RECs. Avoided costs are highest in Counterfactual #3 and #4, which feature the same set of avoided costs and have the highest loads (as they both ignore any energy efficiency added in 2021 or later, but also model additional load from building electrification).

Table 49. Avoided cost of RPS compliance for Counterfactual #1 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$6.59	$6.92	$5.61	$2.66	$14.96	$1.34
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.05	$5.44	$0.03	$2.56
Total	**$7.93**	**$7.37**	**$11.81**	**$8.10**	**$14.99**	**$3.90**

Table 50. Avoided cost of RPS compliance for Counterfactual #2 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$3.43	$3.10	$3.10	$1.31	$5.62	$0.75
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$1.80	$5.11	$0.03	$1.93
Total	**$4.77**	**$3.55**	**$9.04**	**$6.41**	**$5.66**	**$2.67**

Table 51. Avoided cost of RPS compliance for Counterfactual #3 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$7.50	$8.11	$6.66	$3.18	$16.77	$1.58
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.13	$5.49	$0.03	$2.86
Total	**$8.84**	**$8.56**	**$12.93**	**$8.67**	**$16.81**	**$4.44**

[167] Vermont uses the term "tier" while all other New England states use the term "class" to describe RPS categories.

[168] Massachusetts, Connecticut, Maine, and New Hampshire use the term Renewable Portfolio Standard (RPS).

[169] Rhode Island and Vermont use the term Renewable Energy Standard (RES).

[170] All values are levelized over 15 years and include energy losses.

Table 52. Avoided cost of RPS compliance for Counterfactual #4 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$7.50	$8.11	$6.66	$3.18	$16.77	$1.58
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.13	$5.49	$0.03	$2.86
Total	**$8.84**	**$8.56**	**$12.93**	**$8.67**	**$16.81**	**$4.44**

To the extent that the price of renewable energy exceeds the market price of electric energy, LSEs incur a cost to meet the RPS percentage target. That incremental unit cost is the price of a REC. The avoided cost of RPS compliance is not equal to the REC price, however. Instead, the avoided cost is a function of both REC price and load obligation percentage (i.e., the RPS target percentage). Therefore, the state with the highest or lowest REC price does not necessarily have the highest or lowest compliance cost because of the multiplicative impact of the RPS target.

Table 53 shows that avoided costs projected in AESC 2021 are generally higher than those projected in AESC 2018. This is primarily due to recent (or anticipated) increases in RPS target obligations combined with expected increases in load due to electrification. Increases in the cost of RPS compliance in states that have not increased RPS targets (e.g., New Hampshire) are due to an increase in REC demand in the New England-wide REC market, of which all six states are participants.

Table 53. Avoided costs in AESC 2018 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$3.00	$0.22	$1.83	$1.61	$2.54	$0.56
MA CES	-	-	$0.48	-	-	-
All Other Classes	$1.00	$0.33	$1.53	$3.65	$0.03	$1.55
Total	**$4.00**	**$0.55**	**$3.84**	**$5.25**	**$2.57**	**$2.12**

Notes: Values have been converted from 2018 dollars to 2021 dollars. All values shown use a 9 percent loss factor, consistent with AESC 2021, rather than the 8 percent loss factor used in AESC 2018.

7.1. Assumptions and methodology

The purpose of this section is to describe the assumptions and methodology for forecasting the avoided cost of RPS and Massachusetts CES and CPS compliance. REC price forecasts are developed for each RPS sub-category and are based on expectations regarding eligible supply, annual demand targets, and—where applicable—the long-term cost of entry of renewable energy additions. These forecasts are converted to an avoided cost of RPS, CES, and CPS compliance on a dollar per MWh basis. Voluntary demands for Class 1 RECs (such as a portion of corporate renewable energy purchases and community choice aggregation) are also taken into account as a factor influencing Class 1 REC prices.

Renewable portfolio standards and clean energy standards

All six New England states have active RPS or RES policies—referred to hereafter as RPS. Each RPS program has multiple classes—referred to as tiers in Vermont—which are used to differentiate these policy mandates by technology, vintage, emissions, and other criteria that reflect state-specific policy objectives. Massachusetts also has a CES, which is met in large part by the MA Class I RPS obligation. It also has a "CES-E" for existing non-emitting resources—specifically nuclear and hydroelectric facilities from New Hampshire, Connecticut, and eastern Canada. Finally, Massachusetts regulations also include an Alternative Energy Portfolio Standard (APS), which applies to combined heat and power, renewable thermal, flywheel storage, fuel cells, and waste-to-energy, and increases by 0.25 percent per year indefinitely. While largely supporting non-renewable resources, APS program targets and avoided cost are nonetheless included in this section because the mandate is avoided by energy efficiency in the same manner as the RPS. Table 54 provides a summary overview of RPS and CES obligations throughout New England. Maine Class IA and MA CES-E are new policy additions since AESC 2018.

Regional Class I requirements (as well as Class II in New Hampshire and Tier II in Vermont) are intended to create demand for new renewable energy additions. As a result, the RPS targets for these classes increase each year until a specified maximum obligation is attained. Massachusetts Class I is the notable exception to this rule; it increases indefinitely—presumably until the sum of all RPS and CES mandates reaches 100 percent. Class II,[171] Class III, Class IV, and other "existing" supply obligations focus on generators that were already in operation prior to the adoption of RPS programs. These policies are intended to maintain the pre-RPS fleet rather than spur the development of new generating facilities. As a result, the RPS targets for these classes do not generally increase each year, although some are subject to periodic adjustment based either on supply conditions or policymaker discretion. The percentage targets for each class are summarized below in Table 55 and Table 56.

[171] With the exception of NH-II (which is dedicated to "new" solar) and possibly CT-II (which is dedicated to waste-to-energy and is without a vintage requirement).

Table 54. Summary of RPS and CES classes

State	RPS Class or Tier	COD Threshold	Eligibility Notes
Connecticut	Class I	No threshold	Subject to emissions threshold
	Class II	No threshold	Dedicated to WTE; Class I resources also eligible
	Class III	No threshold	Conservation and load management resources
Maine	Class I	Beginning 9/1/2005	Allows refurbished facilities
	Class IA	Beginning 9/1/2005	Does not allow refurbished facilities
	Class II	Before 9/1/2005	Allows hydro up to 100 MW
Massachusetts	Class I	Beginning 1/1/1998	Includes two solar carve-outs
	Class II-Non-WTE	Before 1/1/1998	Includes same biomass standards as Class I
	Class II-WTE	Before 1/1/1998	Dedicated class for waste-to-energy
	APS	Beginning 1/1/2008	Combined heat and power, useful thermal energy
	CES	Beginning 1/1/2011	MA Class I certified resources also eligible
	CES-E	Before 1/1/2011	Nuclear & hydro from NH, CT & eastern Canada
	CPS	No threshold	New MA-1, existing MA-1 w/ storage, DRR
New Hampshire	Class I	Beginning 1/1/2006	Includes a thermal carve-out
	Class II	Beginning 1/1/2006	Solar only
	Class III	Before 1/1/2006	Dedicated to biomass and LFG
	Class IV	Before 1/1/2006	Small hydro only
Rhode Island	New	Beginning 1/1/1998	Fuel standard requirements apply
	Existing	Before 1/1/1998	Fuel standard requirements apply
Vermont	Tier I	No threshold	Class II and RE portion of imports also eligible
	Tier II	Beginning 1/1/2015	Must be in-state and < 5 MW
	Tier III	Beginning 1/1/2015	Class II resources also eligible

Notes: The COD threshold is the date after which a project must have commenced commercial operation in order to be eligible. For the Massachusetts CES, eligible projects must have a COD on or after 1/1/2011; eligible facilities from adjacent control areas must be delivered over transmission energized on or after 1/1/2017. "DRR" are Demand Response Resources; for more information, see https://www.mass.gov/service-details/program-summaries.

In addition to distinguishing between new and existing supply, some New England RPS programs also include specified sub-component requirements for solar, biomass, hydroelectric, combined heat and power, waste-to-energy, thermal resources, energy transformation, or energy efficiency. These classes are also included in Table 54 and their respective targets are summarized in Table 56. For simplicity, this discussion includes these obligations under "RPS and CES requirements," even though some classes include resources that are not renewable.

RPS and CES compliance assumptions

AESC 2021 assumes that each retail LSE complies with RPS and CES obligations, by class and by state, in each calendar year—either by securing certified RECs or by making ACPs to the applicable regulatory authority. RPS requirements are calculated by multiplying obligated load[172] (adjusted for contract exemptions) by the applicable annual class-specific RPS percentage target. The forecast of obligated load is based on the aggregate impact of econometric load, energy efficiency, active demand response, and electrification described in Section 4.3: *New England system demand*. This includes a detailed forecast of BTM generation, which is critical because it both reduces obligated load and generates RECs for RPS compliance.[173] In all states, RPS targets are defined as a percentage of obligated load. Table 55 summarizes RPS targets for new renewable energy additions, while Table 56 summarizes RPS targets for existing resource categories. Beginning in 2025, MA Class I targets are based on legislative proposals expected to pass during the 2020 session. The Massachusetts legislature is also considering a "Greenhouse Gas Emissions Standard" (GGES) for municipal utilities. The GGES is expected to create incremental demand for new renewable capacity beginning 2024. Beginning in 2022, RI "New" targets are assumed to align with Executive Order 20-01 and *The Road to 100% Renewable Electricity by 2030 in Rhode Island* report, which calls for 100 percent renewable electricity by 2030. All other targets reflect current statutes.

[172] Municipal utilities are currently exempted from RPS and CES obligations in all states except Vermont. These exemptions are assumed to remain for the duration of the study period.

[173] Several states have begun to consider whether load offset by BTM generation should be added to the total RPS obligation. These discussions are preliminary, however, and therefore not included in this analysis.

Table 55. Summary of modeled RPS targets for new resource categories

	CT-I	ME-I	ME-IA	MA-I[174]	MA-SREC-I[175]	MA-SREC-II[176]	MA CPS (est.)	MA APS	NH-I[177]	NH-I Thermal	NH-II	RI-New	VT-II
2021	22.5%	10%	5%	18%	1.66%	3.92%	3.0%	5.25%	11.4%	1.8%	0.7%	15.5%	3.4%
2022	24%	10%	8%	20%	TBD	TBD	4.5%	5.50%	12.3%	2.0%	0.7%	24.7%	4.0%
2023	26%	10%	11%	22%	TBD	TBD	6.0%	5.75%	13.2%	2.2%	0.7%	33.8%	4.6%
2024	28%	10%	15%	24%	TBD	TBD	7.5%	6.00%	14.1%	2.2%	0.7%	43%	5.2%
2025	30%	10%	19%	27%	TBD	TBD	9.5%	6.25%	15%	2.2%	0.7%	52.2%	5.8%
2026	32%	10%	23%	30%	TBD	TBD	11.75%	6.50%	15%	2.2%	0.7%	61.3%	6.4%
2027	34%	10%	27%	33%	TBD	TBD	13.75%	6.75%	15%	2.2%	0.7%	70.5%	7.0%
2028	36%	10%	31%	36%	TBD	TBD	15.25%	7.00%	15%	2.2%	0.7%	79.7%	7.6%
2029	38%	10%	35%	39%	TBD	TBD	16.75%	7.25%	15%	2.2%	0.7%	88.8%	8.2%
2030	40%	10%	40%	40%	TBD	TBD	18.25%	7.50%	15%	2.2%	0.7%	98%	8.8%
2031	40%	10%	40%	41%	TBD	TBD	19.75%	7.75%	15%	2.2%	0.7%	98%	9.4%
2032	40%	10%	40%	42%	TBD	TBD	21.25%	8.00%	15%	2.2%	0.7%	98%	10%
2033	40%	10%	40%	43%	TBD	TBD	22.75%	8.25%	15%	2.2%	0.7%	98%	10%
2034	40%	10%	40%	44%	TBD	TBD	24.25%	8.50%	15%	2.2%	0.7%	98%	10%
2035	40%	10%	40%	45%	TBD	TBD	25.75%	8.75%	15%	2.2%	0.7%	98%	10%
2036	40%	10%	40%	46%	TBD	TBD	TBD	9.00%	15%	2.2%	0.7%	98%	10%
2037	40%	10%	40%	47%	TBD	TBD	TBD	9.25%	15%	2.2%	0.7%	98%	10%
2038	40%	10%	40%	48%	TBD	TBD	TBD	9.50%	15%	2.2%	0.7%	98%	10%
2039	40%	10%	40%	49%	TBD	TBD	TBD	9.75%	15%	2.2%	0.7%	98%	10%
2040	40%	10%	40%	50%	TBD	TBD	TBD	10.00%	15%	2.2%	0.7%	98%	10%
2041	40%	10%	40%	51%	TBD	TBD	TBD	10.25%	15%	2.2%	0.7%	98%	10%
2042	40%	10%	40%	52%	TBD	TBD	TBD	10.50%	15%	2.2%	0.7%	98%	10%
2043	40%	10%	40%	53%	TBD	TBD	TBD	10.75%	15%	2.2%	0.7%	98%	10%
2044	40%	10%	40%	54%	TBD	TBD	TBD	11.00%	15%	2.2%	0.7%	98%	10%
2045	40%	10%	40%	55%	TBD	TBD	TBD	11.25%	15%	2.2%	0.7%	98%	10%
2046	40%	10%	40%	56%	TBD	TBD	TBD	11.50%	15%	2.2%	0.7%	98%	10%
2047	40%	10%	40%	57%	TBD	TBD	TBD	11.75%	15%	2.2%	0.7%	98%	10%
2048	40%	10%	40%	58%	TBD	TBD	TBD	12.00%	15%	2.2%	0.7%	98%	10%
2049	40%	10%	40%	59%	TBD	TBD	TBD	12.25%	15%	2.2%	0.7%	98%	10%
2050	40%	10%	40%	60%	TBD	TBD	TBD	12.50%	15%	2.2%	0.7%	98%	10%

Notes: The modeling horizon of AESC 2021 is through 2035; percentage targets are shown through 2050 for reference.

[174] This is the gross MA-I target. The MA-SREC target is carved out of the MA-I target.

[175] Without exemptions for load under contract.

[176] Without exemptions for load under contract.

[177] This is the gross NH-I target. The NH-I Thermal target is carved out of the NH-I target.

Table 56. Summary of RPS targets for other resource categories

	CT-II[a]	CT-III	ME-II	MA-II Non-WTE	MA-II WTE	MA CES	MA CES-E[b]	NH-III[c]	NH-IV	RI-Existing	VT-I[d]	VT-III
2021	4%	4%	30%	3.56%	3.5%	22%	20%	8%	1.5%	2%	55.6%	4.67%
2022	4%	4%	30%	3.6%	3.5%	24%	20%	8%	1.5%	2%	55%	5.33%
2023	4%	4%	30%	TBD	3.5%	26%	20%	8%	1.5%	2%	58.4%	6.00%
2024	4%	4%	30%	TBD	3.5%	28%	20%	8%	1.5%	2%	57.8%	6.67%
2025	4%	4%	30%	TBD	3.5%	30%	20%	8%	1.5%	2%	57.2%	7.33%
2026	4%	4%	30%	TBD	3.5%	32%	20%	8%	1.5%	2%	60.6%	8.00%
2027	4%	4%	30%	TBD	3.5%	34%	20%	8%	1.5%	2%	60%	8.67%
2028	4%	4%	30%	TBD	3.5%	36%	20%	8%	1.5%	2%	59.4%	9.33%
2029	4%	4%	30%	TBD	3.5%	38%	20%	8%	1.5%	2%	62.8%	10.0%
2030	4%	4%	30%	TBD	3.5%	40%	20%	8%	1.5%	2%	62.2%	10.67%
2031	4%	4%	30%	TBD	3.5%	42%	20%	8%	1.5%	2%	61.6%	11.33%
2032	4%	4%	30%	TBD	3.5%	44%	20%	8%	1.5%	2%	65%	12.0%
2033	4%	4%	30%	TBD	3.5%	46%	20%	8%	1.5%	2%	65%	12.0%
2034	4%	4%	30%	TBD	3.5%	48%	20%	8%	1.5%	2%	65%	12.0%
2035	4%	4%	30%	TBD	3.5%	50%	20%	8%	1.5%	2%	65%	12.0%
2036	4%	4%	30%	TBD	3.5%	52%	20%	8%	1.5%	2%	65%	12.0%
2037	4%	4%	30%	TBD	3.5%	54%	20%	8%	1.5%	2%	65%	12.0%
2038	4%	4%	30%	TBD	3.5%	56%	20%	8%	1.5%	2%	65%	12.0%
2039	4%	4%	30%	TBD	3.5%	58%	20%	8%	1.5%	2%	65%	12.0%
2040	4%	4%	30%	TBD	3.5%	60%	20%	8%	1.5%	2%	65%	12.0%
2041	4%	4%	30%	TBD	3.5%	62%	20%	8%	1.5%	2%	65%	12.0%
2042	4%	4%	30%	TBD	3.5%	64%	20%	8%	1.5%	2%	65%	12.0%
2043	4%	4%	30%	TBD	3.5%	66%	20%	8%	1.5%	2%	65%	12.0%
2044	4%	4%	30%	TBD	3.5%	68%	20%	8%	1.5%	2%	65%	12.0%
2045	4%	4%	30%	TBD	3.5%	70%	20%	8%	1.5%	2%	65%	12.0%
2046	4%	4%	30%	TBD	3.5%	72%	20%	8%	1.5%	2%	65%	12.0%
2047	4%	4%	30%	TBD	3.5%	74%	20%	8%	1.5%	2%	65%	12.0%
2048	4%	4%	30%	TBD	3.5%	76%	20%	8%	1.5%	2%	65%	12.0%
2049	4%	4%	30%	TBD	3.5%	78%	20%	8%	1.5%	2%	65%	12.0%
2050	4%	4%	30%	TBD	3.5%	80%	20%	8%	1.5%	2%	65%	12.0%

Notes: Except Massachusetts Class I and Rhode Island "New" targets, RPS target assumptions are based on current law. The modeling horizon of AESC 2021 is through 2035; percentage targets are shown through 2050 for reference.
(a) Connecticut Class I supply can be counted toward compliance with Class II requirements
(b) The CES-E target is 20 percent in 2021 and 2022. Beginning in 2023, the CES-E percentage obligation is determined by a formula that is tier to historical production.
(c) The NH PUC has the authority to review and reduce the NH-III RPS target, retroactively, each year.
(d) Vermont Tier I is derived by subtracting the Tier II requirement from the total VT RES goal. Tier II RECs can be counted toward compliance with Tier I requirements.

Alternative compliance payments

Table 57 provides a summary of ACP values for each RPS category. Note that some ACP values stay constant (in nominal terms) throughout the study period, while other values change over time.

Table 57. Summary of Alternative Compliance Payment levels

		2020 Alternative Compliance Payment (nominal $ per MWh)	Notes
CT	Class I	$55.00	$40 beginning 2021. Fixed and flat.
	Class II	$25.00	Fixed and flat.
	Class III	$31.00	Fixed and flat. There is also a $10 floor price.
MA	Class I	$71.57	Adjusted by CPI each year.
	Solar Carve-out I	$384.00	Schedule set by DOER.
	Solar Carve-out II	$316.00	Schedule set by DOER.
	Class II – RE	$29.37	Adjusted by CPI each year.
	Class II – WTE	$11.75	Adjusted by CPI each year.
	APS	$23.50	Adjusted by CPI each year.
	CES	$53.88	75% of Class I ACP in 2020, 50% in 2021 and after
	CES-E	NA	10% of Class I ACP
RI	New	$71.58	Adjusted by CPI each year.
	Existing	$71.58	Adjusted by CPI each year.
ME	Class I	$50.00	Fixed and flat.
	Class II	$50.00	Fixed and flat.
NH	Class I	$57.61	Adjusted by ½ of CPI each year.
	Class I - Thermal	$26.18	Adjusted by ½ of CPI each year.
	Class II	$57.61	Adjusted by ½ of CPI each year.
	Class III	$34.54	Adjusted by CPI each year.
	Class IV	$29.06	Adjusted by CPI each year.
VT	Tier I	$10.71	Adjusted by CPI each year.
	Tier II	$62.74	Adjusted by CPI each year.
	Tier III	$62.74	Adjusted by CPI each year.

Notes: 2021 Alternative Compliance Payments have not yet been released.
The MA RPS regulations are currently under review. AESC 2021 assumes that the proposed Class I ACP of $60 per MWh in 2021, $50 per MWh in 2022, and $40 per MWh in 2023 and thereafter (fixed and flat) will be approved as part of this review. AESC 2021 further assumes that CES ACP and CES-E ACP will continue to be indexed to Class I ACP at the current ratios.
There is no MA CES-E compliance obligation until 2021.
VT Tier II values are estimated based on $60 per MWh in 2018, escalated by CPI thereafter. VT does not appear to publish its ACP rates.

Impacts of the COVID-19 pandemic on Renewable Energy Deployment and Avoided Cost of RPS Compliance

The COVID-19 pandemic has impacted, and will continue to impact, many facets of the renewable energy industry. For large-scale projects in the pipeline, estimates of COVID-induced delays are based on project-specific research and interviews with developers and investors (see Figure 44). For distributed generation projects, the models assume a range of potential delay impacts to near-term projects. The distributed generation delay options are summarized in Table 58, which shows the number of months of delay modeled for projects expected to come on-line each year from 2020 to 2023. Projects with expected commercial operation dates in 2023 or later are not expected to face COVID-induced delays. The *Base Impact* case is used for all counterfactual cases.

Table 58. Range of potential project delays resulting from COVID-19 pandemic

	2020	2021	2022	2023
Low Impact	2 months	1 month	0.5 months	No delay
Base Impact	3 months	1.5 months	0.75 months	No delay
High Impact	5 months	2.5 months	1.25 months	No delay

Figure 44. Potential impacts of the COVID-19 pandemic on renewable energy deployment

Impacts on Project Development Process

- Site access impaired, leading to delays in site control
- Stay-at-home orders, distancing requirements, and resulting limits to on-site activity
- Permitting and construction delays
- Supply chain disruptions
- Most delays translate into increased cost

Impacts on Project Development Pipeline

- Stay-at-home and distancing orders increase costs
- Contracted projects face reduction in available capital
- Little to no appetite for merchant risk
- Schedule delays impair ability to access expiring federal incentives

Impacts on Investment Climate

- Availability of capital depends on developer type and funding source
- Pool of capital expected to contract as a result of general recessive conditions (cash equity) and reduced federal income tax liability (tax equity)
- Lenders (and all investors) challenged to accurately assess risk in this environment
- Offtaker credit risk subject to particular scrutiny
- However, absence of other attractive investments likely to prevent cost of capital from increasing

Impacts on Operating Projects

- Reduced market prices; ISO New England calls for curtailment in export-constrained areas
- Increased O&M costs; exacerbated by supply chain disruptions
- Travel limitations impact O&M crews, resulting in increased unplanned outages
- Limitations on mobility of fuel suppliers (biomass)

7.2. Renewable Energy Certificate (REC) Price Forecasting

This section summarizes REC price forecasting outcomes. Class 1, or "New" markets, are discussed first followed by "Existing" markets. For context, this section also includes a summary of historical REC prices in each market, as represented by broker quotations.

Historical renewable energy certificate prices

We rely upon recent broker quotes, in part, to inform the market prices at which RECs are transacted. REC markets in New England continue to suffer from a lack of depth, liquidity, and price visibility. Broker quotes for RECs represent the best visibility into the market's view of current spot prices. However, since RPS compliance must be substantiated annually, and actual REC transactions occur sporadically throughout the year, the actual weighted average annual price at which RECs are transacted will not necessarily correspond to the straight average of broker quotes over time. Broker quotes for RECs may span several months with few changes and no actual transactions (being represented by offers to buy or sell), and at other times may represent a significant volume of actual transactions. As a result, analysts should filter such data for reasonableness. This table was developed from a representative sampling of REC brokers quotes, which is comprised of both consummated transactions and bid-ask spreads in periods where transactions were not reported. For reference, Table 59 shows annual average historical REC prices for new RPS markets. Table 60 shows historical REC prices for existing RPS markets

Table 59. Annual average historical REC prices, New supply: 2015-2020 (nominal $ per MWh)

		2015	2016	2017	2018	2019	2020
CT	Class I	$44	$22	$12	$8	$35	$41
MA	Class I	$44	$22	$12	$8	$35	$41
	APS	$21	$21	$20	$17	$9	$7
	CES	NA	NA	NA	NA	NA	NA
RI	New	$43	$23	$12	$7	$34	$41
ME	Class I & IA	$18	$22	$8	$3	$2	$3
NH	Class I	$45	$24	$12	$8	$35	$41
	Class II - Solar	$51	$43	$26	$13	$27	$35
VT	Tier II	NA	NA	NA	NA	NA	NA*
	Tier III	NA	NA	NA	NA	NA	NA*

** Broker quotes not yet available for Vermont markets at the time these data were collected.*

Table 60. Annual average historical REC prices, Existing supply: 2015-2020 (nominal $ per MWh)

		2015	2016	2017	2018	2019	2020
CT	Class II	$1	$1	$7	$6	$20	$20
	Class III	$27	$27	$26	$26	$22	$13
MA	Class II – Non-WTE	$27	$26	$26	$26	$23	$20
	Class II – WTE	$6	$6	$6	$6	$10	$11
	CES-E	NA	NA	NA	NA	NA	$2.75
RI	Existing	$1	$1	$1	$1	$1	$1
ME	Class II	$0	$1	$1	$1	$1	$1
NH	Class III	$37	$28	$23	$13	$40	$38
	Class IV	$25	$25	$25	$26	$26	$23
VT	Tier I	NA	NA	NA	NA	NA	NA*

** Broker quotes not yet available for Vermont markets at the time these data were collected.*

Forecasting renewable energy certificate prices for compliance with Class I RPS obligations

The key input to calculating the avoided cost of RPS compliance is REC price. Class I REC prices are forecast using the REMO and Solar Market Study (SMS) models.[178] We describe key methodological steps and assumptions throughout this document. Sustainable Energy Advantage forecasts non-Class I markets with a range of class-specific methodologies, which we describe later in this section.

Near-term supply and demand, REC prices, and renewable energy additions

The Class I REC price forecast from 2021 to approximately 2030 is based on an assessment of the near-term supply and demand balance, ACP levels in each market, banking limits and observed practices, operating import behavior, and discretional curtailment of operating biomass.

Resources considered in the estimation of near-term Class I REC supply and pricing are those eligible for any of the categories listed in Table 55. These resources may fall into one of the following categories:

a) Certified supply, operating and located in ISO New England

b) Certified supply, operating and imported from adjacent control areas

c) Additional potential imports from adjacent control areas, delivered over existing ties; and

d) Near-term committed renewable resources that (i) are in the interconnection queue; (ii) have been RPS-certified in one or more multiple New England states; (iii) secured financing; or (iv) obtained long-term contracts, either with distribution utilities through competitive solicitations, or through other means.

[178] See Section 4.1: *AESC 2021 modeling framework* for more information.

For near-term committed resources that are not yet operational, this analysis applies a customized probability-derating to reflect the likelihood that not all proposed projects will be built or may not be built on the timetable reflected in the queue or as otherwise proposed by the project sponsors.

In addition to the resources described above, we forecast the generation from renewable resources that are expected to come on-line as a result of existing state procurement policies and incentive programs, including but not limited to:

<u>Large-scale renewables</u>

- MA Sec. 83C Offshore Wind Procurement: 1,600 MW by 2026 (Vineyard & Mayflower Wind). *Project selections have been made, and timing updated, since AESC 2018.*
- MA Additional Offshore Wind Procurement, DOER Authority: up to 1,600 MW by 2031. *This procurement policy goal is new since AESC 2018.*
- MA Offshore Wind Procurement, Additional 83C Authority: 2,400 MW (to be procured by 12/31/2027) is expected to be approved during the 2021 legislative session.
- MA Sec. 83D Hydro Procurement: Delivery of 9.45 TWh beginning 7/1/2023 (date on which NECEC is assumed to be energized). *Timing and resource assumptions have been updated since AESC 2018.*
- CT & RI Joint Offshore Wind Procurement: 700 MW (Revolution Wind) by 2025. *Project selections have been made, and timing updated, since AESC 2018.*
- CT Offshore Wind Procurement: 804 MW (Park City Wind) by 2026. *Project selections have been made, and timing updated, since AESC 2018.*
- RI Additional Offshore Wind Procurement: 600 MW in 2021 as announced by Governor Raimondo. *This procurement is new since AESC 2018.*
- ME Long-Term Procurement: Approximately 1 TWh by 2025. *This procurement policy goal is new since AESC 2018.* Tranche 1 was completed in 2020. The RFP for Tranche 2 was released in January 2021.

<u>Distributed generation</u>

- Solar Massachusetts Renewable Target (SMART) Program: 3,200 MW by 2031. *Program expanded from 1,600 to 3,200 MW since AESC 2018.*[179]

[179] To model the hourly generation impacts from distributed solar in the SMART program and all other distributed solar programs, we rely on Horizons Energy's National Database for solar load shapes. Horizons Energy developed the load shapes using irradiation patterns from NREL's PVWatts. They were chosen from airport locations that were closest to the market areas included in the National Database.

- Solar Massachusetts Renewable Target (SMART) Program Expansion: A 2,000 MW expansion (assumed to be reached by 2033) is included in legislation assumed to pass during the 2021 session.
- CT Low and Zero Emissions Renewable Energy Certificate (LREC/ZREC) Programs. *Quantity and timing updated since AESC 2018.*
- CT Low- and Zero-Emissions Tariff Programs. *This program is new since AESC 2018.*
- CT Residential Solar Home REC (RSIP/SHREC) and Tariff Programs. *The Residential Tariff Program is new since AESC 2018.*
- RI Renewable Energy Growth Program (including expansions). *Timing updated since AESC 2018.*[180]
- VT Standard Offer. *Timing updated since AESC 2018.*
- ME Distributed Generation Solar Policy: Large-Scale Shared; Commercial & Institutional. *This program is new since AESC 2018.*
- Net metering and virtual new metering, as applicable, in all New England states. *Quantity and timing updated since AESC 2018.*

Given the eligibility interaction between the MA CES and MA Class I RPS markets, REC and Clean Energy Credit (CEC) price forecasts are modeled interdependently. RECs and ACPs used for Massachusetts Class I compliance will be counted toward CES compliance. Incremental CES demand above the Massachusetts Class I RPS will be satisfied first by non-RPS eligible large hydro resources delivered over new transmission lines (if available), and second—if applicable—by a combination of Class I resources and Massachusetts CES ACPs, depending on regional Class I supply availability.

Forecasted Class I REC supply is allocated proportionally among the states based on an algorithm that accounts for each state's RPS eligibility requirement, banking limits, relative ACP levels, and the expected discretional behavior of operating imports and biomass plants. Each state's resulting supply-demand balance, banking balances, ACPs, and forward-looking market dynamics are used to inform the forecast of near-term Class I REC prices.

Spot prices in the near term will be driven by supply and demand. But they are also influenced by REC market dynamics and to a lesser extent by the expected cost of entry (through banking), as follows:

- Market shortage: Prices approach the cap or ACP.
- Substantial market surplus, or even modest market surplus without banking: Prices crash to approximately $2/MWh, reflecting transaction and risk management costs.

[180] Here, and throughout this section, "timing" refers to the estimate of when programmatic capacity will come online.

- Market surplus with banking: Prices tend towards the cost of entry, discounted by factors including the time-value of money, the amount of banking that has taken place, expectations of when the market will return to equilibrium, and other risk management factors.

Solar Renewable Energy Certificate (SREC) prices are forecasted using a separate set of proprietary models, developed for Sustainable Energy Advantage's *Massachusetts Solar Market Study*.

Long-term cost of entry and renewable energy additions

The long-term Class I REC price forecast (approximately 2030–2050) is based on the cost of new entry of the marginal renewable energy unit required to meet the incremental RPS demand in each state in each year—and the extrapolation thereof. To estimate the new or incremental REC cost of entry, we constructed a supply curve for incremental New England renewable energy potential that sorts resources from lowest cost of entry to highest cost of entry. The resources in the supply curve model are represented by 1,277 blocks of supply potential from resource studies, each with total MW capacity, capacity factor, and cost of installation and operation applicable to projects installed in each year. This supply curve is based on several resource potential studies commissioned by Sustainable Energy Advantage and is proprietary. The cost components of the supply curve analysis are derived from a combination of public (e.g., NREL's ATB) and confidential sources (e.g., Sustainable Energy Advantage research interviews with dozens of New England renewable energy developers).

The supply curve consists of land-based wind, offshore wind, utility-scale solar PV, biomass, biogas, hydro, landfill gas, and tidal resources.[181] While utility-scale solar is the largest potential resource by MW, land-based wind is the largest source by number of blocks (modeled as 1,031 separate individual land-based wind sites). Modeled wind blocks vary by state, land area, number and size of turbines in each project, wind speed, topography, and distance from transmission.

Resources from the supply curve are modeled to meet net demand, which consists of the gross demand for new or incremental renewables, less the near-term renewable supply (as described above).

The estimated 20-year levelized cost of marginal resources is based on several key assumptions, including projections of capital costs, capital structure,[182] debt terms, required minimum equity returns, and depreciation, which are combined and represented through a carrying charge. The estimated levelized cost of marginal resources also includes fixed and variable O&M costs, generator-lead interconnection costs,[183] transmission network upgrade costs,[184] and wind integration costs. Phase-out

[181] The supply curve includes only the Class I eligible resource potential for each resource type.

[182] For this analysis, we assume incremental new supply will be financed with a blend of fully bundled power purchase agreements for a 20-year term and partial hedging for durations available in the short-term for their RECs, energy, and capacity.

[183] As a function of voltage and distance from transmission.

[184] It is assumed that 15-33 percent of the transmission costs are socialized and thereby not borne by the generators.

of the Federal Production Tax Credit and phase-down of the Investment Tax Credit are modeled as adopted in the *Further Consolidated Appropriations Act of 2020*.

Revenues for land-based wind, offshore wind, and utility-scale solar resources are adjusted in two ways:

1. The value of energy is adjusted to reflect these resources' variability, production profile, and, for land-based wind, historical discount of the real-time market (in which wind plants will likely sell a significant portion of their output) versus the day-ahead market.
2. Land-based wind, offshore wind, and utility-scale solar PV generators are assumed to receive FCM revenues corresponding to only a percentage of nameplate capacity (~25 percent for land-based wind, 45 percent for offshore wind, and 12 percent for utility-scale solar PV), reflecting the seasonal reliability of the intermittent resources, as determined by ISO New England.

The REC cost for each block of the supply curve is estimated for each year. For each generator, we determine the levelized REC premium for market entry, or the additional revenue the project would require in order to attract financing, by performing the following operation: we subtracted (a) the nominal levelized value of production consistent with the AESC 2021 projection of wholesale electric energy and capacity prices from (b) nominal levelized cost of marginal resources.[185] The nominal levelized cost of marginal resources is the amount the project needs in revenue on a levelized $/MWh basis, or:

1. The nominal levelized value of production is the amount the project would receive from selling energy and capacity into the wholesale market; and
2. The difference between the levelized cost and the levelized value represents the REC premium.

Unless the revenue from REC prices can make up the REC premium, a project is unlikely to be developed. Resource blocks are sorted from lowest to highest REC premium price, and the intersection between incremental supply and incremental demand determines the market-clearing REC price for market entry. Our projections assume that REC prices for new renewables can never be negative.

Resource levelized cost is expected to undergo several changes throughout the analysis period. These changes include impacts resulting from capital cost decline, technological improvements (increasing capacity factors), and need for transmission solutions, as well as the level of federal tax credits.

The levelized commodity revenue over the life of each resource is based on the sum of energy and capacity prices. REC prices and avoided cost of RPS compliance are derived through an iterative approach. Draft REC prices were based on preliminary energy and capacity forecasts, and were then used to inform final energy and capacity prices. These final prices are inputs for the final REC price and

[185] We calculated these levelized analyses using discount rates representative of the cost of capital to a developer of renewable resource projects.

avoided RPS compliance cost calculation. See Figure 12 in Section 4.1: *AESC 2021 modeling framework* for more information on this process.

Class 1 or "New" REC price forecasts

Future REC prices in new renewables markets will be driven both by the cost of entry for renewable resources eligible in each state and by the quantity of state-specific supply compared to state-specific demand. RPS eligibility criteria differ by state, and so REC prices are differentiated by state and reflect state-specific expectations with respect to generator certification and LSE-banked compliance. Eligibility criteria also overlap across multiple states, and so the interaction of multi-state supplies and demands and the fungibility of RECs across markets are also considered in this analysis.

For New RPS categories, we assume that in the long run the price of RECs (and therefore the unit cost of RPS compliance) will be determined by the cost of new entry of the marginal renewable energy unit. To estimate the new or incremental REC cost of entry, we constructed a supply curve for incremental New England renewable energy potential based on various resource potential studies. The supply curve sorts the supply resources from the lowest cost of entry to the highest cost of entry.[186] The resources in the supply curve model are represented by 1,390 blocks of supply potential from resource studies, each with total MW capacity, capacity factor, and cost of installation and operation applicable to projects installed in each year.

The supply curve consists of land-based wind, offshore wind, utility-scale solar, biomass,[187] hydro, landfill gas, and tidal resources. The price for each block of the supply curve is estimated for each year. For each generator, we determine the 20-year levelized REC premium for market entry, or additional revenue the project would require to enable financing, by subtracting the nominal, levelized energy and capacity prices from the nominal levelized cost of marginal resources:

- The nominal levelized cost of marginal resources is the amount the project needs in revenue on a levelized $/MWh basis;
- The nominal levelized value of production is the amount the project would receive from selling its commodities (energy and capacity) into the wholesale market; and
- The difference between the levelized cost and the levelized value represents the REC premium.

As described above, unless the revenue from REC prices can make up the REC premium, a project is unlikely to be developed. Resource blocks are sorted from low to high REC premium, and the

[186] These assumptions are based on technology assumptions compiled by Sustainable Energy Advantage, LLC from a range of studies and interviews with market participants, as well as in-house geospatial resource potential studies conducted by Sustainable Energy Advantage, LLC. Typical generator sizes, heat rates, availability and emission rates are consistent with technology assumptions used by ISO New England in its scenario planning process. The resulting supply curve is proprietary to Sustainable Energy Advantage, LLC.

[187] Including biogas and biodiesel.

intersection between incremental supply and incremental demand determines the market-clearing REC price for market entry. Our projections assume that REC prices for new renewables will not fall below $2 per MWh, which is the estimated transaction cost associated with selling renewable resources into the wholesale energy market. This estimate is consistent with market floor prices observed in various markets for renewable resources.

The estimated levelized cost of marginal resources is based on several key assumptions, including projections of capital costs, capital structure, debt terms, required minimum equity returns, and depreciation, which are combined and represented through a carrying charge. The estimated levelized cost of marginal resources also includes fixed and variable O&M costs, transmission and interconnection costs (as a function of voltage and distance from transmission), and wind integration costs.[188] The analysis assumes the currently planned phase-out of Federal Tax incentives.[189] Capital and operating costs were escalated over time using inflation.

We determined the levelized commodity revenue over the life of each resource based on the sum of energy and capacity prices, both utilizing preliminary AESC 2021 estimates of the FCM price and all-hour zonal LMP.

Resources from the supply curve are modeled to meet net demand, which consists of the gross demand for new or incremental renewables, less existing eligible generation already operating. All imports, as well as New England-based biomass facilities, are modeled as discretional and responsive to expected REC prices through an iterative process. In addition, renewable supply expected to result from long-term procurement and distributed generation policies was modeled independently and netted from gross demand.

The projection of the cost of new entry (REC premium) for Counterfactual #1 is summarized in Table 61. REC premium for market entry (2021 $ per MWh). We assume CEC prices for the Massachusetts CES track MA-1 REC prices until CES-eligible hydro comes online (2023). Thereafter, once hydro contracted under MA Sec. 83D is used to fulfill 100 percent of the CES obligation, we assume a price of $0 because the cost of the 83D contracts cannot be avoided.

Even in years when there is market surplus, REC premiums are not necessarily equal to $0 per MWh. This is because we assume a level of banking injections (to hedge against future shortages) that mitigate potential price crashes that could occur even in years with a large surplus.

[188] We assume that reinforcement of major transmission facilities (e.g., improved connections between Maine and the rest of New England) will be socialized.

[189] U.S. Office of Energy Efficiency & Renewable Energy. Last accessed March 10, 2021. "Residential and Commercial ITC Factsheets." *Energy.gov.* Available at https://www.energy.gov/eere/solar/downloads/residential-and-commercial-itc-factsheets.

Table 61. REC premium for market entry (2021 $ per MWh)

	CT-I	ME-I	ME-IA	ME-T	MA-I	MA CES	MA CPS
2021	$39.69	$21.64	$21.64	$2.50	$55.01	$29.82	$44.33
2022	$38.61	$40.18	$40.18	$2.45	$40.18	$24.13	$43.44
2023	$30.14	$31.97	$31.97	$2.40	$31.34	$0.00	$42.60
2024	$20.96	$20.96	$20.96	$2.36	$20.96	$0.00	$35.59
2025	$13.68	$15.04	$15.04	$2.31	$13.90	$0.00	$29.30
2026	$13.56	$14.09	$14.09	$2.27	$13.22	$0.00	$29.59
2027	$12.09	$12.14	$12.14	$2.22	$10.17	$0.00	$34.20
2028	$10.29	$10.40	$10.40	$2.18	$8.44	$0.00	$32.22
2029	$9.89	$10.10	$10.10	$2.13	$8.06	$0.00	$30.26
2030	$22.77	$22.90	$22.90	$2.09	$22.84	$0.00	$28.42
2031	$22.02	$22.27	$22.27	$2.05	$22.14	$0.00	$26.60
2032	$21.62	$21.62	$21.62	$2.01	$21.62	$0.00	$18.85
2033	$7.34	$9.14	$9.14	$1.97	$5.27	$0.00	$17.15
2034	$9.45	$11.14	$11.14	$1.93	$7.65	$0.00	$15.52
2035	$12.67	$13.16	$13.16	$1.90	$12.06	$0.00	$13.95
Levelized (2021-2035)	**$19.38**	**$18.73**	**$18.73**	**$2.19**	**$20.05**	**$3.92**	**$29.99**
	MA APS	**NH-I**	**NH-I Thermal**	**NH-II**	**RI-New**	**VT-II**	**VT-III**
2021	$4.50	$50.55	$23.80	$52.37	$61.13	$55.01	$31.21
2022	$4.41	$40.18	$23.55	$46.21	$49.42	$40.18	$31.20
2023	$4.32	$36.65	$23.33	$36.04	$47.46	$31.34	$31.21
2024	$4.24	$20.96	$20.58	$24.10	$20.96	$20.96	$20.96
2025	$4.16	$9.09	$18.17	$15.99	$13.50	$13.90	$13.90
2026	$4.08	$7.86	$16.03	$15.20	$15.70	$13.22	$13.22
2027	$4.00	$7.20	$14.14	$11.70	$18.12	$10.17	$10.17
2028	$3.92	$5.80	$12.49	$9.71	$15.80	$8.44	$8.44
2029	$3.84	$5.29	$11.00	$9.27	$15.13	$8.06	$8.06
2030	$3.77	$22.90	$9.72	$26.26	$22.90	$22.84	$22.84
2031	$3.69	$22.27	$8.57	$25.46	$22.27	$22.14	$22.14
2032	$3.62	$21.62	$7.56	$24.87	$21.62	$21.62	$21.62
2033	$3.55	$3.90	$6.67	$6.06	$11.56	$5.27	$5.27
2034	$3.48	$4.97	$5.89	$8.80	$13.44	$7.65	$7.65
2035	$3.41	$6.07	$5.20	$13.87	$15.06	$12.06	$12.06
Levelized (2021-2035)	**$3.95**	**$18.24**	**$14.15**	**$22.26**	**$24.88**	**$20.05**	**$17.65**

The REC premium (REC Price) results are highly dependent upon the forecast of wholesale electric energy market prices, including the underlying forecasts of natural gas and carbon allowance prices, as well as the forecast of inflation. A lower forecast of market energy prices would yield higher REC prices than shown, particularly in the long term. In all cases, project developers will need to be able to secure long-term contracts and attract financing based on the aforementioned natural gas, carbon, and resulting electricity price forecasts in order to create this expected REC market environment. This presents an important caveat to the projected REC prices, as such long-term electricity price forecasts (particularly to the extent that they are influenced by expected carbon regulation) are uncertain.

Forecasting renewable energy certificate prices for compliance with existing RPS obligations

As previously described, non-Class I markets are focused on maintaining existing resources—rather than spurring new development—and are therefore fundamentally different from Class I markets. As a result, the approach and assumptions for forecasting non-Class I REC prices must be tailored to a different set of market characteristics. Table 62 describes how REC prices for non-Class I markets are forecasted.

Table 62. REC price forecasting approaches

RPS Market	REC Price Forecast Approach
CT Class II	REC prices are estimated based on current broker quotes and are assumed to trend toward values which reflect a market in equilibrium over time. With limited eligible supply, REC prices are expected to remain modestly below the ACP.
CT Class III	REC prices are estimated based on current broker quotes and are assumed to remain near the minimum nominal Class III REC price of $10/MWh.
ME Class II	REC prices are estimated based on current broker quotes, consider the interaction with other "existing" markets, and reflect an assumption of supply adequacy through the study period.
MA Class II – Non-WTE	In the near term, REC prices are estimated based on current broker quotes. In the long term, REC prices are forecasted as the lesser of the CT Class I REC price and 75 percent of the MA-II-Non-WTE ACP.
MA Class II – WTE	REC prices are estimated based on current broker quotes. With static supply and stable demand targets, REC prices are expected to remain at or near current levels.
MA APS	REC prices are estimated at 90% of the MA APS ACP.
MA CPS	Based on a proprietary model developed by Sustainable Energy Advantage, including preliminary assumptions before market data were available (circa Nov 2020), and derived as an average of six scenarios.
MA CES	CEC prices are the lesser of the MA Class I price and the CES ACP until CES-eligible hydropower is delivered pursuant to MA 83D contracts. Once these deliveries begin, CEC prices are assumed to decrease to $1/MWh. Once 83D deliveries begin, there will be no CEC "market" because supply will dramatically exceed demand <u>and</u> all eligible supply will be controlled by the distribution utilities. Separately, our understanding is that all CECs in excess of CES demand will be retired by the distribution utilities <u>and</u> their associated over-market costs (defined as the contract cost minus energy and capacity revenues collected upon liquidation into the market) will be collected from all distribution customers.
MA CES-E	REC prices are estimated based on current broker quotes and considering the interaction with other "existing" markets.
NH Class II	REC prices are estimated at the lesser of 105% of the MA Class I REC price and 90% of the NH Class II ACP
NH Class III	In the near term, REC prices are estimated based on current broker quotes. In the long term, REC prices are forecasted as 90% of the NH-III ACP, assuming a systemic shortage.
NH Class IV	In the near term, REC prices are estimated based on current broker quotes. In the long term, REC prices are forecasted as the lesser of the CT Class I REC, the MA Class II non-WTE REC price, and 75 percent of the NH Class IV ACP.
RI Existing	REC prices are estimated based on current broker quotes, consider the interaction with other "existing" markets, and reflect an assumption of supply adequacy through the study period.
VT Tier I	REC prices are estimated based on current broker quotes, consider the interaction with other "existing" markets, and reflect an assumption of supply adequacy through the study period.
VT Tier III	Based on the overlap in eligibility, REC prices are estimated based on the lesser of the VT Tier II REC price and the NH Class I Thermal Carve-out Price.

"Existing" REC price forecasts

In contrast to the New RPS markets (where long-term REC prices are based on the cost of new entry), REC prices in Existing RPS markets are based on the relationship between supply and demand, interactions with other markets, and the ACP. Table 63 shows our projection of REC prices for existing resource categories. For reference, Table 60 shows annual average historical REC prices for Existing RPS markets.

Table 63. Summary of REC prices for existing resource categories (2021 $ per MWh)

	CT-II	CT-III	ME-II	MA-II RE	MA-II WTE	MA CES-E	NH-III	NH-IV	RI-Existing	VT-I
2021	$20.50	$12.00	$0.75	$23.25	$12.00	$3.50	$36.47	$23.24	$1.00	$0.88
2022	$20.09	$11.76	$0.74	$22.46	$13.23	$3.43	$36.03	$22.22	$0.98	$0.86
2023	$20.74	$11.53	$0.72	$22.46	$12.97	$3.36	$36.20	$22.23	$0.96	$0.84
2024	$22.37	$11.30	$0.71	$20.96	$12.72	$3.30	$36.33	$20.96	$0.94	$0.82
2025	$21.95	$11.09	$0.69	$13.68	$12.47	$3.23	$36.46	$13.68	$0.92	$0.81
2026	$21.52	$10.87	$0.91	$13.56	$12.23	$3.17	$36.56	$13.56	$1.13	$1.02
2027	$21.09	$10.66	$1.11	$12.09	$11.99	$3.11	$36.65	$12.09	$1.33	$1.22
2028	$20.69	$10.45	$1.31	$10.29	$11.76	$3.05	$36.75	$10.29	$1.52	$1.42
2029	$20.26	$10.24	$1.49	$9.89	$11.52	$2.99	$36.80	$9.89	$1.71	$1.60
2030	$19.88	$10.04	$1.67	$22.47	$11.30	$2.93	$36.89	$22.24	$1.88	$1.78
2031	$19.48	$9.84	$1.85	$22.02	$11.07	$2.87	$36.94	$22.02	$2.05	$1.95
2032	$19.10	$9.65	$2.01	$21.62	$10.85	$2.81	$37.03	$21.62	$2.21	$2.11
2033	$18.72	$9.46	$2.17	$7.34	$10.64	$2.76	$37.11	$7.34	$2.36	$2.27
2034	$18.36	$9.28	$2.32	$9.45	$10.44	$2.71	$37.21	$9.45	$2.51	$2.42
2035	$18.00	$9.10	$2.46	$12.67	$10.23	$2.65	$37.31	$12.67	$2.65	$2.56
Levelized (2021-2035)	**$20.24**	**$10.54**	**$1.36**	**$16.45**	**$11.74**	**$3.07**	**$36.70**	**$16.40**	**$1.58**	**$1.47**

Notes: Connecticut Class I supply can be counted toward compliance with Class II requirements. Vermont Tier II supply can be counted toward compliance with Tier I requirements.

7.3. Avoided RPS compliance cost per MWh reduction

The RPS compliance cost that retail customers avoid through reductions in their energy usage is equal to the price of renewable energy in excess of market prices multiplied by the percentage of retail load that a supplier must meet from renewable energy under the RPS regulation. In other words:

Equation 1. RPS Compliance Costs

$$\frac{\sum_{n} \mathrm{P}_{n,i} \times R_{n,i}}{1-l}$$

Where:

i = year

n = RPS classes

$P_{n,i}$ = projected price of RECs for RPS class n in year i,

$R_{n,i}$ = RPS requirement, expressed as a percentage, for RPS class n in year i,

l = losses from ISO wholesale load accounts to retail meters (modeled at 9 percent)

For example, in a year in which REC prices are $15 per MWh and the RPS percentage target is 10 percent, the avoided RPS cost to a retail customer would be $15 per MWh × 10 percent = $1.50 per MWh.

Comparing results across counterfactuals

Avoided REC prices, and the resulting avoided cost of RPS compliance, are a function of supply and demand dynamics. These dynamics include both policy evolution (i.e., changes to legislation and regulation over time) and market participant behavior (e.g., LSE decisions related to RPS compliance banking, generator decisions related to operations, etc.). The below results differ across counterfactuals based on the relationship between renewable energy buildouts (largely driven by policy), load (driven by both behavior and energy efficiency and electrification assumptions), and REC price. As such, the avoided cost of RPS compliance may vary between counterfactuals as a result of differences in modeled load even when renewable energy buildouts are the same.

Counterfactual #1 results

Table 64 shows the avoided cost of RPS compliance aggregated for all new and other categories. Table 65 and Table 66 provide additional detail, and display the avoided cost of RPS compliance, by year and by category, for both New and Existing RPS programs. All levelized values are 15-year levelized values.

Table 64. Avoided cost of RPS compliance for Counterfactual #1 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$6.59	$6.92	$5.61	$2.66	$14.96	$1.34
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.05	$5.44	$0.03	$2.56
Total	**$7.93**	**$7.37**	**$11.81**	**$8.10**	**$14.99**	**$3.90**

Table 65. Summary of avoided cost of RPS compliance, New RPS categories (2021 $ per MWh)

	CT-I	ME-I	ME-IA	ME-T	MA-I	MA CES	MA CPS
2021	$9.73	$2.36	$1.18	$0.01	$7.57	$1.30	$1.45
2022	$10.10	$4.38	$3.50	$0.02	$6.38	$1.05	$2.13
2023	$8.54	$3.48	$3.83	$0.03	$5.81	$0.00	$2.79
2024	$6.40	$2.28	$3.43	$0.04	$4.73	$0.00	$2.91
2025	$4.47	$1.64	$3.12	$0.05	$3.65	$0.00	$3.03
2026	$4.73	$1.54	$3.53	$0.06	$4.01	$0.00	$3.79
2027	$4.48	$1.32	$3.57	$0.07	$3.55	$0.00	$5.13
2028	$4.04	$1.13	$3.51	$0.08	$3.31	$0.00	$5.36
2029	$4.09	$1.10	$3.85	$0.08	$3.43	$0.00	$5.52
2030	$9.93	$2.50	$9.98	$0.09	$9.96	$0.00	$5.65
2031	$9.60	$2.43	$9.71	$0.09	$9.89	$0.00	$5.73
2032	$9.43	$2.36	$9.43	$0.09	$9.90	$0.00	$4.37
2033	$3.20	$1.00	$3.98	$0.09	$2.47	$0.00	$4.25
2034	$4.12	$1.21	$4.86	$0.08	$3.67	$0.00	$4.10
2035	$5.52	$1.43	$5.74	$0.08	$5.92	$0.00	$3.91
Levelized (2021-2035)	**$6.59**	**$2.03**	**$4.83**	**$0.06**	**$5.61**	**$0.17**	**$3.98**
	MA APS	**NH-I**	**NH-I Thermal**	**NH-II**	**RI-New**	**VT-II**	**VT-III**
2021	$0.26	$6.28	$2.49	$0.40	$10.33	$2.04	$1.59
2022	$0.26	$5.39	$2.64	$0.35	$13.29	$1.75	$1.81
2023	$0.27	$5.27	$2.80	$0.28	$17.50	$1.57	$2.04
2024	$0.28	$3.22	$2.67	$0.18	$9.82	$1.19	$1.52
2025	$0.28	$1.49	$2.53	$0.12	$7.68	$0.88	$1.11
2026	$0.29	$1.29	$2.24	$0.12	$10.50	$0.92	$1.15
2027	$0.29	$1.18	$1.97	$0.09	$13.93	$0.78	$0.96
2028	$0.30	$0.95	$1.74	$0.07	$13.72	$0.70	$0.86
2029	$0.30	$0.86	$1.54	$0.07	$14.65	$0.72	$0.88
2030	$0.31	$3.74	$1.36	$0.20	$24.46	$2.19	$2.66
2031	$0.31	$3.64	$1.20	$0.19	$23.79	$2.27	$2.73
2032	$0.32	$3.54	$1.05	$0.19	$23.10	$2.36	$2.83
2033	$0.32	$0.64	$0.93	$0.05	$12.35	$0.57	$0.69
2034	$0.32	$0.81	$0.82	$0.07	$14.35	$0.83	$1.00
2035	$0.33	$0.99	$0.73	$0.11	$16.09	$1.31	$1.58
Levelized (2021-2035)	**$0.30**	**$2.66**	**$1.80**	**$0.17**	**$14.96**	**$1.34**	**$1.56**

Table 66. Summary of avoided cost of RPS compliance, Existing RPS categories (2021 $ per MWh)

	CT-II	CT-III	ME-II	MA-II RE	MA-II WTE	MA CES-E	NH-III	NH-IV	RI-Existing	VT-I
2021	$0.89	$0.52	$0.25	$0.91	$0.46	$0.76	$3.18	$0.38	$0.02	$0.53
2022	$0.88	$0.51	$0.24	$0.88	$0.50	$0.75	$3.14	$0.36	$0.02	$0.51
2023	$0.90	$0.50	$0.24	$0.88	$0.49	$0.73	$3.16	$0.36	$0.02	$0.54
2024	$0.98	$0.49	$0.23	$0.82	$0.49	$0.72	$3.17	$0.34	$0.02	$0.52
2025	$0.96	$0.48	$0.23	$0.54	$0.48	$0.71	$3.18	$0.22	$0.02	$0.50
2026	$0.94	$0.47	$0.30	$0.53	$0.47	$0.69	$3.19	$0.22	$0.02	$0.67
2027	$0.92	$0.46	$0.36	$0.47	$0.46	$0.68	$3.20	$0.20	$0.03	$0.80
2028	$0.90	$0.46	$0.43	$0.40	$0.45	$0.66	$3.20	$0.17	$0.03	$0.92
2029	$0.88	$0.45	$0.49	$0.39	$0.44	$0.65	$3.21	$0.16	$0.04	$1.09
2030	$0.87	$0.44	$0.55	$0.88	$0.43	$0.64	$3.22	$0.36	$0.04	$1.21
2031	$0.85	$0.43	$0.60	$0.86	$0.42	$0.63	$3.22	$0.36	$0.04	$1.31
2032	$0.83	$0.42	$0.66	$0.85	$0.41	$0.61	$3.23	$0.35	$0.05	$1.50
2033	$0.82	$0.41	$0.71	$0.29	$0.41	$0.60	$3.24	$0.12	$0.05	$1.61
2034	$0.80	$0.40	$0.76	$0.37	$0.40	$0.59	$3.25	$0.15	$0.05	$1.71
2035	$0.78	$0.40	$0.81	$0.50	$0.39	$0.58	$3.25	$0.21	$0.06	$1.81
Levelized	**$0.88**	**$0.46**	**$0.45**	**$0.64**	**$0.45**	**$0.67**	**$3.20**	**$0.27**	**$0.03**	**$1.00**

Counterfactual #2 results

Table 67 shows the avoided cost of RPS compliance aggregated for all new and other categories. Table 68 and Table 69 provide additional detail, and display the avoided cost of RPS compliance, by year and by category, for both New and Existing RPS programs. All levelized values are 15-year levelized values.

Table 67. Avoided cost of RPS compliance for Counterfactual #2 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$3.43	$3.10	$3.10	$1.31	$5.62	$0.75
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$1.80	$5.11	$0.03	$1.93
Total	**$4.77**	**$3.55**	**$9.04**	**$6.41**	**$5.66**	**$2.67**

Table 68. Summary of avoided cost of RPS compliance, New RPS categories (2021 $ per MWh)

	CT-I	ME-I	ME-IA	ME-T	MA-I	MA CES	MA CPS
2021	$8.95	$0.96	$0.48	$0.01	$5.02	$1.29	$1.45
2022	$5.90	$2.46	$1.97	$0.02	$3.58	$0.98	$2.13
2023	$6.60	$2.54	$2.79	$0.03	$4.32	$0.00	$2.79
2024	$3.94	$1.36	$2.04	$0.04	$3.13	$0.00	$2.91
2025	$3.98	$1.32	$2.51	$0.05	$3.30	$0.00	$3.03
2026	$0.63	$1.09	$2.50	$0.06	$3.04	$0.00	$3.79
2027	$2.92	$0.87	$2.35	$0.07	$2.99	$0.00	$5.13
2028	$2.39	$0.75	$2.33	$0.08	$2.46	$0.00	$5.36
2029	$2.20	$0.63	$2.21	$0.08	$2.29	$0.00	$5.52
2030	$1.92	$0.47	$1.89	$0.09	$2.07	$0.00	$5.65
2031	$1.75	$0.38	$1.53	$0.09	$2.03	$0.00	$5.73
2032	$1.88	$0.37	$1.49	$0.09	$2.30	$0.00	$4.37
2033	$2.23	$0.44	$1.75	$0.09	$2.86	$0.00	$4.25
2034	$2.69	$0.55	$2.19	$0.08	$3.57	$0.00	$4.10
2035	$2.66	$0.61	$2.44	$0.08	$3.37	$0.00	$3.91
Levelized (2021-2035)	**$3.43**	**$1.00**	**$2.03**	**$0.06**	**$3.10**	**$0.16**	**$3.98**
	MA APS	**NH-I**	**NH-I Thermal**	**NH-II**	**RI-New**	**VT-II**	**VT-III**
2021	$0.26	$4.54	$2.49	$0.32	$6.17	$1.35	$1.59
2022	$0.26	$3.02	$2.64	$0.20	$6.06	$0.98	$1.31
2023	$0.27	$3.35	$2.80	$0.20	$8.59	$1.17	$1.52
2024	$0.28	$1.12	$2.67	$0.12	$6.13	$0.79	$1.01
2025	$0.28	$1.02	$2.53	$0.11	$7.57	$0.80	$1.01
2026	$0.29	$0.81	$2.24	$0.09	$7.61	$0.70	$0.87
2027	$0.29	$0.61	$1.97	$0.08	$5.58	$0.65	$0.81
2028	$0.30	$0.57	$1.74	$0.06	$4.79	$0.52	$0.64
2029	$0.30	$0.57	$1.54	$0.05	$4.90	$0.48	$0.59
2030	$0.31	$0.54	$1.36	$0.04	$4.21	$0.46	$0.55
2031	$0.31	$0.51	$1.20	$0.04	$3.72	$0.47	$0.56
2032	$0.32	$0.49	$1.05	$0.04	$4.01	$0.55	$0.66
2033	$0.32	$0.55	$0.93	$0.05	$4.43	$0.66	$0.80
2034	$0.32	$0.65	$0.82	$0.07	$4.86	$0.81	$0.97
2035	$0.33	$0.75	$0.73	$0.06	$5.25	$0.75	$0.90
Levelized (2021-2035)	**$0.30**	**$1.31**	**$1.80**	**$0.10**	**$5.62**	**$0.75**	**$0.93**

Table 69. Summary of avoided cost of RPS compliance, Existing RPS categories (2021 $ per MWh)

	CT-II	CT-III	ME-II	MA-II RE	MA-II WTE	MA CES-E	NH-III	NH-IV	RI-Existing	VT-I
2021	$0.89	$0.52	$0.25	$0.91	$0.46	$0.76	$3.13	$0.38	$0.02	$0.53
2022	$0.88	$0.51	$0.24	$0.88	$0.50	$0.75	$1.97	$0.36	$0.02	$0.51
2023	$0.90	$0.50	$0.24	$0.88	$0.49	$0.73	$2.03	$0.36	$0.02	$0.54
2024	$0.98	$0.49	$0.23	$0.51	$0.49	$0.72	$3.17	$0.21	$0.02	$0.52
2025	$0.96	$0.48	$0.23	$0.48	$0.48	$0.71	$3.18	$0.20	$0.02	$0.50
2026	$0.94	$0.47	$0.30	$0.07	$0.47	$0.69	$3.19	$0.03	$0.02	$0.67
2027	$0.92	$0.46	$0.36	$0.31	$0.46	$0.68	$3.20	$0.13	$0.03	$0.80
2028	$0.90	$0.46	$0.43	$0.24	$0.45	$0.66	$3.20	$0.10	$0.03	$0.92
2029	$0.88	$0.45	$0.49	$0.21	$0.44	$0.65	$3.21	$0.09	$0.04	$1.09
2030	$0.87	$0.44	$0.55	$0.17	$0.43	$0.64	$3.22	$0.07	$0.04	$1.21
2031	$0.85	$0.43	$0.60	$0.16	$0.42	$0.63	$3.22	$0.07	$0.04	$1.31
2032	$0.83	$0.42	$0.66	$0.17	$0.41	$0.61	$3.23	$0.07	$0.05	$1.50
2033	$0.82	$0.41	$0.71	$0.20	$0.41	$0.60	$3.24	$0.08	$0.05	$1.61
2034	$0.80	$0.40	$0.76	$0.24	$0.40	$0.59	$3.25	$0.10	$0.05	$1.71
2035	$0.78	$0.40	$0.81	$0.24	$0.39	$0.58	$3.25	$0.10	$0.06	$1.81
Levelized	**$0.88**	**$0.46**	**$0.45**	**$0.39**	**$0.45**	**$0.67**	**$3.04**	**$0.16**	**$0.03**	**$1.00**

Counterfactual #3 results

Table 70 shows the avoided cost of RPS compliance aggregated for all new and other categories. Table 71 and Table 72 provide additional detail, and display the avoided cost of RPS compliance, by year and by category, for both New and Existing RPS programs. All levelized values are 15-year levelized values.

Table 70. Avoided cost of RPS compliance for Counterfactual #3 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$7.50	$8.11	$6.66	$3.18	$16.77	$1.58
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.13	$5.49	$0.03	$2.86
Total	**$8.84**	**$8.56**	**$12.93**	**$8.67**	**$16.81**	**$4.44**

Table 71. Summary of avoided cost of RPS compliance, New RPS categories (2021 $ per MWh)

	CT-I	ME-I	ME-IA	ME-T	MA-I	MA CES	MA CPS
2021	$9.46	$2.36	$1.18	$0.01	$6.81	$1.30	$1.45
2022	$10.10	$4.38	$3.50	$0.02	$6.38	$1.05	$2.13
2023	$8.56	$3.55	$3.90	$0.03	$5.82	$0.00	$2.79
2024	$7.04	$2.52	$3.77	$0.04	$5.21	$0.00	$2.91
2025	$4.55	$1.68	$3.20	$0.05	$3.67	$0.00	$3.03
2026	$4.67	$1.50	$3.45	$0.06	$4.03	$0.00	$3.79
2027	$4.26	$1.37	$3.70	$0.07	$2.94	$0.00	$5.13
2028	$3.83	$1.25	$3.87	$0.08	$2.70	$0.00	$5.36
2029	$3.86	$1.21	$4.24	$0.08	$2.63	$0.00	$5.52
2030	$9.80	$2.50	$9.98	$0.09	$9.88	$0.00	$5.65
2031	$9.63	$2.43	$9.71	$0.09	$9.91	$0.00	$5.73
2032	$8.85	$2.36	$9.43	$0.09	$9.72	$0.00	$4.37
2033	$7.56	$1.89	$7.56	$0.09	$8.13	$0.00	$4.25
2034	$9.18	$2.30	$9.18	$0.08	$10.10	$0.00	$4.10
2035	$11.33	$2.81	$11.25	$0.08	$12.94	$0.00	$3.91
Levelized (2021-2035)	**$7.50**	**$2.28**	**$5.77**	**$0.06**	**$6.66**	**$0.17**	**$3.98**
	MA APS	**NH-I**	**NH-I Thermal**	**NH-II**	**RI-New**	**VT-II**	**VT-III**
2021	$0.26	$5.61	$2.49	$0.40	$9.31	$1.84	$1.59
2022	$0.26	$5.39	$2.64	$0.35	$13.29	$1.75	$1.81
2023	$0.27	$5.37	$2.80	$0.28	$17.53	$1.57	$2.04
2024	$0.28	$3.55	$2.67	$0.20	$10.82	$1.31	$1.68
2025	$0.28	$1.51	$2.53	$0.12	$8.00	$0.88	$1.12
2026	$0.29	$1.32	$2.24	$0.12	$9.98	$0.93	$1.16
2027	$0.29	$1.27	$1.97	$0.07	$14.83	$0.64	$0.79
2028	$0.30	$1.06	$1.74	$0.06	$14.03	$0.57	$0.70
2029	$0.30	$0.97	$1.54	$0.05	$15.66	$0.55	$0.67
2030	$0.31	$3.74	$1.36	$0.20	$24.45	$2.17	$2.64
2031	$0.31	$3.64	$1.20	$0.19	$23.78	$2.27	$2.74
2032	$0.32	$3.54	$1.05	$0.19	$23.10	$2.31	$2.78
2033	$0.32	$2.83	$0.93	$0.15	$18.52	$1.89	$2.27
2034	$0.32	$3.44	$0.82	$0.18	$22.50	$2.30	$2.76
2035	$0.33	$4.21	$0.73	$0.23	$28.36	$2.88	$3.45
Levelized (2021-2035)	**$0.30**	**$3.18**	**$1.80**	**$0.19**	**$16.77**	**$1.58**	**$1.86**

Table 72. Summary of avoided cost of RPS compliance, Existing RPS categories (2021 $ per MWh)

	CT-II	CT-III	ME-II	MA-II RE	MA-II WTE	MA CES-E	NH-III	NH-IV	RI-Existing	VT-I
2021	$0.89	$0.52	$0.25	$0.91	$0.46	$0.76	$3.18	$0.38	$0.02	$0.53
2022	$0.88	$0.51	$0.24	$0.88	$0.50	$0.75	$3.14	$0.36	$0.02	$0.51
2023	$0.90	$0.50	$0.24	$0.88	$0.49	$0.73	$3.16	$0.36	$0.02	$0.54
2024	$0.98	$0.49	$0.23	$0.88	$0.49	$0.72	$3.17	$0.36	$0.02	$0.52
2025	$0.96	$0.48	$0.23	$0.55	$0.48	$0.71	$3.18	$0.23	$0.02	$0.50
2026	$0.94	$0.47	$0.30	$0.53	$0.47	$0.69	$3.19	$0.22	$0.02	$0.67
2027	$0.92	$0.46	$0.36	$0.45	$0.46	$0.68	$3.20	$0.19	$0.03	$0.80
2028	$0.90	$0.46	$0.43	$0.38	$0.45	$0.66	$3.20	$0.16	$0.03	$0.92
2029	$0.88	$0.45	$0.49	$0.37	$0.44	$0.65	$3.21	$0.15	$0.04	$1.09
2030	$0.87	$0.44	$0.55	$0.88	$0.43	$0.64	$3.22	$0.36	$0.04	$1.21
2031	$0.85	$0.43	$0.60	$0.87	$0.42	$0.63	$3.22	$0.36	$0.04	$1.31
2032	$0.83	$0.42	$0.66	$0.80	$0.41	$0.61	$3.23	$0.33	$0.05	$1.50
2033	$0.82	$0.41	$0.71	$0.68	$0.41	$0.60	$3.24	$0.28	$0.05	$1.61
2034	$0.80	$0.40	$0.76	$0.83	$0.40	$0.59	$3.25	$0.34	$0.05	$1.71
2035	$0.78	$0.40	$0.81	$0.88	$0.39	$0.58	$3.25	$0.36	$0.06	$1.81
Levelized	**$0.88**	**$0.46**	**$0.45**	**$0.72**	**$0.45**	**$0.67**	**$3.20**	**$0.30**	**$0.03**	**$1.00**

Counterfactual #4 results

Table 73 shows the avoided cost of RPS compliance aggregated for all new and other categories. Table 74 and Table 75 provide additional detail, and display the avoided cost of RPS compliance, by year and by category, for both New and Existing RPS programs. All levelized values are 15-year levelized values.

Table 73. Avoided cost of RPS compliance for Counterfactual #3 (2021 $ per MWh)

	CT	ME	MA	NH	RI	VT
Class 1/New	$7.50	$8.11	$6.66	$3.18	$16.77	$1.58
MA CES & CPS	-	-	$4.14	-	-	-
All Other Classes	$1.34	$0.45	$2.13	$5.49	$0.03	$2.86
Total	**$8.84**	**$8.56**	**$12.93**	**$8.67**	**$16.81**	**$4.44**

Table 74. Summary of avoided cost of RPS compliance, New RPS categories (2021 $ per MWh)

	CT-I	ME-I	ME-IA	ME-T	MA-I	MA CES	MA CPS
2021	$9.46	$2.36	$1.18	$0.01	$6.81	$1.30	$1.45
2022	$10.10	$4.38	$3.50	$0.02	$6.38	$1.05	$2.13
2023	$8.56	$3.55	$3.90	$0.03	$5.82	$0.00	$2.79
2024	$7.04	$2.52	$3.77	$0.04	$5.21	$0.00	$2.91
2025	$4.55	$1.68	$3.20	$0.05	$3.67	$0.00	$3.03
2026	$4.67	$1.50	$3.45	$0.06	$4.03	$0.00	$3.79
2027	$4.26	$1.37	$3.70	$0.07	$2.94	$0.00	$5.13
2028	$3.83	$1.25	$3.87	$0.08	$2.70	$0.00	$5.36
2029	$3.86	$1.21	$4.24	$0.08	$2.63	$0.00	$5.52
2030	$9.80	$2.50	$9.98	$0.09	$9.88	$0.00	$5.65
2031	$9.63	$2.43	$9.71	$0.09	$9.91	$0.00	$5.73
2032	$8.85	$2.36	$9.43	$0.09	$9.72	$0.00	$4.37
2033	$7.56	$1.89	$7.56	$0.09	$8.13	$0.00	$4.25
2034	$9.18	$2.30	$9.18	$0.08	$10.10	$0.00	$4.10
2035	$11.33	$2.81	$11.25	$0.08	$12.94	$0.00	$3.91
Levelized (2021-2035)	**$7.50**	**$2.28**	**$5.77**	**$0.06**	**$6.66**	**$0.17**	**$3.98**
	MA APS	**NH-I**	**NH-I Thermal**	**NH-II**	**RI-New**	**VT-II**	**VT-III**
2021	$0.26	$5.61	$2.49	$0.40	$9.31	$1.84	$1.59
2022	$0.26	$5.39	$2.64	$0.35	$13.29	$1.75	$1.81
2023	$0.27	$5.37	$2.80	$0.28	$17.53	$1.57	$2.04
2024	$0.28	$3.55	$2.67	$0.20	$10.82	$1.31	$1.68
2025	$0.28	$1.51	$2.53	$0.12	$8.00	$0.88	$1.12
2026	$0.29	$1.32	$2.24	$0.12	$9.98	$0.93	$1.16
2027	$0.29	$1.27	$1.97	$0.07	$14.83	$0.64	$0.79
2028	$0.30	$1.06	$1.74	$0.06	$14.03	$0.57	$0.70
2029	$0.30	$0.97	$1.54	$0.05	$15.66	$0.55	$0.67
2030	$0.31	$3.74	$1.36	$0.20	$24.45	$2.17	$2.64
2031	$0.31	$3.64	$1.20	$0.19	$23.78	$2.27	$2.74
2032	$0.32	$3.54	$1.05	$0.19	$23.10	$2.31	$2.78
2033	$0.32	$2.83	$0.93	$0.15	$18.52	$1.89	$2.27
2034	$0.32	$3.44	$0.82	$0.18	$22.50	$2.30	$2.76
2035	$0.33	$4.21	$0.73	$0.23	$28.36	$2.88	$3.45
Levelized (2021-2035)	**$0.30**	**$3.18**	**$1.80**	**$0.19**	**$16.77**	**$1.58**	**$1.86**

Table 75. Summary of avoided cost of RPS compliance, Existing RPS categories (2021 $ per MWh)

	CT-II	CT-III	ME-II	MA-II RE	MA-II WTE	MA CES-E	NH-III	NH-IV	RI-Existing	VT-I
2021	$0.89	$0.52	$0.25	$0.91	$0.46	$0.76	$3.18	$0.38	$0.02	$0.53
2022	$0.88	$0.51	$0.24	$0.88	$0.50	$0.75	$3.14	$0.36	$0.02	$0.51
2023	$0.90	$0.50	$0.24	$0.88	$0.49	$0.73	$3.16	$0.36	$0.02	$0.54
2024	$0.98	$0.49	$0.23	$0.88	$0.49	$0.72	$3.17	$0.36	$0.02	$0.52
2025	$0.96	$0.48	$0.23	$0.55	$0.48	$0.71	$3.18	$0.23	$0.02	$0.50
2026	$0.94	$0.47	$0.30	$0.53	$0.47	$0.69	$3.19	$0.22	$0.02	$0.67
2027	$0.92	$0.46	$0.36	$0.45	$0.46	$0.68	$3.20	$0.19	$0.03	$0.80
2028	$0.90	$0.46	$0.43	$0.38	$0.45	$0.66	$3.20	$0.16	$0.03	$0.92
2029	$0.88	$0.45	$0.49	$0.37	$0.44	$0.65	$3.21	$0.15	$0.04	$1.09
2030	$0.87	$0.44	$0.55	$0.88	$0.43	$0.64	$3.22	$0.36	$0.04	$1.21
2031	$0.85	$0.43	$0.60	$0.87	$0.42	$0.63	$3.22	$0.36	$0.04	$1.31
2032	$0.83	$0.42	$0.66	$0.80	$0.41	$0.61	$3.23	$0.33	$0.05	$1.50
2033	$0.82	$0.41	$0.71	$0.68	$0.41	$0.60	$3.24	$0.28	$0.05	$1.61
2034	$0.80	$0.40	$0.76	$0.83	$0.40	$0.59	$3.25	$0.34	$0.05	$1.71
2035	$0.78	$0.40	$0.81	$0.88	$0.39	$0.58	$3.25	$0.36	$0.06	$1.81
Levelized	**$0.88**	**$0.46**	**$0.45**	**$0.72**	**$0.45**	**$0.67**	**$3.20**	**$0.30**	**$0.03**	**$1.00**

8. NON-EMBEDDED ENVIRONMENTAL COSTS

Some environmental costs are embedded (economists would say "internalized") in energy prices through regulations that require expenditures to reduce emissions. Other environmental impacts, which also impose real damages on society, are not embedded in prices. Non-embedded costs are (by definition) not included in the AESC 2021 modeling of avoided energy costs. In contrast, costs associated with RGGI, SO_2 regulation programs, and Massachusetts' 310 CMR 7.74 regulation are included in the AESC 2021 modeling of energy prices and thus impact the avoided energy costs in a quantifiable way (see Section 4.8: *Embedded emissions regulations* for a discussion of how these costs are modeled).

For the AESC 2021 Study, we estimate values for some of the principal non-embedded environmental costs. Here we address two such categories: the non-embedded portion of GHG impacts, and the costs of NO_X emissions.

Because different states participating in the AESC study have differing policy contexts, we offer several different options and approaches for calculating the non-embedded GHG cost. AESC 2021 provides these approaches to enable individual states to address specific policy directives regarding GHG impacts. Table 76 and Table 77 compares these four values to values described in AESC 2018.

- A "damage cost" approximated by the social cost of carbon (SCC). There are many different options for a social cost of carbon. The Synapse Team recommends using a value that applies low discount rates, considers global damages, and considers the impact of high-risk situations. One source for this value is the December 2020 SCC Guidance published by the State of New York. Using a 2 percent discount rate (the one also recommended by New York for most decision-making), we recommend a 15-year levelized SCC of $128 per short ton in AESC 2021. We also recommend that program administrators continually review this value (e.g., for the purposes of mid-term modifications), as updates to the federally-recommended SCC are expected in early 2022.

- An approach based on global marginal abatement costs. In AESC 2021, we estimate a total environmental cost based on the cost of large-scale CCS equal to $92 per short ton of CO_2-eq. This is lower than the $105 per short ton of CO_2-eq value (in 2021 dollars) described in AESC 2018. This lower cost reflects the declining costs of this technology.

- An approach based on New England marginal abatement costs, assuming a cost derived from electric sector technologies. In AESC 2021, this is a total environmental cost of $125 per short ton of CO_2-eq emissions, based on a projection of future cost trajectories for offshore wind energy along the eastern seaboard. This compares to a cost of $72 per short ton of CO_2-eq emissions (in 2021 dollars) based on a projection of future costs of offshore wind energy, as described in AESC 2018. This increased cost reflects updated information on this technology in the United States, as well as lower energy costs in this edition of AESC.

- An approach based on New England marginal abatement costs, assuming a cost derived from multiple sectors. In AESC 2021, this is a total environmental cost of $493 per short ton of CO_2-eq emissions, based on a projection of future cost trajectories for RNG derived from power-to-gas technology. This approach may be useful for policymakers who are considering more ambitious carbon reduction targets (e.g., 90 percent or 100 percent reductions by 2050).

Table 76. Comparison of GHG costs under different approaches (2021 $ per short ton) in Counterfactual #1

	AESC 2018	AESC 2021	Difference	% Difference
Social cost of carbon (SCC or "damage cost") at 2% discount rate	Not quantified	$128	-	-
Global marginal abatement cost	$105	$92	-$13	-12%
New England-based marginal abatement cost, derived from the electric sector	$72	$125	$53	75%
New England-based marginal abatement cost, derived from multiple sectors	Not calculated	$493	-	-

Notes: All values shown are levelized over 15 years. All AESC 2021 values except the SCC are levelized using a 0.81 percent discount rate (SCC uses a 2.0 percent discount rate). All AESC 2018 values are levelized using a 1.34 percent discount rate, then converted into 2021 dollars. In AESC 2018, damage costs were discussed, but not quantified. AESC 2018 did not discuss or estimate a New England-based marginal abatement cost derived from multiple sectors. Values shown above remove energy prices, but not embedded costs. Values shown above do not include losses.

Table 77. Comparison of GHG costs under different approaches (2021 cents per kWh) in Counterfactual #1

	AESC 2018	AESC 2021	Difference	% Difference
Social cost of carbon (SCC or "damage cost") at 2% discount rate	Not quantified	4.87	-	-
Global marginal abatement cost	4.64	3.41	-1.23	-26%
New England-based marginal abatement cost, derived from the electric sector	2.83	4.74	1.91	67%
New England-based marginal abatement cost, derived from multiple sectors	Not calculated	19.72	-	-

Notes: Values shown above remove embedded costs (e.g., RGGI, MA 310 7.74, MA 310 7.75. All values are quoted using a summer on-peak seasonal marginal emission rate, and include a 9 percent energy loss factor.

AESC users may wish to include a non-embedded cost to fully account for the cost of GHG impacts or GHG abatement. In order to do this, users must first subtract out the RGGI cost (in Connecticut, Maine, New Hampshire, Rhode Island, or Vermont) or both the RGGI cost and 310 CMR 7.74 cost (in Massachusetts only) from the relevant GHG emission cost to determine the remaining cost that is non-embedded. The non-embedded NO_X cost may be simply added to the energy cost, as we do not model an embedded NO_X cost in AESC 2021. We find a non-embedded NO_X emission cost of $14,700 per short ton of NO_X, based on a review of findings in the literature.

See Appendix B: *Detailed Electric Outputs* and Appendix G: *Marginal Emission Rates and Non-embedded Environmental Cost Detail* for more detail on this topic.

8.1. Non-embedded GHG costs

Costs of GHG emissions are partially embedded in prices through RGGI allowances, state regulations such as 310 CMR 7.74 and 310 CMR 7.75 in Massachusetts, and federal policies such as the previously proposed Clean Power Plan. However, the costs embedded by these policies represent only a portion of the total environmental impacts of GHG emissions. Therefore, we estimate the total cost of GHG emissions; the non-embedded portion is the difference between our total cost estimates and the smaller, embedded portion of GHG impacts. Because different states participating in the AESC study have differing policy contexts, we offer several different options and approaches for calculating the non-embedded GHG cost. Because of the time horizon of modeling in AESC 2021, our costs are focused on the likely costs expected in the timeframe of 2021 through 2035.

There are two leading methods for estimating environmental costs: based on damage costs or based on marginal abatement costs. (In the idealized market of textbook economics, the two would coincide; in the real world, they are not necessarily identical.)

Social cost of carbon (damage cost)

The SCC attempts to monetize the current and future damages resulting from CO_2 emissions.[190] Policymakers can use this value to assess policies that address climate change. Developing a reasonable value for the SCC can be a complex endeavor. This section describes the SCC promulgated and used by the U.S. federal government, as well as SCC studies and guidelines by other parties. This section closes with an SCC recommendation for users of AESC.

Federal agency consideration of the SCC

In a series of analyses beginning in 2009, the Obama Administration convened an Interagency Working Group (IWG) to develop a recommendation for an SCC value to use in decision-making by federal agencies. The revised technical support document published in August 2016 relies on outputs from three different integrated assessment models (IAM) to develop sets of SCC values.[191] These different sets of values vary according to the discount rate used (i.e., how heavily future damages are discounted) and whether or not they include lower-probability, higher-impact values. The Obama Administration issued a central recommendation of a 3 percent discount rate, without the inclusion of higher-impact values. This yields an SCC value of $49 per short ton of CO_2 in 2021, (in 2021 dollars). These values escalate over time; by 2050, these values are 1.7 times larger than the 2020 values, in real-dollar terms.

[190] In most contexts, the SCC is recommended to also be applied to other GHGs (e.g., methane, nitrous oxides). In these situations, the SCC is converted using a series of calculations that seek to estimate the equivalent impacts of disparate GHGs. For purposes of simplification, this text makes reference to "SCC" only, although this value should appropriately be converted and applied to other GHG emissions as necessary.

[191] Interagency Working Group on Social Cost of Greenhouse Gases. August 2016. *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866.* Available at https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf.

In 2017, the Trump Administration issued guidance to update the SCC estimate that only included domestic impacts of carbon emissions and to recommend discount rates from 3 to 7 percent. At the lower bound of 3 percent, the Trump Administration estimated the SCC to be $7 per short ton of carbon dioxide in 2020 (in 2021 dollars). This value is just one-seventh of the Obama Administration's estimate. At a discount rate of 7 percent, the Trump Administration found an SCC of $1 per short ton of carbon dioxide in 2020 (in 2021 dollars).[192] The issue with measuring only domestic damages of carbon, however, is that the emissions quickly spread on a global scale and contribute to climate change impacts around the world. Moreover, high discount rates such as 7 percent are a way to reflect returns on capital, rather than climate change impacts for future generations.[193]

In February 2021, the Biden Administration issued its draft guidance for the SCC.[194] The draft guidance rescinds the 2019 draft GHG guidance issued by the Trump Administration, effectively rejecting the 7 percent discount rate and the notion that climate change damages caused by U.S. emissions but suffered in other countries should be ignored. The Biden Administration has stated that it intends to re-convene the IWG, re-estimate the SCC, and re-issue new guidance on a federal SCC in January 2022. We should anticipate that the update will reflect recent information and analysis of climate impacts, valuation of damages, and discounting. The February 2021 guidance states that, "[I]n the interim, agencies should consider all available tools and resources in assessing GHG emissions and climate change effects of their proposed actions, including, as appropriate and relevant, the 2016 GHG Guidance."[195]

Other SCC recommendations

The federal IWG SCC is one among many SCC calculations. Some other calculations of the SCC use one of the identical models used by the IWG, but update key parameters.[196] Yet other calculations of the SCC utilize different models and also take low-probability but higher-impact costs into account (see, for

[192] U.S. Government Accountability Office. June 2020. *Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis.* Available at https://www.gao.gov/assets/gao-20-254.pdf. See Page 57, Table 10.

[193] U.S. Government Accountability Office. June 2020. *Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis.* Available at https://www.gao.gov/assets/gao-20-254.pdf. See Page 32.

[194] Council on Environmental Quality. February 19, 2021. "National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions." *Federalregister.gov.* Available at https://www.federalregister.gov/documents/2021/02/19/2021-03355/national-environmental-policy-act-guidance-on-consideration-of-greenhouse-gas-emissions.

[195] Executive Office of the President. January 20, 2021. "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." *Federalregister.gov.* Available at https://www.federalregister.gov/documents/2021/01/25/2021-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis.

[196] Nordhaus, W.D. 2017. "Revisiting the social cost of carbon." *Proceedings of the National Academy of Sciences,* 114 (7) 1518-1523; DOI: 10.1073/pnas.1609244114. https://doi.org/10.1073/pnas.1609244114 and Hansel, C. M. et al. 2020. "Climate economics support for the UN climate targets." *Nature Climate Change*. http://acdc2007.free.fr/hansel720.pdf.

example the 2014 meta-analysis described in AESC 2018).[197] These studies may also recommend the use of lower discount rates than those analyzed by the IWG.[198] While high discount rates may be useful in contexts relating to financial rates of return, lower discount rates are thought to be more ethically compatible with preserving the planet for future generations of humanity, and thus more appropriate for an SCC. Still other calculations may be derived through other means, including meta-analysis of other research.[199] Depending on the year being described and discount rate used, SCCs in these studies range from roughly $53 to $820 per short ton of CO_2 (in 2021 dollars). We note there are also published recommendations on the SCC that do not necessarily specify values, but instead suggest best practices for performing the calculation.[200]

Generally speaking, experts examining or calculating an SCC typically recommend using reasonable, low discount rates; evaluating the SCC with a global perspective; and including the evaluation of low-probability, high-impact events in either the "main" SCC being recommended or in separate sensitivities.

New York State Social Cost of Carbon Guideline

In December 2020, the New York State Department of Environmental Conservation released a guideline document titled "Establishing a Value of Carbon" (the NYS SCC Guideline).[201] This document provides a range of carbon values as well as guidance for state entities on which values to use. Most notably, the NYS SCC Guideline recommends using the values identified as an interim SCC by the Biden Administration in February 2021 (and previously issued by the Obama Administration in 2016), but with a different range of discount rates. We discuss this guidance document in detail due to New York's similar energy landscape and policy context to the six New England states.

The NYS SCC Guideline recommends basing the SCC on the estimations calculated by the federal IWG in 2016 and identified as interim in 2021, as these use a global scope of emissions impacts and estimate impacts through the year 2300. As described above, the federal IWG uses an average SCC from three different IAMs models to provide robustness to the final calculation. The NYS SCC Guideline also recommends that the full scope of impacts of all relevant GHGs (e.g., methane, nitrous oxide) should be considered, not just CO_2. This is necessary to ensure that reducing one type of emissions does not transfer the pollution to another emission or jurisdiction. Similarly, the NYS SCC Guideline explains the

[197] J.X.J.M. van den Bergh and W.J.W. Botzen (2014), "A lower bound to the social cost of CO_2 emissions," *Nature Climate Change* 4, 253-258

[198] Stern, N., and J. E. Stiglitz. 2021. "The Social Cost of Carbon, Risk, Distribution, Market Failures: An Alternative Approach." NBER Working Paper Series. http://www.nber.org/papers/w28472

[199] Richard S J Tol, 2018. "The Economic Impacts of Climate Change." *Review of Environmental Economics and Policy*, Volume 12, Issue 1, Pages 4–25, https://doi.org/10.1093/reep/rex027. Also available at https://academic.oup.com/reep/article/12/1/4/4804315#110883856.

[200] National Academies of Sciences, Engineering, and Medicine. 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24651.

[201] New York State Department of Environmental Conservation. 2020. *Establishing a Value of Carbon: Guidelines for Use by State Agencies.* Available at: https://www.dec.ny.gov/docs/administration_pdf/vocfguid.pdf

necessity of considering the global impact of emissions, as carbon impacts are not localized. Furthermore, the NYS SCC Guideline recommends staying up-to-date with peer-reviewed literature related to the SCC to ensure the most accurate cost estimates. Finally, the NYS SCC Guideline encourages the use of an appropriate discount rate, different from the range in the IWG document.

While the federal IWG provides SCC values using discount rates of 2.5 percent, 3 percent, and 5 percent (with a "central" identified value of 3 percent) the NYS SCC Guideline recommends calculating the SCC at a discount rate of 1 percent, 2 percent, and 3 percent to understand the range of potential SCC values.[202] In particular, the NYS SCC Guideline also recommends using a central discount rate of no more than 2 percent for decision-making. The NYS SCC Guideline recommends relying on the central discount rate of 2 percent or less for several reasons:

- First, higher discount rates are more appropriate for evaluating private investments, while the issues here are about long-term impacts to the public from global climate change.
- Second, the NYS SCC Guideline points out that recent research has found that the federal IWG underestimates the value of avoiding emissions damages (see discussion above on other estimates of the SCC that utilize the same methodology as the IWG, but update key input parameters). The NYS SCC Guideline notes that the federal IWG estimates do not fully account for damages from high-impact events or climatic tipping points, and that these damages could be accounted for through the use of lower discount rates.
- Third, the NYS SCC Guideline does not recommend using a discount rate of 0 percent at this time. A discount rate of 0 percent values the present and future equally, which is potentially not representative of how society values the present and future.
- Fourth, the NYS SCC Guideline notes that, "Experts now generally consider a range of 1–3 percent to be more acceptable." A 2 percent discount rate is the central value of this range.

As a result, the NYS SCC Guideline recommends a discount rate of no more than 2 percent, as this will best account for public safety and welfare and significant environmental impacts, while recognizing some difference in societal value between the present and the long-term future. The NYS SCC Guideline notes that "[a]dditional approaches such as declining discount rates and providing estimates at the 95th percentile of the central value could also be considered by the Department in the future as more review and refinement of the estimates occur." Accordingly, the NYS SCC Guideline recommends an SCC of

[202] It is theoretically possible to calculate an SCC using any discount rate, rather than the ones enumerated here. However, the application of discount rates in the SCC calculation happens fairly early in the methodology, meaning that users of the SCC are limited to the use of the SCCs calculated using the published discount rates.

$116 per short ton of CO_2 at a 2 percent discount rate (in 2021 dollars), escalating over time.[203] On a 15-year levelized basis, this SCC is equal to $128 per short ton of CO_2.

Recommendation for AESC 2021

Table 78 summarizes the NYS SCC Guideline values across time and provides a levelized 15-year value for each of the three series. We recommend that users of AESC rely on the SCC values shown in the column based on the 2 percent discount rate, with SCC values ranging from $116 (in 2020) to $165 (in 2050) in 2021 dollars per short ton of CO_2, and a 15-year levelized value of $128 per short ton. We recommend the use of a central value of 2 percent for the discount rate in line with the NYS SCC Guideline. This SCC value is likely to be suitable for use in New England states that consider the social cost of GHGs in cost-effectiveness planning, since the New England states are similar to New York in terms of energy landscape and policy context. Moreover, the NYS SCC Guideline values consider the global impact of emissions, use reasonable discount rates, and consider high-impact events through low discount rates. Analyses since the August 2016 IWG report support expectations of greater damages from climate change and the use of lower discount rates. For example, a survey of approximately 200 experts found a mean recommended social discount rate (SDR) of 2 percent, and that "[m]ore than 90 percent are comfortable with a SDR somewhere in the interval of 1 percent to 3 percent."[204]

Note that the discount rate we recommend for the SCC is different than the discount rate used elsewhere in AESC. For the SCC, we recommend the use of a 2 percent discount rate, as this discount rate is based in part on an ethical consideration of the value of future generations of humanity, rather than derived from observations in the financial markets (such as treasury bill rates or utility rates of return, which are largely unrelated to considerations important to the SCC).[205] Other values described in Table 78 may be useful to examine in sensitivity testing of program or measure cost-effectiveness.

[203] New York State Department of Environmental Conservation. 2020. *Appendix: Value of Carbon.* Available at: https://www.dec.ny.gov/docs/administration_pdf/vocfapp.pdf. Values were originally reported in 2020 dollars per metric ton; here, they have been converted into 2021 dollars per short ton using AESC 2021's deflator.

[204] Drupp, M.A., M.C. Freeman, B. Groom, F. Nesje. 2018. "Discounting Disentangled." *American Economic Journal: Economic Policy*, November, page 33.

[205] We note that the original 2003 methodology used to calculate a 3 percent discount rate involved subtracting the 30-year average of year-on-year CPI changes (1973 through 2002) from the 30-year average of 10-year U.S. Treasury yields (1973 through 2002). Using the data currently available from the U.S. Treasury and the Bureau of Labor Statistics, we calculate an implied discount rate of 3.01 percent, which rounds to 3 percent. When this same methodology is applied to a more recent 30-year period spanning 1991 through 2020, we calculate an implied discount rate of 2.02 percent, which rounds to 2 percent. In short, even if one were to rely exclusively on financial markets to determine an appropriate discount rate for the social cost of carbon, it would be appropriate to use a 2 percent discount rate rather than a 3 percent discount rate.

Obama White House Archives. Last accessed March 11, 2021. "Circular A-4." Obamawhitehouse.org. Available at https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/.

U.S. Department of Treasury. Last accessed March, 11. 2021. "Daily Treasury Yield Curve Rates." *Treasury.gov.* Available at https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield.

U.S. Bureau of Land Statistics. Last accessed March 11, 2021. "Historical Consumer Price Index for All Urban Consumers." *Bls.gov.* Available at https://www.bls.gov/cpi/tables/supplemental-files/historical-cpi-u-202101.pdf.

Importantly, we note that this is the recommendation being made by the AESC authors at the time of this report's writing. It is possible—even likely—that this value will change as new information becomes available. Such new information may include new data on high-impact events and climate change risks and feedbacks, information about time preference and discount rates, updated model input parameters, or other factors. This information may be promulgated by the federal government in the course of the Biden Administration's final SCC rulemaking, due to be released in January 2022, or from independent assessments published by various third parties. We recommend that program administrators continually review this value and potentially revisit an update to this value for mid-term modification purposes in early 2022.

Whenever possible, we also recommend considering the full scope of emissions impacts and the effect on non-carbon emissions to ensure one pollutant is not replaced by another.

Table 78. Comparison of social costs of carbon at varying discount rates from NYS SCC Guideline and federal IWG (2021 dollars per short ton)

	3.0%	2.0%	1.0%
2020	$49	$116	$390
2021	$49	$118	$391
2022	$51	$119	$394
2023	$52	$120	$396
2024	$53	$122	$399
2025	$55	$124	$401
2026	$56	$125	$403
2027	$56	$127	$405
2028	$57	$129	$408
2029	$57	$130	$410
2030	$59	$131	$413
2031	$60	$133	$415
2032	$61	$135	$416
2033	$62	$136	$419
2034	$64	$138	$421
2035	$65	$140	$424
2036	$66	$142	$426
2037	$68	$143	$428
2038	$68	$144	$430
2039	$69	$146	$432
2040	$70	$148	$434
2041	$72	$150	$437
2042	$72	$152	$440
2043	$73	$154	$442
2044	$74	$155	$445
2045	$75	$157	$447
2046	$77	$158	$449
2047	$78	$160	$451
2048	$79	$162	$452
2049	$81	$163	$454
2050	$81	$165	$456
15-year levelized	**$57**	**$128**	**$407**

Sources and notes: Values are obtained from https://www.dec.ny.gov/docs/administration_pdf/vocfapp.pdf. All values have been converted into 2021 dollars per short tons. Value streams are shown from lowest to highest, left to right. All levelization calculations were performed using each column's noted discount rate.

Marginal abatement costs

A second approach to pricing carbon is the marginal abatement cost method. This method asserts that the value of damages avoided, at the margin, must be at least as great as the cost of the most expensive abatement technology used in a comprehensive strategy for emission reduction.

There are two interpretations of marginal abatement costs, leading to different cost estimates. On the one hand, GHGs are a global problem: because they are persistent and well-mixed in the atmosphere, emissions anywhere affect climate change everywhere. This suggests an international perspective—identifying the marginal abatement cost on a least-cost global scenario for emission reduction. On the other hand, New England states have set their own targets for GHG emission reduction and are developing regional strategies for meeting those targets that may only include the deployment of certain technologies. This suggests a local perspective, identifying the marginal abatement cost on a local scenario for meeting regional emission reduction targets.

International perspective

Previous AESC studies (AESC 2013, AESC 2015, and AESC 2018) all arrived at the conclusion that CCS was the marginal abatement technology in many global scenarios for climate mitigation. These global scenarios often consider both electric and non-electric measures, meaning CCS is the marginal economy-wide technology. In AESC 2018, we determined this value had a total cost of $100 per short ton (in 2018 dollars), according to a 2015 meta-analysis of CCS costs.[206] The latest data assembled by NREL in its 2020 release of the ATB suggests this number has decreased since that study took place.[207] According to this study, a natural gas combined cycle (NGCC) power plant running at an average capacity factor built with CCS has an incremental cost of $29 per MWh versus a standard NGCC running at the same capacity factor (in 2018 dollars). Under this report's assumptions, a CCS system is capable of avoiding 90 percent of carbon emissions, producing an avoided emissions rate of 0.33 short tons per MWh. Dividing $29 per MWh by 0.33 short tons per MWh yields an incremental cost of $88 per short ton (in 2018 dollars). In 2021 dollars, this is a cost of $92 per short ton. This is our international perspective estimate.

Local perspective

AESC 2021 proposes two different local marginal abatement costs for New England states with different policy contexts.

[206] Edward S. Rubin, John E. Davison and Howard J. Herzog (2015), "The cost of CO_2 capture and storage," *International Journal of Greenhouse Gas Control*, https://www.cmu.edu/epp/iecm/rubin/PDF%20files/2015/Rubin_et_al_ThecostofCCS_IJGGC_2015.pdf. The estimate cited here is the midpoint of the range in Table 16, line 1 (stated as $59 - $143 per metric ton in 2013 dollars).

[207] NREL (National Renewable Energy Laboratory). 2020. 2020 Annual Technology Baseline. Golden, CO: National Renewable Energy Laboratory. Available at https://atb.nrel.gov/electricity/2020/data.php.

Derived from the electric sector

AESC 2018 proposed an electric-sector technology as the marginal abatement technology in New England, as it assumed that all end-uses would need to be electrified and then powered by zero- or low-carbon electric-sector technologies in order to achieve substantial GHG emission reductions. In AESC 2018, we determined that the most appropriate marginal abatement technology for New England was offshore wind.

After reviewing recent literature on this topic, under the AESC counterfactual paradigm, we find that offshore wind remains the best estimate from a local perspective. Conventionally, marginal abatement technologies are identified through comparative analysis of technology costs (measured in dollars-per-ton abated) and potentials (measured in total potential tons to abate). It is expensive and challenging to define a regional marginal abatement technology for four reasons:

- First, prices of technologies change over time as technologies improve and new policies come into effect.
- Second, technology potentials change over time as new data becomes available, as technologies improve, and as new resources are constructed (thereby decreasing the amount of future emissions-reducing potential).
- Third, the “demand” for future emission reductions is not always known. Some states may have defined emission reduction goals, targets, or requirements for some years, but not all years being considered. Other states may not identify emission reduction targets for the sectors of interest to AESC, or may be ambiguous in terms of how “required” these emission reductions are.
- Finally, in an ideal world, this exercise would be performed for every year being considered for analysis. This temporal aspect complicates each of the factors described above.

Given that AESC 2021 does not have the scope or time available to perform an exhaustive marginal abatement estimate, we look to the literature. One 2019 study, relying in part on cost and potentials data assembled by the Synapse Team in AESC 2018, found that in 2030 offshore wind represents about half of the overall emissions reduction potential for Massachusetts.[208] Furthermore, if this same study were performed absent the resources being tested for cost-effectiveness with AESC 2021 (e.g., future energy efficiency or electrification), we would likely find offshore wind to be the marginal resource.[209] Because of offshore wind’s large resource potential, it is likely to be the marginal resource in any

[208] Stanton, E., T. Stasio, B.Woods. 2019. *Marginal Cost of Emissions Reductions in Massachusetts.* Applied Economics Clinic for the Green Energy Consumers Alliance. Available at https://static1.squarespace.com/static/5936d98f6a4963bcd1ed94d3/t/5de5363d20783a433fff5ffe/1575302718557/Marginal+Cost+of+Emissions+Reductions+in+Massachusetts_Nov+2019.pdf.

[209] Other information may be available from a forthcoming climate policy sensitivity. See Chapter 12: *Sensitivity Analysis* for more information.

number of scenarios that test the sensitivity of marginality to variables like prices, potentials, states considered to have "required" emission reductions, and year being considered for marginality.

With this under consideration, the Synapse Team performed a review of the literature to develop an up-to-date forecast of offshore wind prices over the AESC 2021 study period. In October 2020, NREL published its *2019 Offshore Wind Technology Data Update*, which contained the levelized adjusted strike prices for over 30 different offshore wind auctions across the United States and Europe.[210] The NREL strike price refers to the contract price agreed upon by the buyer and seller of energy for a given project. This price is typically tied to a specific contract length, represents what the project will be paid for the energy and other benefits, and likely includes some profit margin for the developer. In this document, NREL has adjusted all strike prices to include grid connection and development costs in order to ensure an apples-to-apples comparison across projects. NREL has also accounted for differences in contract length by converting the annual strike price to a present value. Since this report contains strike price data for projects with estimated online dates between 2020 and 2025, we used the average cost in each year to develop our price forecast.

In order to project how the cost of offshore wind could change after 2025, we referenced NREL's most recent ATB.[211] NREL releases a new version of the ATB each year as a way to track how improvements in R&D and supply chain can affect technology costs and performance assumptions. One of the metrics provided in the ATB is the levelized cost of energy. This metric uses the projected technology cost and performance to calculate the total costs as spread out over the total anticipated energy generation. NREL's moderate technology innovation scenario projects a decrease in offshore wind's levelized cost of energy over time, largely due to increasing turbine sizes and increased efficiency in the supply chain. This year-over-year cost decline was used in conjunction with the average strike price from 2025 to develop a more forward-looking trend out through 2035.[212] Figure 45 shows the offshore wind price trajectory used to calculate the marginal abatement cost over the AESC 2021 study period. Price data for Mayflower wind was adjusted based on new information pertaining to the extended investment tax credit released in January 2021.[213]

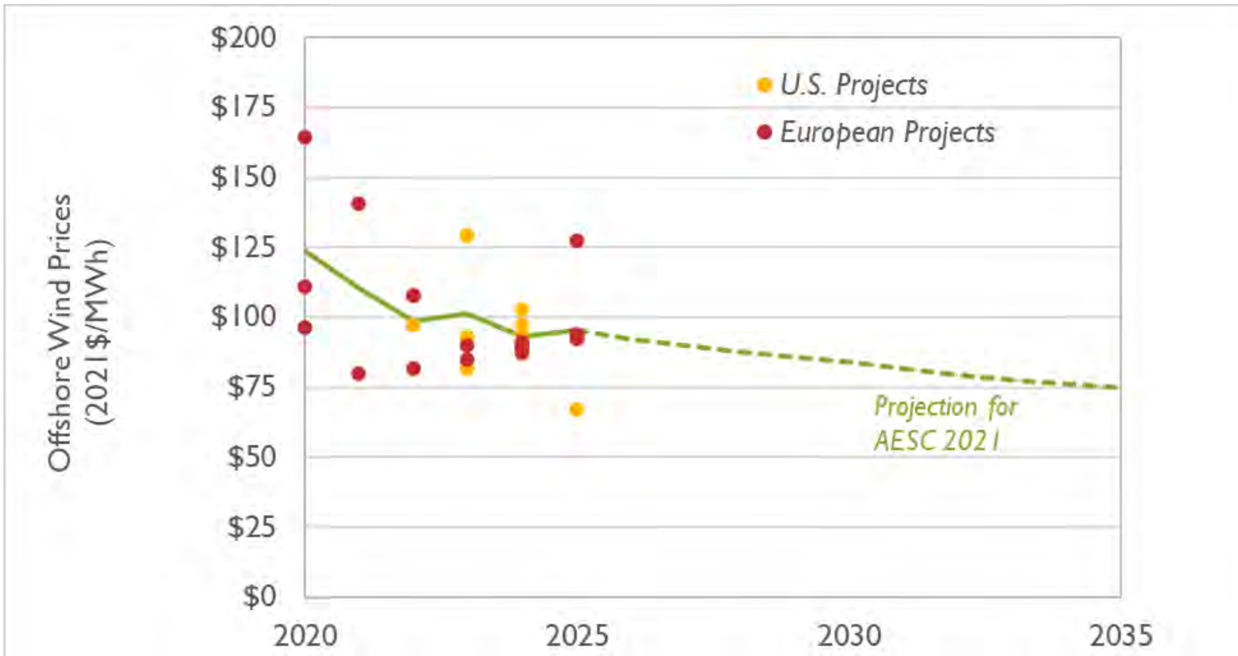
[210] NREL (National Renewable Energy Laboratory). 2020. *2019 Offshore Wind Technology Data Update.* Available at https://www.nrel.gov/docs/fy21osti/77411.pdf.

[211] NREL (National Renewable Energy Laboratory). 2020. "2020 Annual Technology Baseline." Available at: https://atb.nrel.gov/electricity/2020/about.php

[212] We referenced the levelized cost of energy trajectory that assumed the "Market + Policies" financial case, a moderate technology innovation scenario, and the default technology class. The Market + Policies case considers federal tax credits and debt interest rates. Class 3 was selected as the default technology class by NREL because it "best represents the resource characteristics of near-term deployment for fixed bottom technology". See https://atb.nrel.gov/electricity/2020/index.php?t=ow for more detail.

[213] Mayflower Wind. January 8, 2021. "Mayflower Wind "Low-Cost Energy" Price Anticipated to go Even Lower Due to Unique Commitment to Pass Cost Savings of Federal Tax Credits to Customers." *Mayflowerwind.com*. Available at https://mayflowerwind.com/mayflower-wind-low-cost-energy-price-anticipated-to-go-even-lower-due-to-unique-commitment-to-pass-cost-savings-of-federal-tax-credits-to-customers/.

Figure 45. Price trajectory for offshore wind



Sources: Data from NREL, "2019 Offshore Wind Technology Data Update" and 2020 Annual Technology Baseline. Datapoint for Mayflower Wind based on updated pricing announced in a January 8, 2021 by the project developers.

After we developed the cost trajectory using the methodology described above, we subtracted the estimated energy costs from the total offshore wind price.[214] Because the amount paid for energy represents revenue to the offshore wind project owner, only the remainder is considered the abatement cost.[215] This abatement cost represents the incremental cost of this non-emitting technology. After levelizing the abatement cost stream into a present value, the cost was multiplied by the annual marginal emissions rates of described below in Table 80. The final value translates to a cost per avoided short ton of CO_2 of $125 per short ton.

In AESC 2018, the cost of avoided CO_2 was reported to be $68 per short ton in 2018 dollars or $72 per short ton in 2021 dollars. We find that the AESC 2021 cost is 75 percent higher. This cost increase is driven by three factors:

- First, in AESC 2021, we have access to more cost data specific to U.S. projects in New Jersey, New York, Massachusetts, and Maryland. The previous AESC 2018 report primarily relied upon European prices due to a lack of U.S. data.

[214] For the calculations described in this paragraph, we have subtracted the energy costs associated with Counterfactual #1.

[215] This calculation does not remove capacity payments. These are unknown for projects that are currently proposed in New England, and given the rules of the FCM, are highly dependent on the timing of retiring power plants. This cost also does not account for any additional costs related to network upgrades or storage (e.g., for balancing purposes). If these components were included, the total cost would be higher, making the cost described above a conservative estimate.

- Second, in AESC 2021, we assume annual changes in the cost of offshore wind (e.g., costs start relatively high but decline over time). AESC 2018 assumed a single, unchanging cost throughout the study period.

- Third, the projected energy prices are lower in this edition of AESC 2021. This causes the residual cost of offshore wind to be higher, relative to AESC 2018.

Derived from multiple sectors

AESC 2018 assumed that all end-uses would need to be electrified in order to achieve substantial GHG emission reductions. However, in some policy contexts, policymakers (including utilities and program administrators) who are considering more ambitious carbon reduction targets (e.g., 90 percent or 100 percent reductions by 2050) may have another avenue to eliminate GHG emissions. In particular, end-uses in the thermal sector that are currently powered by the on-site combustion of fossil fuels could instead be powered by low- or zero-carbon variations of that same fuel. This comparison may be a necessary one in cases where policymakers are seeking to develop a complete list of comparative, politically feasible technologies that would lead to decarbonization, or in other cases where electrification is not being considered as a viable technology (e.g., under one of the counterfactuals). Under this construct, we would compare the cost of the marginal abatement technology derived from the electric sector (described above) with the cost of the marginal abatement technology derived from the thermal sector (described below). The more expensive of these two costs could then be said to be the marginal abatement cost across these two sectors.[216]

One such technology is RNG.[217] RNG is a term for natural gas that is derived from biomass or other renewable resources and is fully interchangeable with conventional natural gas. RNG can be produced through a variety of methods, including deriving biomethane from waste via anaerobic digestion or gasification, deriving hydrogen from electrolysis, and deriving synthetic natural gas from hydrogen and a renewable CO_2 source (like biomass).[218] RNG produced from each of these methods varies in both potential and costs. Of these methods, some are established technologies with decades of operating experience (e.g., extracting and purifying biomethane from biogas sources such as landfills and waste digesters), whereas other methods are still in their technological infancy (e.g., processes where electrolysis is used to produce RNG, sometimes called “power-to-gas” or “P2G”). The Synapse Team reviewed the literature to determine what an appropriate cost of RNG should be for New England.

[216] GHG emissions are of course produced from other sectors (e.g., industrial, transportation, agriculture). Because program administrators are primarily concerned with installed measures that impact the electric and thermal sectors only, we ignore costs derived from technologies in the other sectors.

[217] Other technologies, such as diesel with high biofuel contents (e.g., B100) were also considered for analysis. However, they were ultimately not included due to (a) their low availability and (b) the challenges and costs associated with converting existing furnaces and boilers to utilize this fuel. In other words, RNG can be used alongside or in place of conventional natural gas in existing heating technology; the same cannot be said for B100 and home heating oil.

[218] “The Challenge of Retail Gas in California’s Low-Carbon Future.” California Energy Commission. April 2020. Available at https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf.

The primary source we evaluated is a March 2020 report published by ICF on behalf of Washington Gas Light Company.[219] ICF provides an estimate of nationwide RNG production for four years (2025, 2030, 2035, and 2040) across three scenarios (conservative low, achievable, and aggressive high) for nine different types of RNG. The maximum potential in 2035 (the scope of AESC 2021) is 6 quadrillion Btu per year for the nation as a whole. This is compared to natural gas consumption in New England in the residential and commercial sectors of 9 quadrillion Btu in 2019.[220] This suggests that even if the entire country's potential for RNG were dedicated to New England, the marginal cost of RNG would be the most expensive technology available, if it were being deployed at a scale to considerably abate GHG emissions.

The ICF study identifies P2G as being the most expensive variation of RNG. This technology involves having renewable technology produce hydrogen, which is then combined with CO_2 to create methane. P2G is also the RNG variation that is least limited by available feedstocks, and thus able to meet marginal needs comparable in scale to the regional demand for natural gas.

ICF states that P2G has a production cost of about $25 per MMBtu, assuming large economies of scale. Assuming RNG derived from P2G completely replaces the consumption of natural gas (which has an emissions rate of 53 kg CO_2 per MMBtu), this translates into a cost of $471 per metric ton.[221] This value does not include the cost of CO_2 for the methanation reaction, which ICF estimates at $30 per metric ton.[222] Other estimates describe the cost of CO_2 direct air capture in the 2035 timeframe at about $60

[219] Note that the 2020 report is discussed here as it is the most recent and most comprehensive contribution from ICF on this topic.

"Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area." ICF Resources Inc. March 2020. Available as Appendix D at https://edocket.dcpsc.org/apis/api/filing/download?attachId=101994&guidFileName=e69b6cb2-963c-4122-aca3-3b45e838b2b7.pdf.

American Gas Foundation. December 2019. *Renewable Sources of Natural Gas*. Available at https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Executive-Summary-Final-12-18-2019-AS-1.pdf.

ICF International. Last accessed March 11,2021. "Design Principles for a Renewable Gas Standard." ICF.com Available at https://static1.squarespace.com/static/53a09c47e4b050b5ad5bf4f5/t/5a56701dec212d1888aa212a/1515614239606/ICF_WhitePaper_Design_Principles.pdf.

[220] Data on natural gas consumption obtained from https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_m.htm. This quantity does not include natural gas consumed in the industrial sector, electric power sector, or for pipeline and distribution use. Altogether, natural gas consumption in New England in 2019 totaled about 32 quadrillion Btu.

[221] Some types of RNG are described as having negative emission rates as they avoid upstream GHGs associated with natural gas (e.g., from production). Because P2G simply avoids the use of conventional natural gas, these emissions can be ignored. We also ignore emission reductions associated with pipeline leakage, as these emissions are not considered elsewhere in the AESC study.

U.S. Energy information Administration. February 2, 2016. "Carbon Dioxide Emissions Coefficients." Eia.gov. Available at https://www.eia.gov/environment/emissions/co2_vol_mass.php.

[222] ICF 2020, at page 76. Units are assumed to be in metric tons. Another set of costs that are not included here are the costs of a heat sink (for the waste heat produced from methanation). Because these costs could theoretically be a benefit (i.e., the heat could be repurposed), we ascribe no cost or benefit to this component.

per metric ton.[223] Adding either of these two CO_2 costs to $471 per metric ton and performing unit conversions yields a range of $455 to 482 per short ton (in 2018 dollars). Averaging these two values and converting to 2021 dollars produces a value of $493 per short ton. Depending on the policy envisioned, it is possible that this cost could be imposed at its full value and carried through to the end of the study period, or implemented along some phase-in trajectory (e.g., evoking an RPS-like policy for natural gas). For purposes of simplification, and to match assumptions made for other marginal abatement costs, we assume that the same RNG cost is used in all analyzed years. Because this is greater than the abatement cost derived from the electric sector, this is our local perspective estimate for an abatement cost derived from multiple sectors.

Caveats to damage costs and marginal abatement costs

Both damage costs and marginal abatement costs have uncertainties. Damage costs are typically based on sophisticated climate and economic modeling, and may depend on the inputs being used or the algorithms applied. Damage costs are also sensitive to assumptions on discount rates, geographic scope, and considerations of high-risk situations. Likewise, of abatement cost modeling requires numerous assumptions on available technologies, costs, potentials, emissions reduction targets, and timescales.

8.2. Non-embedded NO_X costs

Combustion of natural gas creates NO_X emissions. NO_X contributes to ground-level ozone and smog, and a cause of respiratory illness. These emissions are reduced but not eliminated by current regulations.

As in previous AESC studies, we have conducted a review of the literature to develop an estimate of the damage cost of NO_X emissions (e.g., the cost that NO_X emissions impose on human health). As in AESC 2018, we rely on one 2015 study's published averages for the continental United States in the early 2010s.[224] Converted to 2021 dollars per short ton of nitrogen (N) (and rounded to the nearest $100), it found a low case of $7,200, a median of $32,600, and a high case of $68,800.[225] Based on molecular weights, a price per ton of N implies a lower price per ton of NO_X: 47 percent of the N price for NO, and

[223] Sutherland, B. G. (2019). Pricing CO_2 Direct Air Capture. *Joule*, Cell Press. Volume 3, Issue 7, 17 July 2019, Pages 1571-1573. https://doi.org/10.1016/j.joule.2019.06.025.

[224] U.S. Environmental Protection Agency. "Public Health benefits per kWh of Energy Efficiency and Renewable Energy in the United States: a Technical Report." Epa.gov. Available at https://www.epa.gov/sites/production/files/2019-07/documents/bpk-report-final-508.pdf

Other sources examined include Gilmore, E. A., Heo, J., Muller, N. Z., Tessum, C. W., Hill, J. D., Marshall, J. D., & Adams, P. J. (2019). An inter-comparison of the social costs of air quality from reduced-complexity models. *Environmental Research Letters*, 14(7), 074016. https://doi.org/10.1088/1748-9326/ab1ab5. These sources were not ultimately included in this review as they cover a more limited scope of NO_X impacts, or are more concerned with variations in modeling approaches of air quality, as opposed to the resultant NO_X costs themselves.

[225] Daniel J. Sobota, Jana E. Compton, Michelle L. McCrackin, and Shweta Singh (2015), "Cost of reactive nitrogen release from human activities to the environment in the United States," *Environmental Research Letters* 10, 025006. https://doi.org/10.1088/1748-9326/10/2/025006. Calculated from Table 1, assuming $1.00 in 2008 = $1.17 in 2018. Values are calculated by summing the aggregate effects from "atmospheric NO_X" from each column (low, median, and high).

30 percent for NO_2.[226] Assuming a 90/10 mix of NO and NO_2, this median value translates into a price of $14,700 per short ton of NO_X.[227]

Using the dollar-per-short ton cost described in the first study, and assuming the summer on-peak marginal NO_X emissions rate in Table 80, we find an avoided cost for NO_X equal to $0.77 per MWh.

8.3. Applying non-embedded costs

Non-embedded costs can be applied to both the electric sector and non-electric sectors. The following sections describe the approaches for each.

Electric sector

AESC 2021 embeds three electric-sector regulations in New England in its forecast of avoided energy costs: one (RGGI) is modeled regionwide, while two (310 CMR 7.74, a mass-based, declining cap on in-state CO_2 emissions, and 310 CMR 7.75, the Clean Energy Standard) apply only to Massachusetts and are used to represent a reasonable and current estimate for the cost of compliance for the Massachusetts GWSA regulations. In AESC 2021, we sum these embedded costs (all three for Massachusetts, RGGI only for the other five states), then subtract the annual values from the relevant marginal abatement cost (see Table 79).

Table 79. Interaction of non-embedded and embedded CO_2 costs.

Component description	Formula
Marginal abatement cost (including non-embedded components)	a
Non-MA allowance price (embedded components, including RGGI)	b
MA allowance price (embedded components RGGI, 310 CMR 7.74, 310 CMR 7.75)	c
Externality cost (non-MA)	d = a - b
Externality cost (MA)	e = a - c

The resulting cost stream (measured in dollars per short ton) can then be multiplied by a marginal emissions rate (measured in short tons per MWh) to be converted into dollars per MWh. In this context, a “marginal” emission rate refers to the emission rate associated with the resources that change their output (e.g., ramp up or ramp down) as more demand is added or removed from the grid.[228] There are short-run and long-run emission rates, each of which has separate implications for the resulting dollar-

[226] A one-ton 50/50 mixture of NO and NO_2 contains 770 lb of N based on molar fractions of N in both NO and NO_2. The value of the nitrogen in the one-ton mixture of the AESC NO_x will be 38.6 percent of the dollar price per ton.

[227] Fluid. Last accessed March 11, 2021. *Nitrogen oxides Formation in Combustion Processes*. Available at http://fluid.wme.pwr.wroc.pl/~spalanie/dydaktyka/combustion_en/NOx/NOx_formation.pdf. Pg. 42

[228] This can be contrasted with an “average” emissions rate, which refers to the total emissions produced by the grid over a long period of time (often a year) divided by the total generation output by the grid. This emissions rate includes many resources (e.g., nuclear, hydro) that do not economically respond to changes in demand.

per-MWh values. Short-run and long-run marginal costs may both be applied to measures that decrease electricity consumption (e.g., energy efficiency) the same way they are applied to measures that increase electricity consumption (e.g., heat pumps).

Short-run marginal emission rates

Using EnCompass, we calculate the marginal CO_2 and NO_X emission rates by comparing results in Counterfactual #1 with results in Counterfactual #2. Specifically, we calculate the change in emissions in each year, and divide that number by the change in demand. The result is the marginal emissions rate for any given year.[229] This emissions rate can then be aggregated over multiple hours to provide a set of summarized marginal emissions rates (see Table 80). Marginal CO_2 emission rates in the early periods are similar those found in other sources.[230] Marginal NO_X emission rates in the early periods tend to be lower than other sources for a number of reasons: chief among them, NO_X emission rates continue to fall as the grid relies more often on cleaner power plants and as the dirtiest power plants retire.

[229] This is the same theory used to produce marginal emissions and emission rates in U.S. Environmental Protection Agency's AVoided Emissions and geneRation Tool (AVERT).

U.S. Environmental Protection Agency. Last accessed March 11.2021. "Avoided Emissions and Generation Tool (AVERT)." *Epa.gov.* Available at https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert.

[230] For example, see Table 150 in AESC 2018 (available at https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-Oct-ReRelease.pdf), Table 5-5 in ISO New England's 2018 Air Emissions Report (available at https://www.iso-ne.com/static-assets/documents/2020/05/2018_air_emissions_report.pdf), and data from U.S. EPA's AVERT model for uniform energy efficiency measures installed in New England (available at https://www.epa.gov/sites/production/files/2020-09/avert_emission_factors_09-08-20.xlsx).

Table 80. Modeled electric sector marginal emissions rates (lb per MWh)

	CO_2				NO_X			
	Winter		Summer		Winter		Summer	
	On Peak	*Off Peak*	*On Peak*	*Off Peak*	*On Peak*	*Off Peak*	*On Peak*	*Off Peak*
2021	756	791	779	799	0.09	0.21	0.14	0.11
2022	740	752	729	813	0.10	0.09	0.14	0.11
2023	732	826	663	932	0.09	0.08	0.11	0.09
2024	791	869	767	967	0.10	0.08	0.12	0.10
2025	796	881	812	966	0.07	0.07	0.12	0.10
2026	756	878	772	939	0.07	0.07	0.11	0.09
2027	682	824	760	930	0.07	0.08	0.11	0.10
2028	686	735	764	822	0.08	0.07	0.12	0.09
2029	702	718	753	794	0.08	0.07	0.11	0.08
2030	636	669	732	760	0.06	0.06	0.09	0.07
2031	648	692	723	768	0.06	0.06	0.09	0.07
2032	644	720	686	774	0.06	0.06	0.09	0.07
2033	652	702	737	788	0.06	0.06	0.08	0.07
2034	678	693	752	770	0.06	0.06	0.08	0.07
2035	691	690	761	793	0.06	0.05	0.07	0.06

Notes: We assume all four counterfactuals feature the same marginal emission rates.

This same step can be applied for both non-embedded GHG costs and non-embedded NO_X costs. Because there are no embedded NO_X prices included in AESC 2021's production cost modeling (e.g., in the same way that RGGI embeds some of the cost of CO_2 emissions), there is no preliminary Table 79-equivalent subtraction step required.[231]

These emission rates are "short-run" because they assume a single year that has no other changes to the grid other than the assumed "dummy" resource. In other words, they account for the hourly system demand for wholesale generation decreasing in response to this "dummy" resource, but do not incorporate any second-order effects. These short-run marginal emission rates are best used for analyzing emission changes over a period of less than one year.

Long-run marginal emission rates

Conversely, a long-run marginal emission rate takes these second-order effects into account. For the purposes of AESC 2021, the primary second-order effect to consider are renewable builds. These marginal emission rates are best used for analyzing emission changes over a period greater than one year. The following paragraphs provide guidance on one methodology that AESC users can apply to adjust their marginal emission rates.[232]

[231] Costs of controls or technology that limit or reduce NO_X emissions from individual power plants are not considered.

[232] Because the avoided energy, avoided capacity, and other avoided costs do not change based on the selected emissions accounting approaches, these avoided costs are independent of the AESC user choice of a long-run marginal emission rate approach.

All New England states have some kind of RPS policy in effect (see Chapter 7: *Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies* for more information). Under these policies, LSEs (such as electricity utilities) must procure a quantity of RECs equal to a specified percentage of that entity's electricity sales in a particular year. In many jurisdictions, this percentage increases over time for "Class 1" markets. However, consider a hypothetical in which the percentage is flat: if electricity sales go up, then the entity will have to purchase and retire more RECs (implying the addition of more renewables to the grid). If electricity sales go down (e.g., as a result of increased energy efficiency programs) the entity will have to purchase and retire fewer RECs.[233] Because the renewables driven by these RPS policies would also displace marginal generators and decrease emissions, ignoring the effects of these policies will overestimate the emissions-reducing impacts of energy efficiency and other DSM resources.

For time periods of one year or more, the marginal emissions rate is derived from not only the marginal displaced resource, but also RPS percentage targets (which require demonstration of compliance annually). One can determine the effect of these RPS policies on the overall marginal emissions rate by calculating a weighted average of the model-derived emissions rate and the share of resources purchased to meet RPS targets. For example, consider a hypothetical state with a 50 percent Class 1 RPS target and a supporting policy to meet this obligation through long-term contracts with zero-carbon resources. In this situation, if 1 MWh of energy efficiency were deployed, load would decrease by 1 MWh, avoiding the purchase (and possibly creation) of 0.5 MWh of zero-carbon generation.[234] As a result, this 1 MWh would avoid 0.5 MWh associated with the marginal emissions rate described in Table 80, and 0.5 MWh of zero-emitting energy. We assume this methodology is applicable only to RPS categories where compliance is achieved through the retirement of RECs associated with non-emitting resources.[235]

However, renewable policies only impact the marginal emissions rate in certain circumstances:

- First, some states may have policies that require utilities to purchase renewables or other types of zero-emitting generation on an absolute MWh basis. In these circumstances, contracts for renewable energy are not linked to load, meaning that variations in load (due to energy efficiency or other DSM programs) do not have any effect on marginal emission rates. If a state only had policies of this type (i.e., with no RPS-style policies), the long-run marginal emission rates would be equivalent to the short-run marginal emission rates.

[233] Importantly, the renewable energy attributes of these MWh must be claimed in some way (i.e., the retirement of RECs) in order to ensure there is no double-counting among different entities in New England.

[234] This simplified example does not consider impacts of T&D losses.

[235] For example, there are some RPS categories where compliance is primarily achieved through the retirement of RECs associated with combined-heat-and-power plants. These plants have similar emissions rates to the systemwide marginal emission rate, and therefore do not contribute to avoided emissions.

- Second, because of the overlap among resources that qualify for both these contracting policies and RPS policies, sometimes the amount of available renewable energy exceeds the quantity required under an RPS. For example, consider a hypothetical where utilities in a state with 20 TWh are (a) required to purchase 12 TWh of renewable resources in any given year, and (b) the state also has an RPS wherein utilities must purchase and retire RECs equivalent to 50 percent of their electricity sales (10 TWh). In this hypothetical, the state's RPS policy is exceeded by 2 TWh, meaning that changes to load (short of increasing load by 2 TWh) will not have an impact on the quantity of renewables purchased by that state.

For any one state, the marginal renewable (RE) fraction that should be applied to the modeled marginal emissions rate can be calculated using the algorithm in Equation 2. The marginal RE fraction is then applied to the modeled marginal emissions rate in Equation 3 to determine the final marginal emissions rate.

Equation 2. Marginal renewable (RE) fraction

$$[A]\ Total\ RPS\ requirement\ (\%) = RPS\ Class\ 1\ \% + RPS\ Class\ 2\ \% + \cdots + RPS\ Class\ N\ \%$$

$$[B]\ Required\ RE\ as\ a\ fraction\ of\ sales\ (\%) = \frac{Contracted\ RE + Zero\ Carbon\ (RECs\ not\ resold) + Additional\ RECs\ retired\ (MWh)}{State\ electricity\ sales}$$

If [B] > [A]

Then marginal RE fraction (%) = 0%

Else marginal RE fraction (%) = [A]

Equation 3. Final marginal emissions rate

$$Final\ marginal\ emissions\ rate = Modeled\ marginal\ emissions\ rate \times (1 - marginal\ RE\ fraction)$$

In our example, [A] is equal to 50 percent. Because the total number of RECs retired is 12 TWh (all 12 TWh of RECs from the contracting policy as assumed retained, with no further RECs needed to meet the RPS policy), [B] is equal to 12 TWh divided by 20 TWh, or 60 percent. Because B is greater than A, the marginal RE fraction is zero. This makes the final marginal emissions rate equal to the modeled marginal emissions rate.

In some circumstances, if [A] and [B] are very close together, applying some quantity of demand-side measures may cause [A] to exceed [B] or vice versa. In these situations, the marginal RE fraction should be calculated separately first for (i) the quantity of demand-side measures that are under the threshold where [A] is less than [B] (or vice versa) and second for (ii) the quantity of demand-side measures that are over the threshold. Calculating the marginal emissions rate in this situation is challenging, but doable. Practically speaking, this circumstance is unlikely to occur for two interrelated reasons:

- First, based on our renewable energy market fundamentals analysis, we anticipate an RPS compliance surplus in each state, in each counterfactual, and in each study year.

REC supply and demand are expected to be closest to equilibrium during the first three years of the study period. During this time, while current-year REC supply *may* trail current-year demand in one or more years, RPS-obligated entities currently hold large 'bank balances' (which refers to excess RPS compliance that LSEs collectively already have at their disposal) which can be used to fulfill RPS obligations and therefore provide a clear signal that no incremental renewable energy builds are required. In the middle and later years of the study period, regional REC surpluses of up to 5,600 GWh *per year* are expected.

- Second, the quantity of demand-side measures would likely have to be very large to cause the positions of [A] and [B] to switch. At any given time, program administrators are likely only screening one to three years' worth of measures or programs, a quantity that is unlikely to absorb the modeled REC surpluses by itself.

In other words, because regional REC surpluses are expected throughout the study period—obviating the need for renewable energy builds beyond policy-mandated supply—in all counterfactuals, any quantity of demand-side measure deployed (whether it increases or decreases demand) is unlikely to affect the quantity of renewables built.

Some AESC users may take a state- or utility-specific approach to calculating changes in emissions that result from changes in an area's load, using an area-specific emission inventory, rather than the regionwide approach described above. For example, a state may account for emissions based only on the amount and type of RECs retired by utilities serving load in the relevant sub-regional area. For these users, procurements of fixed quantities of renewable or zero-carbon resources outside of the relevant jurisdiction may not affect the jurisdiction's emissions, and RPS policies could be considered to be binding if the area-level value of [A] exceeds [B]. In this approach and circumstance, the final marginal emission rate would be equal to (i) the modeled emissions rate multiplied by (ii) the number of RECs divided by the statewide electricity load.[236]

Non-electric sectors

The approach for the non-electric sectors is simpler. The dollar-per-ton non-embedded value is simply multiplied by the relevant non-electric emissions rate (measured in tons per MMBtu) to produce dollar-per-MMBtu values. These emission rates may be fuel- and sector-specific (see Table 17 and Table 18 for more information on non-electric emission rates). Because policies like RGGI and RPS only impact the electric sector, they should not be taken into account when calculating non-electric sector impacts (i.e., they are not embedded).

[236] This term (ii) is functionally equal to the state or sub-region's annual RPS percentage, assuming that all RECs procured to meet the annual RPS percentage are retired.

9. DEMAND REDUCTION INDUCED PRICE EFFECT

DRIPE refers to the reduction in prices in the wholesale markets for capacity and energy—relative to the prices forecast in the Reference case—resulting from the reduction in quantities of capacity and of energy required from those markets due to the impact of efficiency and/or demand response programs. Thus, DRIPE is a measure of the value of efficiency in terms of the reductions in wholesale prices seen by all retail customers in a given period. In some contexts, DRIPE maybe called “price suppression” or “price effect.”

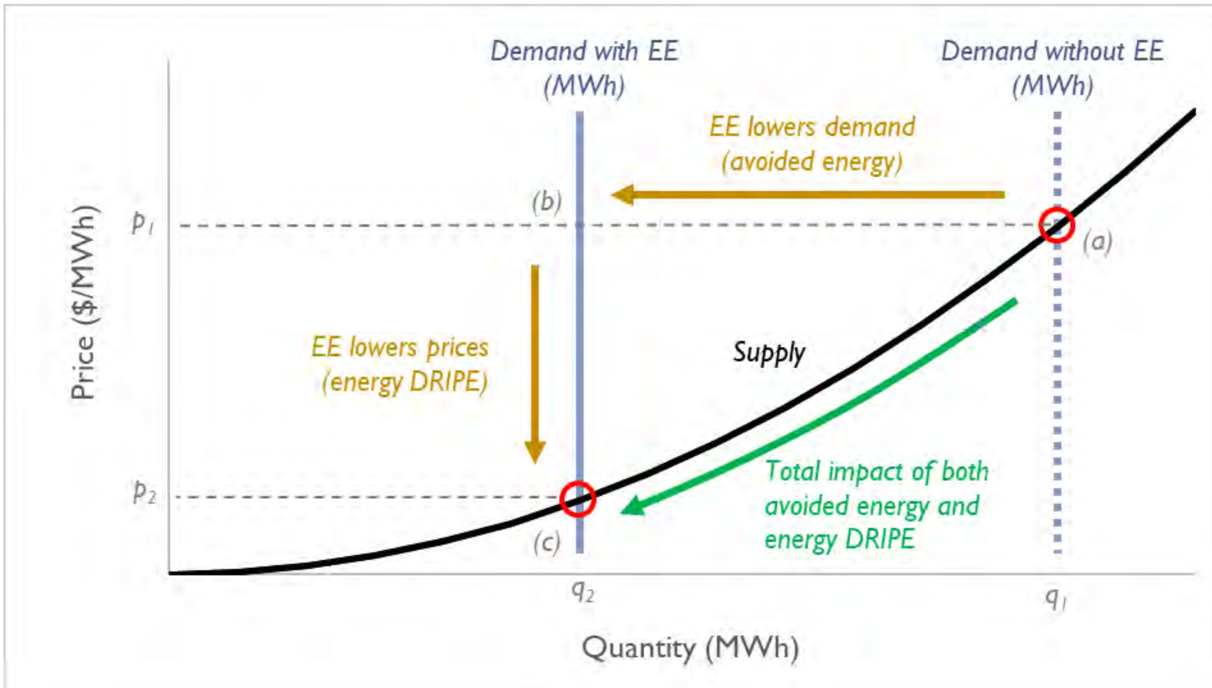
This chapter describes our results, methodology, and assumptions for energy DRIPE, capacity DRIPE, natural gas DRIPE, fuel-oil DRIPE and cross-DRIPE effects using a combination of quantitative analyses of national and New England data rather than modeling projected market conditions.

DRIPE results in AESC 2021 differ from those in AESC 2018 as a result of updated information about supply in each of the markets examined. Generally speaking, we find (a) lower energy DRIPE and capacity DRIPE values due to projections of flatter supply curves compared to AESC 2018, (b) lower natural gas DRIPE values due to lower commodity prices and flatter supply curves, and (c) lower oil DRIPE values due to changes in the underlying projection of crude oil prices. See each of the subsections below for detailed comparisons of DRIPE values in AESC 2018 and AESC 2021.

9.1. Introduction

DRIPE is a measure of the value of efficiency in terms of the reductions in wholesale prices seen by all retail customers in a given period. It is a separate and distinct benefit from avoided energy, avoided, capacity, avoided natural gas, and avoided oil. Figure 46 illustrates the impact of DRIPE. Whereas avoided energy (for example) describes the benefits associated with a quantity reduction, avoided energy DRIPE describes the benefits associated with a price reduction. These effects are not double-counting—in this Figure 46, each energy DRIPE and avoided energy (yellow arrows) are separate vector components of the aggregate effect (green arrow). The total cost at point (a) is equal to p_1 x q_1, while the total cost at point (c) is equal to p_2 x q_2. If DRIPE were uncounted, the total cost would incompletely be calculated as the cost at point (b), or p_1 x q_2.

Figure 46. Example figure depicting separate and non-overlapping avoided energy and energy DRIPE effects



Note: This example figure depicts impacts in the energy market, but the principles are the same for all other DRIPE categories. This figure also uses "EE" as an example measure. DRIPE effects can be calculated for any measure (EE or otherwise), including measures that increase the demand of a commodity.

Broadly speaking, we model five categories of DRIPE in AESC.

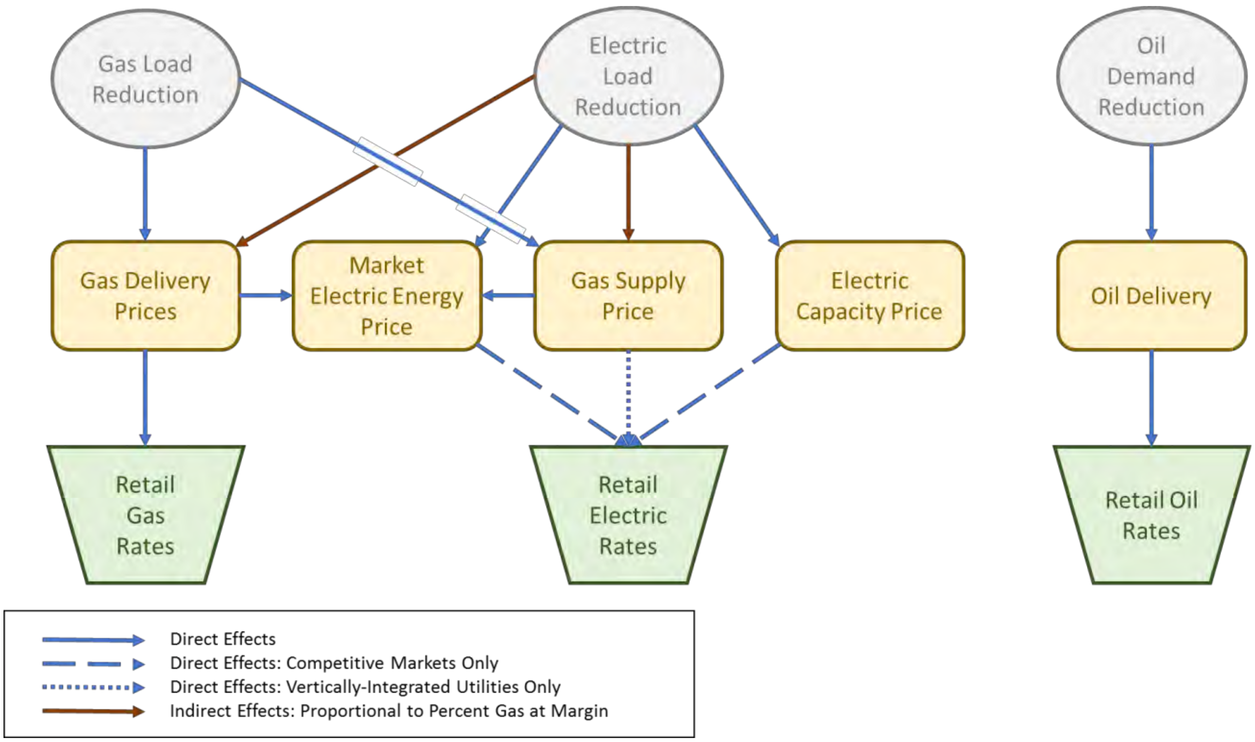
- **Energy DRIPE:** The consumer savings from reducing load, resulting in the market price being set by a plant with a better heat rate or less expensive fuel (e.g., natural gas rather than oil). These computations hold gas prices constant, avoiding any overlap with the Electric-Gas-Electric cross-DRIPE discussed below.
- **Capacity DRIPE:** The change in state and regional electricity bills due to reductions in electric capacity prices.
- **Own-price natural gas DRIPE:** The value of reduced natural gas demand on both gas commodity prices (gas supply DRIPE) and transportation costs to New England from the production area (gas basis DRIPE).
- **Cross-DRIPE:** The value that gas reductions have on electricity prices and that electricity reductions have on natural gas prices. Cross-DRIPE is separate from, and in addition to, own-price DRIPE values. It does not double-count any benefits.
  - **Gas-to-Electric (G-E) cross-DRIPE**: The benefits to electricity consumers that result from lower gas demand reducing gas prices for electric generation.
  - **Electric-to-Gas (E-G) cross-DRIPE**: The benefits to gas consumers from a reduction in electricity demand and hence gas demand for generation.

  - **Electric-to-Gas-to-Electric (E-G-E) cross-DRIPE**: The benefits of reductions in electricity demand on gas prices which in turn reduce electricity prices, even if the marginal generator does not change. E-G-E DRIPE measures the electric bill savings associated with reduction in the cost of gas for the marginal price-setting power plant, resulting from the decline in natural gas usage for electricity.

- **Own-price oil DRIPE:** The value of reduced demand for petroleum products (e.g., gasoline, diesel, residual) on petroleum prices.

The interactions of DRIPE effects are shown in Figure 47.

Figure 47. DRIPE effect interactions



There are two elements to these estimates: magnitude and duration. The magnitude of DRIPE depends on market prices, market size, and the market price responsiveness. DRIPE benefits are unlikely to exist in perpetuity, however, so benefits are adjusted downward, or decayed, to reflect how other market participants respond to changes in market price over time.

Our estimates indicate that the DRIPE effects are very small when expressed in terms of an impact on market prices, i.e., reductions of a fraction of a percent. However, the DRIPE impacts are significant when expressed in absolute dollar terms for the state or region. Very small impacts on market prices, when applied to all energy and capacity being purchased in the market, translate into large absolute dollar amounts.

General DRIPE methodology

In AESC, DRIPE is estimated according to the following steps:

1. First, a "price shift" is calculated. This shift represents the change in price (e.g., dollars per MWh) for a change in demand (e.g., MWh). Aggregated over many data points, this price shift represents the supply curve of a particular resource. For many DRIPE categories, this is calculated using a regression, where we observe many hundreds or thousands of historical datapoints to establish a relationship between prices and demand. For other DRIPE categories, these price shifts are based on an assumed supply curve. This most notably occurs for capacity DRIPE, where there is not enough information to develop a regression from historical data.

2. Second, these price shifts are multiplied by total future market demand, so that they may then be applied to any generic change in demand. In other words, the price shift is expressed in terms of price-per-demand.[2] Multiplying the price shift by demand translates it into a price-per-demand value that can then be multiplied by a measure's anticipated savings.[237]

3. Finally, the price-per-demand value is adjusted. This may include accounting for hedged demand which has, in theory, already been purchased and is not subject to price shifts. Or, it may involve reducing benefits to account for decays in effects, or "phasing in" of effects to describe a lag in the way the market realizes these impact. Importantly, only some categories of DRIPE have these shifts applied.

Depending on the DRIPE category, these steps may be more complex or performed in a different order (in order to facilitate computation).

Price effects impact the entire region because there is only one market each for electric energy, electric capacity, and natural gas. For all the DRIPE categories described in AESC, we estimate both intra-zonal DRIPE (i.e., the benefits that accrue within a zone from load impacts within that zone, sometimes called own-zone or zone-on-zone) and inter-zonally (i.e., the benefits that accrue beyond that zone's borders in the "rest of pool"). Intra-zonal DRIPE is calculated by multiplying the price effect for a particular category of DRIPE by a single state's projected demand (rather than the regional total). Meanwhile, inter-zonal DRIPE is calculated by subtracting the intra-zonal value from the regional total.[238]

In some jurisdictions, only "intra-zonal" DRIPE benefits are used in cost-effectiveness testing. The reason may vary, but in some cases, there may be a regulatory directive to only count the benefits that accrue to a particular state's ratepayers. However, we note that the inter-zonal benefits continue to exist even if

[237] Throughout this chapter, we frequently discuss DRIPE in terms of benefits relating from savings, but DRIPE is a non-directional value that can also describe price increases resulting from increased demand. Some measures that reduce the use of one kind of fuel (e.g., natural gas) but increase use of another fuel (e.g., electricity) may end up utilizing nearly all the DRIPE categories described in this chapter.

[238] An equivalent mathematical operation would be to multiply the price shift by the regional total demand less the demand for the state in question.

they are not counted in a measure's cost-effectiveness test. We also note that these benefits are not counted by any other state.

The remaining text of this chapter describes the specific methodology used to generate DRIPE benefits for each category of DRIPE.

9.2. Electric energy DRIPE

A reduction in electricity demand should reduce wholesale energy prices, which benefits all market participants. This section describes the AESC 2021 methodology and assumptions for electric energy DRIPE, discusses the benefits and detriments of various model forms, and presents our estimates of energy DRIPE. Energy DRIPE values are presented in two ways: first, by zone, month, and period; second for the "top" 100 load or price hours. The monthly values provide DRIPE estimates for programs targeting baseline reductions while the "top" hour assessments provide estimates for more targeted applications.

Our estimates of electric energy DRIPE follow the same approach used in previous AESC studies from 2009 to 2018. Generally speaking, we conduct a set of regressions of historical zonal hourly market prices against zonal and regional load to develop elasticities. Then, we estimated the timing and duration of benefits based upon the following market realities:

1. The reductions in wholesale prices are assumed to flow through to customers as existing contracts and other resources (legacy resources, renewable contracts, basic-service and other default contracts, direct contracts with marketers) expire.
2. Customers will respond to lower energy prices by using somewhat more energy.[239]
3. The generation market will respond to sustained lower prices by some combination of retiring and de-rating existing generating capacity and delaying new resources that reduce market energy prices (such as gas combined-cycle units and high-efficiency combustion turbines).
4. Lower loads will tend to result in lower acquisition mandates under renewable and other alternative-energy standards that are stated as a percentage of energy sold.

Regression model selection

AESC 2021, like AESC 2018, estimates the magnitude of wholesale energy market DRIPE by year by conducting a set of regressions of historical zonal hourly market prices against regional load. This top-down approach assumes that there is an underlying relationship between prices and loads which can be

[239] Other factors (e.g., purchases of renewables, transmission construction, grid modernization, recovery of energy-efficiency costs) may simultaneously raise prices. The energy DRIPE considers only the marginal effect on market energy prices on retail prices and hence usage.

represented using a single equation. This approach has the benefit that it is easy to understand and that it captures the key features of the system transparently.

Regressions also have the benefit of modeling the average relationship between price and demand and providing structure to heterogeneous data. Periods with similar demand often have very different prices. Price dispersion is a product of an uncertain system that contains dynamic unit commitment decisions as well as a host of other stochastics such as generator-forced outages or transmission constraints. By assessing all system price and demand data, it is possible to capture both structural trends as well as uncertain events that occurred in past years.

In prior AESC studies, we considered many functional forms to describe the relationship between zonal prices and loads. We tested the significance of variables related to ISO system performance (e.g., capacity surplus, maintenance), system implied heat rate, and zonal and regional loads. After considering these candidate variables and various functional forms, we settled on a polynomial model to characterize the relationship between zonal prices and loads. The model, described in Equation 4, relates zonal price to ISO-wide demand and to natural gas prices.

Equation 4. Regression equation relating zonal electric energy prices to ISO demand and natural gas prices

$$LMP_{Zone} = \beta_0 + \beta_1 Demand_{ISO} + \beta_2 Demand_{ISO}^{\ 2} + \beta_3 Demand_{ISO}^{\ 3} + \beta_4 Price_{NG}$$

Equation 4 describes a cubic function. A cubic function allows for a “hockey stick”-like profile where prices increase slowly at first, then quickly during high load periods. For example, at the extreme right side of the supply curve (e.g., when the market’s marginal unit might switch from a gas peaker to a natural gas-fired combined cycle unit), prices will increase by approximately 30 percent even though demand might only increase a few MW. In the middle of the offer stack, by contrast, switching from a more efficient gas combined cycle to a slightly less efficient one will only increase prices by a few percent. In Equation 4, changes in natural gas prices shift the overall curve up or down but do not skew the shape of the curve itself. This polynomial model offers five advantages over other assessed models:

1. **Non-linearity** that depicts very high prices at high load times and flatter prices under lower loads
2. **Explicit control for natural gas prices**, which is a major driver of winter price volatility
3. Significantly **better goodness-of-fit** compared to linear models (e.g., R^2 or sum-of-squared errors)
4. **Single functional form** for all zones, months, and periods
5. **Simple formulation**, where only key attributes are included

Note that the “ISO Demand” described Equation 4 is <u>not</u> the total ISO-wide demand for electricity. Instead, this variable is perhaps better described as “net demand,” which is calculated by subtracting hourly wind, solar, and nuclear output from gross demand reported by ISO New England. Wind and solar vary throughout the day predictably (especially for solar) and less predictably (as a function of weather).

Nuclear output is quite even most days, but is sometimes reduced or eliminated due to planned and unplanned outages. None of these generators are subject to load- or price-based dispatch, since they self-schedule or bid into ISO New England's energy market at very low (in the case of wind, even negative) prices.[240] As a result, we remove the MWh contribution of these non-price-responsive generators from our "ISO Demand" variable.

In AESC 2021, we utilize data from January 2018 through December 2019 as the basis for our regressions.[241] Figure 48 plots actual price and demand data (in blue) against predicted data (in red) estimated using Equation 4 for one illustrative region and period. A similar regression was performed for nine regions (ISO-wide, Connecticut, Maine, New Hampshire, Rhode Island, Vermont, SEMA, NEMA, and WCMA), and for 24 time periods (one off-peak period and one on-peak period for each month).[242]

[240] In earlier AESC studies, we also examined the impact of removing the hourly contribution of other resource types from the regression. Availability of other generation may also affect market energy prices, but the relationship between price and output is complicated. The dispatch of thermal plants is driven by loads and energy prices; commitment of steam and combined-cycle plants is driven by forecast loads and prices; and hydro is scheduled within the week and the day to minimize costs of energy and reserves. It is therefore difficult to determine whether a plant is not running (1) because it is not available, (2) because energy price is below the plant's energy bid, or (3) because it is being held back as reserve (especially in the case of hydro and fast-start combustion turbines) or to meet higher loads expected later in the hydro operating cycle. The output of most fossil units can be determined from EPA's Air Market Programs dataset, and ISO New England provides total daily capacity that is unavailable due to outages or failure to commit in the day-ahead market, but these sources do not provide enough detail to determine why particular units are not operating. In any event, the regression results are very similar whether gross load or net load is used in Equation 4, reducing the usefulness of any additional complexity.

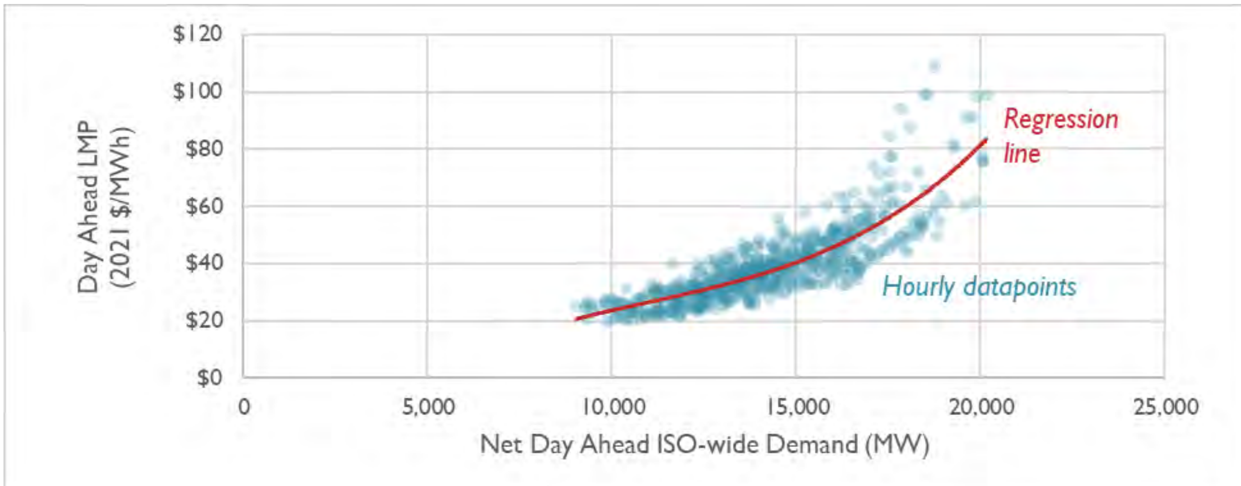
[241] This time period spans 17,520 datapoints, which provides our regressions with sufficient detail to accurately predict the relationship between prices and loads. Hourly energy price data and gross load data was obtained from ISO New England (ISO New England. 2019. *ISO new England Public*. Available at https://www.iso-ne.com/static-assets/documents/2019/02/2019_smd_hourly.xlsx) and (ISO New England. 2018. *ISO New England Public.* Available at https://www.iso-ne.com/static-assets/documents/2018/02/2018_smd_hourly.xlsx)

Sub hourly data on ISO New England's fuel mix was downloaded from ISO NE (ISO New England. Last accessed March 11, 2021. "Dispatch Fuel Mix." *Iso-ne.com*. Available at https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/gen-fuel-mix) then averaged to produce hourly results for wind, solar, and nuclear generation. Daily data on delivered prices to Algonquin Citygate were obtained from (NGI. 2021. "Algonquin Citygate Daily Natural gas Price Snapchat." Available at https://www.naturalgasintel.com/data-snapshot/daily-gpi/NEAALGCG/)

For points with very low zonal LMP, elasticities are very large. This is a byproduct of the modeling and elasticity calculation, not of any structural phenomenon. When LMP is $0/MWh, the elasticity is infinite. We exclude calculated point elasticities when zonal prices are less than $5/MWh. These exclusions occur very rarely—for the ISO New England region, for example, there is one such hour.

[242] A similar approach is used to calculate regressions for "top" hours, for use in DSM measures that do not operate the entire year but are instead targeted at certain hours. Rather than 24 periods, we calculate regressions for 374 periods for all 9 regions. This includes 68 summer off-peak regressions, 58 summer on-peak regressions, 132 winter off-peak regressions, and 116 winter on-peak regressions. Each of these batches of regressions is divided in half into regressions that span "Top Load" and "Top LMP" hours. Within Summer, On-Peak, Top Load (for example), there exists regressions that cover the top 50 hours (sorted by ISO-wide demand), the top 100 hours, the top 150 hours, and so on. Asymmetry in number of regressions across different time slices (summer, winter, on-peak, and off-peak) is due to differences in the number of hours included within each time slice.

Figure 48. Illustrative regression for WCMA, July on-peak hours



Note: This chart is shown for illustrative purposes only. To plot the red, fitted line in the figure, we assume a daily price of $0 per MMBtu for natural gas (as multivariate regression cannot be displayed in a two-dimensional chart). This differs from our actual analysis where different natural gas prices were used for each point. Final DRIPE calculations use monthly timeframes instead of quarterly; different zones have different price/load pairs.

In general, the model produces a good fit (R^2 above 0.7) for 87 percent of the 216 regressions (24 periods X 9 regions). The remaining regressions feature R^2 values that range from 0.5 to 0.7. These poorer fits are typically found during off-peak or spring and fall time periods. The average R^2 value for the gross-demand model, across all zones, months, and periods is 0.8, and the minimum R^2 across all zones/periods/months is 0.5.

Calculating elasticities from the regression

After establishing a functional form to model the relationship between price and demand, we then estimate elasticities using these regressions. For each regression, we first calculate the derivative of the polynomial regression model (Equation 4) with respect to demand:

Equation 5. Calculation of regression derivative

$$Instantaneous\ slope = \frac{\partial LMP_{Zone}}{\partial Demand_{ISO}} = \beta_1 + 2\beta_2 Demand_{ISO} + 3\beta_3 Demand_{ISO}{}^2$$

For each hour within a regression, this derivative describes how price would change in each hour for a small change in demand. Next, we apply Equation 6 to describe the elasticity for each hourly data point (e.g., an estimate of the percent change in price per percent change in demand).

Equation 6. Calculation of elasticity

$$Elasticity = \frac{\%\ change\ in\ price}{\%\ change\ in\ demand} = \frac{Instantaneous\ slope\ of\ price\ relative\ to\ demand}{Hourly\ electricity\ price} \times Hourly\ demand$$

Each of the resulting elasticities are then aggregated into a single load-weighted elasticity for each regression. This average elasticity represents the average price response to a small change in demand for a given zone, season, and period. Electric energy DRIPE elasticities are presented in Table 81 by zone, month, and period.[243]

Table 81. Energy DRIPE elasticities

Period	Month	ISO NE	ME	NH	VT	CT	RI	SEMA	NEMA	WCMA
Annual		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Off-peak	**1**	2.3	2.4	2.3	2.3	2.2	2.2	2.2	2.2	2.3
	2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	3	1.1	1.2	1.1	1.1	1.1	1.0	1.1	1.1	1.1
	4	1.0	1.0	1.0	1.0	0.9	1.1	1.4	0.9	0.9
	5	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.7	0.7
	6	0.7	0.8	0.7	0.7	0.8	0.7	0.7	0.7	0.7
	7	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.0
	8	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.2
	9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	10	1.1	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1
	11	1.4	1.5	1.4	1.4	1.3	1.3	1.4	1.4	1.4
	12	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4
On-peak	**1**	2.7	2.7	2.6	2.7	2.7	2.7	2.7	2.7	2.7
	2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	3	1.1	1.2	1.1	1.2	1.1	1.1	1.2	1.1	1.1
	4	0.9	1.1	1.0	1.0	0.9	0.9	0.9	0.9	0.9
	5	0.9	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9
	6	0.7	0.6	0.7	0.7	0.8	0.7	0.7	0.7	0.7
	7	1.7	1.6	1.6	1.6	1.7	1.7	1.7	1.6	1.7
	8	2.1	2.0	2.1	2.1	2.1	2.2	2.2	2.1	2.1
	9	1.1	1.1	1.1	1.1	1.1	1.2	1.4	1.1	1.1
	10	1.5	1.6	1.6	1.6	1.5	1.6	1.7	1.5	1.5
	11	1.8	2.0	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	12	1.5	1.5	1.4	1.4	1.5	1.5	1.5	1.4	1.5

Note: Elasticities for Connecticut subregions (Southwest CT and Other CT) are assumed to be equal to the Connecticut-wide elasticity. A Massachusetts-wide elasticity is calculated based on a weighted average of the demand for the three subregions. These values are available in the AESC 2021 User Interface.

The results are stable across zones but vary by month and period. The modest spread in elasticity values by zone indicates zonal prices are strongly correlated with system load. On an annual basis, a 1.0 percent reduction in demand yields a 1.4 percent reduction in price. Depending on the month, a 1.0 percent

[243] We also calculate elasticities for "top" hours (described in footnote 242) using an analogous methodology to the one described here. These elasticities are not shown in this report due the large size of the table, but may be found in the *AESC 2021 User Interface*.

reduction in load throughout New England results in a 0.7 to 2.3 percent reduction in off-peak price, and a 0.7 to 2.7 percent reduction in peak price.

Comparison with AESC 2018

Table 82 describes the summary statistics from Table 81, and compares the results with analogous values from AESC 2018. Elasticities in AESC 2021 are generally lower due to differences in years analyzed (AESC 2018 estimates regressions based on data from September 2015 through August 2017, while AESC 2021 uses data for January 2018 through December 2019), and minor modifications to the elasticity algorithm.

Table 82. Comparison of energy DRIPE elasticities, AESC 2018 and 2021

		AESC 2018			AESC 2021		
		Min	*Median*	*Max*	*Min*	*Median*	*Max*
Annual		1.81	1.83	1.87	1.35	1.36	1.40
Winter	On-peak	1.95	2.35	2.59	0.87	1.38	2.71
	Off-peak	1.77	1.91	2.31	0.72	1.18	2.35
Summer	On-peak	0.98	1.81	1.94	0.65	1.50	2.22
	Off-peak	1.49	1.50	1.61	0.72	1.00	1.21

Calculating energy DRIPE

Next, we apply the above elasticities to hourly prices and loads to calculate the DRIPE benefit for any 1 MWh reduction in load. Conceptually, the value of DRIPE is equal to the change in price that results from a 1 MWh reduction in load, multiplied by the amount of load that benefits from that reduction in price.

We calculate the value of DRIPE both intra-zonally (i.e., the benefits that accrue within a zone from load impacts within that zone) and inter-zonally (i.e., the benefits that accrue beyond that zone's borders in the "rest of pool"). Equation 7 describes the calculation for intra-zone DRIPE, while Equation 8 describes the calculation for inter-zone DRIPE. Intrazonal and interzonal values are added to determine the total DRIPE effect.

The first term in Equation 7 calculates the change in zonal price given a change in ISO demand. It is multiplied by the load in Zone Z to calculate the collective benefit of that price reduction. Equation 8 is similar, but reflects how the demand reduction in Zone Z reduces prices in all other zones.

As in prior AESC studies, we assume that the value of DRIPE is reduced in two ways:

- First, rather than relying on the full energy demand values, we instead rely only on the unhedged portion of demand to calculate energy DRIPE. This is the portion of demand that has not already been purchased through long-term contracts.
- Second, we assume that the DRIPE effect decays over time. This is a series that aggregates expected effects related to resources responding to changes in prices, demand elasticity, and binding RPS policies.

Each of these two effects are described more in the subsequent subsection.

Intrazonal DRIPE values are roughly proportional to the percentage of ISO load in a given zone. Zones with less load will have lower zone-on-zone energy DRIPE values than zones with higher load. For example, Maine accounts for roughly one-fifth as much load as Massachusetts and has a zone-on-zone DRIPE value approximately one-fifth as large.[244] Conversely, interzonal estimates are approximately proportional to the difference between ISO load and zonal load. Zones with lower load will have higher zone-on-Rest-of-Pool values.

Equation 7. Value of intra-zonal electric energy DRIPE

$$DRIPE_{\substack{Zone\ Z\ |\ Zone\ Z \\ Period\ P}} = \left[\frac{\varepsilon_{\substack{Zone\ Z \\ Period\ P}} P_{\substack{Zone\ Z \\ Period\ P}}}{Q_{\substack{ISO \\ Period\ P}}} \times Q_{\substack{Zone\ Z \\ Period\ P}} \right] \times D$$

Equation 8. Value of inter-zonal electric energy DRIPE

$$DRIPE_{\substack{Rest-of-Pool\ |\ Zone\ Z \\ Period\ P}} = \frac{(1-\delta)_{Period\ P}}{Q_{\substack{ISO \\ Period\ P}}} \sum_{\substack{x \in Zones \\ x \neq Zone\ Z}} \varepsilon_{\substack{x \\ Period\ P}} P_{\substack{x \\ Period\ P}} Q_{\substack{x \\ Period\ P}}$$

Where:
ε is elasticity
P is the zonal market energy price ($/MWh)
$Q_{Zone\ Z}$ is zonal load less hedged supply (i.e., "unhedged load")
Q_{ISO} is ISO energy load
D is the aggregate decay effect

Energy DRIPE reductions

We assume that the value of energy DRIPE is reduced due to (a) some portion of energy purchased being bought outside the spot market for energy (i.e., hedged) and (b) a decay factor. The following subsections describe the assumptions underlying each of these effects.

Hedging assumptions

Substantial energy is purchased months or up to several years in advance of delivery, through utility contracting for standard service or a third-party contract. Hence, we assume energy DRIPE benefits are calculated only using the share of demand that is unhedged (i.e., the share that is purchased on the energy spot market). Our assumptions on energy hedging are based on four factors:

1. **Investor-owned utility contracts.** These contracts include pre-restructuring legacy contracts, post-restructuring reliability contracts in Connecticut, renewables purchases, and pending purchases from Hydro Québec.[245]

[244] There are subtle differences that make comparison inexact because DRIPE also depends on zonal elasticity and hedging estimates.

[245] Data on these contracts is obtained from utility IRPs and FERC Form 1.

2. **Hedging in Vermont**. Vermont is the sole remaining New England state that is vertically integrated statewide. Based on the 2018 IRP for Green Mountain Power, we assume that all utilities in Vermont have about 60 percent of their energy hedged in all years.[246]

3. **Hedging of vertically integrated energy in the other five New England states**. The resources owned or under contract to the vertically-integrated utilities (various mixes of municipals and coops in the other five states) are estimated based data from EIA 861.[247] Because exact data on hedged energy is difficult to compile, we assume that all load related to vertically integrated utilities (outside Vermont) are 50 percent hedged in all years.

4. **Short term contracts.** In addition to long-term hedging, some load is also subject to short-term contracts. Based on our knowledge of the procurement policies for standard service, the length of third-party contracts, and information provided by some of the participating utilities, we assume that 50 percent of energy is pre-contracted for the year of measure installation, 20 percent in the following year, and 10 percent in the third year. Depending on the measure vintage selected, this assumption is shifted by one year or more.

Table 83 depicts the aggregate unhedged share of energy by year in Counterfactual #1.

[246] The 2018 IRP of Green Mountain Power (which serves the majority of Vermont load) reports 70 percent of its energy comes from owned resources and long-term contracts. The price of the 24 percent of GMP's energy supply that came from Vermont's long-term contract with Hydro Québec varies in undisclosed part with market prices, so perhaps 60 percent of GMP's energy supply is price hedged. We assume all other utilities in Vermont use the same percentage of hedged energy.

[247] EIA Form 861, 2015-2019. Available at https://www.eia.gov/electricity/data/eia861/.

Table 83. Percent of load assumed to be unhedged in Counterfactual #1

Year	ISO	CT	MA	ME	NH	RI	VT
2021	40%	27%	45%	47%	45%	46%	20%
2022	63%	43%	70%	75%	72%	73%	33%
2023	75%	54%	79%	94%	90%	91%	41%
2024	68%	48%	69%	91%	90%	76%	41%
2025	63%	38%	64%	88%	90%	73%	41%
2026	61%	39%	60%	88%	90%	73%	41%
2027	62%	43%	61%	89%	90%	73%	41%
2028	63%	46%	62%	89%	90%	74%	41%
2029	64%	47%	62%	89%	90%	74%	41%
2030	66%	55%	63%	89%	90%	75%	41%
2031	71%	76%	64%	90%	91%	75%	41%
2032	72%	76%	64%	90%	91%	76%	41%
2033	72%	77%	65%	90%	91%	76%	41%
2034	73%	77%	65%	91%	91%	77%	41%
2035	73%	77%	66%	91%	91%	77%	41%

Note: Because total energy demand varies for each counterfactual, and because assumptions on contracted MWh are fixed, these percentages vary for each counterfactual. See the AESC 2021 User Interface for detail on each counterfactual.

Decay assumptions

We assume three factors tend to reduce energy DRIPE as time passes after the initial effect on market prices:

1. **Resources respond to changes in prices.** Owners of existing generating capacity would tend to allow their energy-producing assets to become less efficient and less reliable as low energy prices make continued operation of the units less attractive, leading to more outages and higher market-clearing prices.

2. **Demand elasticity.** Over time, customers might respond to lower energy prices by using somewhat more energy, pushing prices back up somewhat. We assume demand elasticities that start at 3 percent in 2021 and increase to 8 percent by 2026, where they are sustained through the study period.[248]

3. **Impact from binding RPS policies. F**or every megawatt-hour not required due to energy efficiency, generation service providers will not need to procure a fraction of a REC from new renewable resources, assuming that these policies are "binding" (i.e., drive construction of new renewable resources in New England).[249] We assume that reducing load under conditions where RPS policies are binding will generally result in fewer renewables being built, partially offsetting the reduction in energy load. This percentage varies by state, year, and counterfactual.

[248] Elasticities are derived from Paul, A., et al. "A partial adjustment model of U.S. electricity demand by region, season, and sector." Resources for the Future. Published April 2009.

[249] For more discussion on binding RPS policies, see Chapter 7: *Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies* and Section 8.3: *Applying non-embedded costs*.

We calculate the aggregate decay effect in each year as the product of (a) one less the percent of load that is binding under the state's RPS policies, (b) one less the demand elasticity factor, and (c) one less the resource fade-out factor. This effect is shown in Table 84, for Counterfactual #1, for measures installed in 2021.

Table 84. Energy DRIPE decay factors for measures installed in 2021 in Counterfactual #1

Year	ISONE	CT	MA	ME	NH	RI	VT
2021	93%	96%	91%	96%	93%	96%	88%
2022	90%	93%	88%	93%	91%	93%	85%
2023	88%	92%	86%	92%	89%	92%	82%
2024	87%	90%	84%	90%	87%	90%	79%
2025	85%	88%	82%	88%	85%	88%	76%
2026	82%	85%	80%	85%	83%	85%	73%
2027	78%	82%	76%	82%	79%	82%	69%
2028	73%	76%	71%	76%	74%	76%	63%
2029	66%	69%	64%	69%	67%	69%	56%
2030	54%	57%	52%	57%	55%	57%	46%
2031	37%	39%	36%	39%	38%	39%	31%
2032	0%	0%	0%	0%	0%	0%	0%
2033	0%	0%	0%	0%	0%	0%	0%
2034	0%	0%	0%	0%	0%	0%	0%
2035	0%	0%	0%	0%	0%	0%	0%

Note: This decay schedule will vary for measures installed in other years, under other counterfactuals. See the AESC 2021 User Interface for detail on each counterfactual.

Energy DRIPE values

After combining the effects of the price shifts, unhedged demand, and decay, we are able to calculate the energy DRIPE benefits. Table 85 provides 15-year levelized energy DRIPE benefits for efficiency measures installed in 2021 using Equation 7 and Equation 8. These values may be multiplied by a MWh quantity (e.g., energy savings from energy efficiency or energy increases from electrification) to estimate the resultant DRIPE impact in dollars. Values are shown for measures installed in 2021; values for measures installed in other years may be calculated using the *AESC 2021 User Interface*.

Table 85. Energy DRIPE values for 2021 installations (2021 $ per MWh) for Counterfactual #1

	Year	Intrazonal (Own Zone)						Interzonal (Rest-of-Pool)					
		CT	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
Winter off-peak	2021	$3.01	$9.25	$2.39	$2.11	$1.37	$0.42	$15.64	$9.09	$16.24	$16.45	$17.22	$18.11
	2022	$5.50	$16.68	$4.38	$3.91	$2.54	$0.77	$28.46	$16.72	$29.55	$29.89	$31.33	$32.96
	2023	$6.76	$18.66	$5.41	$4.82	$3.13	$0.93	$33.19	$20.59	$34.50	$34.92	$36.69	$38.71
	2024	$6.23	$16.75	$5.41	$4.98	$2.69	$0.94	$30.99	$19.82	$31.79	$32.06	$34.41	$35.98
	2025	$4.81	$15.49	$5.21	$4.93	$2.54	$0.92	$29.27	$18.00	$28.89	$29.01	$31.46	$32.89
	2026	$4.69	$13.99	$5.06	$4.76	$2.46	$0.87	$27.32	$17.44	$26.96	$27.11	$29.46	$30.86
	2027	$4.89	$13.30	$4.79	$4.49	$2.33	$0.80	$25.92	$16.91	$26.01	$26.17	$28.38	$29.70
	2028	$5.09	$13.07	$4.71	$4.40	$2.29	$0.77	$25.44	$16.84	$25.81	$25.98	$28.12	$29.43
	2029	$4.80	$12.29	$4.42	$4.10	$2.15	$0.70	$23.87	$15.77	$24.24	$24.43	$26.41	$27.65
	2030	$4.61	$10.27	$3.69	$3.40	$1.79	$0.57	$19.93	$13.71	$20.82	$20.99	$22.63	$23.67
	2031	$4.45	$7.23	$2.60	$2.38	$1.26	$0.39	$14.04	$10.80	$15.82	$15.96	$17.10	$17.84
Winter on-peak	2021	$3.94	$11.92	$3.04	$2.72	$1.79	$0.55	$20.13	$11.76	$21.00	$21.25	$22.21	$23.37
	2022	$6.64	$19.80	$5.12	$4.64	$3.07	$0.92	$33.75	$19.91	$35.22	$35.56	$37.21	$39.19
	2023	$7.78	$21.14	$6.03	$5.45	$3.61	$1.06	$37.56	$23.41	$39.25	$39.65	$41.59	$43.93
	2024	$7.17	$18.96	$6.01	$5.62	$3.10	$1.07	$35.01	$22.46	$36.12	$36.34	$38.92	$40.74
	2025	$5.52	$17.51	$5.78	$5.56	$2.92	$1.04	$33.01	$20.35	$32.76	$32.82	$35.51	$37.17
	2026	$5.54	$16.26	$5.78	$5.52	$2.92	$1.02	$31.70	$20.30	$31.47	$31.56	$34.23	$35.89
	2027	$6.00	$16.07	$5.68	$5.41	$2.87	$0.98	$31.25	$20.45	$31.56	$31.65	$34.25	$35.90
	2028	$5.81	$14.67	$5.18	$4.92	$2.62	$0.87	$28.49	$18.93	$29.09	$29.20	$31.54	$33.05
	2029	$5.39	$13.49	$4.79	$4.52	$2.37	$0.78	$26.16	$17.40	$26.74	$26.87	$29.06	$30.41
	2030	$5.20	$11.31	$4.01	$3.76	$1.99	$0.64	$21.92	$15.19	$23.06	$23.19	$25.00	$26.14
	2031	$5.02	$7.95	$2.82	$2.63	$1.39	$0.44	$15.43	$11.98	$17.53	$17.65	$18.90	$19.71
Summer off-peak	2021	$1.60	$4.90	$1.10	$1.05	$0.78	$0.20	$8.07	$4.62	$8.56	$8.59	$8.88	$9.42
	2022	$2.38	$7.17	$1.65	$1.58	$1.17	$0.30	$11.95	$6.92	$12.65	$12.68	$13.12	$13.93
	2023	$2.87	$7.86	$2.00	$1.91	$1.42	$0.35	$13.65	$8.36	$14.49	$14.52	$15.06	$16.04
	2024	$2.81	$7.49	$2.12	$2.09	$1.29	$0.38	$13.47	$8.49	$14.14	$14.11	$14.93	$15.77
	2025	$2.18	$6.98	$2.06	$2.09	$1.23	$0.37	$12.81	$7.74	$12.93	$12.84	$13.73	$14.49
	2026	$2.12	$6.27	$1.98	$2.00	$1.18	$0.35	$11.87	$7.46	$12.00	$11.92	$12.77	$13.51
	2027	$2.22	$6.02	$1.90	$1.91	$1.13	$0.33	$11.38	$7.31	$11.69	$11.63	$12.43	$13.14
	2028	$2.44	$6.23	$1.96	$1.96	$1.17	$0.33	$11.76	$7.68	$12.22	$12.17	$12.98	$13.73
	2029	$2.30	$5.84	$1.83	$1.82	$1.09	$0.30	$11.00	$7.16	$11.44	$11.40	$12.15	$12.85
	2030	$2.24	$4.95	$1.56	$1.54	$0.92	$0.25	$9.32	$6.33	$9.97	$9.95	$10.58	$11.17
	2031	$2.16	$3.49	$1.10	$1.07	$0.65	$0.17	$6.57	$5.02	$7.59	$7.58	$8.02	$8.44
Summer on-peak	2021	$2.89	$8.79	$1.81	$1.83	$1.46	$0.35	$14.35	$8.16	$15.39	$15.32	$15.73	$16.78
	2022	$4.03	$12.12	$2.55	$2.61	$2.07	$0.48	$19.99	$11.48	$21.42	$21.29	$21.88	$23.37
	2023	$4.46	$12.18	$2.83	$2.89	$2.29	$0.53	$20.89	$12.72	$22.47	$22.34	$22.99	$24.64
	2024	$4.40	$11.77	$3.04	$3.20	$2.12	$0.57	$20.89	$13.06	$22.20	$21.96	$23.09	$24.51
	2025	$3.45	$11.07	$2.97	$3.22	$2.03	$0.57	$20.02	$11.98	$20.48	$20.15	$21.39	$22.72
	2026	$3.55	$10.49	$3.03	$3.27	$2.07	$0.56	$19.58	$12.20	$20.08	$19.76	$21.01	$22.36
	2027	$3.93	$10.61	$3.06	$3.28	$2.08	$0.55	$19.76	$12.60	$20.59	$20.29	$21.53	$22.90
	2028	$3.79	$9.66	$2.78	$2.97	$1.89	$0.49	$17.97	$11.64	$18.94	$18.67	$19.79	$21.04
	2029	$3.58	$9.08	$2.61	$2.77	$1.78	$0.45	$16.85	$10.90	$17.79	$17.55	$18.58	$19.76
	2030	$3.51	$7.72	$2.22	$2.34	$1.51	$0.37	$14.33	$9.70	$15.57	$15.38	$16.25	$17.25
	2031	$3.44	$5.52	$1.59	$1.66	$1.08	$0.26	$10.26	$7.81	$12.03	$11.91	$12.52	$13.24

Note: Values differ across states because states vary in terms of size of unhedged electricity demand.

Table 86 provides the levelized value for energy DRIPE installed in each state, broken down between the value of price reductions in the state of installation (intrazonal) and in the rest-of-pool (interzonal). Intrazonal and interzonal values may be added to determine the total DRIPE effect.

Table 86. Seasonal energy DRIPE values for measures installed in 2021 (2021 $ per MWh)

Type	Season	Period	CT	MA	ME	NH	RI	VT
Intrazonal	Summer	On-Peak	$2.78	$7.41	$1.93	$2.04	$1.38	$0.35
		Off-Peak	$1.72	$4.56	$1.31	$1.29	$0.82	$0.23
	Winter	On-Peak	$4.34	$11.50	$3.68	$3.44	$1.95	$0.64
		Off-Peak	$3.72	$9.99	$3.26	$3.00	$1.67	$0.55
Interzonal	Summer	On-Peak	$13.23	$8.29	$14.05	$13.89	$14.58	$15.51
		Off-Peak	$8.27	$5.23	$8.66	$8.64	$9.13	$9.67
	Winter	On-Peak	$21.36	$13.71	$21.99	$22.13	$23.66	$24.82
		Off-Peak	$18.61	$11.91	$19.05	$19.21	$20.58	$21.57

Note: Values shown are levelized over 15 years.

9.3. Electric capacity DRIPE

This section describes our methodology and assumptions for capacity market DRIPE effects. If the capacity market were in equilibrium, and all the marginal sources of capacity had similar cost characteristics, reducing demand or adding capacity would not have much effect on capacity price. However, results from recent forward capacity auctions have shown that this is not the case (see discussion in Chapter 5: *Avoided Capacity Costs*). Instead, the marginal sources of capacity vary in price. The bid prices for individual units appear to have declined over time, as well. Hence, the clearing price of capacity continues to be sensitive to the amount of energy efficiency resources cleared in the FCM, and to the effect of uncleared energy efficiency resources on demand.[250] As a result, we can be certain that capacity price effects are both real and material.

AESC estimates two varieties of capacity DRIPE effects:

- Cleared DRIPE benefits, which are benefits of measures that clear in the ISO New England FCM
- Uncleared DRIPE benefits, which are benefits of measures that are not submitted into or otherwise do not clear in the ISO New England FCM

This section describes the methodology used to calculate both types of capacity DRIPE. We begin with a discussion of price shifts, then describe which components of regional demand these price shifts are eligible to be applied, then describe the methodologies for calculating benefits in the two categories of capacity DRIPE.

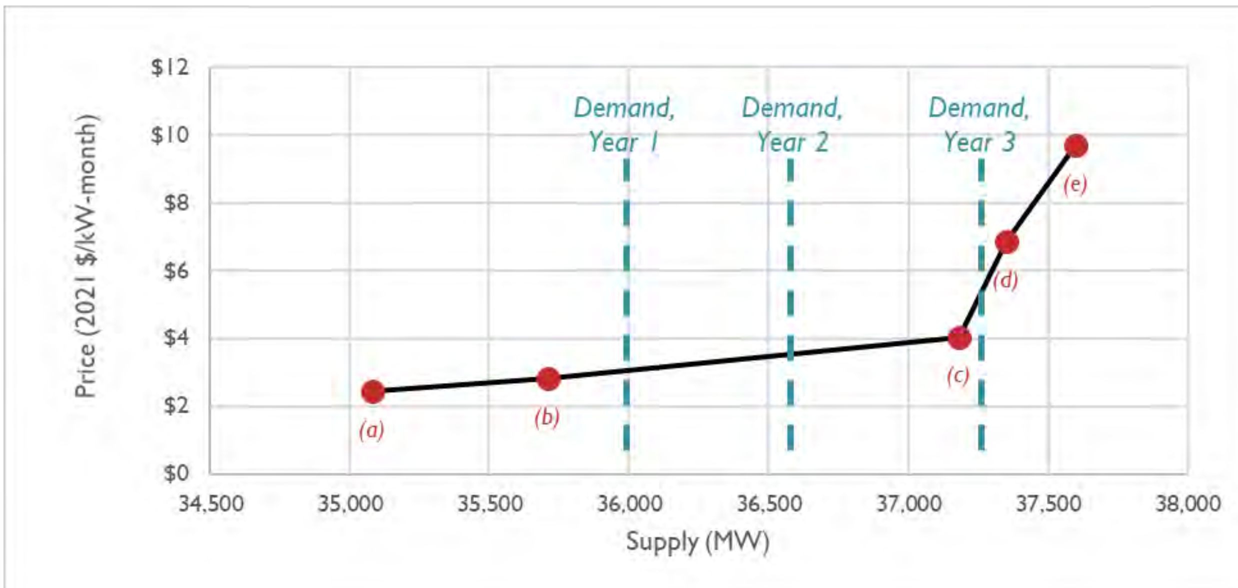
[250] FCM prices will be determined to a large extent by the prices at which existing resources choose to delist. By delisting, existing resources in New England are able to: (1) sell into another market such as New York, (2) shut down, or (3) operate in the energy market without obligations in the capacity market. New resources can defer implementation or operate in the energy market. Resources that do not clear in one FCA can bid into the subsequent auctions, including Annual Reconfiguration Auctions, or sell capacity bilaterally, such as to assume the capacity obligation of a resource that cleared.

Calculating price shifts in the capacity market

The "price shift" of capacity refers to how much the price of capacity (measures in $/kW-year per MW) changes in response to changes in demand. As in past AESC, we estimate price shifts for future years using the slope of the most recent capacity market auction (in the case of AESC 2021, this is FCA 15, conducted in February 2021), shifted to reflect the change in supply capacity that has occurred since that auction.

Figure 49 depicts the five known datapoints for supply and price in FCA 15.[251] The line segment between each one of these points has a slope, which is effectively the price shift used in AESC 2021. Depending on where demand crosses the supply curve, the clearing price will have a different associated price shift. For example, in Figure 49, demand in Year 1 and Year 2 will produce the same price shift. Demand in Year 3, however, crosses at a different line segment and will yield a different price shift. Practically speaking, the shallower the line segment, the lower the price shift's value is. Conversely, steeper line segments produce higher price shifts. See Table 87 for our estimates of the price shifts for each counterfactual.

Figure 49. Supply curve for FCA 15 with illustrative demand lines



Note: Demand lines are illustrative and do not represent actual or projected demand in any year.

[251] ISO New England. Last accessed March 11, 2021. *Forward Capacity market (FCA 15) Result.* Available at https://www.iso-ne.com/static-assets/documents/2018/05/fca-results-report.pdf

Table 87. Price shifts for capacity DRIPE (2021 $/kW-month per MW) in rest-of-pool region

	FCA	Counterfactual #1	Counterfactual #2	Counterfactual #3	Counterfactual #4
2021	12	$0.00038	$0.00038	$0.00038	$0.00038
2022	13	$0.00033	$0.00033	$0.00033	$0.00033
2023	14	$0.00051	$0.00051	$0.00051	$0.00051
2024	15	$0.00058	$0.00058	$0.00058	$0.00058
2025	16	$0.00058	$0.00058	$0.00058	$0.00058
2026	17	$0.00058	$0.00058	$0.00058	$0.00058
2027	18	$0.00083	$0.00083	$0.00083	$0.00083
2028	19	$0.00083	$0.00083	$0.00083	$0.00083
2029	20	$0.00083	$0.00083	$0.00083	$0.00083
2030	21	$0.00083	$0.00083	$0.00083	$0.00083
2031	22	$0.00083	$0.00083	$0.00083	$0.00083
2032	23	$0.00083	$0.00083	$0.00083	$0.00083
2033	24	$0.00083	$0.00083	$0.00083	$0.00083
2034	25	$0.01657	$0.01657	$0.01657	$0.01657
2035	26	$0.00083	$0.00083	$0.00083	$0.00083

Notes: Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

Calculating capacity DRIPE

Price shifts are described in units of dollars-per-kW-month per MW (effectively, price per demand). To allow these numbers to be applied to any generic change in demand (e.g., from an energy efficiency measure), we multiply these values by the projected demand.

We calculate demand using two different sets of numbers. First, using the EnCompass model, we project future demand for each state and the region as a whole given the inputs described in Chapter 4: *Common Electric Assumptions*. Second, we multiply this by the fraction of demand that is unhedged. Unhedged demand is the quantity of electricity that has not already been procured ahead of time, and is thus subject to changes in the capacity market prices.

The unhedged percentage varies by state. Vermont utilities are vertically integrated and own (or have under long-term contract) a large portion of their capacity requirements. The same is also true for municipal utilities. The Connecticut utilities have contracts for differences with a number of generators built to relieve a transmission constraint, and all the restructured states have some legacy contracts and/or small post-restructuring contracts that provide capacity. In general, the long-term purchase of capacity has fallen out of favor, even where the utilities are purchasing energy long term.[252] For Vermont, we estimate hedged demand percentages based on data from the most recently available

[252] In addition, the generation-supply offers by the utilities, municipal aggregators, and third-party marketers provide short-term price certainty for a sizable portion of load. By the time those rates are locked in, the capacity price is generally known. For the small percentage of power-supply contracts for more than three years into the future, the capacity component is generally subject to market adjustment. Hence, retail power-supply contracts have little if any value in hedging capacity price risk.

Green Mountain Power IRP, and we assume hedged demand share in the rest of the state is similar.[253] Specific data on hedged capacity for other states is less available. We rely on capacity contracts as published in FERC Form 1 and we assume half of all remaining vertically integrated demand is hedged as a proxy for the above-mentioned dynamics.

Table 88 describes the resulting unhedged capacity demand assumptions for Counterfactual #1. Values for Counterfactual #2 are lower, given its lower projections of load. Values for Counterfactual #3 and Counterfactual #4 are similar to Counterfactual #1. See the *AESC 2021 User Interface* for detail on all counterfactuals.

Table 88. Unhedged capacity for Counterfactual #1

	ISO	CT	MA	ME	NH	RI
2021	25,091	5,740	12,436	2,057	2,502	1,972
2022	25,797	5,841	12,712	2,108	2,556	2,015
2023	26,280	5,941	12,989	2,110	2,609	2,057
2024	26,458	5,949	13,099	2,132	2,629	2,072
2025	27,305	6,126	13,525	2,211	2,713	2,138
2026	26,877	5,982	13,350	2,183	2,674	2,106
2027	27,514	6,104	13,678	2,245	2,738	2,156
2028	27,988	6,184	13,930	2,294	2,786	2,194
2029	28,517	6,277	14,208	2,347	2,840	2,235
2030	28,967	6,347	14,443	2,401	2,885	2,273
2031	29,427	6,419	14,684	2,457	2,931	2,312
2032	29,832	6,469	14,952	2,486	2,965	2,336
2033	30,452	6,578	15,269	2,557	3,026	2,385
2034	31,004	6,668	15,555	2,624	3,081	2,430
2035	31,575	6,761	15,851	2,693	3,138	2,477

Notes: Data on clearing prices for other counterfactuals can be found in the AESC 2021 User Interface.

Price shifts and unhedged capacity quantities are two of the primary inputs used to estimate capacity DRIPE. The following sections describe the methodologies used to translate these values into (a) cleared capacity benefits and (b) uncleared capacity benefits.

Calculating cleared capacity DRIPE

AESC 2021, like previous AESC studies, utilizes a decay schedule for cleared capacity DRIPE. This schedule describes how these effects phase in and phase out.

First, we assume that all cleared measures have full DRIPE benefits in the first year they are installed. However, we assume that this effect does not last indefinitely. Over time, customers will respond to lower prices by using somewhat more energy, including at the peak. In addition, lower capacity prices may result in the retirement of some generation resources and termination of some demand-response resources, which will result in these resources being removed from the supply curve. Further, some new

[253] See *2018 Integrated Resource Plan*. Green Mountain Power. Chapter 8. Figure 8-20.

proposed resources that have not cleared for several auctions may be withdrawn (if, for example, contracts and approvals expire, raising the cost of offering the resource into future auctions).[254] As a result, we assume that the effects of DRIPE fade out over time. Based on expert judgement, we use the same assumption used in prior AESC studies, wherein the phase-out is linear over time, reaching an effect of zero in the seventh year. We assume that measures with shorter lifetimes use the same decay schedule, rather than a compressed decay schedule or some other alternative. This is because the phase-out of DRIPE effects is based on market dynamics, rather than the features of individual measures.

Table 89 shows the decay schedule used for cleared capacity measures installed in 2021. Measures installed in later years have the same decay schedule, but shifted by one or more years.

Table 89. Decay schedule used for cleared capacity for measures installed in 2021

	Decay	1- Decay
2021	0%	100%
2022	17%	83%
2023	33%	67%
2024	50%	50%
2025	67%	33%
2026	83%	17%
2027	100%	0%
2028	100%	0%
2029	100%	0%
2030	100%	0%
2031	100%	0%
2032	100%	0%
2033	100%	0%
2034	100%	0%
2035	100%	0%

After calculating this decay schedule, we calculate cleared capacity DRIPE as using the formulas described in Equation 9 (for interzonal DRIPE) and Equation 10 (for intrazonal). Interzonal DRIPE is calculated by multiplying the price shift for a given year by the unhedged capacity quantity for a given state, by one minus the decay percentage for that year. Meanwhile, intrazonal DRIPE uses the exact same calculation, except replaces the unhedged capacity quantity for the given state with the unhedged capacity quantity for the rest of the region (less the state in question).

Equation 9. Calculation of interzonal (zone-on-zone) cleared capacity DRIPE

$$Capacity\ DRIPE_{\substack{Zone\ Z\ |\ Zone\ Z \\ Period\ P}} = \left[Price\ Shift\ \times Hedged\ Capacity_{\substack{Zone\ Z \\ Period\ P}}\right] \times (1 - Decay)$$

[254] We note, however, that the historical record of (a) retirements and (b) cancelation of planned generation does not show any clear association with falling capacity prices.

Equation 10. Calculation of intrazonal (zone-on-rest-of-pool) cleared capacity DRIPE

$$Capacity\ DRIPE_{\substack{ROP\ |\ Zone\ Z \\ Period\ P}} = \left[Price\ Shift \times \left(Hedged\ Capacity_{\substack{ISO \\ Period\ P}} - Hedged\ Capacity_{\substack{Zone\ Z \\ Period\ P}}\right)\right] \times (1 - Decay)$$

Table 90 shows cleared capacity DRIPE for each region for measures that are installed in 2021.

Table 90. Cleared capacity DRIPE by year for measures installed in 2021 (2021 $ per kW-year)

	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	$116	$26	$57	$9	$12	$9	$2	$89	$58	$106	$104	$106	$114
2022	$86	$19	$42	$7	$9	$7	$2	$66	$44	$79	$77	$79	$84
2023	$108	$24	$53	$9	$11	$8	$2	$84	$55	$99	$97	$100	$106
2024	$92	$21	$46	$7	$9	$7	$2	$72	$47	$85	$83	$85	$90
2025	$63	$14	$31	$5	$6	$5	$1	$49	$32	$58	$57	$58	$62
2026	$32	$7	$16	$3	$3	$3	$1	$25	$16	$29	$29	$29	$31
2027	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2028	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2034	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2035	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
15-year levelized	**$34**	**$8**	**$17**	**$3**	**$3**	**$3**	**$1**	**$27**	**$17**	**$32**	**$31**	**$32**	**$34**

Calculating uncleared capacity DRIPE

Demand-response and load-management programs that do not clear in the FCM also generate capacity DRIPE benefits, albeit with different timing and of different magnitudes. Capacity DRIPE for uncleared resources is calculated analogously to that of cleared resources, but the decay schedule and market clearing prices are adjusted to reflect different market features.

To calculate uncleared capacity DRIPE, we utilize a modified version of the same phase-in / phase-out schedule described above in Section 5.2: *Uncleared capacity calculations*. As with uncleared capacity, we assume that uncleared capacity DRIPE effects do not appear until five years after a measure is installed, and that they persist at various magnitudes and lengths of time depending on the measure's lifetime. However, uncleared capacity DRIPE differs in that we also assume that DRIPE effects decay over time, following the same decay schedule described in Table 89.

As with uncleared capacity, the calculations of uncleared capacity DRIPE also utilize estimates of reserved margin and scaling factors (also described above in Section 5.2: *Uncleared capacity calculations*).

To estimate uncleared capacity DRIPE, we use the following calculations:

- For intrazonal (zone-on-zone) uncleared capacity DRIPE in a particular state and year, we calculate the product of (a) the state's unhedged demand, (b) the price shift for that year, (c) the effect-and-decay schedule that matches the measure's lifetime, and (d) the scaling factor, if relevant. Unlike cleared capacity DRIPE, this value is then multiplied by one plus the reserve margin to reflect the fact that since the measure is uncleared, it is capable of avoiding some reserve margin.[255]

- For interzonal (zone-on-rest-of-pool) uncleared capacity DRIPE for a particular state and year, we calculate the product of (a) regional unhedged demand minus the state's unhedged demand, (b) the price shift for that year, (c) the effect-and-decay schedule that matches the measure's lifetime, and (d) the scaling factor, if relevant. This value is then multiplied by one plus the reserve margin.

Table 90 shows uncleared capacity DRIPE for each region for measures that are installed in 2021, assuming a measure life of 10 years. Here, we observe uncleared capacity DRIPE benefits that are higher than cleared capacity DRIPE benefits primarily because this particular example describes avoided costs for a measure with a 10-year life. Measures with this program lifetime provide substantial uncleared DRIPE benefits in the mid-2020s and early 2030s, but do not provide cleared capacity DRIPE benefits in those same years.

[255] As the measure is uncleared, it is effectively "counted" in the demand side of the capacity auction (i.e., within the load forecast). In contrast, measures that are cleared are effectively treated the same as conventional power plants (i.e., supply), and through the auction effectively require the purchase of some extra amount of capacity to act as a reserve margin.

Table 91. Uncleared capacity DRIPE by year for measures installed in 2021 (2021 $ per kW-year)

	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2024	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2025	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2026	$64	$14	$32	$5	$6	$5	$1	$49	$32	$58	$57	$59	$62
2027	$140	$31	$70	$11	$14	$11	$3	$109	$71	$129	$126	$129	$137
2028	$181	$40	$90	$15	$18	$14	$4	$141	$91	$166	$163	$167	$177
2029	$211	$47	$105	$17	$21	$17	$5	$165	$106	$194	$190	$195	$207
2030	$198	$43	$99	$16	$20	$16	$4	$155	$99	$182	$178	$182	$194
2031	$146	$32	$73	$12	$15	$11	$3	$114	$73	$134	$131	$134	$143
2032	$91	$20	$46	$8	$9	$7	$2	$71	$45	$83	$82	$84	$89
2033	$52	$11	$26	$4	$5	$4	$1	$41	$26	$48	$47	$48	$51
2034	$471	$101	$236	$40	$47	$37	$10	$370	$235	$431	$424	$434	$461
2035	$6	$1	$3	$1	$1	$0	$0	$5	$3	$6	$6	$6	$6
15-year levelized	**$102**	**$22**	**$51**	**$8**	**$10**	**$8**	**$2**	**$79**	**$51**	**$93**	**$92**	**$94**	**$100**

Note: This chart assumes a measure life of 10 years. Measures with other measure lives will have completely different uncleared capacity DRIPE effects. See the AESC 2021 User Interface for more information.

<u>Important caveats for applying uncleared capacity DRIPE values</u>

Uncleared capacity DRIPE is different than many other avoided cost categories. Because uncleared capacity DRIPE describes an effect that fades out over time due to the market's responses to that effect, users should sum avoided costs over the entire study period, regardless of any one measure's lifetime. For example, the avoided costs of a 1 MW measured installed in 2021 would be equal to the sum of the values from 2021 through 2055, regardless of whether that measure had a 1-year measure life or a 30-year measure life.[256]

Uncleared resources affect the load forecast only to the degree that these resources provide load reductions on the hours used in the load forecast regression. Some resources—such as demand response resources—may be active only on one or some of the hours used in the load forecast. As a result, these resources would provide a diminished uncleared capacity benefit. We recommend that program administrators apply a scaling factor to the benefits detailed in Table 91 to account for this effect. See Appendix K: *Scaling Factor for Uncleared Resources* for more information on how this scaling factor is calculated and how it can be applied.

[256] We note that this is the same approach used for summing avoided costs for uncleared capacity and uncleared capacity DRIPE, but no other avoided cost categories.

9.4. Natural gas DRIPE

Just as reducing electric load reduces electric energy prices, reducing natural gas usage reduces demand for natural gas in producing regions and therefore reduces the market price of that natural gas supply. This natural gas price reduction effect is natural gas DRIPE. The price for natural gas—and associated benefits—can be broken into two components:

1. The supply component, determined by North American demand and supply conditions on a largely annual basis.
2. Transportation costs or "basis," determined by contract prices for LDCs and by the balance of regional demand and supply (mostly from pipelines) on a daily and seasonal basis for other users, especially electric generators.

Importantly, only the supply component of natural gas DRIPE is used in cost-effectiveness screening of gas measures. This is because LDCs and most other suppliers of gas to the end-use rely primarily on firm long-term contracts for pipeline and storage capacity to allow for delivery of natural gas. As a result, the basis DRIPE effect benefits only electric customers.

Natural gas supply DRIPE

This section focuses on the calculation of natural gas supply DRIPE. This is the DRIPE effect that is applied to end-use measures that produce natural gas savings.

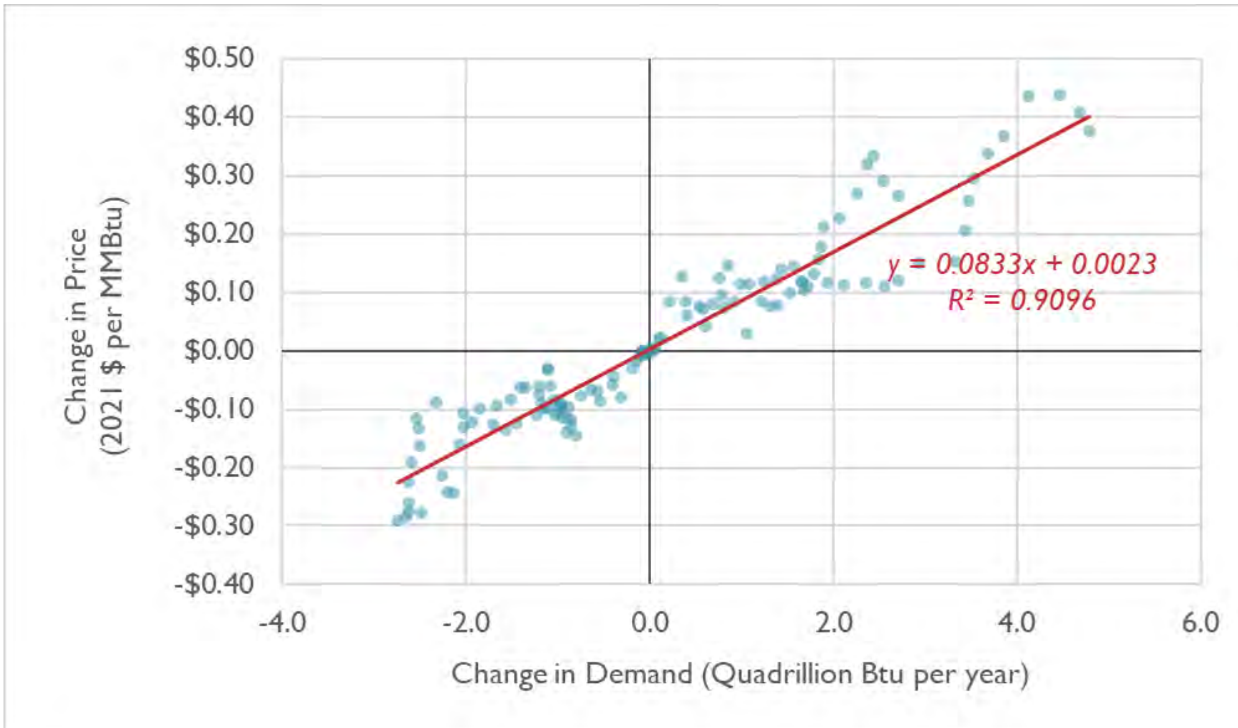
Calculating elasticities

Elasticity describes how prices of a commodity respond to changes in demand. In AESC 2018, we relied on a literature review of recent estimates of natural gas elasticities (including both top-down and bottom-up empirical estimates). For AESC 2021, we instead rely on a calculation of the implied response of natural gas prices to supply changes observed in different scenarios modeled in EIA's AEO 2021.

Figure 50 compares annual data points from AEO 2021. Each data point represents the difference in both prices and demand for one AEO side scenario relative to the price and demand for natural gas in AEO 2021 Reference case for the same year. This figure includes datapoints from four different AEO side scenarios: the High economic growth, Low economic growth, High renewable cost, and Low renewable cost cases. This analysis encompasses all years from 2020 through 2050. A linear regression of this dataset provides a slope that indicates how changes in price are related to changes in demand.

Overall, we find that reducing demand by one quadrillion Btu reduces EIA's estimate of the market price by $0.083 per MMBtu in 2021 dollars. This is about half of the AESC 2018 value of $0.16/MMBtu per quadrillion Btu/year (in 2021 dollars).

Figure 50. Effect of changing gas demand on gas price



Note: Deltas compare annual prices and demand in four AEO 2021 scenarios versus the AEO 2021 Reference case.

Calculating natural gas supply DRIPE

As with electricity DRIPE effects, the price reduction per MMBtu saved is a very small portion of the price per MMBtu, but each MMBtu saved reduced prices for a very large number of MMBtus. According to AEO 2021, each year, New England is expected to consume 0.5 quadrillion Btu for non-electric uses.[257] Multiplying this quantity by the price shift ($0.083/MMBtu per quadrillion Btu) yields a natural gas supply DRIPE effect of $0.05 per MMBtu. The quantity of gas consumed for non-electric uses changes over time, and among states. Between 2021 and 2035, AEO 2021 estimates that non-electric gas demand will increase by about 16 percent. Demand in each state is projected based on recent historical observations from 2014 through 2018. Vermont, for example, is projected to consume about 0.01 quadrillion Btu while Massachusetts is projected to consume about 0.3 quadrillion Btu. These differences yield different DRIPE effects for each state.

We do not expect any decay in gas DRIPE; benefits should continue as long as the efficiency measure continues to reduce load. In contrast to intra-month price variation driving the electric energy DRIPE, the studies and AEO gas-price forecasts reflect the full long-term costs of gas development (at least after the first few years), not just the operation of existing wells. In addition, gas supply DRIPE is measuring

[257] Gas supply DRIPE is applied to gas efficiency measures which displace consumption of gas that has been purchased by LDCs. As a result, we use non-electric consumption for this calculation.

the effect of demand on the marginal cost of extraction for a finite resource. If anything, lower gas usage in 2021 will leave more low-cost gas in the ground to meet demand in 2022, causing the DRIPE effect to accumulate over time.

However, we do assume that only a portion of consumption is responsive to DRIPE as a result of short-term contracts for gas. In Year 1, we assume that half of all gas demand is tied up in short-term contacts and is thus not impacted by DRIPE effects. This decreases to 20 percent in Year 2 and is assumed to fade away entirely in Year 3. Table 92 describes this impact schedule for measures that are installed in 2021. Measures installed in subsequent years would see these values shifted by one or more years. This is the same assumption used for short-term energy contracts for energy DRIPE (see Section 9.2: *Electric energy DRIPE*).

Table 92. Share of demand that is responsive to natural gas supply DRIPE

Year	Share of demand not impacted by DRIPE	Share of demand impacted by DRIPE
2021	50%	50%
2022	20%	80%
2023	0%	100%
…	…	…
2035 and later	0%	100%

Note: Values shown are for measures installed in 2021. Measures installed in 2022 would see these effects shifted by one year, measures installed in 2023 would see these effects shifted by two years, and so on.

Natural gas supply DRIPE values

Table 93 depicts the value of demand reduction for each state. This is calculated by obtaining the product of (a) the price shift (in 2021 $/MMBtu per quadrillion Btu), (b) the state's non-electric natural gas consumption, and (c) the share of demand that is responsive to natural gas supply effects.[258] Table 93 also shows the DRIPE effects for each state on the rest of the region. These values are calculated by subtracting the own-state value from the New England total in each year.

Using this table, we can see estimate the benefit for a reduction in gas use in each year. For example, a 1 MMBtu reduction in natural gas demand in 2023 yields a gas supply DRIPE benefit of $0.045 for New England as a whole.

AESC 2021's gas supply DRIPE estimates are lower than those found in AESC 2018, mostly due to lower price shift ($0.083/MMBtu per quadrillion Btu, down from $0.158/MMBtu per quadrillion Btu). Other changes are due to differences in historical gas consumption and projected gas consumption across the six states.

[258] Note that this consumption (and everything related to natural gas supply DRIPE) is independent of the natural gas price and avoided cost forecasts developed in Chapter 0:

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Table 93. Natural gas supply DRIPE benefit (2021 $ per MMBtu)

	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.020	0.005	0.011	0.001	0.001	0.002	0.000	0.015	0.009	0.019	0.019	0.019	0.020
2022	0.036	0.009	0.019	0.002	0.002	0.003	0.001	0.027	0.016	0.033	0.034	0.033	0.035
2023	0.045	0.011	0.024	0.003	0.002	0.003	0.001	0.034	0.021	0.042	0.043	0.042	0.044
2024	0.046	0.011	0.025	0.003	0.002	0.003	0.001	0.034	0.021	0.043	0.043	0.042	0.045
2025	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.042	0.045
2026	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.042	0.045
2027	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.042	0.045
2028	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.042	0.045
2029	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.043	0.045
2030	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.043	0.044	0.043	0.045
2031	0.046	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.044	0.044	0.043	0.045
2032	0.047	0.011	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.044	0.044	0.043	0.045
2033	0.047	0.012	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.044	0.044	0.043	0.046
2034	0.047	0.012	0.025	0.003	0.002	0.004	0.001	0.035	0.021	0.044	0.044	0.043	0.046
2035	0.047	0.012	0.025	0.003	0.002	0.004	0.001	0.035	0.022	0.044	0.045	0.043	0.046
10-year levelized	**0.044**	**0.011**	**0.024**	**0.003**	**0.002**	**0.003**	**0.001**	**0.033**	**0.020**	**0.041**	**0.041**	**0.040**	**0.043**

Note: Values differ across states because states vary in terms of size of non-electric gas consumption.

Natural gas basis DRIPE

Reductions in annual gas use will not only reduce the supply cost of natural gas, but also the basis. The basis is the price differential between the wholesale market price of gas in New England and the prices in the supply areas (sometimes called the “transportation” cost of natural gas). Since LDCs and most other suppliers of gas to the end-use rely primarily on firm long-term contracts for pipeline and storage capacity to allow for delivery of natural gas, the basis DRIPE effect benefits only electric customers and is thus only used in G-E cross-DRIPE and below in E-G-E cross-DRIPE (see more below in Section 9.5: *Cross-fuel market price effects*).

Calculating elasticities

The majority of the price differential for natural gas in New England is attributable to constraints on gas delivery capacity into New England from the Mid-Atlantic region. As a result, our analysis focuses on the basis between the Texas Eastern Transmission Zone M-3 (in Pennsylvania and New Jersey) and the Algonquin Gas Transmission citygates in Connecticut, Rhode Island, and eastern Massachusetts.[259]

[259] To be clear, this calculation of DRIPE ignores effects from gas delivered to New England directly from Canada or from LNG.

Using data spanning three winters (December 2017 through March 2020), we examine prices and demand for gas to determine price shifts over different periods of time. First, we utilize daily natural gas delivery data for the Algonquin Pipeline and Tennessee Gas Pipeline to determine the total amount of gas delivered to New England from the south.[260] For each day, we calculate the aggregate surplus capacity for these two pipelines. Separately, we also estimate the price paid for gas flowing each day at both the TETCO M3 Hub and the Algonquin Citygate.[261] The difference between these two values is the assumed basis for natural gas in New England.

Next, we assess a set of regressions of this surplus and basis data to determine what the price shift is at different times of the year. The slope of a linear regression describes the price shift. Table 94 describes the time periods and estimated price shifts. Note the use of two different "winter" periods and two different "summer" periods—one for electricity and one for gas. The seasonal assignments for the electric seasons are based on ISO New England's definition, while the gas seasons are consistent with the analysis in Chapter 0:

[260] Spectra Energy. Last accessed March 11, 2021. "Algonquin Gas Transmission." *Spectraenergy.com*. Available at https://infopost.spectraenergy.com/infopost/AGHome.asp?Pipe=AG.

Tennessee Gas Pipeline Company. Last accessed March 11, 2021. "Informational Postings: Point Capacity." *Kindermorgan.com*. Available at https://pipeline2.kindermorgan.com/Capacity/OpAvailPoint.aspx?code=TGP.

[261] Natural Gas Intelligence. Last accessed March 11, 2021. "Texas Eastern M-3, Delivery Daily natural Gas Price Snapshot." *Naturalgasintel.com*. Available at https://www.naturalgasintel.com/data-snapshot/daily-gpi/NEATETM3DEL/.

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Table 94. Gas basis price shifts by season

Season	Months included	Basis price shift (2021 $/MMBtu per BBtu/day)
Summer, electric	June through September	$0.00035
Winter, electric	October through May	$0.00203
Summer, gas	April through October	$0.00132
Winter, gas	November through March	$0.00328
Annual	**All months**	**$0.00180**

Over time, we assume that these basis price shifts decay as a result of a rebound effect (e.g., consumers using more gas given that it is cheaper), response of existing generation to price changes (i.e., gas units stay online longer and generate more electricity because of lower gas prices), and response of new generation to price changes (i.e., as prices remain low, there is less pressure to switch to newer, more efficient gas units). The combined effect of these drivers results in the decay schedule described in Table 95. Note that this schedule is for measures installed in 2021; measures installed in later years (e.g., 2021, 2022, and so on) use this same decay schedule but shifted by one year.

Table 95. Percent of gas basis decayed by year for measures installed in 2021

	Gas Basis Decay (%)
2021	1.3%
2022	4.1%
2023	6.8%
2024	16.3%
2025	25.4%
2026	46.8%
2027	67.0%
2028	76.0%
2029	84.5%
2030	92.5%
2031	100.0%
2032	100.0%
2033	100.0%
2034	100.0%
2035	100.0%

We then apply these decay percentages to the price shifts described above. Table 96 shows the decayed basis values for a measure installed in 2021, with the supply gas DRIPE values (which are not decayed) for comparison. All values have been converted in to $/MMBtu per Quadrillion Btu terms, as these are otherwise very small numbers.

Table 96. Decayed natural gas DRIPE values (2021 $/MMBtu per Quadrillion Btu reduced)

	Basis					*Supply*
	Electricity Summer	*Electricity Winter*	*Gas Summer*	*Gas Winter*	Annual	*Annual*
2021	0.0028	0.0083	0.0061	0.0214	0.0049	0.0001
2022	0.0028	0.0080	0.0059	0.0208	0.0047	0.0001
2023	0.0027	0.0078	0.0058	0.0202	0.0046	0.0001
2024	0.0024	0.0070	0.0052	0.0182	0.0041	0.0001
2025	0.0021	0.0062	0.0046	0.0162	0.0037	0.0001
2026	0.0015	0.0045	0.0033	0.0116	0.0026	0.0001
2027	0.0009	0.0028	0.0020	0.0072	0.0016	0.0001
2028	0.0007	0.0020	0.0015	0.0052	0.0012	0.0001
2029	0.0004	0.0013	0.0010	0.0034	0.0008	0.0001
2030	0.0002	0.0006	0.0005	0.0016	0.0004	0.0001
2031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2035	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

In New England, basis benefits are significantly larger than supply benefits, for two reasons. First, New England demand is only a small portion of North American demand, so a percentage change in regional load has a much smaller percentage effect on continent-wide demand. Second, while gas producers can increase production from year to year, pipeline constraints are much less flexible, requiring years of planning, siting, permitting and most importantly contracting.

Basis price shifts are not outright applied to any measures. Instead, they are combined with several other factors and used to calculate cross-DRIPE. See "G-E cross-DRIPE" and "E-G-E cross-DRIPE" subsections below in Section 9.5: *Cross-fuel market price effects*. See these subsections for comparisons of AESC 2021 values with analogous values from AESC 2018.

9.5. Cross-fuel market price effects

The preceding sections calculated direct DRIPE effects where a reduction in demand for a given commodity reduced prices for that same commodity. DRIPE benefits also accrue indirectly through cross-DRIPE, which measures the impact that a reduction in one commodity has on a different commodity. We assess three kinds of cross-DRIPE:

1. **Gas-to-electric (G-E) cross-DRIPE ($/MWh)** measures the benefits to electricity consumers that result from a reduction in gas demand. Gas-fired generators set electric market prices in most hours, so reducing gas prices should reduce electricity prices.

2. **Electric-to-gas (E-G) cross-DRIPE ($/MMBtu)** measures the benefits to gas consumers from a reduction in electricity demand. Electric power accounts for about one-third of the region's gas demand, so reducing electricity demand should reduce gas prices.
3. **Electric-to-gas-to-electric (E-G-E) cross-DRIPE ($/MWh)** combines the first two benefits. Reductions in electricity demand should reduce gas prices (E-G cross-DRIPE) which should, in turn reduce electricity prices (G-E cross-DRIPE). E-G-E cross-DRIPE is separate from direct electric energy DRIPE and does not double-count any benefits. Reductions in electricity demand yield two benefits. First, lower demand levels will tend to switch the marginal unit to something lower cost, yielding a market price reduction through plant substitution. Second, lower electricity demand levels reduce the demand for, and price of, natural gas. Thus, natural gas power plants, which set prices in most hours, burn less expensive gas than they would have otherwise. Electric energy DRIPE captures the first benefit, while E-G-E cross-DRIPE captures the second benefit. In our energy DRIPE calculations, we explicitly control for natural gas prices, which means own-fuel energy DRIPE is only measuring the benefits of switching from a less efficient plant to a more efficient plant. For E-G-E DRIPE, we hold the powerplant constant, and reflect how a change in gas prices changes electric prices.

Electric-to-gas (E-G) cross-DRIPE

Electric-to-Gas (E-G) cross-DRIPE measures the benefits to gas consumers from a reduction in electricity demand. Electric power accounts for approximately one-third of the region's gas demand, so reducing electricity demand should reduce gas prices, all else equal.

To calculate E-G cross-DRIPE, we utilize the supply gas price shift calculated in Section 9.4: *Natural gas DRIPE*: $0.083/MMBtu per quadrillion Btu. Next, we convert this price shift's units into $-per-MWh per quadrillion Btu so that it may be applied to MWh savings. We do this by relying on data about the marginal heat rate for emitting plants as reported by ISO New England.[262] According to this data, the marginal emitting plant heat rate is 7.74 MMBtu per MWh.[263] If we scale this to reflect the amount of time gas is expected to be on the margin in the energy market, we estimate a marginal gas heat rate of 6.43 MMBtu per MWh.[264] This value can then be multiplied by the price shift to produce an estimate of $0.54/MWh per quadrillion Btu (see Equation 11).

[262] ISO New England. May 2020. *Electric Generator Air Emissions Report.* Available at https://www.iso-ne.com/static-assets/documents/2020/05/2018_air_emissions_report.pdf.

[263] Id, Section 5.3.2.2.

[264] According to ISO New England, from 2014 to 2018, natural gas plants and pumped storage plants (which are generally powered by marginal units) were marginal 83 percent of the time (see 2018 Air Emissions Report, Figure 4-7).

Equation 11. Price shift in dollar-per-MWh terms

$$Dollar\ per\ MWh\ price\ shift = dollar\ per\ MMBtu\ price\ shift \times marginal\ gas\ heat\ rate$$

$$= \frac{\frac{\$0.083}{MMBtu}}{Quadrillion\ Btu} \times \frac{6.43\ MMBtu}{MWh} = \frac{\frac{\$0.54}{MWh}}{Quadrillion\ Btu}$$

To determine E-G DRIPE, we then follow the same overall process used to estimate natural gas supply DRIPE. For each year and state, we calculate the product of (a) estimated natural gas consumption, (b) the estimated share of consumption that is DRIPE-responsive (see Table 92), and (c) the price shift.

Table 97. Electric-to-gas (E-G) cross-DRIPE benefit (2021 $ per MWh)

	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.129	0.032	0.070	0.008	0.006	0.010	0.003	0.097	0.059	0.121	0.123	0.119	0.126
2022	0.229	0.057	0.124	0.014	0.011	0.018	0.005	0.173	0.105	0.215	0.218	0.212	0.224
2023	0.291	0.072	0.157	0.018	0.015	0.022	0.007	0.219	0.133	0.273	0.276	0.268	0.284
2024	0.293	0.072	0.158	0.018	0.015	0.022	0.007	0.221	0.135	0.275	0.278	0.271	0.286
2025	0.295	0.073	0.159	0.018	0.015	0.023	0.007	0.222	0.135	0.276	0.280	0.272	0.288
2026	0.295	0.073	0.159	0.018	0.015	0.023	0.007	0.222	0.135	0.277	0.280	0.272	0.288
2027	0.295	0.073	0.159	0.018	0.015	0.023	0.007	0.222	0.135	0.277	0.280	0.272	0.288
2028	0.296	0.073	0.160	0.018	0.015	0.023	0.007	0.222	0.136	0.277	0.281	0.273	0.289
2029	0.296	0.073	0.160	0.018	0.015	0.023	0.007	0.223	0.136	0.278	0.281	0.274	0.289
2030	0.297	0.073	0.161	0.018	0.015	0.023	0.007	0.224	0.137	0.279	0.282	0.275	0.290
2031	0.298	0.074	0.161	0.018	0.015	0.023	0.007	0.224	0.137	0.280	0.283	0.275	0.291
2032	0.299	0.074	0.162	0.019	0.015	0.023	0.007	0.225	0.137	0.280	0.284	0.276	0.292
2033	0.300	0.074	0.162	0.019	0.015	0.023	0.007	0.225	0.138	0.281	0.284	0.277	0.292
2034	0.300	0.074	0.162	0.019	0.015	0.023	0.007	0.226	0.138	0.282	0.285	0.277	0.293
2035	0.301	0.074	0.163	0.019	0.015	0.023	0.007	0.227	0.138	0.283	0.286	0.278	0.294
15-year levelized	**0.280**	**0.069**	**0.151**	**0.017**	**0.014**	**0.021**	**0.007**	**0.211**	**0.129**	**0.263**	**0.266**	**0.259**	**0.273**

Note: Values differ across states because states vary in terms of size of non-electric gas consumption.

Using this table, we can see estimate the benefit for a reduction in gas use in each year. For example, a 1 MWh reduction in electricity demand in 2023 yields an E-G cross-DRIPE benefit of $0.291 for New England as a whole. As with other DRIPE categories, zone-on-rest-of-region DRIPE benefits for each year are calculated for each state by subtracting the own-zone value for a given state from the New England-wide value.

As with gas supply DRIPE, AESC 2021's gas supply DRIPE estimates are lower than those found in AESC 2018, mostly due to lower price shift ($0.083/MMBtu per quadrillion Btu, down from $0.158/MMBtu per quadrillion Btu). Other changes are due to differences in historical gas consumption and projected gas consumption across the six states.

Gas-to-electric (G-E) cross-DRIPE

Just as reductions in electricity demand can produce benefits to gas consumers, so too can reductions in gas demand benefit electric customers. Because this effect changes seasonally, we provide separate DRIPE benefits for annual and winter periods. Annual DRIPE benefits may be best applied to measures that provide savings throughout the year (such as hot water heating efficiency measures) while winter benefits may be best applied to measures that provide savings during the winter only (such as space heating efficiency measures).

To calculate G-E cross-DRIPE values, we first begin with the total price shifts described in Table 96. To calculate the price shift for each season, we add the supply price shift (which does not vary by season) to the basis price shift (which does vary by season). Because the gas basis price shift decays but the gas supply price shift does not, by 2031, the "total" price shift for any seasons is equal to the supply price shift component.

Next, these values undergo a unit conversion. We multiply these price shifts (measured in dollar-per-MMBtu per quadrillion Btu) by the heat rate derived above in the E-G cross-DRIPE section (which is measured in MMBtu per MWh). This translation yields price shifts in dollar-per-MWh per MMBtu.

These price shifts are multiplied by each state's unhedged energy to estimate total DRIPE benefits. For each state, the "energy" is the quantity of electricity demand (in MWh) in the state in question, consumed during the relevant period (e.g., winter, gas), under a particular counterfactual. This total quantity of energy is scaled by the portion of energy that is assumed to be unhedged in each state (i.e., the portion of energy purchases not expected to be subject to the spot market). This unhedged assumption is the same used in energy DRIPE, described above in Table 83. Because system load changes across counterfactuals, the unhedged percentage also changes.

Table 98 summarizes the resulting G-E cross-DRIPE values. For annual effects, we utilize the annual price shift; for winter effects, we rely on gas winter period price shifts.

Table 98. Gas-to-electric cross-fuel heating DRIPE, 2021 gas efficiency installations (2021 $ per MMBtu) for Counterfactual #1

		Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
		NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
Annual (e.g., water heating)	2021	1.45	0.24	0.73	0.17	0.16	0.11	0.03	1.21	0.72	1.28	1.29	1.34	1.42
	2022	2.19	0.36	1.09	0.26	0.25	0.17	0.05	1.82	1.10	1.92	1.94	2.01	2.14
	2023	2.52	0.44	1.19	0.32	0.30	0.21	0.06	2.08	1.33	2.20	2.22	2.31	2.46
	2024	2.03	0.35	0.93	0.28	0.27	0.16	0.05	1.68	1.10	1.76	1.76	1.88	1.98
	2025	1.68	0.24	0.77	0.24	0.24	0.13	0.04	1.43	0.90	1.44	1.43	1.54	1.63
	2026	1.16	0.17	0.51	0.17	0.17	0.10	0.03	0.98	0.64	0.99	0.99	1.06	1.13
	2027	0.73	0.12	0.32	0.11	0.11	0.06	0.02	0.61	0.41	0.62	0.62	0.67	0.71
	2028	0.52	0.09	0.23	0.08	0.07	0.04	0.01	0.43	0.29	0.44	0.45	0.48	0.51
	2029	0.32	0.06	0.14	0.05	0.05	0.03	0.01	0.27	0.18	0.27	0.28	0.30	0.31
	2030	0.15	0.03	0.06	0.02	0.02	0.01	0.00	0.12	0.09	0.13	0.13	0.14	0.15
	2031	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.02	0.02	0.02
	2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Winter (e.g., space heating)	2021	2.66	0.44	1.33	0.32	0.30	0.20	0.06	2.21	1.32	2.34	2.36	2.46	2.59
	2022	4.00	0.67	1.99	0.49	0.46	0.31	0.09	3.33	2.01	3.52	3.54	3.70	3.91
	2023	4.61	0.81	2.18	0.59	0.56	0.37	0.11	3.80	2.43	4.02	4.05	4.24	4.50
	2024	3.72	0.64	1.70	0.51	0.50	0.28	0.10	3.08	2.02	3.21	3.22	3.44	3.62
	2025	3.06	0.45	1.41	0.44	0.44	0.23	0.08	2.61	1.65	2.62	2.62	2.83	2.98
	2026	2.10	0.32	0.93	0.31	0.31	0.17	0.06	1.78	1.17	1.79	1.79	1.94	2.04
	2027	1.30	0.21	0.57	0.19	0.19	0.10	0.03	1.09	0.73	1.11	1.11	1.20	1.27
	2028	0.92	0.16	0.40	0.13	0.13	0.07	0.02	0.76	0.52	0.78	0.78	0.85	0.89
	2029	0.55	0.10	0.24	0.08	0.08	0.04	0.01	0.46	0.31	0.47	0.47	0.51	0.54
	2030	0.24	0.05	0.10	0.03	0.03	0.02	0.01	0.19	0.14	0.20	0.21	0.22	0.23
	2031	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Values differ across states because states vary in terms of size of unhedged electricity demand.

This table indicates that the annual New England-wide value of G-E cross-DRIPE for 2021 is $1.45 per MMBtu. The winter value ($2.66 per MMBtu) is nearly twice as large because of the higher basis values in the winter months. Importantly, since electricity generation everywhere in New England serves electricity demand throughout New England, the cross-price effect on electric consumers in a given state is not dependent on the amount of gas burned for electric generation in that same state. For each state and year, the zone-on-Rest-of-Pool benefit equals the difference between the ISO-wide benefit and the zonal benefit.

Table 99 provides a comparison of gas-on-electric cross-DRIPE effects between AESC 2018 and AESC 2021. As with other DRIPE categories relying on the price shift of natural gas supply, avoided costs for this category are lower in AESC 2021, compared to AESC 2018. This is primarily due to the reduced natural gas supply price shift, but it is also due to differences in projected loads and gas bases price shifts.

Table 99. Comparison of levelized gas-to-electric (G-E) cross-DRIPE benefits (2021 $ per MMBtu)

	ISO NE	CT	MA	ME	NH	RI	VT
Annual							
AESC 2018	2.73	0.58	1.33	0.27	0.29	0.20	0.06
AESC 2021	1.29	0.21	0.61	0.17	0.17	0.10	0.03
Difference ($)	-1.44	-0.37	-0.73	-0.10	-0.12	-0.10	-0.03
Difference (%)	-53%	-64%	-54%	-38%	-42%	-48%	-47%
Winter							
AESC 2018	5.03	1.07	2.45	0.50	0.53	0.36	0.11
AESC 2021	2.34	0.39	1.10	0.31	0.30	0.18	0.06
Difference ($)	-2.68	-0.68	-1.35	-0.19	-0.22	-0.18	-0.05
Difference (%)	-53%	-64%	-55%	-38%	-42%	-50%	-45%

Note: All values are levelized over 10 years.

Electric-to-gas-to-electric (E-G-E) cross-DRIPE

A reduction in electricity prices will reduce the price of natural gas; this reduction in natural gas prices will, in turn, reduce the price of electric energy. The magnitude of this reduction depends both on supply and on basis. E-G-E cross-DRIPE is separate from and offers benefits in addition to electric energy DRIPE.

To calculate E-G-E cross DRIPE, we begin with the price shifts described above in Table 96. As with G-E cross-DRIPE, to calculate the price shift for each season, we add the supply price shift (which does not vary by season) to the basis price shift (which does vary by season). Because the gas basis price shift decays but the gas supply price shift does not, by 2031, the "total" price shift for is simply equal to the supply price shift component.

Next, these values undergo a unit conversion. Just as with G-E cross-DRIPE, we multiply these price shifts (measured in dollar-per-MMBtu per quadrillion Btu) by the heat rate derived above in the E-G cross-DRIPE section (which is measured in MMBtu per MWh). However, for this DRIPE category, we multiply this heat rate by the price shift twice. This translation yields price shifts in dollar-per-MWh per MWh (rather than dollar-per-MWh per MMBtu, as with G-E cross-DRIPE).

As with G-E cross-DRIPE, these price shifts are then multiplied by each state's unhedged energy to estimate total DRIPE benefits. For each state, the "energy" is the quantity of electricity demand (in MWh) in the state in question, consumed during the relevant period (e.g., winter, electric), under a particular counterfactual. This total quantity of energy is scaled by the portion of energy that is assumed to be unhedged in each state (i.e., the portion of energy purchases not expected to be subject to the spot market). As with G-E cross-DRIPE, this unhedged assumption is the same used in energy DRIPE, described above in Table 83.

Table 100 summarizes the E-G-E values for the annual period: these are the values that appear in the *AESC 2021 User Interface* and are applied by program administrators using Appendix B. Table 98 summarizes the summer and winter effects for historical comparison with AESC 2018. These values are not used in cost-effectiveness testing (except to the degree that the seasonal price shifts inform the annual price shift).

Table 100. Annual electric-to-gas-to-electric cross-fuel heating DRIPE, 2021 gas efficiency installations (2021 $ per MWh)

		Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
		NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
Annual	2021	9.32	1.55	4.68	1.11	1.04	0.73	0.21	7.77	4.63	8.21	8.27	8.59	9.11
	2022	14.05	2.34	6.99	1.69	1.60	1.12	0.31	11.71	7.06	12.36	12.44	12.93	13.74
	2023	16.19	2.81	7.67	2.05	1.94	1.35	0.37	13.37	8.52	14.14	14.25	14.83	15.82
	2024	13.07	2.25	5.97	1.78	1.73	1.01	0.32	10.82	7.10	11.29	11.33	12.06	12.74
	2025	10.77	1.56	4.98	1.54	1.55	0.86	0.28	9.21	5.80	9.23	9.22	9.92	10.49
	2026	7.45	1.12	3.31	1.10	1.10	0.61	0.20	6.32	4.14	6.34	6.35	6.84	7.25
	2027	4.68	0.77	2.06	0.68	0.68	0.38	0.12	3.92	2.63	4.00	4.00	4.31	4.56
	2028	3.34	0.57	1.46	0.48	0.48	0.27	0.08	2.77	1.88	2.86	2.86	3.07	3.26
	2029	2.06	0.36	0.90	0.30	0.29	0.17	0.05	1.71	1.16	1.77	1.77	1.90	2.01
	2030	0.96	0.19	0.41	0.14	0.13	0.08	0.02	0.78	0.55	0.83	0.83	0.89	0.94
	2031	0.13	0.03	0.05	0.02	0.02	0.01	0.00	0.10	0.08	0.12	0.12	0.12	0.13
	2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 101. Seasonal electric-to-gas-to-electric cross-fuel heating DRIPE, 2021 gas efficiency installations (2021 $ per MWh)

		Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
		NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
Electric Summer	2021	1.96	0.33	0.99	0.22	0.21	0.16	0.04	1.63	0.97	1.74	1.74	1.80	1.92
	2022	2.95	0.50	1.48	0.33	0.33	0.25	0.06	2.45	1.47	2.62	2.62	2.70	2.89
	2023	3.40	0.60	1.62	0.41	0.40	0.30	0.07	2.80	1.78	3.00	3.01	3.10	3.33
	2024	2.74	0.48	1.27	0.35	0.36	0.22	0.06	2.26	1.48	2.39	2.39	2.52	2.68
	2025	2.26	0.34	1.06	0.31	0.32	0.19	0.06	1.93	1.21	1.96	1.95	2.07	2.21
	2026	1.57	0.24	0.71	0.22	0.23	0.14	0.04	1.33	0.87	1.35	1.35	1.44	1.53
	2027	1.00	0.17	0.44	0.14	0.14	0.09	0.02	0.83	0.56	0.86	0.86	0.92	0.98
	2028	0.72	0.13	0.32	0.10	0.10	0.06	0.02	0.60	0.40	0.62	0.62	0.66	0.71
	2029	0.46	0.08	0.20	0.06	0.06	0.04	0.01	0.38	0.25	0.39	0.39	0.42	0.45
	2030	0.22	0.04	0.10	0.03	0.03	0.02	0.00	0.18	0.13	0.19	0.19	0.21	0.22
	2031	0.05	0.01	0.02	0.01	0.01	0.00	0.00	0.04	0.03	0.04	0.04	0.04	0.05
	2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electric Winter	2021	10.09	1.66	5.05	1.24	1.15	0.76	0.23	8.43	5.04	8.85	8.94	9.33	9.86
	2022	15.21	2.50	7.54	1.89	1.76	1.17	0.35	12.71	7.68	13.32	13.45	14.04	14.87
	2023	17.53	3.02	8.27	2.29	2.13	1.42	0.41	14.51	9.26	15.24	15.40	16.11	17.12
	2024	14.16	2.41	6.44	1.99	1.91	1.06	0.36	11.75	7.72	12.17	12.25	13.10	13.80
	2025	11.66	1.67	5.36	1.72	1.70	0.89	0.32	9.99	6.31	9.94	9.97	10.77	11.35
	2026	8.04	1.20	3.55	1.23	1.21	0.64	0.22	6.84	4.49	6.81	6.84	7.40	7.82
	2027	5.02	0.81	2.19	0.76	0.74	0.39	0.13	4.21	2.83	4.27	4.28	4.63	4.89
	2028	3.55	0.60	1.54	0.53	0.52	0.28	0.09	2.95	2.01	3.02	3.04	3.28	3.46
	2029	2.17	0.37	0.94	0.32	0.31	0.17	0.05	1.80	1.23	1.85	1.86	2.00	2.11
	2030	0.97	0.19	0.41	0.14	0.14	0.07	0.02	0.79	0.56	0.83	0.84	0.90	0.95
	2031	0.09	0.02	0.03	0.01	0.01	0.01	0.00	0.07	0.05	0.07	0.08	0.08	0.08
	2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Values differ across states because states vary in terms of size of unhedged electricity demand.

This table indicates that the summer New England-wide value of G-E cross-DRIPE for 2021 is $1.96 per MMBtu. As with G-E cross-DRIPE, the winter value ($10.09 per MMBtu) is an order of magnitude larger because of the higher basis values in the winter months. For each state and year, the zone-on-Rest-of-Pool benefit equals the difference between the ISO-wide benefit and the zonal benefit. Table 102 provides a comparison of gas-on-electric cross-DRIPE effects between AESC 2018 and AESC 2021. As with other DRIPE categories relying on the price shift of natural gas supply, avoided costs for this category are lower in AESC 2021, compared to AESC 2018. This is primarily due to the reduced natural gas supply price shift, but it is also due to differences in projected loads and gas bases price shifts.

Table 102. Comparison of 10-year levelized electric-to-gas-to-electric (E-G-E) cross-DRIPE benefits (2021 $ per MWh)

	ISO NE	CT	MA	ME	NH	RI	VT
Electric Annual							
AESC 2018	-	-	-	-	-	-	-
AESC 2021	8.29	1.37	3.89	1.10	1.07	0.66	0.20
Difference ($)	-	-	-	-	-	-	-
Difference (%)	-	-	-	-	-	-	-
Electric Summer							
AESC 2018	7.10	1.55	3.48	0.68	0.72	0.53	0.14
AESC 2021	1.75	0.29	0.83	0.22	0.22	0.15	0.04
Difference ($)	-5.35	-1.25	-2.65	-0.46	-0.50	-0.38	-0.10
Difference (%)	-75%	-81%	-76%	-68%	-69%	-72%	-71%
Electric Winter							
AESC 2018	16.50	3.52	8.03	1.66	1.72	1.20	0.34
AESC 2021	8.95	1.46	4.18	1.22	1.17	0.69	0.22
Difference ($)	-7.55	-2.05	-3.85	-0.44	-0.56	-0.51	-0.12
Difference (%)	-46%	-58%	-48%	-26%	-32%	-42%	-35%

Note: Annual values were not provided in AESC 2018.

9.6. Oil supply DRIPE

Reducing demand for petroleum and refined products should lead to a reduction in oil prices. Oil demand may be lessened by further electrifying the transportation sector (oil-electricity substitution effects) or by reducing electricity demand during high load winter periods when oil is on the margin (oil-gas substitution). This reduction in oil prices induced by a change in oil demand is termed oil DRIPE.

Oil's global dimension makes modeling oil DRIPE more uncertain than the analysis of natural gas DRIPE. The analysis in Chapter 3: *Fuel Oil and Other Fuel Costs* relies on analysis of oil supply fundamentals which, in turn, does not consider the impact of oil supply disruptions or other sources of short-term volatility in oil price. For AESC 2021, we conduct a relatively high-level model of oil DRIPE in the following steps:

1) Estimate the relevant elasticity (i.e., the percentage change in oil price per percentage change in demand for crude oil).
2) Calculate the crude oil DRIPE value.
3) Calculate refined product DRIPE values using the ratios of crude-to-refined-product price from EIA's AEO 2021 for years 2021–2035.

Estimating elasticities

Elasticity describes how prices of a commodity respond to changes in demand. We use oil play breakeven analysis to estimate elasticity for crude oil.

Oil play breakeven analysis models the price at which a given geological formation is revenue neutral (a specific oil field or formation is known in the industry as a "play"). Different plays have different breakeven points, and when considered in aggregate, a supply curve can be made to show the prices at which various sources of new supply would enter the market. This curve can be thought of as analogous to an electric market's power plant offer stack.

By examining a set of these supply curves, we can assess the average relationship between price and supply for a marginal barrel of oil. Table 103 presents elasticities from five different breakeven analyses. Two of these curves display a supply curve with a very steep right tail. The Wood Mackenzie supply curve, for example, indicates that an additional million barrels per day of oil supply would increase breakeven price by about $3 per barrel. In other words, it indicates that a 1.0 percent increase in cumulative oil production in this region would increase costs by 0.36 percent.

Table 103. Percent change in crude oil price for a 1.0 percent change in global demand

Forecast	Curve Segment	Date Published	Elasticity	Sources
Wood Mackenzie	Entire curve	2016	0.36	(A)
Rystad Energy	Entire curve	2015	1.39	(B)
IEA	Entire curve	2013	2.00	(C)
Goldman Sachs	Low only	2012	0.47	(D)
Goldman Sachs	High only	2012	2.66	(D)
BP/PIRA	Low only	2015	0.88	(E)
BP/PIRA	High only	2015	3.60	(E)
Average (All)			**1.62**	
Average (Low Only + Entire Curve)			**1.02**	

Sources: (A) https://www.woodmac.com/news/editorial/pre-fid-oil-projects-commercial/, (B) https://www.rystadenergy.com/NewsEvents/PressReleases/global-liquids-supply-cost-curve, (C) https://www.financialsense.com/contributors/joseph-dancy/iea-shale-mirage-future-crude-oil-supply-crunch, (D) http://crudeoilpeak.info/oil-price-analysis, and (E) https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/news-and-insights/speeches/new-economics-of-oil-spencer-dale.pdf.

A simple average of all elasticities yields a value of 1.62. If the two "High only" slopes are removed, the resulting average elasticity is 1.02. Given the uncertain nature of this analysis, AESC 2021 models oil supply as unit elastic in the relevant region study, so a 1 percent change in demand would yield a 1 percent change in price.[265] Critically, demand in this context is *global demand* (currently 98 million barrels/day, of which the United States consumes about one-fifth).[266]

[265] The assumption of unit elasticity may overstate price effects because estimates of shale resources have increased in the past years and estimates of shale extraction costs have fallen—both effects reduce the slope of the supply curve, and its corresponding elasticity.

[266] For more information, see https://www.iea.org/oilmarketreport/omrpublic/.

This estimate is similar to our estimate of elasticity of supply for natural gas. This is expected given the similarities between the two hydrocarbons, their disposition, and their extraction.

Next, we convert this elasticity into a "price shift" which represents how the price (in dollars per MMBtu) that changes in response to changes in demand (measured in quadrillion Btu per year). To do this, we multiply the elasticity by a forecast for West Texas Intermediate (WTI) crude oil prices ($8 to $14 per MMBtu, depending on the year) and divide the result by a forecast of crude oil consumption (estimated to be about 220 quadrillion Btu worldwide).[267] This yields a price shift of about $0.05 /MMBtu per quadrillion Btus for any given year.

Calculating oil DRIPE

As with the electric and natural gas DRIPE effects, the price reduction per MMBtu of oil saved is very tiny compared to the price per MMBtu. But each MMBtu saved reduced prices for a very large number of MMBtus. That said, given the modest size of New England oil demand in comparison to the entire global market (about 0.7 percent of worldwide consumption), the overall value of DRIPE remains modest.[268]

According to the latest EIA SEDS database, in 2014 through 2018, New England consumed approximately 1.4 quadrillion Btu of petroleum products yearly.[269] Over time, AEO 2021 forecasts demand gradually falling, averaging about 1.2 quadrillion Btu of petroleum products yearly between 2021 and 2035.

As a result, a 1 MMBtu reduction in crude oil demand yields an average regional benefit of about $0.07 per MMBtu (i.e., $0.05/MMBtu per quadrillion Btu multiplied by 1.2 quadrillion Btu). The value for each state, presented in Table 104, are proportionally smaller, ranging from about $0.003 per MMBtu to $0.030 per MMBtu per 1 MMBtu reduction.[270] Zone-on-zone values are calculated based on each state's share of oil consumption relative to the New England-wide total. Meanwhile, zone-on-region values are equal to the New England total minus the value from each respective state.

[267] Crude oil prices are based on WTI prices from AEO 2021 and worldwide crude oil consumption is based on values in EIA's 2019 edition of the International Energy Outlook.

EIA. Last accessed March 11, 2021. "Petroleum and Other Liquids Prices." *Eia.org.* Available at https://www.eia.gov/outlooks/aeo/excel/aeotab_12.xlsx.

EIA. 2019. "Liquids Consumption: OECD: OECD Americas." *Eia.gov*. Available at https://www.eia.gov/outlooks/aeo/data/browser/#/?id=5-IEO2019&sourcekey=0.

[268] Calculated based on data from 2014 to 2018 using data from EIA. 2019. "State Energy Data System: Updates by Energy Source." *Eia.gov.* Available at https://www.eia.gov/state/seds/seds-data-fuel.php?sid=US#DataFiles

[269] See https://www.eia.gov/state/seds/seds-data-fuel.php?sid=US#DataFiles for more information.

[270] The United States consumes about 37 quads of petroleum products annually, compared with 1.4 quads consumed in New England. The value of a 1 MMBtu reduction in oil demand anywhere within the United States has a US-wide DRIPE value of $2.25 per MMBtu.

Table 104. Crude oil DRIPE by state (2021 $ per MMBtu)

	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	NE	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.049	0.011	0.020	0.006	0.005	0.003	0.003	0.038	0.028	0.042	0.043	0.046	0.046
2022	0.052	0.012	0.022	0.007	0.006	0.003	0.003	0.041	0.031	0.045	0.047	0.049	0.049
2023	0.058	0.013	0.024	0.008	0.006	0.003	0.003	0.045	0.034	0.050	0.051	0.054	0.054
2024	0.061	0.014	0.025	0.008	0.007	0.004	0.003	0.047	0.035	0.053	0.054	0.057	0.057
2025	0.063	0.014	0.026	0.008	0.007	0.004	0.004	0.049	0.037	0.055	0.056	0.060	0.060
2026	0.065	0.015	0.027	0.009	0.007	0.004	0.004	0.050	0.038	0.056	0.058	0.061	0.061
2027	0.066	0.015	0.028	0.009	0.007	0.004	0.004	0.052	0.039	0.058	0.059	0.063	0.063
2028	0.068	0.015	0.028	0.009	0.008	0.004	0.004	0.053	0.040	0.059	0.061	0.064	0.064
2029	0.069	0.016	0.029	0.009	0.008	0.004	0.004	0.054	0.040	0.060	0.061	0.065	0.065
2030	0.071	0.016	0.029	0.009	0.008	0.004	0.004	0.055	0.041	0.061	0.063	0.066	0.067
2031	0.071	0.016	0.030	0.009	0.008	0.004	0.004	0.055	0.042	0.062	0.063	0.067	0.067
2032	0.072	0.016	0.030	0.010	0.008	0.004	0.004	0.056	0.042	0.063	0.064	0.068	0.068
2033	0.072	0.016	0.030	0.010	0.008	0.004	0.004	0.056	0.042	0.063	0.064	0.068	0.068
2034	0.073	0.016	0.030	0.010	0.008	0.004	0.004	0.056	0.042	0.063	0.065	0.068	0.069
2035	0.073	0.016	0.030	0.010	0.008	0.004	0.004	0.056	0.042	0.063	0.065	0.068	0.069
10-year levelized	**0.062**	**0.014**	**0.026**	**0.008**	**0.007**	**0.004**	**0.004**	**0.048**	**0.036**	**0.054**	**0.055**	**0.058**	**0.059**

Note: Values differ across states because states vary in terms of size of oil consumption.

As with natural gas supply DRIPE, oil DRIPE are not decayed. Because oil DRIPE is not decayed, the values in the preceding table reflect the actual value of a demand reduction in each year (e.g., a regionwide demand reduction in 2021 is worth $0.049 per MMBtu and a reduction in 2025 is worth $0.063 per MMBtu). Oil DRIPE benefits are low because of the relatively modest amounts of demand in New England states compared to the size of the global oil market.

In order to apply oil DRIPE values to specific commodities (e.g., gasoline, home heating fuel), we multiply the values in Table 104 by the refined-price to crude-price ratio found in Table 105. For example, the levelized value of gasoline DRIPE across New England is worth $0.108 per MMBtu reduced ($0.062 per MMBtu x 1.73).

Table 105. AEO 2021 prices of crude oil and refined petroleum products

Product	2021-2035 Avg Price (2021 $ per gallon)	Ratio of product price to WTI price
WTI Crude Oil	1.59	-
Home heating oil	2.77	1.75
Residual fuel oil	1.63	1.03
Motor gasoline	2.75	1.73
Motor diesel	3.21	2.03

Source: EIA AEO 2021 Table: "Petroleum and Other Liquids Prices." Available at. *https://www.eia.gov/outlooks/aeo/excel/aeotab_12.xlsx*.

This analysis assumes that oil supply drives the price of refined products and that a reduction in the demand of any petroleum product impacts the price of all other crude products. In reality, there may not be a one-to-one price benefit for reductions in gasoline on fuel oil (for example). This simplifying assumption is reasonable given the small magnitude of oil DRIPE effects and the high-level analysis undertaken.

Table 106 illustrates the differences between crude oil DRIPE calculated in AESC 2018 and AESC 2021. In AESC 2021, oil DRIPE values for New England as a whole are 27 percent lower than in the previous study. This change is primarily due to reductions in forecasts of crude oil prices and crude oil consumption.

Table 106. Comparison of oil DRIPE values (2021 dollars per MMBtu)

	New England	CT	MA	ME	NH	RI	VT
AESC 2018	0.085	0.022	0.032	0.011	0.011	0.011	0.007
AESC 2021	0.062	0.014	0.026	0.008	0.007	0.004	0.004
Difference ($)	-0.023	-0.008	-0.007	-0.003	-0.004	-0.008	-0.003
Difference (%)	-27%	-38%	-20%	-27%	-39%	-67%	-48%

Note: Values shown are levelized over 10 years. AESC 2018 uses a discount rate of 1.34 percent while AESC 2021 values use a discount rate of 0.81 percent.

10. TRANSMISSION AND DISTRIBUTION

In addition to avoiding various types of generation costs (energy, capacity, and associated DRIPE), load reductions can contribute to deferring or avoiding the addition of load-related T&D facilities, due to reduced load growth and reduced loading of existing equipment.[271] The chapter describes a methodological approach that program administrators can use to estimate avoidable T&D costs for planning and reporting of efficiency program benefits.

In AESC 2018, we developed a general framework for the calculation of avoided T&D values, including identifying general principles for such calculations. AESC 2018 also surveyed some of the sponsoring utilities (National Grid, United Illuminating, and Eversource Connecticut) for information on utility avoided T&D value estimates, along with the methods used to calculate those values. AESC 2018 separated PTF transmission for a separate treatment and developed an estimate of the value of avoided PTF transmission of $94 per kW-year in 2018 dollars ($99 per kW-year in 2021 dollars).

For AESC 2021, we present four separate threads for analysis of avoided T&D costs, building on the foundation established in the 2018 AESC and updating or expanding the analysis presented. The four aspects are:

1. Updating the avoided costs for PTF facilities using a forward-looking projection, rather than a historical estimate. The updated analysis finds an updated PTF value of $87 per kW-year in 2021 dollars.
2. Reviewing utility approaches to generic avoided cost values for non-PTF T&D and evaluating these approaches on a common evaluation rubric to facilitate cross-comparison and learning.
3. Reviewing utility approaches to calculating geographically localized avoided costs, such as for NWAs.
4. Developing an approach to the avoided cost of natural gas system T&D. See Section 2.4: *Avoided natural gas cost methodology* for more information on the assumptions used in AESC with respect to natural gas T&D.

In addition to evaluating different approaches to geographically localized avoided costs for NWAs as a standalone aspect of analysis, AESC 2021 examines across each aspect whether the appropriate treatment or calculation of T&D avoided costs differs for other specific technology types or program applications, such as distributed generation and electrification or other fuel switching programs. AESC

[271] Many energy efficiency programs will be cost-effective without consideration of avoided T&D costs, and many load-control programs will not reliably reduce peak loads on T&D equipment. These will not be eligible to be credited with avoided T&D equipment. For some energy efficiency measures and programs, especially those with very peaky load shapes, the avoided T&D costs may be critical in demonstrating cost-effectiveness.

2021 address the locational value of potential services provided by efficiency and other DERs; we do not address programmatic or other barriers to using DERs to address T&D costs.

This section begins with an overview of the recommended approach for calculating avoided T&D costs, which can then be tailored to the specific situation for which costs are to be calculated. We then proceed through the different aspects and scales of such analysis in New England, beginning with region-wide PTF. The subsequent two sections address avoided T&D at smaller scales: first for a utility service territory or other program-wide jurisdiction, and then for specific locations on areas within a service territory which may warrant location-specific avoided T&D values due to an existing constraint. For each of these scales, we present an evaluation of the relevant methods currently used by utilities within the region. The section concludes with an analysis of the equivalent structure for natural gas distribution (see Section 2.4: *Avoided natural gas cost methodology* for more information).

10.1. General approach to estimating the value of system-level avoided T&D

The following steps, unchanged from AESC 2018, summarize a standardized approach to estimate generic system-level avoidable transmission or distribution costs:

- Step 1: Select a time period for the analysis, which may be historical, prospective, or a combination of the two.
- Step 2: Determine the actual or expected relevant load growth in the analysis period, in megawatts.[272]
- Step 3: Estimate the load-related investments in dollars incurred to meet that load growth.
- Step 4: Divide the result of Step 3 by the result of Step 2 to determine the cost of load growth in $ per MW or $ per kW.
- Step 5: Multiply the results of Step 4 by a real-levelized carrying charge to derive an estimate of the avoidable capital cost in $ per kW-year.
- Step 6: Add an allowance for operation and maintenance of the equipment to derive the total avoidable cost in $ per kW-year.

The data for this approach may come from historical top-down accounting data, such as from page 206 of the utility's annual FERC Form 1 filing, or from bottom-up data based on past and future expenditures by project or budget line item.

These generic avoided T&D costs are not intended to represent the potential value of targeted load reductions, as part of NWAs to specific T&D projects. Analysis of targeted NWAs requires information

[272] The data could be for hypothetical growth levels, but the effort of determining the investments necessary to meet a hypothetical growth level is likely to be excessive. Hence, most analyses rely on actual investments (which are known) or fully developed investment projects for the relatively short-term future.

about the cost and timing of the specific project to be avoided and the amount of load reduction required to defer project need for one or more years. The methodology for localized value of avoided T&D is the subject of Section 10.4 below.

The goal of these generic avoided-cost computations is not to identify specific projects that can be avoided, but to estimate the overall, long-term ratio of T&D savings per kW of avoided load growth (and hence of a kW of peak savings).[273] Under this approach, historical data can be as meaningful as forecast data, and the sunk costs of planned additions are as relevant as the future costs.

The avoided T&D value is generally applied as if every kW of load reduction in any location will have the same value. This is a useful simplification, which is reasonable for widespread energy efficiency programs. In some places and times, even small load reductions that keep load below the capacity of existing equipment may defer or avoid very large incremental T&D investments. In other places and times, relatively large load reductions may have little effect on T&D investments. The location contributing to new T&D investments can vary from perhaps a dozen residential customers sharing a line transformer to thousands of customers sharing a substation or a transmission line. Since avoidable T&D costs are estimated as the ratio of actual or near-term expected investment to actual or expected load growth, the specific past projects used in the analysis were not usually avoided, and near-term future projects may also not be avoided.

Depending on the amount of excess capacity on the various levels of T&D equipment in a particular area, reducing load by any particular customer may defer or avoid the addition of a line transformer in the next year. It may also contribute to delaying or avoiding the reconfiguration of feeder, the upgrading of a substation, and the construction of transmission lines in following years. At another location, load reductions may have little effect on T&D investment for many years. Recognizing this complex dynamic, the general approach in this report computes the average ratio of all load-related investments to all load growth, rather than just the load growth that has the greatest effect on investment to develop avoided costs.[274]

The methods and approach described here are generally independent of the technology or program that changes peak load. For example, the value of avoiding transmission investments does not depend on whether the peak was reduced by energy efficiency, demand response, or distributed generation—as long as the peak reductions are the same. It is also critical that the peaks in question are the same peaks: if transmission needs are driven by a summer system-wide peak, or distribution needs are driven by a winter morning, then the characteristics of a given measure or program at those times are what matter for avoiding expenditures. The marginal benefit of reduced peak should also be the same as the marginal cost of increased peak: electrification measures that increase a peak that is relevant for T&D

[273] Analysts do not generally have *ex post* estimates of costs that have actually been (or are expected to be) avoided by energy efficiency; such analysis, if feasible, would usually be prohibitively expensive.

[274] Geographically targeted load reductions, such as part of an NWA to a transmission or distribution project, may have much higher values, depending on the magnitude and time of need, as discussed in more detail in Section 10.4.

infrastructure planning will, on the margin, create costs at the same rate (in $/kW) that load reduction measures reduce them. Note that time coincidence matters for electrification as well as energy efficiency: electrification measures that increase a winter peak do not cause T&D expenditures if those expenditures would be driven by the need to meet loads at a summer peak.

The remainder of this section provides an overview of background, context, and considerations to be kept in mind and used as guidance in developing avoided T&D values. The following two subsections apply these lessons and guidance to PTF transmission (Section 10.2) and to evaluation of the methods used for generic avoided T&D in the region today (Section 10.3).

Criteria for avoided T&D estimation

The following considerations are useful in guiding the estimation of avoided T&D costs:

- **Time period.** In estimating the avoided T&D cost, any analysis should use data from complete, consistent, and reasonable time periods for both load and investment. It may be useful to align these timelines with those used for distribution planning and capital investment planning processes.
- **Investment plans and budgets for any future period must be reasonably complete.** It is important to capture all of the expected T&D costs along with all of the expected changes in load within the period selected for analysis. Investment plans that include only a portion of projected costs (for example, those associated with only larger projects with long lead times) should not be the only source of cost information.
- **The analysis period should provide a reasonable proxy for the long-term relationship between load and investment.** If the period starts with the system overbuilt due to unexpected load reductions, the analysis will tend to understate the cost per kilowatt and vice versa. The analysis should avoid or correct for unrepresentative conditions due to unexpected growth or deferred investments.

On a related point, adjusting the loads to account for the weather conditions is likely to be more representative than actual loads in determining the amount of load growth in the analysis period, so weather adjustment may be necessary. Taking actual load growth between a hot summer with high loads and a subsequent mild summer with low loads would understate the amount of load growth driving the investment, and vice versa.

Some T&D investments are driven by load growth from new customers in areas that are not currently served, or are not served in a manner that would accommodate the growth, even with very aggressive energy efficiency efforts in new and existing loads in the area. For example, serving major commercial development in a previously residential exurban area or a 100-unit residential development in an agricultural area may require a new substation or feeder respectively, regardless of any conceivable load reduction. Analyses of avoided T&D costs generally omit these projects; where possible, the load growth served from these projects should also be omitted from the computation.

Even utility systems with little total load growth tend to have areas in which peak loads are growing, offset by areas in which peak loads are declining (due to some combination of energy efficiency programs, other conservation, and economic and demographic trends). In those situations, the computation of avoided T&D costs should ideally represent the investments in the growing areas, divided by load growth in those same growing areas. This greater level of detail is rarely possible, especially on a feeder-specific or transformer-specific basis.

Investments should be converted to some common price basis (such as by adding or removing inflation) so that investments in differing years (e.g., 1997, 2007, 2017, and 2027) can be added together. Any projections or hypothetical adjustments to the historical periods should be handled consistently for load growth and investment.

The AESC avoided costs are based on hypothetical worlds in which no energy efficiency programs (and/or no other load management or electrification programs) are implemented going forward. For consistency in identifying the full T&D costs avoidable by energy efficiency programs, it would be desirable to start with the loads that would have occurred and the investments that would have been needed without energy efficiency efforts. Estimating the effect of the energy efficiency programs on historical and forecast loads may be feasible. Unfortunately, estimating the T&D investments that would have been needed without the energy efficiency programs is generally infeasible, requiring a large amount of engineering analyses to develop hypothetical needs at the feeder level.[275]

If a fully consistent no-energy efficiency (no-EE) analysis could be performed, that would be ideal. But an analysis that combined loads from a "no-EE" premise with investments from the "with-EE" reality would understate avoidable costs.

Disaggregation of growth

For each type of equipment, the computed load growth should reflect the load on that type of equipment. The T&D system consists of several types of equipment, which may be simplified into the following categories:

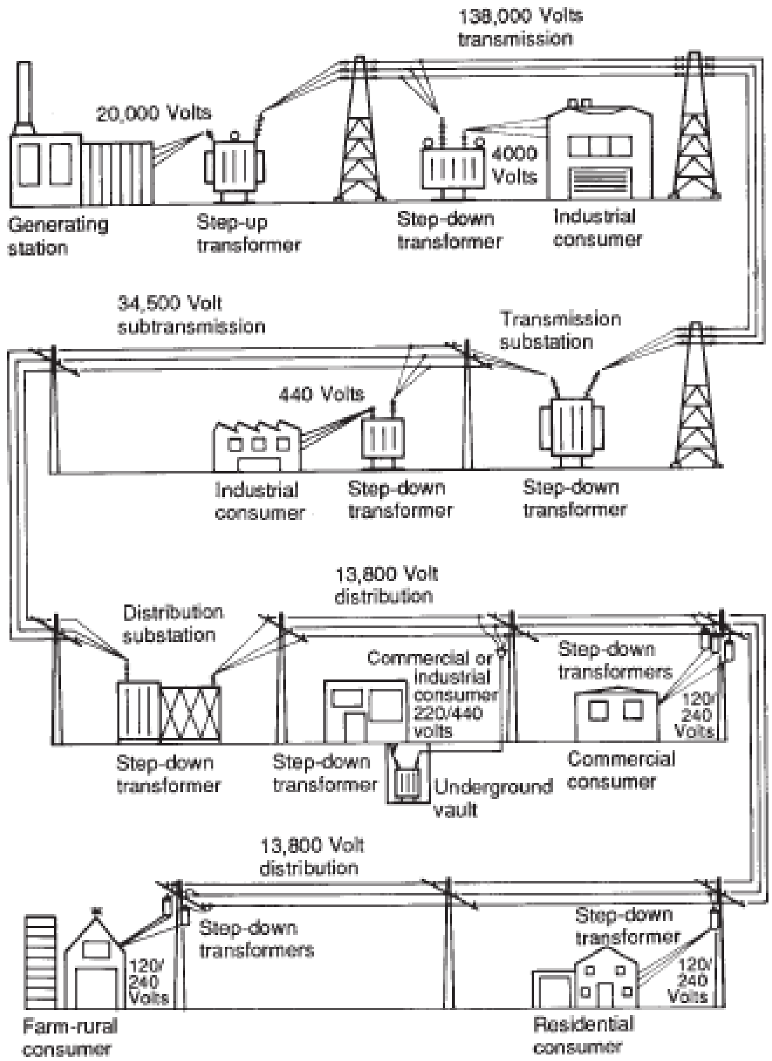
- high-voltage transmission lines (115 kV to 345 kV);
- transmission substations connecting transmission lines at different voltages;
- subtransmission lines (e.g., 69 kV) that connect to distribution substations and some very large customers;
- bulk distribution substations that step transmission voltages down to generally high distribution voltages (mostly at 13.8 kV to 25 kV);

[275] The actual and projected energy efficiency may have avoided the planning and construction of more expensive T&D projects, but those costs are not generally available. The available data generally estimates the benefit of additional load reductions, on top of those that have occurred and are planned.

- high-voltage primary feeders that distribute power from the bulk substations to lower-voltage substations, some primary-voltage customers, and line transformers;
- lower-voltage substations that step down the power to lower (mostly legacy) voltages, in the 2 kV to 8 kV range;
- low-voltage primary feeders that distribute power to primary-voltage customers and line transformers;
- line transformers that step power down from the primary distribution voltages (2 kV to 35 kV) to secondary voltages (110 V to 500 V);
- secondary lines from the transformer customer service drops; and
- service drops from the street to customer meters.

Figure 51 illustrates the general design of T&D systems. The range of voltages considered to be subtransmission varies among utility systems.

Figure 51. Schematic of a T&D system



Source: Electric Power Generation, Transmission and Distribution eTool. United States Department of Labor. Available at https://www.osha.gov/SLTC/etools/electric_power/illustrated_glossary/.

Any load reduction may result in avoidance or delay of investments at one or more of these levels, in the near term or over many years.

All loads use transmission; primary and secondary loads use the primary distribution system; and only secondary loads uses line transformers and secondary lines. Hence, T&D analyses should use the peak loads applicable to the transmission or distribution capacity appropriate to the particular analysis.

Computation of T&D avoided costs

Generally, the computation of avoided costs in $/kW should use the same measure of load that will be used in screening. This criterion requires that the units of load reduction used to attribute avoided costs to programs be consistent with the units of load used to compute those avoided costs. The units should be consistent on a number of dimensions, including the timing of the load peaks, the treatment of seasonal load, the use of normal or extreme loads, and the treatment of losses.

Generation capacity avoided costs are driven by load at the time of the ISO New England peak, which has by convention been associated with an hour ending at 3 p.m. or 5 p.m. on a hot summer day. For simplicity, energy efficiency screening often uses these same peak conditions for estimating contribution to T&D peaks, in which case the avoided T&D costs should be computed per kilowatt of growth in contribution to regional peak. Since T&D assets reach their peak loads at different times, in both summer and winter, some utilities may use a different measure of peak load (e.g., sum of class peaks, sum of summer and winter peak) to derive the $/kW ratio, in which case that alternative measure of peak load should be used for valuing the T&D savings in the screening process.

If the avoided T&D costs are to be allocated between summer and winter peak contributions in screening, then the avoided-cost analysis should similarly reflect both summer and winter load growth. Assuming that winter peak growth equals summer peak growth is rarely realistic.

Transmission and some distribution facilities are planned for extreme weather (or other conditions), such as those in the ISO New England's 90/10 load forecasts. It may thus be tempting to divide investment by the growth in load that would occur under extreme conditions, rather than normal peak conditions (e.g., those that would be expected to be exceeded about half the time). If the analysis computes avoided T&D costs in $\$/kW_{extreme}$, screening must use estimates of load reduction under extreme conditions. For some end-uses, load reductions will be very similar at normal and extreme peaks, but for others (air conditioning and solar in the summer, heating in the winter) the reductions under extreme conditions will exceed those at normal peaks.[276] If screening assumptions cannot be developed for extreme conditions, analysts should avoid the use of extreme loads in the avoided-cost analyses. Note that this may mean using different weather for the purposes of demand-side measure evaluation than is used for T&D system planning, and tracking different "flavors" of peak load or developing equivalency relationships may be required.

Similarly, if screening uses load reduction at the end-use, the avoided T&D costs should use load growth at the end-use. If this apples-to-apples structure is not possible (such as if load growth is measured at transmission level) the appropriate loss factor must be added to the avoided cost.

Identifying load-related investments

The investment should include all identifiable load-related costs, but no more. AESC 2021 recommends using top-down accounting analyses to identify the accounts that are primarily load-related,[277] and net

[276] Something must use more energy at the extreme peak, or it would not be an extreme peak.

[277] As the availability and granularity of data improves through technologies and planning advancements, we anticipate improvements in the methodology for identification of load-related investments that can be avoided through DERs and applicability to more feeders. The methodology described in AESC 2021 is based on identifying load-related investments using current distribution system planning practices.

out an allowance for the costs of replacing retired equipment in kind. The FERC Form 1 data include both additions and retirements by account. Bottom-up analyses should be used to identify the projects and blanket accounts that are primarily load-related.[278]

For the bottom-up analyses, AESC 2021 recognizes that differentiating investments between those required by load growth from those required for other considerations can be complex. The non-load-related investments may include:

- Distribution assets (primarily meters and services) that are driven entirely or predominantly by the number of customers.[279]
- Primary distribution projects that extend service into areas that have not previously been served, to connect new customers. New construction energy efficiency programs may avoid a small portion of the wire costs. However, most of the costs are related to the extension of supply to new areas.
- Some transmission projects that are required to integrate generation or allow targeted imports. Generation interconnection costs will generally be included in the generation market prices. Transmission projects supporting policy-driven imports of renewable energy from Canada or offshore wind are unlikely to be affected much by load reductions, at least in the short term.[280]
- Some T&D investments simply replace old equipment. Other investments relocate facilities due to road widening, loss of easements, and similar factors. Neither type of investmetns are load-related.

In contrast, other investments are clearly required to accommodate load growth, including:

- Most new transmission lines and substations and additional transformers at existing substations;
- Additional feeders and line transformers in areas with existing service;
- Reconductoring of lines to increase capacity;
- Increasing the voltage of transmission or distribution lines; and
- Conversion of single-phase feeder branches to two-phase or three-phase operation.

[278] A blanket account in the context of distribution utilities typically includes a large number of similar investments, such as substation upgrades or line-transformer replacements.

[279] Service drops are often sized or upgraded based on the end-uses in a building. In principle, energy efficiency should reduce the required service size and cost. It is not clear how consistently utilities or contractors take building efficiency into account in determining the size of the service drop to be installed.

[280] Energy efficiency measures installed in the near term may (by reducing the use of fossil generation) reduce the motivation for further clean-import mandates and associated generation. Predicting the timing of future initiatives may be challenging.

A third set of investments is harder to characterize, including such situations as:

- Investments triggered by factors other than load, but whose cost are increased to accommodate higher load levels. For example, if rotting poles are being replaced with taller poles so that the feeder voltage can be increased in the future, the incremental cost of the taller poles is load-related. The cost of replacement may be unavoidable, but the load-related improvement may be avoidable.[281]
- The costs of removing aging, but functional equipment to allow installation of higher-capacity equipment. The existing equipment might need to be replaced in another decade or two, even without the load growth, but most of the present value of the replacement cost would be due to the load-related timing of the project.
- Investments required to complete or modernize projects already in service, such as improved lightning arrestors or added SCADA equipment on existing feeders. These investments may be considered as a continuing cost of the original load-related projects (as post-operational capital additions are considered part of the cost of a power plant), and hence an adder to avoided cost (perhaps computed in dollars per MW of load, rather than dollars per MW of load growth). On the other hand, if the improvements are being driven by a one-time change in reliability or safety standards or technology, perhaps no similarly deferred improvements should be anticipated for equipment driven by future load growth.
- Replacement of equipment degraded by both age and loading levels. For example, high loads (especially high loads over many hours in a day) increase the rate at which insulation breaks down in underground lines, substation transformers, and line transformers. High loads on transmission lines also increase the line sag (possibly violating clearance requirements) and weaken the conductor. Replacements of load-carrying equipment will generally be at least partly driven by load levels, but the extent of this effect may be difficult to separate from the effects of time.
- Investment driven by load-related energy considerations, including transmission congestion relief and reduction of line losses.[282]

AESC 2021 recognizes that these situations complicate the neat division of projects and accounts into load-related and non-load related categories. Classification of specific projects or accounts as avoidable or unavoidable by energy efficiency should be clearly documented and explained.

Matching investment to load growth

Bottom-up analyses should include all the investment in load-related equipment entering service in the analysis period, including investment prior to the start of the analysis period. Any project costs that

[281] In principle, the decision not to downsize the replacement may also be load-related, but the incremental component of project cost may be difficult to quantify.

[282] Line losses should be computed on a marginal basis, where possible.

stretch beyond the in-service date of the equipment (e.g., for removal of retired equipment, environmental compliance, addition of communications or control equipment) should be included as well. Top-down accounting-based data will include all the costs of a project in the year that the project enters service but may count some deferred costs in the following year.

The load growth used in computing avoided distribution costs should reflect the loads at the distribution level, excluding loads served directly from transmission lines, for which the utility does not provide distribution equipment. Similarly, where the avoided cost of secondary distribution is computed separately from the primary distribution, the load growth should reflect only the loads served at the secondary distribution level.

While the load growth used in computing avoided distribution costs should reflect the loads of customers served at distribution, the growth in distribution loads may be stated in terms of megawatts at the transmission level, at the distribution level, or at the meter.[283] Contribution of distribution loads to system or area peaks are highest when measured at the transmission level, lower at the distribution level, and still lower at the customer's meter. This is because the transmission-level loads include line losses from the meter to transmission, distribution-level loads include line losses from the meter to the feeder or substation, and loads at the meter include no losses. As a result, the avoided costs will be higher measured as $ per kW at the meter and lowest as $ per kW measured at transmission. Since energy efficiency program load reductions are generally estimated at the end-use, the cost-benefit analysis must reflect avoided costs at the end-use (or the customer meter, as a proxy for the end-use). If the avoided cost is computed per kilowatt of load data at the transmission level, rather than using end-use load, losses from the meter to transmission must be added back to get the avoided cost in $/kW of load at the meter.[284]

Investments in T&D infrastructure to support load growth generally do not increase the capacity of the relevant portions of T&D system by only the exact amount of projected load growth. Instead, it is typical to use standard equipment (which may be larger than strictly necessary) or to design in an allowance for future growth over the multi-decade useful life of a piece of infrastructure. For example, the aggregate capacity of all of a utility's distribution infrastructure often far exceeds the sum of substation peak loads. When matching the load growth to the investment, it is therefore necessary to determine whether the relevant capacity is the increase in peak load, or the increase in capacity of the relevant portion of the T&D system.

The only choice that is consistent with an avoided cost formulation for demand-side measures is to use the actual growth in peak load, rather than the capacity of the new hardware. This is because the load avoided by a demand-side measure is the actual peak load. If the avoided T&D value were calculated by

[283] Regardless of where load is measured, it should include only the contribution from the voltage levels driving the need for that type of equipment (i.e., all distribution load for substations and feeders, secondary load for transformers).

[284] Similarly, if the load growth is estimated at a distribution voltage, the avoided cost must be increased by the losses from the meter to that voltage.

dividing the infrastructure cost by its additional peak capacity (that is, if the value were in units of $ per $kW_{hardware}$) then when multiplying this value by the peak reduction produced by an energy efficiency program ($kW_{end\text{-}use}$) the calculation would understate the value of efficiency by a ratio of $kW_{hardware}$ per $kW_{end\text{-}use}$. In addition, the extent of overcapacity built into hardware once the decision is made to construct is entirely independent of the incremental peak capacity that caused the decision.

For example, take a load-growth-related investment with an annual carrying cost of $100,000 that is caused by an increase in load of 100 kW, but increases the capacity of the relevant portion of the grid by 1 MW. If the avoided cost value were based on the hardware installed, it would be $100 per $kW_{hardware}$-year, while if it is based on the load, it would be $1,000 per $kW_{end\text{-}use}$-year. If load were actually reduced by 100 kW through a demand-side intervention, these two avoided cost calculations would imply different values of the avoided cost: $100,000 per year in the end-use case and only $10,000 per year in the hardware case. Since we know that the $100,000 per year investment would have been avoided by the 100 kW load reduction, only the load-derived calculation can be correct.

While in theory a generic ratio of $kW_{end\text{-}use}$ to $kW_{hardware}$ could be used to adjust for this effect, when combining many such decisions across time and across a service territory, consistency and coherence in the meaning and scale of $kW_{hardware}$ would almost certainly be lost. Therefore, the calculation of avoided T&D costs should use the actual kW of load, rather than the kW of new hardware capacity.

Dealing with absence of system load growth

As noted previously, some utilities have experienced little or no overall growth in total load for some years and may forecast little growth in peak loads for some years. Nonetheless, utilities can have load-related investments to address parts of their service territories that are experiencing load growth. Dividing the load-related investments by zero, a negative number, or even a small positive load growth will produce meaningless results. In those situations, a utility may either use historical data from a period with load growth, or compute the avoided cost per kilowatt growth for the fraction of the system that has experienced growth.[285] The AESC Reference (Scenario 1) case assumes a world with no new energy efficiency, no active demand management, and no building electrification programs, in which the avoided costs computed for the areas with growth would be applicable to the entire utility.

Carrying cost

The annualization of the capital costs should reflect the utility's cost of capital, income taxes, property taxes, and insurance. The useful life used in determining the carrying charge should match the expected life of the equipment. If a transmission plant has a longer operating life than distribution plant, the analysis should use a lower carrying charge for transmission than distribution. This is one reason that avoided transmission and distribution are usually computed separately.

[285] We are unaware of any utilities that have estimated what capital expenditures would have been without historical DSM effects or what capital expenditures would be in the absence of future DSM effects.

The carrying charge should be computed in $/kW-year levelized in real terms. The real-levelized carrying charge is the first-year charge that, if escalated at the inflation rate, will have the same present value as the revenue requirements for the project or the nominally levelized charge. The real-levelized carrying charge in each year represents the present value benefit of a one-year delay adding the investment, and hence a one-year reduction in load growth.

Annual revenue requirements, real-levelized costs, and nominally levelized costs have the same present value, but the revenue requirements are front-loaded. Nominally levelized costs are flat in nominal terms and real-levelized costs are flat in real terms, rising with inflation.

Operation and maintenance

Most T&D plant additions (a new transmission line, substation, feeder, or line transformer) also incur additional O&M costs, such as for vegetation control, inspections, repairs, repainting of towers and structures, and the like. Some expenditures, such as reconductoring a feeder or replacing poles for a voltage upgrade, may not increase (and may actually decrease) O&M costs.

The best practice for extrapolating O&M from historical data would generally be to determine the unit O&M cost ($/MVA of substation operation and maintenance, $/mile of feeder) and apply that value to the avoided cost. That process is straightforward for additional substations and transmission lines, which have their own accounts in the FERC Form 1. But it would be more difficult for other distribution facilities for which O&M expenses are less clearly delineated. It is generally reasonable to assume that the ratio of O&M cost to gross plant for the avoidable capacity is the same as for the existing plant mix, although ideally the historical investments would be restated to include inflation.[286] Any assumption that O&M associated with new equipment is less than the average O&M for similar existing equipment should be carefully considered and fully justified.

In addition to avoiding new facilities and their O&M, lower loads will also tend to reduce the rate of failures of existing equipment and thus the capital and O&M costs involved in repairing and replacing the damaged equipment.

Overheads

Utilities generally allocate a range of overhead or administrative costs (e.g., senior management, legal, financial, human resources, purchasing and contracting, information technology, warehousing, office expense, vehicles) on labor or a similar broad measure of O&M and construction costs. Some of those overheads may not vary linearly with the number of personnel required to design, build, maintain and operate the assets, but increased construction will generally require more of the overheads as a whole.

[286] “Gross plant” is defined as the total capital assets dedicated to utility service and is used to determine rate base.

The utility's overhead adders should be included in both the load-related investments and the associated O&M. Any exclusion of overhead costs from avoided T&D investment should be carefully considered and fully justified.

10.2. Avoided pool transmission facilities transmission

All load in New England pays for PTFs, in addition to local facilities in the local networks. AESC 2018 used ISO New England's then-current Transmission Cost Allocation (TCA) data to identify $6.7 billion (in 2018 dollars) in load-related investments in substations, new lines, voltage upgrades, and additional capacitors and transformers for projects completed or planned for 2003 through 2020, plus two small projects planned for 2021 and 2024. Using the most expansive interpretation of the actual and projected load growth that would have justified those investments, AESC 2018 estimated the avoided PTF cost as $94 per kW-year in 2018 dollars (equal to $99 per kW-year in 2021 dollars).

After the completion of AESC 2018, several stakeholders raised a concern that the analysis was backward-looking rather than prospective. To address this concern, we reviewed the projects in the October 2020 Draft Regional System Plan (RSP) Project List, which includes descriptions and estimated costs for projects under construction, planned or proposed through 2023, plus two small projects planned for 2024 and 2026.[287] This listing may contain some projects that will never be approved, but it probably does not include all the projects that will be scheduled through 2023, let alone 2026. The October 2020 RSP Project List update added several projects proposed for service as early as December 2021, so more projects are likely to eventually be proposed for 2023–2026.[288]

We do not have data on the amount of past and projected load growth driving these transmission expansion plans. The overall ISO New England peak loads are declining, due in part to the energy efficiency programs. However, loads in some areas have been growing and are expected to continue growing, justifying addition of the RSP load-related projects.

Lacking detailed data on the recent projected load growth for which the RSP projects are proposed, we examined whether the proposed annual rate of PTF additions is comparable to the annual rate of PTF additions in the historical data used in the 2018 AESC analysis. Specifically, we computed the apparently load-related expenditures by year for the historical data and the projected RSP costs. For the future-looking RSP costs, we excluded any projects listed as under construction in the ISO England October 2020 project list to make the computation entirely forward-looking.

[287] ISO New England. October 2020. *ISO-New England Project Listing Update*. Available at https://www.iso-ne.com/static-assets/documents/2020/10/final_project_list_october_2020.xlsx.

[288] Several other projects planned for completion in the early 2020s in the October RSP Project List were first proposed in 2018 through early 2020. Costs of projects currently proposed, planned, or under construction may rise by the time the projects are completed.

Table 107. Comparison of annual load-related additions, historical and projected (2021 dollars)

Historical Project Costs (based on TCA)			Future Project Costs (based on RSP)		
period	*$M*	*$M/year*	*period*	*$M*	*$M/year*
2003-2020	$7,008	$389	2021-2023	$991	$330
2003-2024	$7,050	$321	2021-2026	$1,074	$179

The historical TCA data appear to be quite comprehensive through 2018 (the last year containing actual cost data) and even through 2020, and then became sparse. Similarly, the RSP data appear to be complete through 2023 (with 37 reliability projects) and thin thereafter (with only one project scheduled for 2024 and another for 2026). Between June and October 2020, 13 load-related projects totaling $126 million were added to the RSP with in-service dates of 2021 to 2023, in addition to the two later projects, with an estimated cost of $84 million.[289] It is likely that additional projects will be added for in-service dates after 2023. Excluding the thin and incomplete tails (post-2020 for the historical costs and post 2023 for the projected costs), projected future annual investments are equal to 85 percent of the historical investment-per-year rate ($330 million per year, compared to $389 million per year in as estimated in AESC 2018).

We assume that the forecasted localized load growth underlying the future RSP budgets is comparable to the historical load growth driving the historical TCA projects. As a result, we calculate an avoided PTF cost for future years by multiplying the value derived in AESC 2018 by 89 percent. This yields a value of $84 per kW-year in 2021 dollars. Regional transmission needs are driven, and have been driven, by summer peak loads. Therefore, the regional PTF value should be applied to evaluation of measures that change the summer peak.

10.3. Survey of utility avoided costs for non-PTF transmission and distribution

AESC 2021 includes a new rubric to evaluate and compare the methodologies for non-PTF avoided T&D used by utilities in the Study Group. AESC 2018 included a discussion of methods used by several utilities (National Grid, United Illuminating, and Eversource Connecticut). AESC 2021 builds on that structure by formalizing this rubric. This rubric is based on the parameters and areas detailed in Section 10.1 above. The key areas of evaluation rubric include:

1. Load (whether past, forecast, or a combination);
2. Identifying which expenditures are avoidable or deferable by changes in load (e.g., are “load-growth-related”);
3. Matching the changes in load to the load-growth-related investments (e.g., in time);

[289] Dollar years are not indicated in the RSP document. Because some spending may be underway today, because there may be a mix in reporting dollar years in terms of current real dollars and future-year nominal dollars, and because the inflation over the 2021–2026 is minimal, we assume that all spending is in 2021 dollars for purposes of simplification.

4. Mapping lumpy investments to an annual value; and
5. Inclusion of other costs associated with T&D investments, such as O&M and overhead.

Evaluation of current utility methods

The following describes our review of data provided by participating utilities that informs the T&D avoided cost quantification approach. Below, we present summary tables of the evaluation rubric, applied to each utility that responded to the request for information about their current avoided T&D cost calculation methodologies. Table 108 summarizes the avoided T&D values currently in use. Table 109 provides a summary of the load forecast methodologies used in developing these avoided T&D cost values. Table 110 provides more detailed methodological considerations used in deriving the avoided cost values.

Table 108. Summary of utility avoided T&D cost methodologies

Criterion	Eversource CT	Eversource MA	Eversource NH	National Grid MA	National Grid RI	UI CT	Vermont VT	Maine ME	Unitil MA
In evaluating or screening DSM, does utility have a method for valuation of avoided distribution costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The existing value of avoided distribution costs used by utility in evaluating and screening DSM	$14.05/kW (2018$)	$198/kW (2018$)	$79.98/kW (2018$)	$102.48/kW (2019$)	$80.24/kW (2019$)	$30.29/kW (2017$)	$0/kW-Yr	Mid Value: $246.79 (nominal)	$222.56 (2018$)
The year in which avoided distribution cost was developed	2018	2018	2017	2019	2019	2017	2018	2020	No data available
Frequency at which avoided distribution cost is updated by utility	No regular frequency	Every 3 years	No regular frequency	Every 3 years	With AESC Update	No regular frequency	No regular frequency	No regular frequency	No data available
In evaluating or screening DSM, does utility have a method for valuation of avoided transmission costs	Yes (PTF and Non-PTF)	Yes (PTF only)	Yes (PTF only)	Yes (PTF only)	Yes (PTF only)	Yes	Yes (PTF only)	Yes	Yes
The existing value of avoided transmission costs currently used in evaluating and screening DSM	Applies $1.03 $/kW-Yr in addition to $94/kW-yr	$94/kW-yr	$94/kW-yr	$94/kW-yr	$94/kW-yr	$0.84/kW-yr	$94/kW-yr (Efficiency VT); $45/kW-yr (BED)	Mid Value: $56.88/kW-yr + PTF ($94/kW-yr)	$94/kW-yr
The year in which avoided transmission costs were developed	2018	2018	2018	2018	2018	2017	2018 (Efficiency VT); 2012 (BED)	2020	2018
Frequency at which avoided transmission costs are updated	No Regular Frequency	With AESC Update	With AESC Update	With AESC update	With AESC update	No Regular Frequency	With AESC update (Efficiency VT) No Regular Frequency (BED)	PTF portion with AESC update	With AESC Update

Notes: Methodology for Maine represents EMT's proposed approach. For details on Unitil's approach, see D.P.U. 18-110 – D.P.U. 18-119 Three-Year Plan 2019-2021, October 31, 2018 Exhibit 1, Appendix C - Electric Page 36 of 43 https://ma-eeac.org/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no-bulk.pdf.

Table 109. Avoided T&D load forecast methodologies

Criterion	Eversource			National Grid		UI	Vermont	Maine
	CT	*MA*	*NH*	*MA*	*RI*	*CT*	*VT*	*ME*
Load forecast granularity used in calculating avoided costs at a utility-wide level	Transmission and Substation	Transmission and Substation	Transmission and Substation	Transmission and Supply area level	Transmission and Supply area level	Transmission Level	Transmission (Based on AESC)	Based on data available from CMP
Inclusion of the following in load forecasts:								
Operational EE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Based on data available from CMP
Operational PV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Operational DR	Yes	Yes	Yes	Yes	Yes	No	No	
Inclusion of the following in load forecasts:								
Projected EE	Yes	Yes	Yes	No	No	Yes	Yes	Based on data available from CMP
Projected PV	No	No	No	Yes	Yes	Yes	Yes	
Projected DR	Eversource sponsored programs only	Eversource sponsored programs only	Eversource sponsored programs only	Yes	Yes	No	No	
Inclusion of any electrification goals or mandates reflected in current policy	No	No	No	Yes	Yes	No	Yes	Based on data available from CMP
Existence of a process for identifying expenditures *avoidable* through load reductions	Yes	Yes	Yes	Yes	Yes	Yes	No	Based on data available from CMP
Existence of a process for identifying expenditures *deferrable* through load reductions	Yes	Yes	Yes	Yes	Yes	Yes	No	Based on data available from CMP

Notes: In Massachusetts and Rhode Island, National Grid excludes projected energy efficiency beyond the current plan in its forecast for determining the value of avoided distribution costs for DSM. It does account for continued lifetime savings from the current and prior plan years with a decay rate over time.

Table 110. Detailed considerations for calculation of load-specific avoided T&D costs

Criterion	Eversource			National Grid		UI	Vermont	Maine
	CT	*MA*	*NH*	*MA*	*RI*	*CT*	*VT*	*ME*
Existence of a process for deciding years of expenditure that factor into avoided transmission and distribution cost	Yes	Yes	Yes	Yes	Yes	Yes	N/A - using AESC avoided PTF	Based on data available from CMP
Use of the following when calculating avoided T&D costs (past values/future values/combination of past and future)	Combination	Combination	Combination	Combination	Combination	Combination	N/A - using AESC avoided PTF	Based on data available from CMP
Existence of a process for matching load levels to load-growth-related investments	No	No	No	No	No	No	N/A - using AESC avoided PTF	Range of values presented matching load levels to investments.
Whether utility applies a carrying cost to these investments to annualize investment values when calculating the avoided cost	Yes	Yes	Yes	Yes	Yes	Yes	N/A - using AESC avoided PTF	Yes
Whether utility applies avoided O&M costs associated with investments when calculating avoided cost	Yes	Yes	Yes	Yes	Yes	Yes	N/A - using AESC avoided PTF	Yes
Whether utility applies an avoided overhead cost associated with investments when calculating avoided cost	Yes	Yes	Yes	Yes	Yes	Yes	N/A - using AESC avoided PTF	Yes

The following sections present short descriptions of the methods used by each responding utility.

National Grid (Massachusetts and Rhode Island)

National Grid calculates its avoided distribution capacity values for both its Massachusetts and Rhode Island DSM programs using a workbook developed in 2005 by ICF International, Inc., updated with recommendations from the 2018 AESC Study. The company updates this workbook for each three-year planning cycle. The workbook calculates an annualized value of statewide avoided distribution capacity values from company-specific inputs that include historical and projected capital expenditures and peak loads, carrying charges, FERC Form 1 accounting data, and O&M costs.[290] National Grid uses a combination of historical and forecasted values within the workbook and accounts for operational energy efficiency, PV, and demand response programs. The load forecast used to determine the value of avoided distribution only includes projected PV and continued lifetime energy efficiency savings from prior plans and the current plan. The analysis does not include forecasted savings from future energy efficiency plans.

National Grid determines the percentage of the total distribution investments that are load-growth-related but not associated with new business. The resulting percentage is then applied to the distribution investment forecast. For avoided transmission costs, National Grid uses the 2018 AESC PTF of $94 per kW-year (in 2018 dollars) in both Massachusetts and Rhode Island. It does not account for non-PTF transmission costs.[291]

Table 111 summarizes the distribution methodology employed by National Grid, as well as recommendations for improvement.

[290] The Narragansett Electric Company d/b/a National Grid. Docket No. 5076 - 2021 Annual Plan. Attachment 4.

[291] The analysis in this section is based on National Grid MA and RI - 2018 Avoided T&D Workbooks,

Table 111. Assessment of National Grid's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Overall T&D Methodologies	The methodology is mostly consistent with recommended methodologies in its consideration of load-growth-related T&D investments.	National Grid should account for non-PTF transmission costs.	-
Categories of investments considered	National Grid uses historical and forecasted T&D investments and assumes a percentage of that investment is related to load growth not associated with new business and is therefore avoidable with DSM.	It is not clear how the percentage of avoidable distribution investments were calculated since they are significantly lower than the overall distribution investments. It is unclear whether this estimate of the avoidable investments reflects all load-growth-related projects, including any capacity-related projects undertaken for non-load growth purposes such as reliability improvements.	National Grid should provide more transparency regarding the calculation of percentages representing load growth and new business. National Grid should use a more granular approach in the breakout of its T&D investments.
Load Forecast Methodologies	National Grid includes the impact of historical adoption of EE measures but does not include the impact of forecasted EE adoption.	National Grid should use a load forecast that includes future projected EE savings since the investment forecast assumes continued EE programs.	-
Detailed Considerations	National Grid uses a relatively short period of 11 years (5 years of historical data and 6 years of forecasted data) which may not be long enough to account for lumpiness associated with investments across the years. National Grid applies a carrying cost to investments when calculating avoided costs. National Grid includes both O&M and overhead costs in calculation of avoided costs.	National Grid should use a longer-term period for its analysis, in the range of 25-27 years. .	-

United Illuminating

United Illuminating developed estimates of the avoided T&D expenditures due to Conservation and Load Management (CLM) based on values from a 2017 Harbourfront Group study.[292] The 2017 Harbourfront study uses principles of marginal cost of service in order to develop a marginal cost of transmission based on coincident peak demand and a marginal cost of service based on non-coincident peak demand. The study calculated values for both historical years (2000–2016) and future years (2017–2026). The analysis assumed that non-coincident peak impacts resulted in substation and feeder demand reduction from all CLM measures, therefore resulting in the maximum estimate. The study also

[292] United Illuminating, Avoided Transmission and Distribution Cost Study 2000–2006.

assumed that the T&D costs that are avoided by the implementation of a CLM load reduction measure are the same as the marginal cost of T&D for adding or subtracting an increment of load. For the distribution system, the process involves identifying the T&D projects by separating out those that are load-growth-related from those that are not growth-related. For the transmission system, only projects that are undertaken to meet regional and national transmission and reliability standards were considered. The categories for the projects considered include transmission substation, transmission lines, distribution substations, and distribution feeders. The denominator for the marginal cost calculations is the added capacity or the load-serving capability of the capital project. The methodology used an economic carrying charge model and includes O&M expenses and overheads.

Table 112 summarizes the distribution methodology employed by United Illuminating, as well as recommendations for improvement.

Table 112. Assessment of UI's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations for Improvement	Recommendations on Clarity
Overall T&D Methodologies	The methodology is broadly consistent with Avoided T&D methodologies in its consideration of load-growth-related T&D investments. The methodology is inconsistent with Avoided T&D methodologies in its consideration of load growth. The study is a marginal cost of service study more suited for application for purposes of cost allocation across different rate classes.	The study provides a marginal cost which uses a different methodology compared with the Avoided T&D cost methodologies suggested in this AESC. In the marginal cost development, the total investments identified for load growth projects were divided by the load-serving capability in developing the marginal costs. However, for an Avoided T&D study we recommend dividing instead by the growth in peak demand during the timeframe identified. The avoided costs were developed in context of the CLM program and its applicability to other programs should be evaluated and updated accordingly.	UI has used a weighting construct where 20% of their Avoided T&D value is combined with 80% of Eversource Avoided T&D value at the distribution level and transmission level. Further information would be beneficial regarding the accuracy and rationale of these assumptions.
Categories of investments considered	UI includes all growth- and capacity-related projects in calculation of avoided T&D costs. This includes capacity-related investments associated with projects that are undertaken for reliability improvements. UI considers both transmission and distribution investments at the substation and also considers feeder level distribution investments.	-	UI should clarify how it considers and includes investments that may be harder to characterize as solely load growth projects but may also contribute to alleviating load constraints.
Load Forecast Methodologies	In evaluating investments, UI includes the impact of historical adoption of CLM measures but does not include in forecasted CLM adoption. This methodology is accurate in	UI should include the impacts of electrification and state policy goals when identifying avoided T&D investments Although UI has developed a load forecast for identification of load	The load forecast methodology is not clear in terms of other energy efficiency measures included in the load forecast and the applicability of these values across other programs.

Topic	Overall Assessment	Recommendations for Improvement	Recommendations on Clarity
	quantifying the infrastructure costs that would be required without CLM provided that the investments and capital expenditure estimates also reflect growth without CLM included for consistency	growth related investments, for an Avoided T&D study we recommend dividing these investments by the growth in peak demand during the time frame identified as opposed to the load serving capacity of these projects identified.	
Detailed Considerations	Although there is no process for matching investments to load growth years, application of the relatively long period of 27 years (17 years of historical data and 10 years of forecasted data) accounts for some of the lumpiness associated with investments across the years. The analysis includes projects that could potentially be avoided or delayed by the implementation of CLM measures. UI has applied a carrying cost to investments when calculating avoided costs. UI has included both O&M and overhead costs in calculation of avoided costs.	-	-

Eversource (Connecticut, Massachusetts, and/or New Hampshire)

Eversource developed avoided or deferred T&D estimates using broadly similar methodologies across the three states it serves (Connecticut, Massachusetts, and New Hampshire) with some key differences in calculation of the percentage of avoidable or deferrable investments that could be considered in calculating the avoided costs. Its analysis in all three states considered both historical and forecasted investments on the T&D system.[293] For Massachusetts and New Hampshire, the methodology involved developing a value using the incremental investments and the incremental peak load growth over the same timeframe. In each of these states, Eversource assumed a certain percentage of the total T&D investments, respectively, were load-growth-related.

In the case of Connecticut, Eversource used a different approach. The methodology involved developing an additional regression analysis between historical investments and new customers to find the unavoidable investments associated with customer growth. These historical T&D investments that are related to customer growth are not considered avoidable/deferrable and are therefore removed from the analysis. Eversource used results of the regressions to evaluate the percentage of the T&D

[293] The analysis in this section is based on Eversource MA–2018 Avoided T&D Workbooks, Eversource CT–2018 Avoided T&D Workbooks and Eversource NH–2012 Avoided T&D Workbooks.

investments in Connecticut that are avoidable/deferrable, instead of the application of a percentage for Massachusetts and New Hampshire. Following this, Eversource conducted a regression analysis between incremental investments and peak load growth to assess the incremental investments associated with peak load growth in $/MW. The results of the two steps were combined to develop an annualized Avoided T&D cost.

Table 113 summarizes the distribution methodology employed by United Illuminating, as well as recommendations for improvement.

Table 113. Assessment of Eversource's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Overall T&D Methodologies	The methodology used by Eversource is broadly consistent with Avoided T&D methodologies in its consideration of load-growth-related T&D investments and load growth. In the case of NH, the recommendations outlined are based on review of the workbooks used in developing the 2012 values. Eversource indicated that the methodology in subsequent updates has remained consistent.	Eversource does not currently estimate avoided/deferred T values for MA and NH. Synapse recommends calculating these values and updating at a consistent frequency.	Certain assumptions outlined below have not been supported with underlying sources and calculations. These should be provided in future updates. For CT, both United Illuminating and Eversource have indicated the use of a 20/80 weighted average based on the respective customer base. Calculations outlining the weighting process should be provided to ensure consistency between both entities.
Categories of investments considered	Eversource does address the inclusion of growth- and capacity-related projects in calculation of avoided T&D costs, although it is unclear if these have been accurately estimated.	In the case of NH and MA methodologies, it is not clear how the percentage of avoidable/deferrable investments were calculated and whether they are fully capturing all the avoidable load-growth-related investments. In the case of CT, the non-avoidable or deferrable T&D investments were derived using a top-down approach based on the number of customers added to the system. Eversource should consider looking at specific projects on a case-by-case basis that could be avoided or deferrable through load reductions.	To increase transparency and ensure consistency with AESC methodologies in calculation of avoidable/deferrable investments, Eversource should identify underlying sources that specify the methodology and calculations applied in identifying the historical and forecasted capital investments. This should include sources that outline the following: 1. The categories of investments considered (e.g., substation/feeder) and the inclusion of investments in the analysis that are incurred to address local load growth. 2. The analysis conducted in classification of investments as avoidable or deferrable including any calculations made to derive the avoidable/deferrable percentage estimates for both MA and NH Avoided D estimates.

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Load Forecast Assumptions	As of 2018, Eversource had not included the impacts of electrification in its forecast of T&D capital expenditures for the purpose of calculating avoided/deferred T&D costs. However, Eversource has indicated that future load and capital expenditure forecasting will include the impact of electrification.	-	The CT regression methodology for statewide T&D uses a presumed rate of load growth based on historical growth using data from the CT Siting Council. However, it is not clear if the load growth assumed for identifying the capital investments (typically done through T&D planning process) used this same estimate of load growth. These should be consistent. For MA and NH, due to limited data availability underlying the development of the load forecasts and capital expenditures, further details are required to ensure consistency with methodologies outlined in AESC. Eversource has indicated that the load forecasts used for T&D investment planning are consistent with those used for Avoided T&D estimates.
Detailed Considerations	Although there is no process for matching investments to load growth years, application of the relatively long period of data accounts for some of the lumpiness associated with investments across the years. Eversource has applied a carrying cost to investments when calculating avoided/ deferred costs. Eversource has included both O&M and overhead costs in calculation of avoided/deferred costs.	-	-

Unitil (Massachusetts and/or New Hampshire)

No specific information was provided.

Vermont

For statewide energy efficiency programs administered through Efficiency Vermont, the state uses the 2018 AESC PTF of $94/kW-year as a proxy for both the statewide average avoided cost of distribution and transmission combined.

This is due to the fact that within Vermont loads are expected to remain on a flat-to-declining trajectory for the foreseeable future and there have been no geographic locations where targeted energy efficiency could defer needed T&D investments since 2012. In addition, Vermont is facing generation constraints where substations are at thermal loading capacity, as described in more detail in the section below. This means that energy efficiency could create additional costs instead of avoided costs.

Similarly, the City of Burlington Electric Department (BED) does not assume any avoided distribution costs because the system is overbuilt. BED uses a value of $45 per kW for avoided transmission costs that was originally developed and approved in 2012.

Table 114 summarizes the distribution methodology employed in Vermont, as well as recommendations for improvement.

Table 114. Assessment of Vermont's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations for Improvement	Recommendations on Clarity
Overall T&D Methodologies	Vermont uses only the PTF value, for the combination of PTF and non-PTF transmission, and distribution. The PTF methodology is consistent with the recommendations of this chapter, by default. The Burlington value does not reflect the region-wide nature of avoided PTF. Vermont does not derive any value for avoided non-PTF transmission or for distribution.	Vermont should apply the same avoided PTF transmission costs across the state. Vermont should consider tracking winter distribution peaks to identify whether electrification could cause the need for distribution upgrades and whether CLM could mitigate those costs.	Vermont should explicitly analyze and document the use of a $0 value for avoided non-PTF transmission and distribution costs, taking into account in-state differences in loads, distributed generation, and the impact of potential electrification.
Categories of investments considered	Because Vermont does not have a state-specific methodology for avoided T&D costs, it does not consider which investments are load-growth-related or whether to conduct analysis at the substation or feeder level.	-	-
Load Forecast Methodologies	VELCO Long Range Transmission Plan (LRTP) includes load forecasts that account for EE, PV, DR, and adjusts for the amount of efficiency embedded in the actual data along with the amount of efficiency expected to occur in the future.	-	-
Detailed Considerations	None	-	-

Maine

Efficiency Maine Trust (EMT) engaged Synapse as a subcontractor to ERS to develop statewide avoided T&D costs in dollars per kilowatt-year ($/kW-year). The methodology used in developing the values is consistent with methodology outlined in AESC. The analysis was dependent on data provided by Central Maine Power (CMP). Based on this limited data availability, Synapse has assumed that the avoided T&D cost for CMP will serve as a proxy for the statewide avoided T&D cost.[294] The developed avoided T&D

[294] Synapse did not have access to Versant data. While Synapse assumes the value for Versant will be nonzero, Synapse has no further information at this time and thus cannot include it in the statewide estimate.

value is based on the overall long-term ratio of T&D savings per kW of avoided growth using peak load forecasts and planned capital additions based on CMP data.

In calculated the distribution expenditures, CMP uses forecasted load at the level of the service center as part of Chapter 330 filings.[295] Synapse used the 50/50 load forecast from these filings. CMP provided Synapse with data for load-growth-related distribution capital expenditures. Some of the distribution capital expenditures were classified as both transmission and distribution; and in those cases a portion of such projects were allocated to transmission avoided cost calculations. In addition to transmission investments related to distribution projects, CMP also provided similar load-growth-related investments associated with the non-PTF transmission costs. In estimating the avoided non-PTF cost, Synapse assumed these needs to be driven by the ISO New England CELT forecast. Synapse also applied a real levelized carrying charge and an avoided O&M allowance based on data provided by CMP. Since Synapse had limited data regarding matching of the CMP's capital investment time periods with the load growth, Synapse presented a range of values based on different assumptions of time periods for both the capital investments and the load growth. EMT chose to use the mid-point value across this range.

10.4. Localized value of avoided T&D

In addition to crediting demand-side measures with value for avoiding T&D costs across a service territory, it may also be necessary to estimate the value of these measures in a location-specific context. One example includes the evaluation an NWA (or hybrid solution) as an alternative to a proposed or potential traditional infrastructure-based solution to a projected reliability issue. To comprehensively estimate the value that DERs, namely energy efficiency and demand response, provide to localized T&D systems, program administrators can develop and rely on localized T&D values. This section describes the approach developed in AESC Supplemental Study Part II: *Localized Transmission and Distribution Benefits Methodology* (Supplemental Study) to AESC 2018 at the request of a subset of the AESC 2018 Study Group. The section then surveys the landscape of location-specific avoided T&D methods and approaches in the region.[296]

Summary of supplemental study approach to localized T&D value

The key aspects of the Supplemental Study methodology are to:

1. Identify target areas and required load reduction
2. Determine benefits of targeted load reductions by identified target area

[295] Central Maine Power Company Annual Filing of Schedule of Transmission Line Rebuild or Relocation Projects, 35-A M.R.S.A. §3132(3); and Schedule of Minor Transmission Line Construction Projects, 35-A M.R.S.A. §3132 (3-A).

[296] Chang, M., J. Hall, D. Bhandari, P. Knight. May 1, 2020. *AESC Supplemental Study, Part II. Localized Transmission and Distribution Benefits Methodology.* Synapse Energy Economics for AESC Supplemental Study Group. Available at https://www.synapse-energy.com/sites/default/files/AESC_Supplemental_Study_Part_II_Localized_TD.pdf

3. Calculate avoided cost ($/kW) based on the present value of deferred expenditures and the required load reduction

The following sections detail the three-step process for determining localized T&D values. We also describe current practices followed by participating utilities when evaluating NWAs. We recognize that the decision process for evaluating NWAs relative to traditional engineering solutions is a different process from quantifying the avoided T&D costs for DSM planning. These three steps will require program administrators to obtain information from their respective planning groups.

Step 1: Identify target areas and required load reduction

The localized T&D value requires the identification of target projects and required load reduction and duration in order to calculate the avoided cost. This first step of identifying target projects utilizes a utility's planning processes that identify system contingencies at peak load levels under normal and contingency operations.

Build on existing T&D planning

The first step in identifying target locations for evaluation is based on the results from utility's existing peak load forecasts at the transmission, sub-transmission, and distribution levels. The peak load forecasts should only account for program-related NWA components such as energy efficiency, PV, and demand response that are currently online and active.[297] The peak load forecasts should be conducted in accordance with the utility's T&D planning practices and regulatory requirements (typical forecasts of five to 10 years in the future for distribution planning and 10 years for transmission and sub-transmission planning). This process may involve developing resource-specific forecasts. Stakeholders may consider evaluating peak load forecasts to include any state/local/regional electrification goals mandated by current policy, if not required by statute.

Local transmission and sub-transmission: After estimating peak load levels, the next step is to establish the system planning criteria and performance objectives. The system planning criteria should be based on the utility's local transmission system planning guidelines and regulatory obligations. This would involve designing the system in accordance with any relevant standards and/or design practices. For example, in New England this may include planning criteria for the bulk electric system as defined by ISO New England, NERC standards, and Northeast Power Coordinating Council (NPCC). In addition, local standards may also apply (e.g., Maine's local "safe harbor" reliability standards). An example of system planning criteria would involve establishing the voltage operating ranges and loading criteria for system components under normal and contingency operation—such as normal, long-term emergency and short-term emergency limit ratings for each type of equipment, i.e., the loading at which the equipment can operate in normal and emergency situations.

[297] The load forecast should be the same for evaluating NWAs and traditional engineering solutions.

As part of the planning process, the planning group will run power flow simulations to identify the system contingencies and violations under varying system configurations. This may include understanding and applying the specific contingency standards (e.g., loss of element contingency such as N-0, N-1, N-1-1) that define the minimum infrastructure necessary to maintain security standards depending on the needs of the specific region. At a transmission level this is typically done through load flow analysis software such as Siemens' PSS/E.[298] The analysis should also estimate the required load reduction in order to mitigate the contingency.

Distribution system: The distribution system planning process will follow a similar process as transmission planning. Distribution planning requires projecting the peak load. This should include summer and winter peak load forecasts at a substation and circuit level. The peak load forecast should be done over a timeline that is consistent with the utility's distribution planning process. Depending on the utility, this forecast is typically done over a 10-year period.

The next step involves setting up the design criteria for planning of the distributions system. This includes establishing criteria for equipment loading, phase balancing, and ranges of system voltages, etc. Following this, a circuit analysis is conducted to identify where planning criteria and design threshold violations exist and where the system constraints are expected to occur. This is typically done using distribution system planning tools, e.g., Eaton's CYME software to assess the critical load levels, thermal, and voltage violations.[299] This step would also involve estimating the load reduction required to mitigate any identified contingencies.

Distribution system analysis should also include a process to identify potential areas where there may be reliability concerns that could be mitigated through NWA solutions.

Considerations

To prioritize areas for targeted NWAs, utilities currently consider various additional factors before assessing the potential for an NWA option. For example, utilities may establish minimum threshold criteria to meet when addressing a system contingency or considering an NWA as a resource option.

Utilities also currently consider the timeline required for building the NWA and whether this can be done in time to avoid the identified contingency or violation that it is meant to address based on local conditions. There are issues that may not be considered imminent or immediate concerns (e.g., issues that may have been accepted for many years) and should also be addressed accordingly. For example, contingencies that have sufficient lead time could be considered for NWA solutions whereas projects with imminent needs may not be suitable for NWAs.

[298] Siemens. Last accessed March 10, 2021. "PSS®E – High Performance Transmission Planning and Analysis Software." *new.siemens.com*. Available at https://new.siemens.com/global/en/products/energy/energy-automation-and-smart-grid/pss-software/pss-e.html.

[299] CYME. Last Accessed March 10, 2021. "CYME International" *Cyme.com.* Available at http://www.cyme.com/

In addition, the severity and nature of the overload (e.g., the contingency number) are a consideration for the NWA process. The conditions under which the constraint or planning violation has been identified should be factored in the analysis. This might include examining the degree to which the constraint is present in normal conditions or extreme conditions (such as hot weather). Utilities also consider the nature of the contingencies in terms of whether they are suitable applications for an NWA. In identifying target areas where there are concerns about backing up critical loads, these areas should not be automatically disqualified from NWA consideration—instead hybrid solutions between the NWA and a wires solution could also be considered and evaluated by the planning group.[300]

DSM planning and implementation

On the energy efficiency side, there is need to factor in the lead time for marketing, implementation, and verification of DSM under an NWA solution. As noted in the responses provided by the utilities and stated above, current NWA evaluation processes require a window of time prior to the need to start construction on T&D infrastructure. In their DSM planning processes, program administrators should also factor the amount of DSM that could be based on potential annual load reduction (percent) by class and projected overload, as well as estimates of distributed generation and storage capacity. Conversely, a conventional engineering solution will also take time, especially if it requires separate regulatory approval and other siting review.

Identifying expenditures avoidable by load reductions

This section describes an approach to identifying expenditures that are avoidable by load reductions. It incorporates ideas from existing methodologies used by utilities to identify regions suitable for NWAs.[301]

In identifying the expenditures avoidable by load reductions, first it is necessary to identify the magnitude, duration, and coincidence of the load reduction compared to the location and the timing of the traditional utility solution that would solve any system contingencies. Any constraints identified should be listed as such based on the first year that the constraint is identified. As discussed above, this should be identified through the system power flow analysis. At minimum, most utilities consider load growth and reliability as the expenditures that can be avoided by NWAs.[302] However, other projects may also have some suitability in replacing a wires solution.

If a project addresses both NWA-eligible constraints and also non-NWA-eligible constraints, the costs for such projects should be broken down between those that are NWA-eligible and non-NWA-eligible in estimating the avoided cost expenditures. The utility should clearly identify which investments are

[300] As the availability and granularity of data improves through technologies and planning advancements, we anticipate improvements in methodology and applicability to more feeders.

[301] This methodology does not comment on the accessibility of detailed load, engineering, and cost data for feeders and components.

[302] While overall system load growth may be flat or declining for a given utility, there still may be individual feeders that are experiencing load growth.

considered as avoidable or deferrable through an NWA and the expenditures identified should be estimated in accordance with the utility capital investment planning guidelines. The expenditures should include operating expenses (e.g., reconfiguration) and capital investments and O&M associated with new facilities (net of any savings from retiring old equipment).

Utilities may establish a traditional engineering solution cost threshold before considering NWA solutions. Small projects that can be solved through traditional utility options (low-cost load transfers, etc.) may be less costly than procuring an NWA solution. Similarly, longer-term projects that do not have an imminent need and are above an established cost threshold may be more suitable projects for NWA consideration.

Identify type and period of required reduction

After identifying the expenditures that are avoidable by targeted load reductions, it is critical to identify the time at which the required load reduction is needed. This involves answering questions such as:

- Does the load reduction need to occur in a specific season?
- Does the load reduction need to occur in specific hours of the day?
- Over how many hours or days must the load reduction occur?

In addition, it is important to identify the number of years in which the reduction must occur. For example, if the goal is to defer an expenditure for three years, and the load is expected to exceed the system's capability for all three of those years, then an effective load reduction plan requires the load reduction to sustain for three years. Program administrators will need to coordinate with the utility's distribution planning group to ensure that localized demand reduction programs will meet the planning criteria as an appropriate solution.

Step 2: Determine benefits of targeted load reductions by identified target area

When calculating the avoided T&D costs, users should quantify the reduced present value of deferred expenditures. The annualized present value should reflect the utility's cost of capital, income taxes, property taxes, and insurance over the life of the equipment. To do so, one must first calculate the real carrying charge (RCC) that is expressed as a percentage. In general, the RCC equals the weighted average cost of capital (WACC), plus income tax, property tax, associated insurance, and O&M:[303]

$$RCC = WACC + Income\ Tax + Property\ Tax + Insurance + O\&M$$

[303] See Section 10.1 for a more detailed discussion of real carrying charge. The associated insurance and O&M costs may be expressed as a percentage of the deferred expenditure being analyzed.

The RCC should then be used to calculate the reduced present value of the avoided expenditures. For example, if the utility's RCC is 15 percent, then a $10 million investment would have an annualized expenditure of $1.5 million per year ($10 million x 15 percent).

There may be situations where a DSM load reduction defers a specific project by some period of time. For those situations and for the purposes of simplifying a more complex process, we recommend that the deferral value represents the traditional engineering expenditure reduced by the RCC and then discounted by the real discount rate.[304] In our illustrative example, if the RCC is 15 percent and the real discount rate is 3.37 percent, a 1-year deferral would have an avoided cost value of 85.5 percent (0.855 = 1 – [0.15 * (1 – 0.0337)]).

Step 3: Calculate avoided cost ($ per kW)

The next step is to calculate the avoided cost in terms of dollar per kilowatt (measured in $ per kW) for each identified target area.[305] To do so, program administrators must first compile:

1. The present value of the benefits from the deferral or avoidance of load-related expenditures identified in Step 2, above; and
2. The required load reduction, in kilowatts, required to achieve the deferral or avoidance of said expenditures.

Next, program administrators should divide the present value of the benefits from deferral or avoidance by the required load reduction to arrive at a localized avoided T&D value in dollars per kilowatt, by target area.

This value can serve as the conceptual average value for which to evaluate load reduction resources and technologies between the planning and energy efficiency groups. In other words, the average cost of the load reduction strategies used to achieve deferral or avoidance should be less than the calculated localized avoided T&D value, which is the value of the traditional engineering solution. If the average cost per kilowatt is greater than the localized avoided T&D value, then the avoidance or deferral portfolio costs more than the load-related expenditures that are targeted for deferral or avoidance. In these cases, alternative portfolios should be evaluated. If none are found to be cost-effective relative to the traditional engineering solution, the traditional engineering solution should be pursued.

Conceptually, it may be helpful to use the localized avoided T&D values as guidelines when compiling a portfolio to achieve the required load reduction. To the extent possible, program administrators should concentrate on achieving the required load reduction at lower costs per kilowatt than the avoided costs.

[304] For the purposes of this methodology, we do not address any probabilistic planning issues that may arise from the continued deferral or acceleration of specific distribution project due to changes in localized loads. A more detailed analysis would require the re-running of power flow analyses based on changed loads that may result in the determination of a different engineering solution.

[305] This methodology does not address issues regarding operational control or visibility associated with the T&D system.

However, specific resources may be less than or even greater than the average avoided cost, as long as the total portfolio cost is less than the localized avoided cost T&D value.

Evaluation of current utility methods

AESC 2021 includes a rubric, developed in parallel with the rubric used in Section 10.3: *Survey of utility avoided costs for non-PTF transmission and distribution* above, to survey current utility methods for quantifying the value of demand-side measures in avoiding or deferring geographically localized investments. The evaluation rubric for localized T&D methods is built on a similar structure to the Supplemental Study, but it is more flexible (and more focused on the raw data sources and approaches to analysis) to reflect different approaches to calculating these values and the relative lack of maturity of this aspect of avoided cost analysis.

The Synapse Team surveyed the utilities in the Study Group regarding their approaches to localized avoided T&D values. The following section describes our review of data and methods provided by participating utilities.

Below, we present summary tables of the evaluation rubric, applied to each utility that responded to the request for information about its methodology about the current locational valuation/NWA methodologies. Table 115 provides a general summary of methodologies related to identification of candidate locations for NWAs and the related load forecast methodologies. Table 116 provides specific criteria/thresholds for selection of a locations as an NWA. Table 117 and Table 118 provide a summary of specific design/engineering criteria that are applied at the T&D level.

Table 115. Summary of location-specific evaluation methodologies and load forecast processes

Criterion	Eversource	National Grid		United Illuminating	Vermont
	MA/NH/CT	MA	RI	CT	
Existence of a process to establish a location-specific value for avoided T&D costs in candidate locations for NWAs	Yes	Yes	Yes	No	Yes
Existence of a process to identify and/or select candidate locations for NWAs	Yes	Yes	Yes	No	Yes
Existence of a process for quantification of the required load reduction from these locations for calculation of the avoided costs	Yes	Yes	Yes	No	Yes
Whether the identification of these locations based on utility load forecasts	Yes	Yes	Yes	No	Yes
Granularity of load forecasts used by the utilities in identification of these locations.	Transmission and substation	System Level	System Level	N/A	Circuit Level
Inclusion of the following in the load forecasts:					
Operational EE	Yes	Yes	Yes	N/A	Yes
Operational PV	Yes	Yes	Yes	N/A	Yes
Operational DR	Only Eversource-sponsored DR	Yes	Yes	N/A	Yes
Inclusion of the following in the load forecasts:					
Projected EE	Yes	Yes	Yes	N/A	Yes
Projected PV	Yes	Yes	Yes	N/A	Yes
Projected DR	Only Eversource-sponsored DR	Yes	Yes	N/A	Yes
Inclusion of any electrification goals or mandates reflected in current policy	Yes	Yes	Yes	N/A	Yes

Notes: For Eversource, exact processes may vary across individual states between New Hampshire, Massachusetts, and Connecticut.

Table 116. Summary of processes for identifying locations that would benefit from load reductions

Criterion	Eversource	National Grid		United Illuminating	Vermont
	MA/NH/CT	MA	RI		
Whether the load growth forecasts are conducted in concert with the utility's T&D planning	Yes	Forecasts feed into assessment	Forecasts feed into assessment	N/A	Yes
Whether the utility applies a minimum threshold load criterion for qualification of a location in being considered for an NWA/used to calculate location-specific avoided costs	Yes	Yes	Yes	N/A	Yes
The existence of threshold load criteria used by the utility in identifying the target locations	Yes	Yes	Yes	N/A	Yes
Whether the utility develops a specific timeline for qualification of a location in being considered for an NWA/used to calculate location-specific avoided costs	Yes	Yes	Yes	N/A	Yes
Is there a timeline established for identification of a targeted location	Yes	Yes	Yes	N/A	Yes

Table 117. Summary of processes for identifying target locations that would benefit from load reductions at the transmission level

Criterion	Eversource	National Grid		United Illuminating	Vermont
		MA	RI		
Whether there is consistency with the utility's local transmission planning guidelines and regulatory obligations	Yes	Not applicable, screening occurs for sub transmission projects only	Not applicable, screening occurs for sub transmission projects only	No	Yes
Whether the targeted locations are identified through power flow simulations	Yes	Not applicable	Not applicable	No	Yes
Tools used for power flow modeling for this purpose	PSS/E, TARA	Not applicable	Not applicable	Not applicable	Not specified
How far into the future are these locations identified	10 years	Not applicable	Not applicable	Not applicable	10 years
What specific contingency standards are applied	NER , NPCC, ISO-NE Planning Eversource SYSPLAN-01 – Eversource Energy Transmission System Reliability Standards	Not applicable	Not applicable	Not applicable	ISO-NE, NERC, and other applicable reliability planning criteria
Are hybrid NWA solutions considered	Yes	Not applicable	Not applicable	Not applicable	Yes
Cost threshold for the traditional solution	Considered but details not specified	Not applicable	Not applicable	Not applicable	>$2.5M
Timeline criteria for the start of construction of the traditional solution	Considered but details not specified	Not applicable	Not applicable	Not applicable	≥2 years but <10 years
Load reduction and/or off-setting generation requirement	Considered but details not specified	Not applicable	Not applicable	Not applicable	1-3 yrs in future = 15% peak load 5 yrs in future = 20% peak load 10 yrs in future = 25% peak load

Table 118. Summary of processes for identifying target locations that would benefit from load reductions at the distribution level

Criterion	Eversource	National Grid		United Illuminating	Vermont
		MA	RI		
Whether the utility applies specific design criteria (for equipment loading, phase balancing, and ranges of system voltages, etc.) in identifying these locations?	Yes	Yes	Yes	No	Yes
The existing design criteria that are applied for this purpose	Equipment Loading limits, reliability targets, voltage limits, resiliency goals; Anti-islanding, flicker/transient limits, fault and short circuit, reverse flow	Yes	Yes	Not applicable	Yes
Consistency of the design criteria with utility distribution planning criteria that are applied in identifying traditional engineering solutions at the distribution level	Yes	Yes	Yes	Not applicable	Yes
Whether the targeted locations are identified through power flow simulations	Not initially	Yes, after initial assessment	Yes, after initial assessment	Not applicable	Yes
Tools used for power flow modeling for this purpose	Synergi, CYME, PSCAD	Not specified	Not specified	Not applicable	CYME
Are hybrid NWA solutions considered	Yes	Yes	Yes	Not applicable	Yes
Cost threshold for the traditional solution	>$1M	≥$500K	>$1M	Not applicable	>$2M or >$250K if relieving a delivery constraint
Timeline criteria for the start of construction of the traditional solution	2 years, less than 7 years from IRP filing date	18 months	30 months	Not applicable	≥2 years but <10 years
Load reduction and/or off-setting generation requirement	>30MW	Load reduction <20% of relevant peak load	Load reduction <20% of relevant peak load	Not applicable	25%

The following subsections present short descriptions of the methods used by each responding utility.

National Grid (Massachusetts and Rhode Island)

In both Massachusetts and Rhode Island, National Grid has a process to consider NWAs as part of its distribution planning process for distribution and subtransmission capital projects and system needs. National Grid identifies system needs as a result of studies, operational issues, process safety issues, occupational safety issues, regulatory requirements, and/or customer requests.[306] If the annual planning process identifies a system need, and that location passes the state-specific NWA screening criteria, then the project is shifted to an NWA analysis team for further review and analysis of the system need. The screening criteria for each state are shown in Table 119 below.

Table 119. National Grid NWA screening criteria

Criteria	Massachusetts	Rhode Island
Project Type Suitability	Project types include Load Relief and Reliability. Other types have minimal suitability and will be reviewed as suitability changes due to state policy or technological changes.	Project types include Load Relief and Reliability. The need is not based on asset condition. If load reduction is necessary, then it will be less than 20% of the total load in the area of the defined need.
Timeline Suitability	Start of construction is at least 18 months in the future.	Start of construction is at least 30 months in the future.
Cost Suitability (Cost of Wires Solution)	Greater than or equal to $500K	Greater than $1M

Source: National Grid. Guidelines for Consideration of Non-Wires Alternatives in Distribution Planning. March 2020.

The avoided cost is based on a NPV calculation based upon costs and benefits of the NWA solution, as well as the avoided costs of not implementing some (in the case of a hybrid solution) or all of the traditional wires solution.

National Grid also considers hybrid NWA opportunities during screening. These are an NWA solution, or a combination of NWA solutions, that addresses part of a specified system need with the rest of the system need addressed by a wires solution.

Table 120 summarizes the NWA methodology employed by National Grid, as well as recommendations for improvement.

[306] National Grid. Guidelines for Consideration of Non-Wires Alternatives in Distribution Planning. March 2020.

Table 120. Assessment of National Grid's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Methodology for Identification of Locations	National Grid has a documented process and guidelines for screening NWAs.	-	Access to analysis and the NWA screening tool would increase transparency.
Transmission Specific NWA Criteria	-	-	-
Distribution Specific NWA Criteria	National Grid has a documented process which outlines the types of projects that can replace traditional solutions for NWA consideration. National Grid has criteria in place for the type of wires projects suitable for NWAs. These include criteria for type of project (load relief, reliability, non-asset condition), timing, and cost.	-	-

United Illuminating

Currently, United Illuminating does not have a regulatory-approved NWA process in place within the state of Connecticut.

Eversource (Connecticut, Massachusetts, and/or New Hampshire)

Eversource has a documented process and framework for identifying locations where DSM could be applied to meet a system need.[307] The need for an investment at a particular location is identified as part of the distribution planning process which accounts for all planned and existing system upgrades including the DERs. The process involves using an in-house screening tool that looks at how NWA approaches can replace traditional solutions. The tool provides a comparison of the revenue requirements between an NWA and deferring a traditional solution in assessing the locational value of an NWA.

For use in the screening tool, Eversource develops a portfolio of possible solutions and technologies which involves market research and gathering information from vendors and suppliers through RFIs (Request for Information). Possible solutions are evaluated based on longevity, dependability, and the specific need identified. These technologies are integrated to the screening tool which is designed to provide a preliminary identification of the NWA solution and whether such a solution will meet the reliability and performance needs of the system.

[307] Survey To Evaluate Program Administrators Avoided T&D methodologies. Responses received on November 16, 2020.

In screening for NWAs, Eversource considers various criteria for identifying locations and selecting technologies including the magnitude of the need (applying N-0 and N-1 criteria to assess the required capacity of the solution), duration of the need, the time of day of occurrence of the need, and the frequency at which the need occurs.

Distribution Planning Screening Criteria

Non-wires candidates include:[308]

- Projects that are capacity-related
- Projects that can be deferred via deployment of NWAs
- Hybrid Solutions: combined deployment of NWAs paired with a traditional system

Some specific suitability criteria and threshold that are excluded from NWA consideration are:

- Upgrades that impact old or failing assets, or those scheduled to be replaced
- Upgrades below a financial threshold (have a projected cost of at least $1 million)
- Upgrades with immediate needs (less than 2 years). Projects must have planned in-service date at least 3 years after the date of the Least Cost Integrated Resource Plan (LCIRP) filing.
- Projects require more than 30 MW of peak load relief within seven years of the latest LCIRP filing.

Transmission Planning Screening Criteria

Eversource is required to comply with the following reliability and planning standards when planning its transmission system:[309]

- NERC TPL-001-04 - Transmission System Standards
- NPCC Regional Reliability Reference Director #1—Design and Operation of the Bulk Power System
- ISO New England Planning Procedure 3 (PP3)—Reliability Standards for the New England Area Bulk Power Supply System

[308] New Hampshire Public Utility Commission. October 1, 2020. "Eversource Least Cost Integrated Resource Plan." *Puc.nh.gov.* Available at: https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-161/INITIAL%20FILING%20-%20PETITION/20-161_2020-10-01_EVERSOURCE_ATT_2020_LCIRP.PDF. Appendix D.

[309] Massachusetts Department of Public Utilities. Last accessed March 11, 2021. "Petitions of Western Massachusetts Electric Company d/b/a Eversource Energy Pursuant to G.L. c. 164 72 and G.L. c. 40A 3."Available at https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/9164120#page=54. Pg. 54-57

- Eversource SYSPLAN-01—Eversource Energy Transmission System Reliability Standards

Specific transmission suitability criteria for Non-Transmission Alternatives ("NTAs") also include response time to contingency conditions, minimum amount of operation time that resource is available for clearing of the contingency conditions, and land availability.[310]

Table 121 summarizes the NWA methodology employed by National Grid, as well as recommendations for improvement.

Table 121. Assessment of Eversource's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Methodology for Identification of Locations	Eversource appears to have a documented process and standardized framework for identifying locations where NWA could be applied to meet a system need on the distribution system.	For NWAs on the distribution system, access to the analysis (e.g., the NWA screening framework) would increase transparency.	-
Transmission Specific NWA Criteria	Targeted locations are identified through power flow simulations and reliability needs; the methodology for evaluation is consistent based on utility's local transmission planning guidelines and regulatory obligations. Eversource uses specific criteria and thresholds to exclude locations where NTAs are not suitable (minimum response time to contingency conditions, development time, land requirements). These may vary depending on the specific requirements of the project. Eversource focuses the NTA analysis on utility-scale resources; forecasted distributed generation, energy efficiency, and demand response are already used, where applicable, to reduce transmission system needs via inclusion in the ISO New England and Eversource load forecasts.	-	-
Distribution Specific NWA Criteria	Eversource has a documented process which outlines the types of projects that can replace traditional engineering solutions for NWA consideration; it also includes in a specific set of suitability criteria for qualification of a location that is suitable to NWA consideration including cost threshold, timeline and the quantity of load reduction required.	-	-

[310] "Non-Transmission Alternative" is the terminology used by Eversource in referring to NWA's at a transmission level.

Unitil (Massachusetts and New Hampshire)

Unitil has a documented process for identification of NWA opportunities. Per this process, Unitil applies design criteria for planning of the distribution and the transmission systems. At the distribution-system level, Unitil establishes a 90 percent planning threshold of seasonal rating for loads on substation transformers, stepdown transformers protective devices and other distribution circuit elements.[311] In addition, at the transmission and distribution levels, NWA projects are reviewed for any piece of major equipment that is expected to exceed 80 percent of its seasonal normal rating during the five-year study period and exceed 90 percent of its seasonal normal rating in year five of the study period during normal operating conditions.[312] The company indicated that the 80 percent threshold accounts for lead times needed to implement NWA solutions.[313] Unitil assumes a minimum of three years to receive, evaluate, and implement NWA proposals.[314] In addition, Unitil typically considers NWAs to be suitable in addressing loading and/or voltage constraints but not suitable for condition-based replacement projects.[315] Projects that address aging equipment may still be evaluated for NWAs, but this may not result in the issuance of an NWA RFP.

To estimate expenditures, Unitil has established a traditional engineering solution cost threshold before considering NWA solutions. Unitil has assessed that NWAs would generally not be evaluated if the recommended traditional option has an estimated cost of less than $250,000.[316]

Should a traditional engineering project meet the above criteria, Unitil will then issue an RFP for NWA solutions. Proposed NWAs are then reviewed through an evaluation process to score relative options for the company.

Vermont

Vermont's planning process are split into two phases.

<u>Transmission Level Process</u>

Every three years, the Vermont Electric Power Company (VELCO) publishes its LRTP. The LRTP analyzes the transmission system, identifies where the system does not meet design and reliability criteria, and describes the transmission alternatives to resolve the concerns.

Within the LRTP, VELCO applies the bulk transmission screening process originally adopted by the Vermont System Planning Committee (VSPC) and submitted to the Vermont Department of Public

[311] Unitil. Distribution Planning Guide. November 19, 2019. Page 8.

[312] Id. Page 8.

[313] Id. Section 4.3.

[314] Unitil. Project Evaluation Procedure, Page 3, July 2018.

[315] Unitil. Project Evaluation Procedure, Page 4, July 2018.

[316] Unitil. Project Evaluation Procedure, Page 3, July 2018.

Service (PSD) in Docket 7081. This screening process helps to determine if there is potential for the deficiency to be resolved through energy efficiency and/or alternatives such as generation or demand response (or a hybrid of transmission with efficiency and/or generation). For any transmission deficiency that screens, the PSD requires a Reliability Plan. In Vermont, Reliability Plans are synonymous with non-transmission alternatives (NTA).

Any affected distribution utility then drafts a project-specific action plan (PSAP) as required by the Docket 7081 Memorandum of Understanding. PSAPs describe a process for moving a deficiency from identification through to implementing a solution.

Sub-transmission and distribution process (geographic targeting)

Distribution utilities identify distribution-level constraints for consideration by VSPC and consider bulk/predominantly bulk transmission-level constraints once an LRTP is published, as described above.

Distribution constraints are typically identified in a utility's IRPs or at any time in intervening years by the utilities via the VSPC "Geotargeting" processes. As part of this process, the energy efficiency utility in consultation with the distribution utility and VELCO will determine the maximum achievable energy efficiency savings potential and costs. VSPC reviews the resulting recommendations for (1) areas needing new Reliability Plans, and (2) ending energy efficiency geographic targeting in any areas where analysis shows it is no longer cost-effective. The VSPC then it makes a recommendation to the PSD. A Reliability Plan is required for distribution constraints identified by distribution utilities in their IRPs or otherwise that screen in for full analysis using the Distributed Utility Planning (DUP) screening tool from Docket 6290.

There have not been any geographic targeting locations identified since 2012. According to the survey response as part of AESC 2021, Vermont noted that 15 percent of Green Mountain Power's substations are at thermal loading capacity due to backflow of distributed generation. This means that energy efficiency in some cases could lead to increased costs on the system. For example, if a substation is at capacity increased efficiency could result in the dumping of renewable generation or require increased investments to ensure reliability. While this issue is currently limited to a small number of hours, it is anticipated to become exacerbated over the next decade as more renewable energy comes online to meet Vermont's clean energy goals.

Table 122 summarizes the NWA methodology employed by Vermont, as well as recommendations for improvement.

Table 122. Assessment of Vermont's avoided distribution methodology and recommendations for improvement

Topic	Overall Assessment	Recommendations on Improvement	Recommendations on Clarity
Methodology for Identification of Locations	Vermont has a robust framework and criteria for identifying transmission, sub-transmission, and distribution-level NWAs.	-	-
Transmission Specific NWA Criteria	Targeted locations are identified through VELCO LRTP using power flow simulations and reliability. The methodology for evaluation is consistent with transmission planning guidelines and regulatory obligations. Vermont has criteria thresholds for excluding locations where NWAs are not suitable (regarding asset condition, cost thresholds, and timeline).	-	-
Distribution Specific NWA Criteria	Vermont has a screening tool specific to distribution-level NWAs. The screening tool contains criteria for excluding locations where NWAs are not suitable (emergency or failing asset, cost and timing thresholds).	-	-

Maine

In June 2019, the Maine Legislature enacted *An Act to Reduce Electricity Costs through Non- wires Alternatives*.[317] This Act identified a non-wires coordinator position in the Office of Public Advocate. Based on this, the criteria and process for identification of NWAs within the state of Maine is currently underway.

Consideration of location-specific costs and benefits in generation-constrained areas

Electrical systems have historically been designed for one-way flow of electrical power from central generators to distributed loads. However, the increased adoption of distributed generation resources is causing changes in that paradigm. This is particularly true in areas where generation can now approach or exceed load, but where the grid was designed and built to serve the load. Such locations have begun

[317] Maine Legislature, An Act to Reduce Electricity Costs through Non-wires Alternatives. http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP0855&item=3&snum=129.

to appear in New England, including several locations in Vermont at both the transmission[318] and distribution[319] levels.

As part of its interconnection process, each generator is generally asked to pay for incremental changes in the grid that are required in order to interconnect safely and without impacting reliable service to customers. However, changes in load are not generally subject to the same type of analysis even though they could change the relationship between load and generation on a given circuit or other grid segment. Changes in end-use load that result in increased load during times when the distributed generation is producing could have the effect of mitigating reliability concerns, reducing strain on transformers or other grid hardware, or allowing more generation to interconnect (thereby potentially advancing state energy policies). On the other hand, changes in end-use load that result in decreased load during times when the distributed generation is producing could exacerbate reliability concerns, increase strain on grid hardware, or cause curtailment of generation.

Many of the general principles and considerations of localized avoided T&D costs could apply in the context of generation-constrained areas, just as they apply in the context of load-constrained areas. For example, the analysis would need to identify the specific costs corresponding to changes in the grid configuration that could be avoided or created by a change in end-use energy demand. With sufficient information regarding costs and the impacts on relevant peak loads (or exports), it would be possible to calculate a location-specific avoided T&D cost value for interventions that increase load, and a location-specific cost caused for interventions that decrease load, using the same approach to location-specific avoided T&D costs described earlier in this section.

The temporal and locational characteristics of the need should be carefully described. For example, if the issue of concern is created on sunny days during shoulder seasons when loads are otherwise low, then changes in an end-use that operates only during the coldest days of winter would have no impact. The dynamic aspects of active demand management and load control measures that can respond to grid conditions (such as different behavior on sunny and cloudy days) should be accounted for. This would entail accounting for the contribution during peak and off-peak hours rather than only accounting for the average behavior across all hours. Hourly load profiles and load shapes for measures, including

[318] See, for example, the discussion in Vermont Public Service Department. 2019. Vermont public Service Department. January 15, 2019. "Identifying and Addressing Electric Generation Constraints in Vermont." Vermont.gov. Available at https://publicservice.vermont.gov/sites/dps/files/documents/2019%20Act%20139%20Generation%20Constraints%20Report%20final.pdf.

[319] See Green Mountain Power. 2019. *Vergennes Generation Constrained Area* available at https://www.vermontspc.com/library/document/download/6603/VSPC%20Vergennes%20%285-21-1019%29%20%28002%29.pdf and Green Mountain Power. 2020. *Substation Generation Constraints: Hypothetical Constraint Review* available at https://www.vermontspc.com/library/document/download/7092/GMP_Hypothetical%20Constraint%20Review.pdf for discussions of issues in the vicinity of Vergennes, Vermont. Other presentations and notes from the Generation Constraints Committee of the Vermont System Planning Committee can be found here: https://www.vermontspc.com/vspc-at-work/subcommittees.

correlations with weather conditions where relevant, may be required to fully evaluate the impacts of traditional efficiency or electrification measures.

10.5. Avoided natural gas T&D costs

See Section 2.4: *Avoided natural gas cost methodology* for more information on the assumptions used in AESC with respect to natural gas transmission and distribution.

11. VALUE OF IMPROVED RELIABILITY

The reduction in electric loads can improve reliability in several ways. First, it can increase installed generation reserves and thus reduce the probability of inadequate supply under variable loads and generation outages. Second, the reduction decreases the thermal wear and tear on transformers and conductors and thereby reduce failures. Thirdly, it reduces the probability of overloads on T&D equipment to reduce faults. The last of these three categories overlaps with avoided T&D costs, since the ISO and utilities usually expand capacity to avoid system overloads. To the extent that lower loads result in less T&D capacity, the reduced capacity will tend to offset the benefits of lower loads. We have not been able to determine a method for accounting for that overlap. Hence, we do not estimate any value for reduced acute overloads on the delivery system, even though there are undoubtedly some situations in which lower load would allow the system to survive some equipment failures, without deferring capacity additions.

In AESC 2021, we find a default average VoLL value of $73 per kWh. This value is almost 3 times as large as the value derived in AESC 2018 ($26 per kWh in 2021 dollars). The change in the VoLL component is a result of updated information on VoLLs. This VoLL is then applied to the calculation of reliability benefits resulting from dynamics in New England's FCM to estimate cleared and uncleared benefits linked to improving generation reliability. In AESC 2021, we find 15-year levelized values of $0.47 per kW-year for cleared benefits and $8.45 per kW-year for uncleared benefits. These are 32 percent lower and 21 percent higher, respectively, than the same values estimated in AESC 2018, after adjusting for inflation. For cleared reliability, despite a higher VoLL, overall benefits are lower as a result of flatter supply curve assumptions for the capacity market. Changes to the capacity market have less of an impact on uncleared resources, which exist outside the capacity market. As a result, an increase in the VoLL produces an increase in the uncleared reliability value.

New in AESC 2021, we provide an estimated benefit for T&D reliability, based on data for National Grid Massachusetts. This section is provided as an example calculation of how different utilities could calculate their own T&D reliability benefit. This value would likely differ for each jurisdiction.

The following sections describe VoLL, the application of that value to generation reliability, and the potential for extension to distribution reliability.

11.1. Calculating value of lost load

In AESC 2018, we identified the most recent and detailed analysis of the VoLL to be that in the Lawrence Berkeley National Laboratory's (LBNL) 2015 study on *Updated Value of Service Reliability Estimated for Electric Utility Customers in the United States.* LBNL estimated costs of unserved energy for outages of one to four hours (typical of generation capacity shortfalls) on the order of $3 per kWh for residential,

$17 per kWh for large commercial and industrial (C&I), and $250 per kWh for small C&I—with shorter outages imposing higher costs per kWh (see Table 123).[320]

Table 123. Average cost per unserved kWh (2021 $ per kWh)

	Duration of Outage					
	Momentary	30 minutes	1 hour	4 hours	8 hours	16 hours
Medium & Large C&I	$218	$43	$25	$14	$15	$15
Small C&I	$2,575	$542	$337	$245	$305	$295
Residential	$35	$7	$4	$2	$2	$1

Source: LBNL. (2015). "Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States." Available at https://eta-publications.lbl.gov/sites/default/files/lbnl-6941e.pdf. Table 1
Notes: Values originally reported in 2013 dollars have been converted into 2021 dollars.

Focusing just on the outages of one to four hours (typical of generation capacity shortfalls), these costs translate into values of on the order of $19 per kWh for medium and large C&I, $291 per kWh for small C&I, and $3 per kWh for residential.

For AESC 2021, we reviewed the recent literature on VoLL, looking for values more relevant to New England. We did not find any new domestic studies to add to our literature review conducted for AESC 2018.

In our updated literature review, we identified a relevant 2018 study from Europe written by Cambridge Economic Policy Associates: "Study on the Estimation of the Value of Lost Load of Electricity Supply in Europe."[321] The 2018 report estimated the VoLL for each European Union country, for residential customers and 13 types of non-residential customers (nine industrial sectors, construction, transportation, services and a combination of agriculture, forestry, and fishing). The values for some sectors vary strongly with the wealth of the country. To increase comparability with New England, we looked at the estimates for the 19 countries with gross domestic product (GDP) of at least half of New

[320] LBNL. (2015). "Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States." Available at https://eta-publications.lbl.gov/sites/default/files/lbnl-6941e.pdf.

[321] Cambridge Economic Policy Associates Ltd. "Study on the Estimation of the Value of Lost Load of Electricity Supply in Europe." July 2018. Available at https://www.acer.europa.eu/en/Electricity/Infrastructure_and_network%20development/Infrastructure/Documents/CEPA%20study%20on%20the%20Value%20of%20Lost%20Load%20in%20the%20electricity%20supply.pdf.

England's $77,574 average GDP per capita.[322] Table 124 shows the estimates for each of those countries and the simple average.[323]

Table 124. Residential VoLL in high-income European countries GDP per capita values

Country	Annual average VoLL for all sectors *2021 $/kWh*	Annual average VoLL for service sector *2021 $/kWh*	GDP per Capita *2021 $/person*
Austria	$12.09	$14.00	$60,631
Belgium	$12.89	$11.76	$56,041
Cyprus	$8.31	$6.24	$42,672
Czech Republic	$4.74	$5.46	$44,094
Denmark	$21.11	$15.56	$62,375
Estonia	$6.95	$3.84	$39,847
Finland	$7.11	$6.52	$52,517
France	$9.29	$9.60	$49,836
Germany	$16.66	$11.48	$58,183
Ireland	$15.46	$18.75	$93,644
Italy	$15.22	$10.51	$45,852
Lithuania	$6.20	$6.00	$40,175
Luxembourg	$18.15	$17.91	$123,535
Malta	$8.56	$6.01	$47,515
Netherlands	$30.79	$11.96	$61,438
Slovenia	$5.80	$6.25	$42,180
Spain	$10.58	$8.91	$44,138
Sweden	$7.41	$9.41	$57,450
United Kingdom	$21.34	$17.52	$50,348
Average	**$12.56**	**$10.40**	**$56,446**

Note: All monetary units have been converted into 2021 dollars.

The $12.56 per kWh average is much higher than the $3 per kWh LBNL estimate for residential customers. Since the average GDP per capita for these countries is $56,446, or 73 percent of the New England GDP/capita, the VoLL for New England households is likely to be higher. For the four highest-income countries, with an average GDP/capita similar to New England's, the average VoLL estimate is 45 percent higher, or $21.38 per kWh. We note that most of the factors that would influence VoLL (cold winters, hot summers, high reliance on computers and related equipment) are at least as powerful for New England as the average European country.

[322] GDP per captia data for New England calculated using U.S. Bureau of Economic Analysis and U.S. Census data (BEA. Last accessed March 3, 2021. "GDP and Personal Income." Bea.gov. Available at https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&acrdn=1) and (U.S. Census Bureau. 2019. "State Population Totals and Components of Change." Census.gov. Available at https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html)

Other than Luxembourg and Ireland, European national GDP per capita is uniformly lower than New England's.

[323] The VoLLs are from Table G.1 of the Cambridge Economic Policy Associates study. The per capita GDP values are from The World Bank. Last accessed March 11, 2021. "GDP Per Capita, PPP – European Union." *Data.worldbank.org.* Available at https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=EU.

The Cambridge Economic Policy Associates study estimates of VoLL for non-residential customers do not map clearly onto the small-C&I and large-C&I categories of the LBNL study. Nor do the industrial sectors in the study map well onto important New England industries, such as biotech. The value for the services sector, which would include a large portion of major New England C&I customers (banking, real estate, data services) is about half of the LBNL estimate for large-C&I customers, at $10.40 per kWh for the nineteen countries. The result is more similar for the European countries most similar to New England in terms of GDP per capita, at $16.04 per kWh.

For AESC 2021, we average the findings from the LBNL and Cambridge Economic Policy Associates studies together for each category of customer. Then, using share-of-sales data from EIA's form 861, we calculate a weighted average (see Table 125). The resulting VoLL is $73 per kWh.

Table 125. Calculation of VoLL

	LBNL *2021 $/kWh*	CEPA Ltd. *2021 $/kWh*	Final *2021 $/kWh*	Sales shares *%*
Residential	$2.80	$12.56	$7.68	40%
Small C&I	$290.87	$10.40	$150.64	45%
Large C&I	$19.36	$10.40	$14.88	14%
Weighted Average VoLL			**$73**	

Notes: Sales shares are estimated using 2019 data from EIA Form 861. We assign "commercial" sales from EIA for Small C&I and "industrial" sales to large C&I.

11.2. Value of reliability: Generation component

We observe that reducing loads can improve generation reliability in three ways:

- Some resources that do not clear the FCA will continue to operate as energy-only resources, adding to available reserves. While not obligated to do so, these resources are likely to operate at times of tight supply and high energy prices. They may also be available to assume the capacity obligations of resources that unexpectedly retire or otherwise become unavailable.

- Not all energy efficiency load reductions will clear in the capacity market or immediately affect the load forecast used to determine the amount of capacity acquired. Those load reductions will increase reserve margins.

- The operation of the ISO New England capacity market increases the amount of capacity acquired as the price falls. To the extent that energy efficiency programs reduce the capacity clearing price, reserve margins and reliability will increase.

The following sections describe how we calculated this component for cleared measures and uncleared measures.

Calculating cleared reliability

In order to calculate cleared reliability benefits, we first assemble several input parameters. First, ISO New England annually publishes marginal reliability index (MRI) curves, which estimate the expected energy lost per MW of additional supply as the reserve margin rises. In AESC 2021, we examine the slope of the MRI curve at each auction's clearing price. The resulting value can be thought of as the estimated change in MWh of reliability benefits per megawatt of reserve. Values calculated in FCA 12 through 15 utilize the MRI curve published for each auction, while all auctions that take place after FCA 15 utilize the MRI curve published for FCA 15. Table 126 displays the estimated change in MWh of reliability benefits per megawatt of reserve, and how it varies with the capacity market clearing price.

Table 126. Change in MWh of reliability benefits per megawatt of reserve for Counterfactual #1 in rest-of-pool region

		Clearing price *2021 $/kW-month*	Δ MWh LOEE per MW *MWh / MW*
FCA 12	2021	$4.77	0.329
FCA 13	2022	$3.96	0.273
FCA 14	2023	$2.47	0.170
FCA 15	2024	$2.75	0.189
FCA 16	2025	$2.72	0.187
FCA 17	2026	$2.88	0.199
FCA 18	2027	$3.11	0.214
FCA 19	2028	$3.30	0.227
FCA 20	2029	$3.59	0.248
FCA 21	2030	$3.42	0.237
FCA 22	2031	$3.67	0.253
FCA 23	2032	$3.90	0.268
FCA 24	2033	$3.86	0.265
FCA 25	2034	$4.67	0.323
FCA 26	2035	$3.66	0.253

Note: Values for other counterfactuals and regions can be found in the AESC 2021 User Interface.

Due to the slopes of the supply and demand curves, bidding an additional MW into the FCA at $0 per kW-month price shifts the supply curve to the right. This shifts out some smaller amount of capacity that would otherwise have cleared, and it results in the amount of cleared supply increasing by only a fraction of the additional supply. That fraction is small when the clearing price is set at a shallow part of the supply curve, and it increases if the clearing price is set at a steeper part of the supply curve (see Table 127). This value is calculated by dividing the supply price shift by the difference between the supply price shift and the slope of the demand curve at the demand value implied by the clearing price.

Table 127. Net increase in cleared supply for Counterfactual #1 in rest-of-pool region

		Clearing price	Net increase in cleared supply
		2021 $/kW-month	*%*
FCA 12	2021	$4.77	8%
FCA 13	2022	$3.96	7%
FCA 14	2023	$2.47	16%
FCA 15	2024	$2.75	17%
FCA 16	2025	$2.72	17%
FCA 17	2026	$2.88	16%
FCA 18	2027	$3.11	20%
FCA 19	2028	$3.30	20%
FCA 20	2029	$3.59	19%
FCA 21	2030	$3.42	20%
FCA 22	2031	$3.67	19%
FCA 23	2032	$3.90	18%
FCA 24	2033	$3.86	18%
FCA 25	2034	$4.67	79%
FCA 26	2035	$3.66	19%

Note: Values for other counterfactuals and regions can be found in the AESC 2021 User Interface.

The final component used to calculate cleared reliability benefits is a decay effect. Over time, customers will respond to lower prices by using somewhat more energy, including at the peak. In addition, lower capacity prices may result in the retirement of some generation resources and termination of some demand-response resources, which will result in these resources being removed from the supply curve. Further, some new proposed resources that have not cleared for several auctions may be withdrawn (if, for example, contracts and approvals expire, raising the cost of offering the resource into future auctions). The decay schedule used for cleared reliability is the same as the one used for cleared capacity DRIPE (see Table 89, above).

Finally, we calculate the cleared reliability benefit by calculating the product of (a) the change in MWh of reliability benefits per megawatt of reserve, (b) the net increase in cleared supply, (c) the decay effect, and (d) the VoLL, as calculated above.[324] Table 128 describes the overall benefit for a measure installed in 2021. We note that these values are very small compared to the estimated avoided costs in many other categories.

[324] Note that the *AESC 2021 User Interface* allows users to specify their own VoLL, if they so choose.

Table 128. Estimated cleared reliability benefits for Counterfactual #1 in rest-of-pool region for measures installed in 2021, assuming a VoLL of $73 per kWh

		Δ MWh LOEE per MW	Net Increase in Cleared supply	Decay Schedule	Cleared reliability benefits
		MWh / MW	*%*	*%*	*2021 $/kW-month*
FCA 12	2021	0.329	8%	100%	$1.92
FCA 13	2022	0.273	7%	83%	$1.22
FCA 14	2023	0.170	16%	67%	$1.29
FCA 15	2024	0.189	17%	50%	$1.15
FCA 16	2025	0.187	17%	33%	$0.77
FCA 17	2026	0.199	16%	17%	$0.39
FCA 18	2027	0.214	20%	0%	$0.00
FCA 19	2028	0.227	20%	0%	$0.00
FCA 20	2029	0.248	19%	0%	$0.00
FCA 21	2030	0.237	20%	0%	$0.00
FCA 22	2031	0.253	19%	0%	$0.00
FCA 23	2032	0.268	18%	0%	$0.00
FCA 24	2033	0.265	18%	0%	$0.00
FCA 25	2034	0.323	79%	0%	$0.00
FCA 26	2035	0.253	19%	0%	$0.00

Note: Values for other counterfactuals, regions, and resource vintages can be found in the AESC 2021 User Interface. The "decay schedule" series is identical for measures installed in later years, except shifted by the relevant number of years.

Calculating uncleared reliability

Like cleared reliability, the calculation of uncleared reliability benefits requires the assembly of several input parameters.

The first is the estimated change in MWh of reliability benefits per megawatt of reserve. This parameter is the same as is used in the calculation of cleared reliability benefits (see Table 126, above).

Second, uncleared reliability benefits are grossed up to account for the impact of the reserve margin. As with uncleared capacity and uncleared capacity DRIPE, because uncleared reliability benefits accrue outside of the FCM, they are effectively "counted" in the demand side of the capacity auction. See Table 44, above, and surrounding text for more information on this effect.

Third, we assume that reliability has a phased impact on the load forecast. In contrast to uncleared capacity and uncleared capacity DRIPE, reliability is not dependent on the operation of ISO New England's load forecasting and capacity market. As soon as load is reduced, the reserve margin increases (since the uncleared capacity does not initially reduce capacity procurement) and reliability is improved. Hedging of capacity supply, either short- or long-term, does not reduce the reliability effect, as it does capacity DRIPE. Thus, the reliability improvement starts at 100 percent in the first year and persists until the load reduction affects the FCA. Unlike other uncleared avoided cost categories, which operate through the effect on the econometric load forecast, the reliability improvement from any given measure does not rise with the number of years it has been in place, but only by the increase in reserves for the year.[325]

Fourth, uncleared reliability benefits will gradually decay over time, as the load reduction is reflected in the load forecast, reducing the amount of capacity that ISO New England acquires. Eventually, the load reduction would be fully captured in the load forecast, and the reliability benefit would be extinguished. The decay of the reliability benefit of uncleared resources starts later and is more gradual than the one used for cleared resources, because the market does not react to the resources and reduce procurement until it is picked up in the load forecast.

Finally, we calculate the uncleared reliability benefit by calculating the product of (a) the change in MWh of reliability benefits per megawatt of reserve, (b) one plus the reserve margin, (c) the load forecast effect, (c) the decay effect, and (e) the VoLL.[326] Table 129 describes the overall benefit for a measure installed in 2021. Generally speaking, reliability effects of uncleared resources are greater than those of cleared resources. This is because the cleared resources immediately displace other resources, resulting in a smaller net gain in reliability. Uncleared resources increase reliability more than cleared resources do, for the same reason that uncleared resources have no immediate effect on capacity bills or prices—unclear resources are invisible to the capacity market.

Table 129. Estimated uncleared reliability benefits for Counterfactual #1 in rest-of-pool region for measures installed in 2021, assuming a VoLL of $73 per kWh

		Δ MWh LOEE per MW *MWh / MW*	**Reserve Margin** *%*	**Load Forecast Effect** *%*	**Decay Schedule** *%*	**Uncleared reliability benefits** *2021 $/kW-month*
FCA 12	2021	0.329	14%	100%	100%	$27.29
FCA 13	2022	0.273	14%	100%	100%	$22.82
FCA 14	2023	0.170	15%	100%	100%	$14.29
FCA 15	2024	0.189	15%	100%	100%	$15.79
FCA 16	2025	0.187	16%	100%	100%	$15.82
FCA 17	2026	0.199	13%	70%	100%	$11.45
FCA 18	2027	0.214	14%	50%	95%	$8.42
FCA 19	2028	0.227	14%	30%	87%	$4.94
FCA 20	2029	0.248	14%	10%	75%	$1.55
FCA 21	2030	0.237	14%	0%	60%	$0.00
FCA 22	2031	0.253	14%	0%	43%	$0.00
FCA 23	2032	0.268	14%	0%	27%	$0.00
FCA 24	2033	0.265	14%	0%	0%	$0.00
FCA 25	2034	0.323	14%	0%	0%	$0.00
FCA 26	2035	0.253	14%	0%	0%	$0.00

Note: Values for other counterfactuals, regions, and resource vintages can be found in the AESC 2021 User Interface. The "decay schedule" series is identical for measures installed in later years, except shifted by the relevant number of years.

[325] In this regard, the reliability benefit of unclear capacity operates more like avoided energy or cleared capacity than like uncleared capacity or capacity DRIPE.

[326] Note that the *AESC 2021 User Interface* allows users to specify their own VoLL, if they so choose.

Important caveats for applying reliability values

Unlike other uncleared avoided cost categories (e.g., uncleared capacity, uncleared capacity DRIPE) uncleared reliability avoided costs are summed over the time period that a measure is active. This is similar to the approach used to sum avoided costs for most categories.

Unlike other uncleared avoided cost categories, users should not apply a scaling factor (like the kind described in Appendix K: *Scaling Factor for Uncleared Resources*). The scaling factor reflects a demand measure's effect on the load forecast, which is a function of the number of daily peaks (the inputs to the ISO New England demand forecast regression) that are reduced by the measure. Because changes in reliability do not impact the load forecast, the scaling factor should not be used to adjust uncleared reliability benefits.

Other considerations: reliability impact on non-summer peak hours

Measures increase generation reliability to the extent that they reduce load at hours that would contribute to ISO New England's estimate of loss-of-energy expectation (LOEE). An efficiency measure that clears as 1 kW of supply in the capacity auction may provide more or less load reduction during the highest LOEE hours. We note that these hours may not necessarily coincide with ISO New England's definition of on-peak hours for on-peak resources (weekday hours ending 14-17 from June through August and hours ending 18 and 19 in December and January) or seasonal resources (hours in June through August, December, and January with load greater than 90 percent of the seasonal 50/50 peak), especially as solar generation reduces LOEE in sunny summer hours.

In setting the demand curve for each capacity auction (both the FCAs and the annual reconfiguration auctions), ISO New England derives various measures of generation risk, including loss-of-load expectation (LOLE), which is a measure of the fraction of time intervals for which supply might be inadequate, and the LOEE, the amount of energy that would not be served on average. ISO New England provided its risk results from the second annual reconfiguration auction for the 2022–2023 capacity compliance period (the period covered by FCA13), as shown in Table 130. All months other than the summer had zero risk in this analysis.

Table 130 suggests that only the reductions in the highest-net-load hours of the summer are likely to have any effect on reliability, at least in the near term.[327] That may change as electrification increases winter loads and storage flattens the effective peaks.

[327] See https://www.synapse-energy.com/sites/default/files/AESC_Supplemental_Study_Part_I_Winter_Peak.pdf for more discussion on this.

Table 130. Monthly distribution of risk prices for capacity commitment period 2022–23, annual reconfiguration auction #2

	June	July	August	Annual
LOLE (days)	0.00066	0.02059	0.07868	0.09994
LOLE (hours)	0.00194	0.11075	0.43035	0.54303
LOEE (MWh)	0.953	119.184	524.418	645.153
Percentage by month				
LOLE (days)	0.7%	20.6%	78.7%	
LOLE (hours)	0.4%	20.4%	79.2%	
LOEE (MWh)	0.1%	18.5%	81.3%	

11.3. Value of reliability: T&D component

New to AESC 2021, we provide an example methodology of how utilities might calculate a value of reliability associated with T&D.

Theory

Reducing loads can also reduce overloads and violations of T&D planning standards, by:

- Leaving additional capacity across this system to accommodate flows from facilities or equipment that are forced out of service by non-load-related problems,
- Reducing overloads under extreme weather conditions, and
- Reducing wear on lines and transformers from the cumulative effects of many hours with high loads.[328]

The aging of transformers (both at substations and along primary feeders) primarily results from the breakdown of insulation due to heating. That deterioration can be driven by:

- Short periods of very high load levels: transformers typically can be operated at over 150 percent of their rated capacity for an hour or two, if they start cool.
- Long periods (such as many hours or days) of lower but still high loads, which heat up the insulation.
- Even more so, very high load levels following a long period of high loads.

Similar considerations also apply to underground T&D lines that are insulated in the ground. These underground lines and their insulation also heat up due to long periods of high loads.

[328] Other causes (tree, weather, animal contact, etc.) of outages are not load-related and are thus outside the scope of this analysis.

Some overhead lines are subject to a different set of load-related failure modes. Generally, the surrounding air cools the lines and reduces the effect of heat buildup at moderate load levels. However when lines are loaded near their thermal ratings, this can lead to deterioration of insulation (if they are insulated). High loads can also stretch and weaken the metal conductor, and reduce line clearance from the ground or other objects below the line. Stretched lines are more vulnerable to breakage from other stresses, such as wind load.[329]

We examined utility reports on distribution outages to attempt to estimate the amount of load lost due to potentially load-related equipment failure, as opposed to events such as tree, vehicle, or animal contact.

The value of increased T&D reliability is complementary, not duplicative, of the avoided T&D costs. Reducing loads (or avoiding rising loads) will tend to increase reliability even when the T&D system does not change. By contrast, the reliability for a T&D element (e.g., distribution substation, feeder, line transformer, secondary lines) is not likely to improve for T&D equipment that is avoided by a load reduction.[330]

Example calculation

For the purposes of AESC 2021, we reviewed the 2019 outages in National Grid Massachusetts "Unplanned Significant Outage Report" in DPU 20-SQ-11, which included about 4,700,000 customer-hours of outage. Those hours were about 65 percent due to trees, with failed equipment accounting for over 14 percent (over 682,000 customer-hours), and other categories (lightning, animals, and other miscellaneous) totaling about 20 percent. The outages that National Grid listed as due to failed equipment included some that were clearly not due to electrical failure, such as broken poles, lightning arresters, and brackets; many categories that might conceivably be related to heavy loading (e.g., "tired fuses," fires, and failed switches, breakers, and reclosers); and a few likely to be load-related (failed transformers, underground cables, and splices). That last group of outages amounted to about 176,000 customer-hours, about 4 percent of the total outage hours. We note that some portion of these outages may be associated with deferred maintenance or defective parts, and may not ultimately be avoidable through load reductions.

Exhibit NG-HSG-3A to National Grid's filing in DPU 18-150 provides customer number and sales by class. The average non-streetlighting customer uses about 15 MWh annually, but many of the largest customers are served at primary or even transmission voltage. The customers served at secondary voltage would be exposed to more outages than customers served at primary voltage, and the transmission-level customers would not be affected by any of these distribution outages. Counting only

[329] Many overhead lines are self-supporting and thus vulnerable to stretching and physical stress. Line supported by much stronger steel messenger wire are less sensitive to the mechanical stresses.

[330] Logically, similar considerations would apply to the reliability of natural gas supply by LDCs, but that subject is beyond the scope of AESC 2021.

50 percent of the sales at primary and none of the sales at transmission, the average usage falls to 14 MWh per customer annually, or about 1.6 kWh per customer-hour.

Multiplying together the number of customer-hours related to load-related outages (about 176,000), 1.6 kWh per customer-hour and $73 per kWh VoLL yields a total annual cost of the potentially load-related outages of about $21 million annually. Dividing by total distribution sales of about 19.8 TWh, this resulting per-MWh cost is $1.04 per MWh. The load-related failures in 2019 were presumably due to accumulated damage over decades of service, but the energy delivered in 2019 will contribute to failures that occur in 2019 as well as future years. Hence, it appears reasonable to estimate the load-related costs of lost distribution reliability in future years to be similar to the cost derived from 2019 data. The distribution reliability cost may vary by time period, with potentially higher costs in peak hours than off-peak hours and higher costs in summer months than the rest of the year.[331]

The methodology of this analysis could be applied for other investor-owned utilities that file similar data, and for additional years. Similar data may be available from electric utilities in other states. We recommend that utilities or program administrators examine data local to their own jurisdictions and evaluate their own estimates of T&D reliability benefits.

[331] High winter loads may also contribute to the aging of transformers, but lower air temperatures reduce overheating and damage. For example, National Grid (MA) aims to change out residential transformers when they reach half-hour peak loads of 160 percent of rated capacity in the summer or 200 percent in the winter (see DPU 16-SG-11 Filing Attachment 2).

12. Sensitivity Analysis

The following sections detail the inputs and results of the sensitivity analysis. In AESC 2021, we evaluate avoided costs under three different sensitivities. These sensitivities include:

- A natural gas price sensitivity with higher gas prices than were used in Counterfactual #1 (“High Gas Price Sensitivity”)
- A climate policy sensitivity, where avoided costs for energy efficiency are calculated under a hypothetical regional climate policy with increased levels of electrification and clean energy (“No New EE Climate Policy Sensitivity”)
- A climate policy sensitivity which models energy efficiency along with increased levels of electrification and clean energy (“All-In Climate Policy Sensitivity”)

These sensitivities were identified through consensus discussion among members of the Study Group.[332]

For each of these sensitivity cases, we find the following:

- In the High Gas Price Sensitivity, energy prices are 27 percent higher, capacity prices are 2 percent lower, RPS compliance costs are 8 percent lower, and non-embedded GHG costs are 21 percent lower. All prices are compared to Counterfactual #1.
- In the No New EE Climate Policy Sensitivity, energy prices are 4 percent lower, capacity prices are 52 percent higher, and RPS compliance costs are 12 percent higher. All prices are compared to Counterfactual #3. This sensitivity features a new avoided cost (the incremental regional clean energy policy compliance cost, or IRCEP), which captures the incremental cost of the region reaching 90 percent non-fossil generation by 2035. This category increases total levelized avoided costs by 0.9 percent.
- In the All-In Climate Policy Sensitivity, energy prices are 4 percent lower, capacity prices are 42 percent higher, and RPS compliance costs are 11 percent higher. All prices are compared to Counterfactual #2. The new IRCEP cost category increases total avoided costs by 0.4 percent, all else being equal.

All of the summary costs described above are framed in terms of 15-year levelized costs for summer on-peak for the WCMA region.

12.1. When and how to use these sensitivities

This section discuss caveats and considerations relating to the modeled sensitivities

[332] This discussion included the distribution of an informal survey by the Synapse Team. Other sensitivities considered, but not analyzed due to time and budget constraints, include a case examining more extended impacts of the COVID-19 pandemic (beyond the effects considered in the main counterfactuals) as well as other versions of a climate policy sensitivity.

High Gas Price Sensitivity

The first sensitivity (the High Gas Price Sensitivity) is modeled primarily because natural gas prices are one of the inputs to which the AESC Study is historically the most sensitive. AESC 2021 is no exception; one of the primary reasons for the decrease in energy values between AESC 2018 and AESC 2021 is the associated decrease in annual natural gas prices. The purpose of this sensitivity is to provide a set of potential avoided energy costs under a future in which natural gas prices prove to be higher than those modeled in the main counterfactuals.

Climate policy sensitivities

The No New EE Climate Policy Sensitivity models a future with ambitious levels of building electrification and transportation electrification, as well as a policy which achieves 90 percent clean energy regionwide by 2035. This sensitivity does <u>not</u> model any incremental energy efficiency installed in 2021 or any later year. This means that it is a suitable sensitivity for considering avoided costs for energy efficiency in a future with more ambitious climate regional policies.

The All-In Climate Policy Sensitivity models a future with ambitious levels of energy efficiency, building electrification, and transportation electrification, as well as a policy which achieves 90 percent clean energy regionwide by 2035. As a result, it can be interpreted not as an avoided cost, but as a projection of <u>expected</u> energy prices, capacity prices, and other price series in a future with ambitious climate policies. Or, it could be interpreted as a projection of avoided costs for energy efficiency and electrification measures beyond those modeled in this scenario. In other words, while the No New EE Climate Policy Sensitivity estimates avoided costs for the first unit or first many units of energy efficiency measures, the All-In Climate Policy Sensitivity estimates avoided costs for the <u>last</u> unit of energy efficiency, or the first unit of energy efficiency beyond what is modeled in this sensitivity.

There are a number of other important caveats to consider relating to the climate policy sensitivities:

- Both climate policy sensitivities model avoided costs under a very specific set of assumptions related to electrification and a hypothetical regional clean energy policy. Different assumptions related to either of these inputs could potentially yield different avoided costs than what are shown here. As a result, these sensitivities are likely most useful in terms of thinking about directions and orders of magnitudes of avoided costs, relative to the main AESC counterfactuals, rather than being useful as sources of avoided costs on their own.
- These sensitivities may be most useful for teeing up questions for future avoided cost studies. They highlight challenges in terms of framing, energy sector modeling, and clean energy policy design that have never before been considered in previous AESC studies. See the subsection at the end of this chapter titled “Other considerations for modeling climate policy sensitivities” for more discussion on this topic.
- Some of the highest costs of a decarbonized grid are most likely after these sensitivities’ modeling horizon (e.g., post-2035), when building and transportation electrification are expected to reach significant scale. The modeling horizons analyzed in these

sensitivities (which are consistent with the 15-year detailed modeling period used in the rest of this report) may undercount avoided costs that occur post-2035. These avoided costs may be of particular importance for measures with lifetimes longer than 12-15 years that are being considered for implementation between 2021 and 2024. Avoided costs derived from these sensitivities would likely be more informative or useful in practical settings if years after 2035 were modeled in more detail. See the subsection at the end of this chapter titled "Other considerations for modeling climate policy sensitivities" for more discussion on this topic.

12.2. Sensitivity inputs and methodologies

This section details the input assumptions and methodologies used in the construction of these sensitivities.

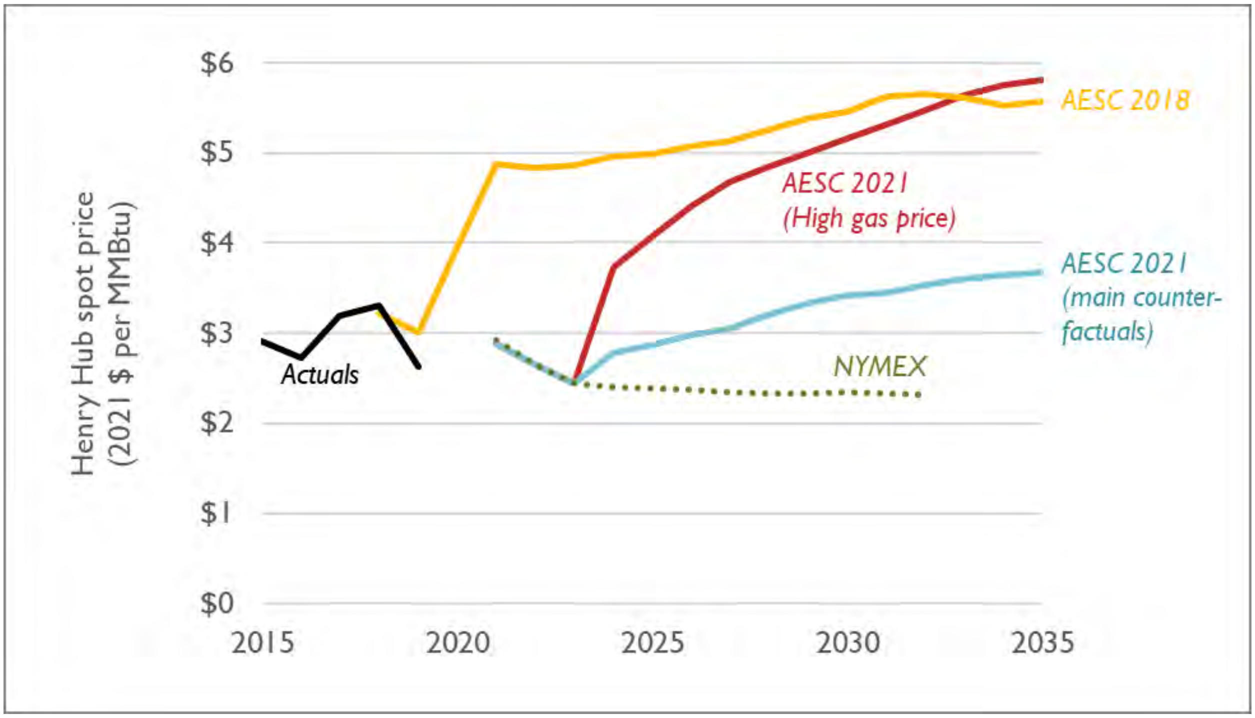
High Gas Price Sensitivity

The High Gas Price Sensitivity is a modification of Counterfactual #1. The primary change made in this sensitivity is a different assumption for long-term gas prices. Figure 52 illustrates the difference between the Henry Hub price used in the main four AESC 2021 counterfactuals and the gas price used in this sensitivity (other series are shown for comparative purposes). The high gas price is identical to the main price in 2021 through 2023. Between 2024 and 2035, the high gas price is 51 percent higher than the main case, on average.

The high gas price trajectory depicted in Figure 52 is created by swapping out the AEO 2021 Reference case series used to create mid- and long-term gas prices in the main four AESC counterfactuals for the AEO 2021 "Low oil and gas supply" case.[333] This series depicts a future with higher gas prices as a result of lower gas recovered per well and lower assumed rates of technological improvement (which would otherwise reduce costs and increase productivity). In this case, domestic natural gas production in 2035 is 30 Tcf, an 11 percent reduction compared to 2020 levels (for comparison, the AEO 2021 Reference case used as a data source for the gas price in the main AESC counterfactuals reaches 39 Tcf in 2035, a 14 percent increase compared to 2020).

[333] This was called the "Low oil and gas resource technology case" in earlier AEO studies, including the one used as a data source for AESC 2018. For more information on these cases, see "Annual Energy Outlook 2021: Case Descriptions." U.S. Energy Information Administration. February 2021. Available at https://www.eia.gov/outlooks/aeo/assumptions/pdf/case_descriptions_2021.pdf.

Figure 52. Henry Hub price forecast in main AESC 2021 case and High Gas Price Sensitivity



We made no further changes to inputs for this sensitivity. This includes no changes to Algonquin basis prices, monthly price changes, or changes to load. Our modeling methodology otherwise followed the methodology described for the four main counterfactuals, as described above.

Climate policy sensitivities

The inputs for the two subsequent sensitivities are discussed together due a large overlap in assumptions. Generally speaking, the inputs in these sensitivities can be split into two categories: inputs that modify demand assumptions, and inputs that modify supply assumptions.

Modifications to demand

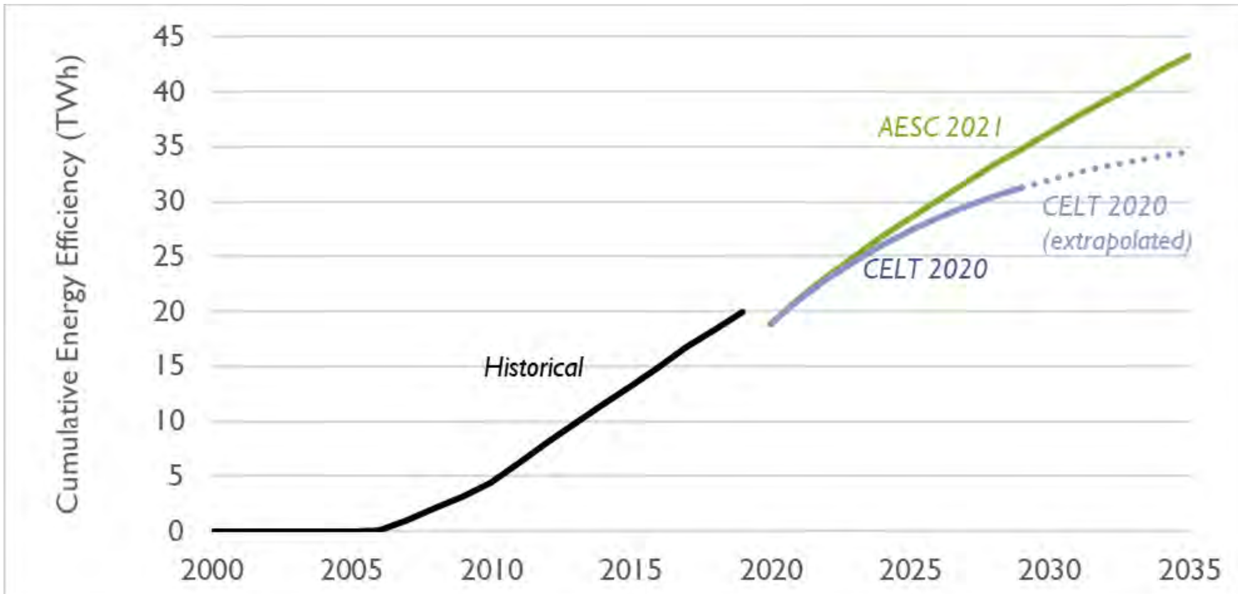
Depending on the climate policy sensitivity considered, we use a different counterfactual as a starting point. The No New EE Climate Policy Sensitivity relies on Counterfactual #3 as a starting point, whereas the All-In Climate Policy Sensitivity relies on Counterfactual #2 as a starting point. We make modifications to assumptions on energy efficiency, building electrification, transportation electrification, and active demand management.

<u>Energy efficiency</u>

In terms of energy efficiency assumptions, the No New EE Climate Policy Sensitivity does not differ from Counterfactual #3. Both series assume that no incremental energy efficiency is installed in 2021 or any later years.

The All-In Climate Policy Sensitivity uses the same energy efficiency assumptions as Counterfactual #2. Both modeling runs rely on a modified version of the energy efficiency forecast described in CELT 2020. This trajectory is illustrated in Figure 53 and discussed in detail above in Section 4.3: *New England system demand*. As in Counterfactual #2, hourly load profiles for energy efficiency match the load shape used in the econometric component of the energy forecast.

Figure 53. Historical and projected cumulative regionwide energy efficiency impacts used in the All-In Climate Policy Sensitivity



Notes: This is a reproduction of Figure 17. The All-In Climate Policy Sensitivity utilizes the "AESC 2021" trajectory for energy efficiency, which is the same assumption used in Counterfactual #2. No incremental energy efficiency installed in 2021 or any later year is modeled in the No New EE Climate Policy Sensitivity.

Building electrification

Both climate policy sensitivities envision a future with more ambitious building electrification policies than were modeled in the AESC 2021 counterfactuals. We note that Counterfactual #3 included some quantity of incremental building electrification (roughly 3.4 TWh regionwide by 2035, according to data produced by ISO New England in CELT 2020) while Counterfactual #2 maintained the level of building electrification identified in 2020 throughout the study period.

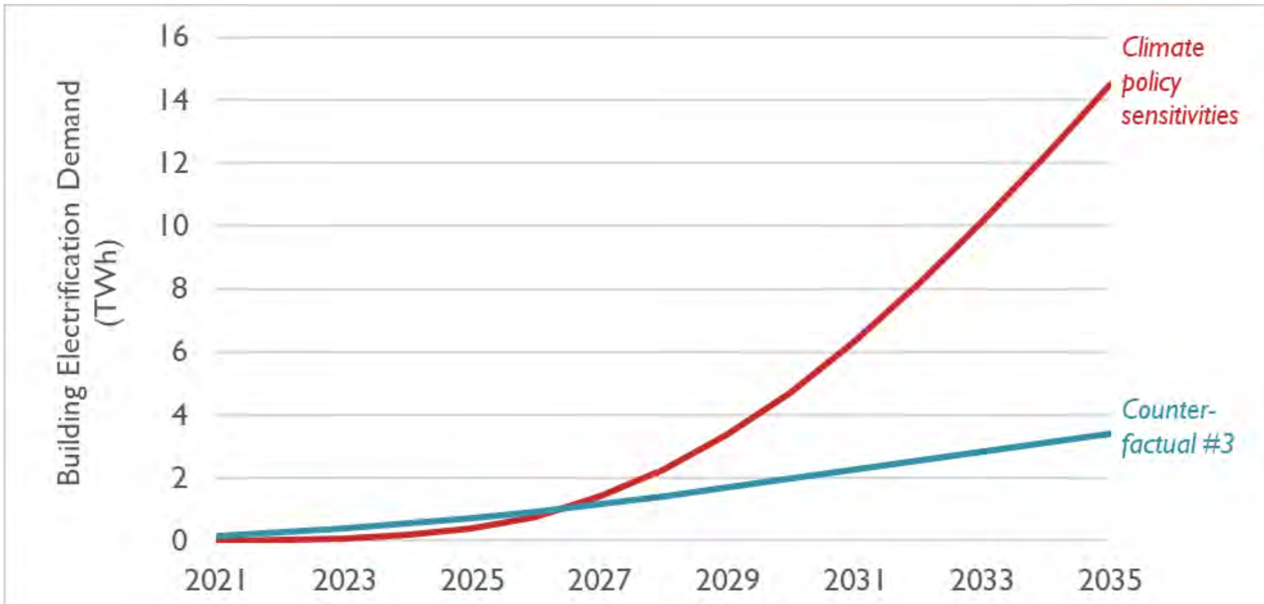
Both climate policy sensitivities use an entirely different projection for building electrification. We rely on inputs described in the December 2020 *Decarbonization Roadmap* study published by the Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA).[334] This study envisions a

[334] A series of reports relevant to the *Decarbonization Roadmap* study can be found at https://www.mass.gov/info-details/ma-decarbonization-roadmap. Detail on building electrification measures can be found in *Building Sector Report: A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study.* December 2020. Massachusetts Executive Office of Energy and Environmental Affairs. Available at https://www.mass.gov/doc/building-sector-technical-report/download.

number of different pathways in which all six New England states (as well as a number of other jurisdictions in the Northeast) achieve net-zero GHG emissions by 2050.

Specifically, we rely on building decarbonization data from the *Decarbonization Roadmap*'s "All Options" case. This case projects an increase in building electrification demand of about 14 TWh in 2035, relative to 2020 levels (see Figure 45).[335] This includes demand from both residential and commercial sectors, and it includes load related to space heating as well as water heating. We note that MA EEA's modeling is conducted through 2050; in 2050, MA EEA projects a total of 44 TWh related to building electrification throughout New England.[336]

Figure 54. Building electrification trajectory used in the climate policy sensitivities, compared with the trajectory used in Counterfactual #3



Note: No incremental building electrification measures installed in 2021 or any later year are modeled in Counterfactual #2.

As in Counterfactual #3 and other AESC 2021 counterfactuals, the hourly load profile assumed for building electrification in this sensitivity analysis relies on load shape data published by ISO New England in CELT 2020. See Section 4.3: *New England system demand* for more information.

[335] Detailed annual and state-specific data was provided to Synapse Team by MA EEA via email in January through March 2021. We note that at the time of AESC 2021's sensitivity analysis, MA EEA is continuing to model scenarios for its Interim Clean Energy and Climate Report for 2030 (more information is available at https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-plan-for-2030). Later scenarios discussed or published by MA EEA may explore different levels of building electrification than was used in this analysis.

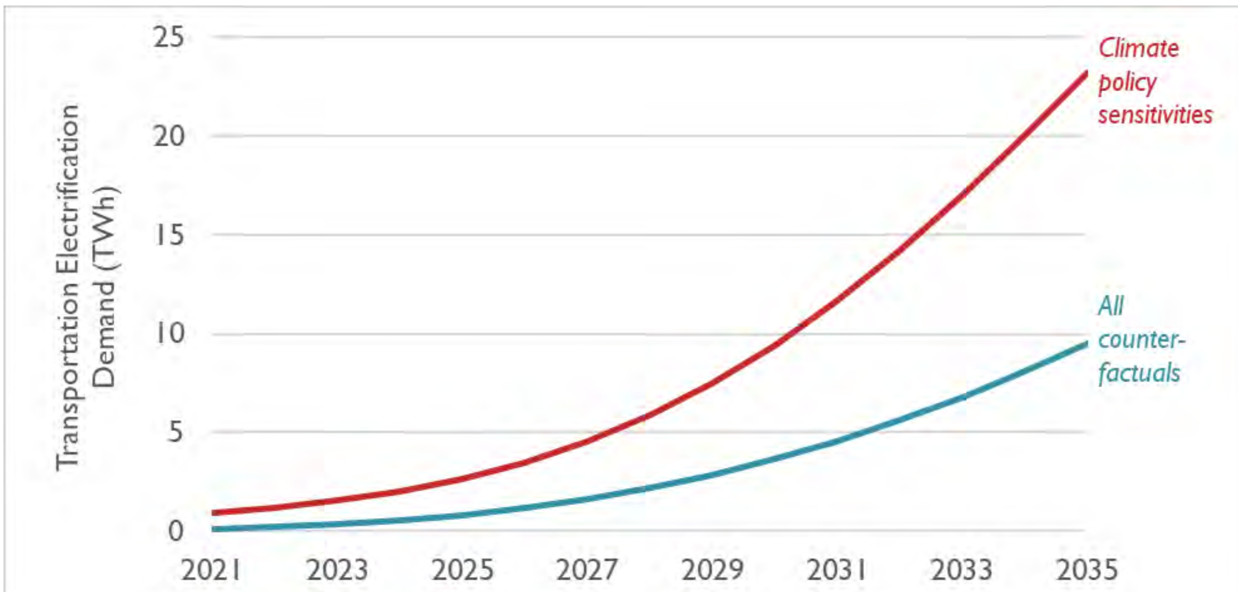
[336] As with all modeling in AESC 2021, our sensitivity analysis focuses on the years 2021 through 2035.

Transportation electrification

In all of the AESC counterfactuals, we rely on a forecast of transportation electrification demand based on Bloomberg New Energy Finance's (BNEF) *Electric Vehicle Outlook 2020*. By 2035, this projection results in 9.5 TWh of transportation electrification demand throughout New England. See Section 4.3: *New England system demand* for more information on how this projection was developed.

As with building electrification, the more ambitious trajectories for transportation electrification modeled in the AESC 2021 climate policy sensitivities are based on data from MA EEA's *Decarbonization Roadmap*. As with building electrification, we rely on annual, state-specific data for the "All Options" case, as provided to the Synapse Team by MA EEA. This projection includes demand from light-, medium-, and heavy-duty vehicles. This projection results in 23.2 TWh of transportation electrification demand throughout New England in 2035 (see Figure 55).

Figure 55. Transportation electrification trajectory used in the climate policy sensitivities, compared with the trajectory used in the AESC counterfactuals



Consistent with the AESC 2021 counterfactuals, the hourly load profile assumed for transportation electrification in this sensitivity analysis relies on load shape data published by ISO New England in CELT 2020. See Section 4.3: *New England system demand* for more information.

Flexible load

The the climate policy sensitivities feature exogenous flexible load resources not modeled in the main AESC counterfactuals. For the purposes of this section, flexible load is defined as the ability of some end-uses to shift the consumption of electricity from one hour to another. Examples of flexible load might include a program that requires, compensates, or requests EV owners to charge their vehicles at a later time, or for owners of electric water heaters to pre-heat their water several hours ahead of expected use.

The four main counterfactuals in AESC 2021 do not explicitly model any flexible load.[337] Instead, end-uses that are expected to allow for flexible load utilize simple, static hourly load shapes (see Section 4.3: *New England system demand* for more information on the assumed load shapes).

To determine an appropriate quantity of flexible load to model in our climate policy sensitivities, we relied upon the *Decarbonization Roadmap* study described above. Documentation for this study provides high-level information on the quantity of flexible load modeled in 2050 in Massachusetts for a number of different end-uses (including water heating, space heating, cooling, and light-duty vehicles).[338] In 2050, MA EEA models about 20 percent of Massachusetts' space and water heating demand being flexible (with a 1- or 2-hour advance or delay), and 50 percent of Massachusetts' LDV demand being flexible (with an 8-hour delay option only). We expand these percentages to the entire region (assuming that the rest of the region implements flexible load on a similar scale) and to years in the AESC 2021 Study Period (based on the modeled level of electrification in 2021 through 2035, relative to 2050). These calculations imply 600 MW of flexible load for space and water heating will be available regionwide in 2035, and 1,125 MW of flexible load for electric LDVs will be available in 2035. Figure 56 illustrates the quantities of flexible load that we modeled in each year. These quantities of flexible load were then assigned to each state based on each state's recent historical electricity demand relative to regionwide demand.

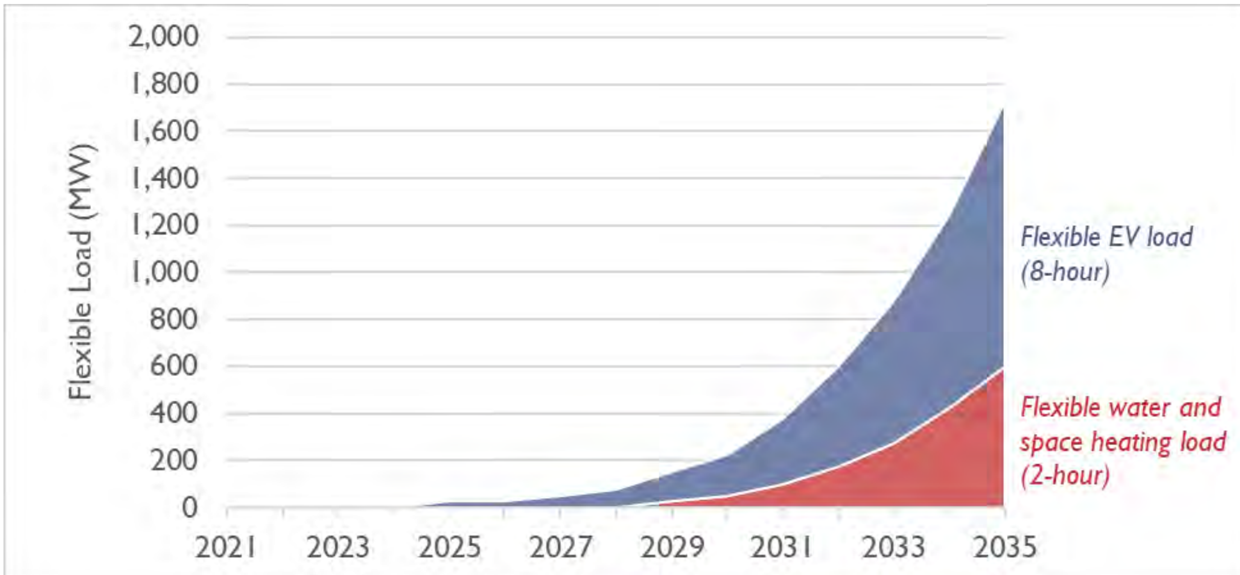
Flexible load is assumed to be eligible for capacity payments. We assume that, like other demand response resources, flexible load has a capacity credit of 90 percent (the same assumption used for battery storage). It is possible that in reality flexible load resources would require some other out-of-market payments or incentives. However, those costs are not modeled in this sensitivity analysis.[339]

[337] However, we note that all counterfactuals include some amount of active demand management, including demand response and behind-the-meter storage.

[338] Detail on flexible load is presented in Section 7.10 of MA EEAs' technical appendix titled *Energy Pathways to Deep Decarbonization: A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study*, available at https://www.mass.gov/doc/energy-pathways-for-deep-decarbonization-report/download.

[339] This is consistent with how this analysis models costs related to building electrification and transportation electrification. Only costs related to existing electricity markets (e.g., energy, capacity RPS, and others) are modeled. Costs associated with other programs are not included.

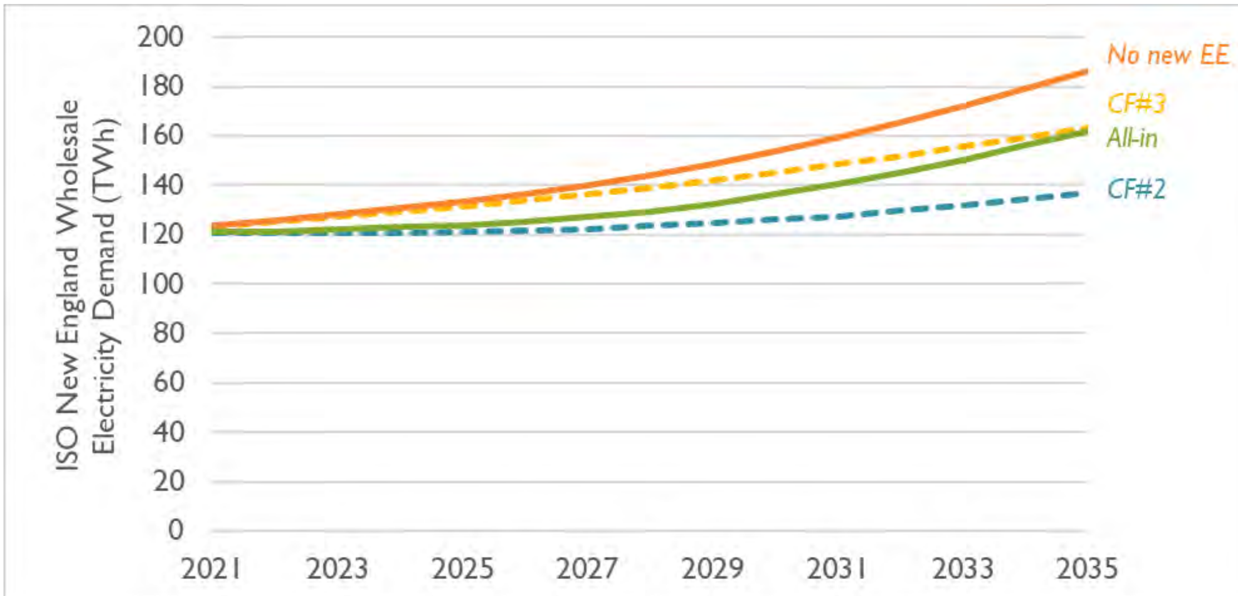
Figure 56. Proposed quantities of flexible load to be modeled in the climate policy sensitivities



Aggregate impacts

The demand-side policies described in the previous sections are combined with the econometric load forecast and produce the aggregate demand trajectories shown in Figure 57. Demand trajectories for Counterfactual #2 (CF#2) and Counterfactual #3 (CF#3) are shown for comparative purposes. We observe that systemwide demand in the All-In Climate Policy Sensitivity coincidently ends at roughly the same level as Counterfactual #3, although it follows a different trajectory (particularly during the mid- to late-2020s). Meanwhile, the No New EE Climate Policy Sensitivity closely resembles Counterfactual #3 through the mid-2020s before diverging and ending at a level roughly 23 TWh than Counterfactual #3 in 2035.

Figure 57. Systemwide wholesale demand in the No New EE and All-In Climate Policy Sensitivities



Modifications to supply

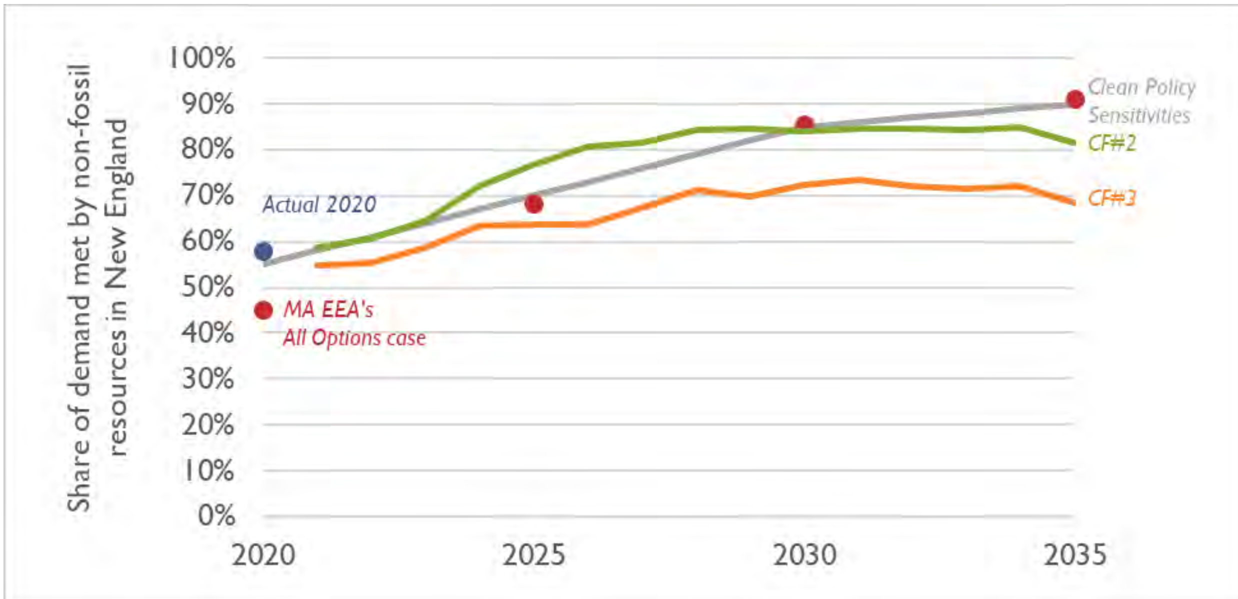
The climate policy sensitivities also envision changes to energy supply, beyond what is described elsewhere in this report. In short, we model an increasing amount of regional electricity demand being met with non-fossil resources. In our climate policy sensitivities, resources that are defined as "fossil" include resources where electricity is generated from burning coal, natural gas, or oil. All other resources are non-fossil, and include wind, solar, hydro, nuclear, biomass, imports, municipal solid waste, and other miscellaneous resource types.

To determine what level of incremental non-emitting supply should be modeled from 2021 through 2035, we return to the "All Options" case in MA EEA's *Decarbonization Roadmap*.[340] The "All Options" case achieves a non-emitting share of 68 percent in 2025, 84 percent in 2030, and 91 percent in 2035. Relying on this data, as well as actual data on the share of non-emitting supply in 2020 from ISO New England, the Synapse Team developed a clean policy trajectory from 2020 to 2035 (see Figure 58). This trajectory begins at 55 percent in 2020, reaches 70 percent in 2025, 85 percent in 2030, and finally 90 percent in 2035. Values in all other years are interpolated.

We do not model any additional renewable procurement policies beyond what is already modeled in the main AESC sensitivities. See Section 7.2 *Renewable Energy Certificate (REC) Price Forecasting* for more information on renewable procurement assumptions.

[340] Detailed annual and state-specific data was provided to Synapse Team by MA EEA via email in January through March 2021.

Figure 58. Shares of demand met by non-fossil resources in Counterfactual #2 (CF#2), Counterfactual #3 (CF#3), MA EEA's All Options Case, and the climate policy sensitivities



Developing an incremental regional clean energy policy

We multiply the clean policy trajectory (Figure 58) by the annual demand requirements (Figure 57) to estimate how much total non-fossil supply needs to be provided under the two climate policy sensitivities in each year. For both climate policy sensitivities, we then subtract the amount of non-fossil supply that is currently modeled in the "starting" counterfactuals (Counterfactual #3 for the No New EE Climate Policy Sensitivity and Counterfactual #2 for the All-In Climate Policy Sensitivity). This provides an initial estimate of how much more non-fossil supply is required to meet the clean policy trajectory. We then perform a series of steps to iterate on this TWh requirement:

- First, we model the policy as beginning in 2025. This is done because new renewable policies in New England frequently have a period between when they are codified and when they go into effect. This period allows the market to begin to respond to the policy and ramp up the production of new clean energy several years ahead of time.
- Second, we simplify the early years of the policy to allow for a gradual phase-in. Again, this is done to allow the clean energy market to respond to the policy and avoid non-compliance with or very high prices for the policy in the mid- to late-2020s.
- Third, we perform an interactive check to evaluate whether the clean policy trajectory described in Figure 58 is achieved.

We created the IRCEP to drive the deployment of this additional clean energy quantity. For the purposes of these sensitivities, the IRCEP has the following parameters:

- IRCEP functions like a new, additional RPS policy covering New England. Using the IRCEP requirements described above, the REMO model identifies which resources are most cost-effective for each sensitivity. Depending on the sensitivity and the year, we observe that these resources include onshore wind, utility-scale solar, and offshore wind.[341]

- IRCEP is a "wrap-around" policy, similar to the Massachusetts CES. To this end, all currently enacted RPS targets count toward satisfaction of the IRCEP. All incremental demand (above current RPS policies) is assumed fulfilled by Class I-eligible resources as defined by states with Class I RPS policies (e.g., Massachusetts, Connecticut, Rhode Island, Maine, and New Hampshire). In general, this includes land-based wind, offshore wind, solar, small hydro facilities meeting minimum sustainability criteria, and ocean energy systems. These resources may be built anywhere in New England or in adjacent control areas and have energy and RECs delivered to ISO New England.
- Unlike RPS policies, the IRCEP (as it is modeled here) does not include the flexibility to bank excess compliance in one year for application in a future year.
- Ordinarily, an RPS policy identifies entities who must legally comply with the policy. For example, in practice, Massachusetts load-serving entities (e.g., Eversource, National Grid, Until, and all competitive retail electricity providers) must retire a specific number of RECs to fulfill the Class 1 RPS requirement for each year. Because the IRCEP is a simplified, hypothetical, regionwide policy created to identify a shadow price of compliance with a climate policy, we do not specify the ultimate means of compliance.

<u>Other resource builds</u>

Unlike the main four counterfactuals in AESC 2021 and the High Gas Price Sensitivity, we disable the model's ability to build new natural gas-fired generators in the two climate policy sensitivities. This is done to align the sensitivities with a future in which 90 percent of electricity is supplied by non-fossil sources.[342]

However, the capacity expansion model is allowed to build energy storage resources. While energy storage is not a resource that will be built to fulfill IRCEP requirements, energy storage resources are available to be built if they are deemed economic. Reasons for economic builds might include reliability requirements for capacity (e.g., due to increased load associated with electrification) or low or negatively priced energy in some hours (e.g., as a result of a large supply of zero-marginal-cost renewables) and high-priced energy in other hours (e.g., when demand due in part to electrified end-uses is high, but supply from renewables is low). See Section 4.5: *Anticipated non-renewable resource additions and retirements* for more discussion on energy storage.

[341] In particular, the cost of offshore wind is assumed to fall over time as later projects take advantage of transmission infrastructure constructed to serve earlier projects.

[342] We performed a number of exploratory runs examining outcomes with natural gas builds allowed. We observed largely consistent finding with the results described here, with similar energy and capacity prices.

Interpreting the resulting costs

IRCEP functions as an RPS policy across the six states. As with other RPS polices, it requires the purchase of RECs in order to comply, implying a cost of compliance.

For each state, we calculate costs resulting from the IRCEP as follows:

1. First, we calculate the total RPS percentage from new and existing programs, absent the IRCEP (see Table 55 and Table 56). In some states and years, this value is as low as 25 percent. In other states and years, this value is as high as 100 percent.
2. Second, we subtract the percentages calculated in Step 1 from the percentages associated with the clean energy trajectory. In some states and years, this calculation implies that 65 percent of statewide load is subject to IRCEP. In other states and years, this value is 0 percent. This percentage describes the amount of clean energy avoided by every 1 MWh of energy efficiency (e.g., a value of 65 percent means that for every 1 MWh of energy efficiency installed, 0.65 MWh of IRCEP-derived clean energy would be avoided).
3. Finally, we multiply the resulting percentages from Step 2 by the calculated cost of new entry for each year, for each state. This cost varies depending on which resources are marginal.

The resulting values would be the cost of compliance under IRCEP for each state. The above methodology is similar to the costs of RPS compliance calculations described in Section 7.3: *Avoided RPS compliance cost per MWh reduction.*

12.3. Results of sensitivity analysis

The following sections detail the results of the sensitivity analysis for energy prices, capacity prices, RPS compliance, and other avoided cost categories.

High Gas Price Sensitivity

This sensitivity is a modification of Counterfactual #1 using a higher natural gas price. As a result, all comparisons examined in this section compare this sensitivity with Counterfactual #1. A summary of the changes in avoided costs is shown in Table 131.

Table 131. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 High Gas Price Sensitivity versus AESC 2021 Counterfactual #1

	Counter-factual #1	High Gas Price Sensitivity	High Gas Price Sensitivity, relative to Counterfactual #1		Notes
	2021 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	1.18	1.15	-0.03	-2%	*3,4,5,6*
Avoided Retail Energy Costs	3.85	4.89	1.05	27%	*5,7,8*
Avoided RPS Compliance	1.28	1.17	-0.10	-8%	*5,7,9*
Subtotal: Capacity and Energy	**6.30**	**7.21**	**0.92**	**15%**	
GHG non-embedded	**4.74**	**3.75**	**-0.98**	**-21%**	*5,10*
NO_X non-embedded	**0.08**	**0.08**	**0.00**	**0%**	*5*
Transmission & Distribution (PTF)	**2.02**	**2.02**	**0.00**	**0%**	*3,5,11*
Value of Reliability	**0.01**	**0.01**	**0.00**	**0%**	*3,5,6,12*
Electric capacity DRIPE	0.41	0.41	0.00	0%	*5,6*
Electric energy and cross-DRIPE	1.20	1.39	0.19	16%	*5,7,13*
Subtotal: DRIPE	**1.61**	**1.80**	**0.19**	**12%**	**-**
Total	**14.77**	**14.89**	**0.12**	**1%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars.
2. All values shown in this figure relate to AESC 2021. AESC 2018 data is not presented in this table.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2021 Counterfactual #1 cost (2021 $/kW-year) of $49/kW-year
AESC 2021 High Gas Price Sensitivity cost (2021 $/kW-year) of $48/kW-year
5. Includes T&D loss adjustments of 9.0% for energy and 16.0% for peak demand
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $33/MWh in Counterfactual #1 and $42/MWh in the High Gas Price Sensitivity
9. Avoided RPS compliance cost of $12/MWh in Counterfactual #1 and $11/MWh in the High Gas Price Sensitivity
10. Assumes non-embedded GHG cost based on New England MAC (electric sector)
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year in both cases. These values do not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.47/kW-year in Counterfactual #1 and $0.47/kW-year in the High Gas Price Sensitivity, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. These DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.

Energy prices

Table 132 compares the wholesale energy price results for this sensitivity with Counterfactual #1. As with the comparison described in Chapter 6: *Avoided Energy Costs*, all comparisons use 15-year levelized costs for WCMA reporting region. Generally, we find that the changes in levelized energy prices for this sensitivity correspond with the differences in Henry Hub prices described above.[343] As in Counterfactual #1, natural gas generators are the marginal resource in most hours of this sensitivity and typically set the price.

Table 132. Comparison of energy prices for WCMA region (2021 $ per MWh, 15-year levelized)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2021 Counterfactual 1	$40.85	$46.86	$45.20	$32.67	$29.86
High Gas Price Sensitivity	$49.79	$55.80	$54.27	$41.57	$38.57
% Change	22%	19%	20%	27%	29%

Notes: Levelization period is 2021–2035 and real discount rate is 0.81 percent.

Capacity prices

Compared to Counterfactual #1, the 15-year levelized capacity price in the High Gas Price Sensitivity is 2 percent lower (see Table 133). This is because the two cases are identical from FCA 12 through FCA 24 (with no differences in resource builds or demand) with only minor differences in resource builds in 2034 and 2035 as a result of higher gas and energy prices.

[343] Note that a one percentage point increase in the Henry Hub price does not correspond to a one percentage point increase in the energy price. This is because other components which contribute to the energy price (e.g., plant heat rates, Algonquin Basis) are unchanged in the two natural gas price sensitivities.

Table 133. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Commitment Period (June to May)	FCA	AESC 2021 Counterfactual #1	AESC 2021 High Gas Price Sensitivity
2021/2022	12	$4.77	$4.77
2022/2023	13	$3.96	$3.96
2023/2024	14	$2.47	$2.47
2024/2025	15	$2.75	$2.75
2025/2026	16	$2.72	$2.72
2026/2027	17	$2.88	$2.88
2027/2028	18	$3.11	$3.11
2028/2029	19	$3.30	$3.30
2029/2030	20	$3.59	$3.59
2030/2031	21	$3.42	$3.42
2031/2032	22	$3.67	$3.67
2032/2033	23	$3.90	$3.90
2033/2034	24	$3.86	$3.86
2034/2035	25	$4.67	$3.75
2035/2036	26	$3.66	$3.24
15-year levelized cost		**$3.51**	**$3.42**
Percent difference			**-2%**

Notes: Levelization period is 2021/2022 to 2035/2036 and real discount rate is 0.81 percent for AESC 2021. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

Cost of RPS compliance

Table 134 shows how the cost of RPS compliance changes in the High Gas Price Sensitivity, relative to Counterfactual #1. Depending on the state and RPS class, costs of compliance in the High Gas Price Sensitivity are between 0 and 17 percent lower than in Counterfactual #1. Generally, higher gas prices yield lower costs of RPS compliance, as the renewables built to fulfill these RPS requirements are able to obtain a larger amount of revenue from the energy market. As a result, they require less in the way of additional costs from the sale of RECs, which lowers the cost of RPS compliance.

Table 134. Avoided cost of RPS compliance (2021 $ per MWh)

		CT	ME	MA	NH	RI	VT
Counterfactual #1	Class 1/New	$6.59	$6.92	$5.61	$2.66	$14.96	$1.34
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$2.05	$5.44	$0.03	$2.56
	Total	**$7.93**	**$7.37**	**$11.81**	**$8.10**	**$14.99**	**$3.90**
High Gas Price Sensitivity	Class 1/New	$5.65	$5.73	$4.76	$2.35	$12.50	$1.15
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$1.96	$5.39	$0.03	$2.33
	Total	**$6.99**	**$6.18**	**$10.86**	**$7.74**	**$12.53**	**$3.47**
Percent Difference	Class 1/New	-14%	-17%	-15%	-11%	-16%	-14%
	MA CES & CPS	-	-	0%	-	-	-
	All Other Classes	0%	0%	-4%	-1%	16%	-9%
	Total	**-12%**	**-16%**	**-8%**	**-4%**	**-16%**	**-11%**

Other avoided costs

We observe minor differences in other avoided cost categories. Relative to Counterfactual #1, avoided costs for PTF, NO_X non-embedded, and capacity DRIPE in the High Gas Price Sensitivity are either identical or nearly so. We observe higher energy and cross-DRIPE values as a result of higher energy prices. Finally, we observe that the GHG non-embedded cost is about 20 percent lower than in Counterfactual #1. This is because when this value is based on a New England-based marginal abatement cost, one of the inputs to this value is energy prices. Higher energy prices imply a smaller residual cost for the marginal resource (in this case, offshore wind), causing the compliance cost to decrease.

No New EE Climate Policy Sensitivity

This sensitivity is a modification of Counterfactual #3 with higher loads and more clean energy. As a result, all comparisons examined in this section compare this sensitivity with Counterfactual #3. A summary of the changes in avoided costs is shown in Table 135. This table differs from similar versions of this table found throughout this report in that it includes a separate line for avoided costs related to IRCEP compliance. It also differs from other versions in that the “GHG non-embedded” row in Table 135 utilizes the social cost of carbon, rather than the marginal abatement cost derived from the New England electricity sector. This is because in some ways, the entire sensitivity is a marginal abatement cost calculation. As a result, we do not provide this comparison in the report in order to avoid improper comparisons and applications. See the subsection at the end of this chapter titled “Other considerations for modeling climate policy sensitivities” for more discussion on this topic.

Table 135. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 No New EE Climate Policy Sensitivity versus AESC 2021 Counterfactual #3, using the SCC

	Counter-factual #3	No New EE Climate Policy Sensitivity	No New EE Climate Policy Sensitivity, relative to Counterfactual #3		Notes
	2021 cents/kWh	*2021 cents/kWh*	*2021 cents/kWh*	*% Difference*	
Avoided Retail Capacity Costs	1.22	1.86	0.64	52%	*3,4,5,6*
Avoided Retail Energy Costs	3.92	3.79	-0.12	-3%	*5,7,8*
Avoided RPS Compliance	1.40	1.56	0.17	12%	*5,7,9*
Avoided IRCEP Costs	-	0.15	-	-	*14*
Subtotal: Capacity and Energy	**6.54**	**7.37**	**0.83**	**13%**	
GHG non-embedded (based on SCC)	**4.87**	**4.87**	**0.00**	**0%**	*5,10*
NO_X non-embedded	**0.08**	**0.08**	**0.00**	**0%**	*5*
Transmission & Distribution (PTF)	**2.02**	**2.02**	**0.00**	**0%**	*3,5,11*
Value of Reliability	**0.01**	**0.01**	**0.00**	**0%**	*3,5,6,12*
Electric capacity DRIPE	0.41	0.41	0.00	0%	*5,6*
Electric energy and cross-DRIPE	1.21	1.20	-0.01	-1%	*5,7,13*
Subtotal: DRIPE	**1.62**	**1.61**	**-0.01**	**-1%**	**-**
Total	**15.15**	**15.96**	**0.81**	**5%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars.
2. All values shown in this figure relate to AESC 2021. AESC 2018 data is not presented in this table.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2021 Counterfactual #3 cost (2021 $/kW-year) of $51/kW-year
AESC 2021 No new EE climate policy sensitivity cost (2021 $/kW-year) of $79/kW-year
5. Includes T&D loss adjustments of 9.0% for energy and 16.0% for peak demand
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $33/MWh in Counterfactual #3 and $32/MWh in the No New EE Climate Policy Sensitivity
9. Avoided RPS compliance cost of $13/MWh in Counterfactual #3 and $16/MWh in the No New EE Climate Policy Sensitivity
10. Assumes non-embedded GHG cost based on the social cost of carbon in both cases
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year in both cases. These values do not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.47/kW-year in Counterfactual #3 and $0.47/kW-year in the No New EE Climate Policy Sensitivity, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. These DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.
14. The IRCEP cost represents this state's incremental cost of deploying enough clean energy for the region to reach 90 percent clean energy by 2035.

Energy prices

Table 136 compares the wholesale energy price results for this sensitivity with Counterfactual #3. As with the comparison described in Chapter 6: *Avoided Energy Costs*, all comparisons use 15-year levelized costs for WCMA reporting region. Generally, we find that prices are 4 percent lower than estimated in Counterfactual #3. This is largely due to zero-marginal-cost renewables lowering the clearing price. However, as in Counterfactual #3, natural gas generators are the marginal resource in most hours and typically set the price.

Table 136. Comparison of energy prices for WCMA region (2021 $ per MWh, 15-year levelized)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2021 Counterfactual 3	$41.34	$47.43	$45.63	$33.28	$29.93
No New EE Climate Policy Sensitivity	$39.82	$46.20	$43.62	$32.23	$28.02
% Change	-4%	-3%	-4%	-3%	-6%

Notes: Levelization period is 2021–2035 and real discount rate 0.81 percent.

Capacity prices

Compared to Counterfactual #3, the 15-year levelized capacity price in the No New EE Climate Policy Sensitivity is 55 percent higher (see Table 137 and Figure 59). Capacity price trajectories are similar until FCA 22, at which point the two series diverge. Capacity prices in the No New EE Climate Policy Sensitivity increase, nearing or reaching the price ceiling implied by the MRI curve in FCA 24 through FCA 26. This price increase is due to a rapid increase in peak demand due to electrification, particularly in FCA 24 through FCA 26 when the system switches to winter peaking.

To model capacity prices in winter peaking years, we follow an identical methodology described above in Chapter 5: *Avoided Capacity Costs*, with two exceptions: (1) we rely on winter peak values to inform the demand quantity and (2) we adjust the capacity contribution for solar and wind to reflect more accurate seasonal capacity contributions from these resources.[344] Otherwise, we assume that the market's operation is unchanged. Likewise, other results that are derived from the capacity price modeling (e.g., capacity DRIPE, reliability) are derived using identical methodologies to that described in previous chapters.

We note that the operation of the capacity market in a winter-peaking future is highly uncertain. However, given what we know about the structure of the market as it exists today, the above changes are the only necessary modifications to successfully model a capacity price.

[344] Based on historical data from ISO New England on capacity obligations (see FCA Obligations workbook at https://www.iso-ne.com/static-assets/documents/2018/02/fca_obligations.xlsx) we assume that the winter capacity contribution of wind is double the summer capacity contribution, and that the winter capacity contribution of solar is 0 percent.

Table 137. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Commitment Period (June to May)	FCA	AESC 2021 Counterfactual #3	No New EE Climate Policy Sensitivity
2021/2022	12	$4.77	$4.77
2022/2023	13	$3.96	$3.96
2023/2024	14	$2.47	$2.47
2024/2025	15	$2.75	$2.75
2025/2026	16	$2.59	$2.46
2026/2027	17	$2.75	$2.66
2027/2028	18	$3.46	$2.86
2028/2029	19	$3.65	$3.15
2029/2030	20	$3.94	$3.57
2030/2031	21	$3.97	$3.95
2031/2032	22	$3.79	$5.59
2032/2033	23	$4.02	$7.73
2033/2034	24	$3.95	$12.80
2034/2035	25	$5.09	$13.13
2035/2036	26	$3.73	$13.13
15-year levelized cost		**$3.65**	**$5.56**
Percent difference			**52%**

Notes: Levelization period is 2021/2022 to 2035/2036 and real discount rate is 0.81 percent for AESC 2021. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

Figure 59. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Cost of RPS compliance

Table 138 shows how the cost of RPS compliance changes in the No New EE Climate Policy Sensitivity, relative to Counterfactual #3. Depending on the state and RPS class, costs of compliance in the No New EE Climate Policy Sensitivity are between 0 and 30 percent higher than in Counterfactual #3. This increase in compliance costs is due to increased energy demand, and as a result, increased REC prices and resulting RPS compliance costs.

Table 138. Avoided cost of RPS compliance (2021 $ per MWh)

		CT	ME	MA	NH	RI	VT
Counterfactual #3	Class 1/New	$7.50	$8.11	$6.66	$3.18	$16.77	$1.58
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$2.13	$5.49	$0.03	$2.86
	Total	**$8.84**	**$8.56**	**$12.93**	**$8.67**	**$16.81**	**$4.44**
No New EE Climate Policy Sensitivity	Class 1/New	$8.82	$10.55	$8.15	$4.07	$21.61	$1.92
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$2.17	$5.54	$0.03	$3.23
	Total	**$10.16**	**$11.00**	**$14.47**	**$9.62**	**$21.64**	**$5.15**
Percent Difference	Class 1/New	18%	30%	22%	28%	29%	22%
	MA CES & CPS	-	-	0%	-	-	-
	All Other Classes	0%	0%	2%	1%	16%	13%
	Total	**15%**	**28%**	**12%**	**11%**	**29%**	**16%**

Other avoided costs

We observe minor differences in other avoided cost categories. Relative to Counterfactual #3, avoided costs for PTF, NO_X non-embedded, capacity DRIPE, energy DRIPE and cross-DRIPE in the No New EE Climate Policy Sensitivity are either identical or nearly so.

All-In Climate Policy Sensitivity

This sensitivity is a modification of Counterfactual #2 with higher loads and more clean energy. As a result, all comparisons examined in this section compare this sensitivity with Counterfactual #2. A summary of the changes in avoided costs is shown in Table 139. This table differs from similar versions of this table found throughout this report in that it includes a separate line for avoided costs related to IRCEP compliance. It also differs from other versions in that the “GHG non-embedded” row in Table 135Table 139 utilizes the social cost of carbon, rather than the marginal abatement cost derived from the New England electricity sector. This is because in some ways, the entire sensitivity is a marginal abatement cost calculation. As a result, we do not provide this comparison in the report in order to avoid improper comparisons and applications. See the subsection at the end of this chapter titled “Other considerations for modeling climate policy sensitivities” for more discussion on this topic.

Table 139. Illustration of avoided retail summer on-peak electricity cost components, AESC 2021 All-In Climate Policy Sensitivity versus AESC 2021 Counterfactual #2, using the SCC

	Counter-factual #2 *2021 cents/kWh*	All-In Climate Policy Sensitivity *2021 cents/kWh*	All-In Climate Policy Sensitivity, relative to Counterfactual #2 *2021 cents/kWh*	 *% Difference*	*Notes*
Avoided Retail Capacity Costs	1.16	1.64	0.48	42%	*3,4,5,6*
Avoided Retail Energy Costs	3.63	3.49	-0.14	-4%	*5,7,8*
Avoided RPS Compliance	0.98	1.08	0.11	11%	*5,7,9*
Avoided IRCEP Costs	-	0.06	-	-	*14*
Subtotal: Capacity and Energy	**5.77**	**6.28**	**0.51**	**9%**	
GHG non-embedded (based on SCC)	**4.87**	**4.87**	**0.00**	**0%**	*5,10*
NO_X non-embedded	**0.08**	**0.08**	**0.00**	**0%**	*5*
Transmission & Distribution (PTF)	**2.02**	**2.02**	**0.00**	**0%**	*3,5,11*
Value of Reliability	**0.01**	**0.01**	**0.00**	**-1%**	*3,5,6,12*
Electric capacity DRIPE	0.39	0.39	0.00	0%	*5,6*
Electric energy and cross-DRIPE	1.08	1.10	0.02	2%	*5,7,13*
Subtotal: DRIPE	**1.47**	**1.48**	**0.02**	**1%**	**-**
Total	**14.22**	**14.75**	**0.53**	**4%**	**-**

Notes:
1. Values are shown for the WCMA reporting zone, summer on-peak, on a 15-year levelized basis; all values are in 2021 dollars.
2. All values shown in this figure relate to AESC 2021. AESC 2018 data is not presented in this table.
3. Assumes load factor of 55%
4. Avoided cost of capacity purchases:
AESC 2021 Counterfactual #2 cost (2021 $/kW-year) of $48/kW-year
AESC 2021 All-in climate policy sensitivity cost (2021 $/kW-year) of $68/kW-year
5. Includes T&D loss adjustments of 9.0% for energy and 16.0% for peak demand
6. This table assumes that 100% of capacity, capacity DRIPE, and reliability values are cleared or bid into the capacity market
7. Includes wholesale risk premium adjustment of 8.0%
8. Avoided wholesale energy cost (2021 $/MWh) of $31/MWh in Counterfactual #2 and $29/MWh in the All-In Climate Policy Sensitivity
9. Avoided RPS compliance cost of $9/MWh in Counterfactual #2 and $10/MWh in the All-In Climate Policy Sensitivity
10. Assumes non-embedded GHG cost based on social cost of carbon in both cases
11. Assumes pooled transmission facility (PTF) cost (2021 $/kW-year) of $84/kW-year in both cases. These values do not include avoided costs related to non-PTF facilities or local T&D systems.
12. Assumes reliability value (2021 $/kW-year) of $0.46/kW-year in Counterfactual #2 and $0.45/kW-year in the High Gas Price Sensitivity, and a VOLL of $73/kWh
13. "Electric energy and cross-DRIPE" is the sum of electric energy, G-E cross-DRIPE and E-G-E cross-DRIPE. These DRIPE values represent the Massachusetts-wide (zone-on-zone) value, but not the Rest-of-Pool amount.
14. The IRCEP cost represents this state's incremental cost of deploying enough clean energy for the region to reach 90 percent clean energy by 2035.

Energy prices

Table 140 compares the wholesale energy price results for this sensitivity with Counterfactual #2. As with the comparison described in Chapter 6: *Avoided Energy Costs*, all comparisons use 15-year levelized costs for WCMA reporting region. Generally, we find that prices are 3 percent higher than estimated in Counterfactual #2. Price increases due to higher loads are largely offset by price decreases due to zero-marginal-cost renewables lowering the clearing price. Winter prices increase as a result of higher winter loads caused by building and transportation electrification.

Table 140. Comparison of energy prices for WCMA region (2021 $ per MWh, 15-year levelized)

	Annual All hours	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
AESC 2021 Counterfactual 2	$37.79	$42.98	$41.66	$30.87	$27.95
All-In Climate Policy Sensitivity	$38.87	$45.70	$43.27	$29.64	$26.63
% Change	3%	6%	4%	-4%	-5%

Notes: Levelization period is 2021–2035 and real discount rate is 0.81 percent.

Capacity prices

Compared to Counterfactual #2, the 15-year levelized capacity price in the All-In Climate Policy Sensitivity is 42 percent higher (see Table 141 and Figure 60). Capacity prices in the All-In Climate Policy Sensitivity are identical or similar to prices in Counterfactual #2 from FCA 12 through FCA 23, as more clean energy comes online and demand does not diverge substantially. Beginning in FCA 24, the All-In Climate Policy Sensitivity features a faster increase in demand, caused by increased electrification and a switch to winter peaking, resulting in higher prices. See the above section on capacity price results for the No New EE Climate Policy Sensitivity for more information on how capacity price modeling was performed for these winter-peaking years.

Table 141. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Commitment Period (June to May)	FCA	AESC 2021 Counterfactual #2	AESC 2021 All-In Climate Policy Sensitivity
2021/2022	12	$4.63	$4.63
2022/2023	13	$3.73	$3.73
2023/2024	14	$1.92	$1.92
2024/2025	15	$2.46	$2.46
2025/2026	16	$2.69	$2.64
2026/2027	17	$2.69	$2.65
2027/2028	18	$3.33	$3.29
2028/2029	19	$3.30	$3.33
2029/2030	20	$3.41	$3.49
2030/2031	21	$3.77	$3.62
2031/2032	22	$3.81	$3.79
2032/2033	23	$3.86	$3.87
2033/2034	24	$4.02	$9.04
2034/2035	25	$4.47	$13.13
2035/2036	26	$3.86	$13.13
15-year levelized cost		**$3.45**	**$4.89**
Percent difference			**42%**

Notes: Levelization period is 2021/2022 to 2035/2036 and real discount rate is 0.81 percent for AESC 2021. Data on clearing prices for other counterfactuals and regions can be found in the AESC 2021 User Interface.

Figure 60. Comparison of capacity prices in rest-of-pool (2021 $ per kW-month)

Cost of RPS compliance

Table 142 shows how the cost of RPS compliance changes in the All-In Climate Policy Sensitivity, relative to Counterfactual #2. Depending on the state and RPS class, costs of compliance in the All-In Climate

Policy Sensitivity are between 0 and 60 percent higher than in Counterfactual #2. This increase in compliance costs is due to increased energy demand, and as a result, increased REC prices and resulting RPS compliance costs.

Table 142. Avoided cost of RPS compliance (2021 $ per MWh)

		CT	ME	MA	NH	RI	VT
Counterfactual #2	Class 1/New	v	$3.10	$3.10	$1.31	$5.63	$0.75
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$1.80	$5.11	$0.03	$1.93
	Total	**$4.77**	**$3.55**	**$9.04**	**$6.41**	**$5.66**	**$2.67**
All-In Climate Policy Sensitivity	Class 1/New	$4.78	$4.67	$3.95	$1.69	$9.02	$0.95
	MA CES & CPS	-	-	$4.14	-	-	-
	All Other Classes	$1.34	$0.45	$1.92	$5.22	$0.03	$2.16
	Total	**$6.12**	**$5.12**	**$10.01**	**$6.91**	**$9.05**	**$3.11**
Percent Difference	Class 1/New	39%	51%	27%	29%	60%	26%
	MA CES & CPS	-	-	0%	-	-	-
	All Other Classes	0%	0%	6%	2%	16%	12%
	Total	**28%**	**44%**	**11%**	**8%**	**60%**	**16%**

Other avoided costs

We observe minor differences in other avoided cost categories. Relative to Counterfactual #2, avoided costs for PTF, NO_X non-embedded, capacity DRIPE, energy DRIPE and cross-DRIPE in the No New EE Climate Policy Sensitivity are either identical or nearly so.

As in the No New EE Climate Policy Sensitivity, we observe large differences between the IRCEP cost and the non-embedded GHG cost based on the marginal abatement cost from the New England electric sector. Compared to the No New EE Climate Policy Sensitivity, non-embedded GHG costs in this sensitivity are lower primarily as a result of lower loads. In this sensitivity, IRCEP drives the addition of only a small amount of incremental renewable capacity before 2029. This produces low costs of compliance in the early years of the study, which are the least-discounted and therefore the most valuable from a levelized perspective.

For more information on why costs under IRCEP differ from costs derived from a New England-derived MAC, see page 313.

Other considerations for modeling climate policy sensitivities

This section focuses on other considerations related to the climate policy sensitivities. These considerations may be useful when developing future AESC analyses.

Energy prices

Except in a few situations described above, we note that energy prices in the climate policy sensitivities closely resemble energy prices in the main counterfactuals. In other words, adding a substantial amount of clean energy to the grid (even above the quantity expected under current legislation and regulations) and increasing electric demand by nearly 20 percent does not substantially change energy prices on annual basis. However, we do note that there are seasonal shifts. In particular, we observe lower summer prices (as more solar depresses energy prices during periods of high insolation) and higher winter prices (as higher levels of building and transportation electrification drive an increased demand for electricity in winter months). As electrification levels continue to increase past 2035, it is possible that we may observe larger changes in energy prices.

In addition, in the No New EE Climate Policy Sensitivity, we observe very low energy prices from the mid-2020s through the early 2030s in Maine. This is caused by a large amount of onshore wind deployments, without corresponding increases in transmission (to link Maine with southern New England) or increased loads in Maine itself (e.g., accelerating deployments of EVs or heat pumps). Future AESC modeling may wish to take these constraints into consideration, as the assumptions used for transmission or load changes may have a substantial impact on energy prices.

Electric sector generation

We observe that implementing the climate policies described above implies that generation from fossil-fired power plants decreases from about 50 TWh in 2020, to about 30 TWh in 2025 to about 20 TWh in 2028 through 2035.

We also note that in years with very high levels of renewables (e.g., the mid-2030s), the model is not always able to reach the IRCEP requirement. For example, in the All-In Climate Policy Sensitivity, we reached 87 percent non-fossil energy in 2035, rather than the 90 percent target. This discrepancy is partly due to wind curtailments and increasing storage demand, as well as non-fossil resources (like nuclear and hydro) being unexpectedly displaced by renewable resources. This observation may in some instances be a modeling artifact, caused by inconsistencies in input assumptions related to weather patterns for renewables and load. In future AESC studies, it may behoove the Study Group to evaluate this phenomenon in more detail.

Finally, the current climate policy sensitivities attribute existing non-emitting generation among the six states at a very high level. As states increasingly deploy polices (like Massachusetts’ CES-E or municipal GGES) that require load-serving entities to procure and retire clean energy certificates, this may cause a shift in the IRCEP compliance cost across the states.

Capacity prices and winter peak

In both climate policy sensitivities, we observe that the New England electricity system becomes winter peaking in the early 2030s. This change to winter peaking may necessitate substantive changes to the design of the current capacity market. In the interim, the capacity prices calculated in this analysis represent our best estimate of capacity prices under the current construct. We do modify seasonal capacity credits for solar and wind, which substantially reduces available supply.

Climate policy sensitivity results and marginal abatement costs

Generally speaking, we observe large differences between the IRCEP cost and the non-embedded GHG cost based on the marginal abatement cost from the New England electric sector (e.g., offshore wind). We note that these approaches represent fundamentally different approaches to calculating the cost of abating climate pollution.

- The New England-specific marginal abatement cost derived from the electric sector is equal to the all-in cost of offshore wind, less energy costs. This cost starts immediately in 2021 at a high price, then decreases over time.
- In the climate policy sensitivity, we begin modeling the IRCEP program beginning in 2025. This means there is no cost in the first four years of the study. Over time, this policy results in dozens of TWh of additional clean energy added to the New England system. This incremental clean energy consists of a mix of solar, onshore wind, and offshore wind.

Because of the different approaches used to create these values, results from these two approaches are challenging to compare on an apples-to-apples basis. Some of the major differences include:

- The New England marginal abatement cost approach assumes that avoided costs begin in 2021 and persist throughout the study period. In the climate policy sensitivities, the IRCEP program begins in 2025. This difference is key when comparing costs in levelized terms. Because of the levelization calculations used in summarizing avoided costs in AESC, where values earlier in the analysis are discounted less than values far into the study period, there are at least four "high-worth" near-term years in the climate policy sensitivities where the cost of compliance is $0 per MWh.
- In the climate policy sensitivities, we derate the cost of new entry by each state's share of load that is subject to the IRCEP. For example, in Massachusetts in 2035, we calculate that 86 percent of EDC load is subject to the RPS or similar programs. Because the regional target in this year under IRCEP is 90 percent, we would multiply the cost of new entry by 4 percent. In another example, in Rhode Island in 2035, 100 percent of load is expected to be met with current RPS programs. This means that there is no incremental cost associated with IRCEP, and therefore the compliance cost is zero. In the New England MAC approach, the compliance cost is not derated.
- The cost of new entry differs in the two approaches. In the New England MAC approach, the cost of new entry is based on offshore wind, which has a high cost early in the period that decreases over time. Meanwhile, in the climate policy sensitivities, the cost of new entry is based on a mix of different resources, including solar, onshore wind, and offshore wind.

Separately, we note that the non-embedded GHG cost under IRCEP is also substantially lower than the social cost of carbon recommended in Chapter 8: *Non-Embedded Environmental Costs*. These represent two fundamentally different approaches to calculating the non-embedded GHG cost. (the social cost of carbon is a damage approach, while IRCEP is a marginal abatement cost approach).

Considering costs after 2035

The climate policy sensitivities are modeled in detail from 2021 through 2035, consistent with the detailed modeling horizon used elsewhere in AESC. This limitation means that costs reported in the period after 2035 are extrapolated based on costs from 2031-2035. In years after 2035, electricity markets will likely face a number of new issues that may lead to substantially different avoided costs than are reported with this extrapolation technique.

- In order for the New England states to reach their climate and decarbonization goals, we expect that that levels of building and transportation electrification are likely to increase substantially after 2035. For example, in the All-in climate policy sensitivity, regional loads in 2035 are projected to be 1.3 times higher than today. Massachusetts' *Decarbonization Roadmap* study suggests that electrification would cause 2040 loads to be 1.5 times higher than today. In 2050, loads would be 1.9 times higher. These higher levels of load may lead to increased energy and capacity prices.
- Higher levels of load would also likely increase RPS compliance and IRCEP compliance costs, all else being equal. IRCEP costs may also increase as a result of clean energy requirements increasing 90 percent (e.g., 100 percent by 2050, as is assumed in the *Decarbonization Roadmap* study). The subsection above titled "Electric sector generation" discusses in more detail the challenges of modeling an electricity system with very high levels of renewable penetration, and the impacts on avoided costs associated with these challenges.
- Reaching very high levels of renewable penetration (e.g., 85-100 percent) and electrification may require other investments not currently addressed in the AESC study. For example, this future may involve high levels of investment in transmission and distribution, increased needs for flexible load and long-duration storage, or novel technologies for smaller, hard-to-reach sectors not considered in these sensitivities (e.g., hydrogen or renewable fuels).
- Because capacity costs rise quickly in the early 2030s, the extrapolation techniques used for calculating avoided costs in 2036-2055 for the main AESC analysis yield implausibly high capacity costs in these years.

Other climate policy costs

The costs analyzed in this chapter are primarily focused on electric sector costs. Our analysis does not include any costs or prices associated with building electrification, transportation electrification, or energy efficiency deployment. Our modeled costs in this chapter also do not include any avoided costs related to renewable fuels (like RNG or B100), which may be useful to consider as a complementary avoided cost for building electrification measures alongside the IRCEP price described here.

Finally, our analysis does not include any costs of distribution investments or enhancements, which may be necessary in some areas as building and transportation electrification increases, or, conversely, mitigated by energy efficiency under these same circumstances. The avoided costs associated with this mitigation may be substantial and are not included in our avoided cost calculations.

APPENDIX A: USAGE INSTRUCTIONS

This appendix describes how values post-2035 are extrapolated, how to compute levelization, how to convert between nominal and constant dollars, and how to compare results from this AESC study to previous versions. This appendix also includes a description of the role of energy efficiency programs in the capacity market.

Extrapolation of values post-2035

Many demand-side measures have lifetimes extending past 2035, which requires the extrapolation of avoided cost values for years 2036 through 2055.[345]

In past editions of AESC, authors used the formula as described in Equation 12 to extrapolate costs for each avoided cost category.[346] The resulting growth rate is then applied to values in 2035 to calculate values in 2036. Subsequent years through 2055 are calculated similarly.

Equation 12. Compound annual growth rate (CAGR) formula used in past versions of AESC

$$CAGR = \left(\frac{Avoided\ Cost_{n+4}}{Avoided\ Cost_n}\right)^{\left(\frac{1}{4}\right)} - 1$$

This extrapolation methodology was chosen historically because it relies on values that are "close to" the extrapolated period, under the theory that extrapolated values would be most influenced by more "recent" values (and should be less influenced by values in the early 2020s, for example). However, members of the AESC 2021 Study Group pointed out that because this methodology only relies on two data points, in certain circumstances (i.e., when the 2031 or 2035 values are divergent relative to the rest of the series) this method can produce a very high or very low growth rate. As a result, it may not be suitable for calculating avoided costs post-2035.

The Synapse Team developed a list of pros and cons of the CAGR extrapolation methodology as well as other methodologies, then provided a recommendation for which approach to use.

Compound annual growth rate (CAGR)

A CAGR spanning a five-year period has been the method used for extrapolating non-modeled values in all recent previous AESC studies. But other CAGR periods (e.g., spanning 6 years, 10 years, or something

[345] Program administrators installing measures with long lifetimes in 2022 or later years will utilize avoided costs in 2051 and later.

[346] In past versions of AESC, this has been referred to this as a "Five-year CAGR" since it spans five data years, although it only covers four years of growth.

else) are also possible candidates for use. Table 143 summarizes the main advantages and disadvantages of the CAGR approach.

Table 143. Advantages and disadvantages of CAGR approach

Advantages	Disadvantages
A shorter-term CAGR relies on data points that are closest to the extrapolated period.	Any CAGR relies on two data points. If these data points are outliers relative to the rest of the series, the growth rate may be too low or too high.
This approach has been used historically and is widely recognized and understood.	

Average annual growth rate (AAGR)

The AAGR is a common alternate to the CAGR. AAGR is calculated by determining the annual year-on-year change in the values of a series, then calculating the simple mathematical mean (average) over that set of resulting growth rates. Unlike CAGR, it relies on a set of numbers to inform future values (rather than only two data points). However, AAGR has a drawback of overstating trends in some circumstances. Consider the example shown in Table 144. In this scenario, the series varies between a value of 100 and 110 over a period of 11 years, but returns to 100 in the final year. Because a unit reduction from a high value is a lower percentage than a unit reduction from a low value, the AAGR is 0.5 percent over this time period, whereas a CAGR would produce a growth rate of 0 percent. If annual variability is small, this effect may not substantially bias the resulting AAGR. However, if the annual variability is large in at least some years, the resulting AAGR may be larger than expected.

Table 144. Example of AAGR calculation over a stationary series

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Value	100	110	100	110	100	110	100	110	100	110	100
Annual Growth rate	-	10%	-9%	10%	-9%	10%	-9%	10%	-9%	10%	-9%
AAGR	-	-	-	-	-	-	-	-	-	-	0.5%

As with CAGR, for AAGR there is a choice to make about what period to rely on for forecasting the future (e.g., spanning 6 years, 10 years, or something else). Table 145 summarizes the main advantages and disadvantages of the AAGR approach.

Table 145. Advantages and disadvantages of AAGR approach

Advantages	Disadvantages
AAGR relies on a set of data points (rather than just two as in the CAGR method), which smooths out the resulting growth rate.	AAGR can be biased towards larger changes in values, even if the series is mostly invariant.
This approach is widely used (outside of AESC) and understood.	This approach has not been used in previous AESC studies.

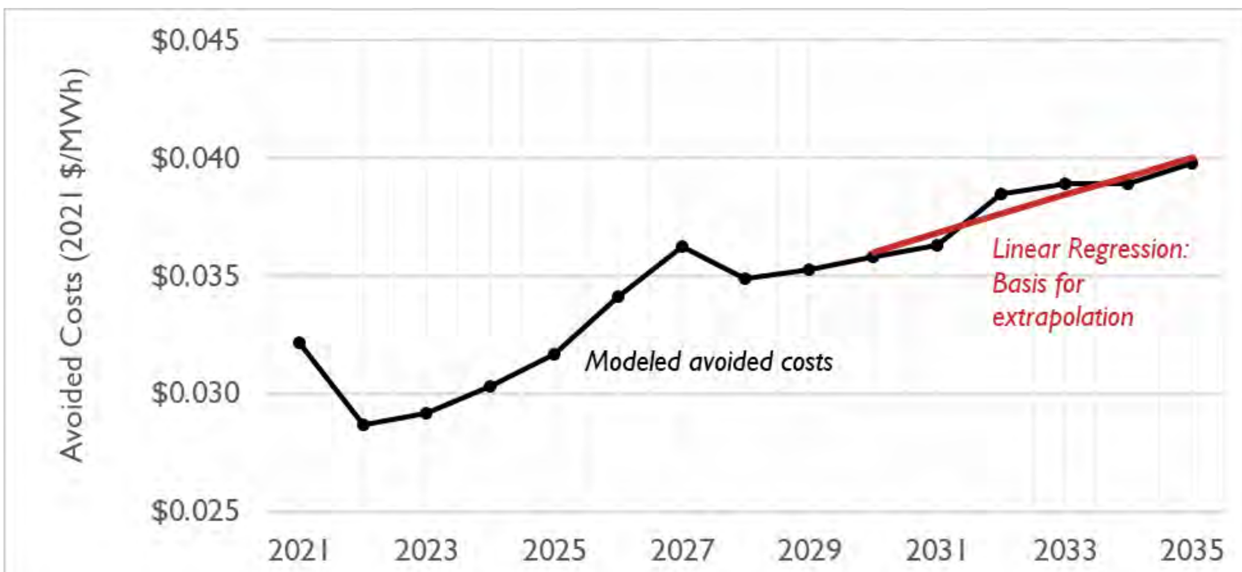
Calculating a growth rate based on a regression

The Synapse Team developed a third extrapolation option aimed at reconciling the following needs:

- The need to extrapolate future values using modeled values that are relatively "near" the extrapolated period
- The need to rely on extrapolate avoided costs that are representative of the recent trend, absent noise in the data

One way to achieve both of these goals is to smooth the values, then calculate the CAGR or AAGR. One smoothing technique is to perform a linear regression over the values in question. Figure 61 depicts a linear regression of the 2030 to 2035 datapoints in an example set of avoided costs. This linear regression creates a basis for extrapolation that is both (a) based on a set of "recent" values and (b) smooths the noise in the series.

Figure 61. Example of linear regression over a short period



We then calculate a CAGR using the first value in the regression and the last value in the regression. Alternately, we could instead calculate the AAGR over the same period (starting with the annual growth rate observed between the second point in the regression and the first point, and so on). For many regressions, these two growth rates will be virtually identical (e.g., within one one-tenth of a percent), with the AAGR being slightly larger than the CAGR due to the regression producing a constant unit change added to smaller, then larger, avoided costs. Table 146 summarizes the advantages and disadvantages of this approach.

Table 146. Advantages and disadvantages of regression-derived growth rate approach

Advantages	Disadvantages
This approach smooths the trend observed over a recent set of data points.	This approach has not been used in previous studies and was derived specifically for AESC.
Resulting CAGR and AAGR will be virtually identical for most series.	

Recommendation for extrapolation

In developing our recommendation, the Synapse Team notes the following:

- The Study Group has expressed a desire for a single extrapolation methodology for use across all avoided cost categories for ease of use.
- The Study Group has expressed a desire for an extrapolation technique to be both (a) based on data from years close to the extrapolation period and (b) be representative of the overall trend during this period (rather than being heavily weighted by one or two outlying data points).
- The “best” extrapolation method should be selected based on the one technique that best meets the needs expressed for extrapolation, rather than the one that produces the best-looking or most reasonable result for a particular avoided cost series.

The Synapse Team recommends the CAGR with regression technique as the extrapolation technique best suited to using recent values that are representative of a number of data points in each avoided cost series. In addition, we recommend increasing the timespan to 2030–2035. The addition of another year covers a period large enough to produce a less-noisy trend. The 2030–2035 time period also continues to represent a period of time that better represents post-2036 trends. The Synapse Team recommends using CAGR rather than AAGR as this method avoids the bias inherent in AAGR related to weighting unit changes applied to larger vs. smaller numbers.[347]

[347] There are two exceptions to this recommendation. First, we estimate capacity price shifts in 2036-2055 (used to calculate capacity DRIPE benefits in these years) by examining the median price shift from 2025 through 2035. A median is used rather than a trend plus CAGR because small year-on-year differences in demand or supply can produce substantial swings in price shifts in one year, followed by a return to the original price shift just one year later. These swings are much larger than any swings observed in other avoided cost inputs, and are an outcome of the stepwise supply function used by ISO New England (and deployed in AESC). This period is chosen because it is the period where capacity prices are projected, rather than based on observed auction data. The second exception is the final avoided cost streams for uncleared measures (e.g., uncleared capacity, uncleared capacity DRIPE). Because avoided costs in these categories vary by measure life, and because they are summed over the entire study period (rather than over the measure life as with all other avoided cost categories), we extrapolate the inputs used for these categories (e.g., capacity clearing prices, loads) but calculate avoided costs explicitly for each year through 2055.

Note that through the use of the *AESC 2021 User Interface* and other appendices, readers of AESC 2021 can calculate their own extrapolated values if their policy context requires some alternate methodology than the one recommended above.

Levelization calculations

The AESC Study presents levelized costs throughout on a 15-year basis; *Appendix B: Detailed Electric Outputs* presents levelized costs over different years. We calculate levelized costs for three different periods:

- 10-year: 2021 to 2030
- 15-year: 2021 to 2035
- 30-year: 2021 to 2050

All levelized costs are calculated using a real discount rate of 0.81 percent.

To calculate levelized costs beyond the three periods documented above, readers of AESC will require (a) a real discount rate (0.81 percent or otherwise specified), (b) the number of years and timeframe over which costs are to be levelized (e.g., 10 years—2021 through 2030 inclusive), and (c) the specific avoided cost values for the relevant reporting region. Equation 13 describes the formula used to estimate a levelized cost within Excel.

Equation 13. Excel formula used for calculating levelized costs

$$Levelized\ cost = -PMT(DiscountRate, NumberOfYears, NPV(DiscountRate, StreamOfCostsWithinPeriod))$$

Converting constant 2021 dollars to nominal dollars

Unless specifically noted, this report presents all dollar values in 2021 constant dollars. To convert constant 2021 dollars into nominal (current) dollars, apply the formula described in Equation 14. Inflator and deflator conversion factors for AESC 2021 are presented in *Appendix E: Common Financial Parameters*.

Equation 14. Nominal-constant dollar conversion

$$Nominal\ Value = \frac{Constant\ Value\ (in\ 2021\ \$)}{Annual\ Conversion\ Factor\ to\ 2021\ \$}$$

Comparisons to previous AESC studies

A reader of the AESC 2021 Study may prepare comparisons of the AESC 20221 Study's 15-year levelized avoided costs with the 2018 AESC Study's avoided costs using the following steps:

- Identify the relevant reporting region and costing period
- Obtain the annual values of each avoided cost component from Appendix B in AESC 2021 and AESC 2018 (for the relevant reporting region and costing period)
- Convert the AESC 2018 values from 2018 dollars to 2021 dollars
- Calculate the 15-year levelized cost in 2021 dollars using the AESC 2021 real discount rate (0.81 percent)

APPENDIX B: DETAILED ELECTRIC OUTPUTS

AESC 2021 provides detailed avoided electricity cost projections, both energy and capacity, for each New England state. This appendix provides an overview of and instructions on how to apply those avoided costs. All values can be found in the *AESC 2021 User Interface* (see Appendix F: *User Interface* for more information) and state values are summarized in the standalone Excel file titled "Appendix B."[348]

Structure of Appendix B tables

For each state, Appendix B presents tables with the following avoided costs:

1. Avoided unit cost of electric energy
2. Avoided REC costs to load
3. Avoided non-embedded GHG costs
4. Avoided NO_X costs
5. Energy DRIPE for intrastate and rest-of-pool for 2021 installations
6. Electric Cross-DRIPE
7. Avoided unit cost of electric capacity by demand reduction bidding strategy
8. Capacity DRIPE for intrastate and rest-of-pool for 2021 installations
9. Avoided reliability costs
10. Avoided cost of pooled transmission facilities (PTF)

Illustrative levelized values are provided for each avoided cost.

Appendix B is organized into wholesale values, then retail values. Users typically do not need to use or modify the wholesale values directly, but users should apply values in accordance with state regulations.

Within these two categories, avoided costs are further arranged into avoided energy-based costs (presented in $ per kWh) and avoided capacity-based costs (presented in $ per kW-year).

[348] For comparative, historical purposes, we also estimate avoided costs for two subregions within Connecticut and three subregions within Massachusetts. Avoided costs for these subregions are not materially different from avoided costs for each of two relevant states. This subregional data is only found in the *AESC 2021 User Interface*.

Energy-based avoided costs, $ per kWh

Avoided electric energy costs are presented by year in four costing periods: on-peak winter, off-peak winter, on-peak summer, off-peak summer. ISO New England defines these costing periods as follows:[349]

- Summer on-peak: The 16-hour block from 7 a.m. till 11 p.m., Monday–Friday (except ISO holidays), in the months of June–September (1,376 Hours, 15.7 percent of 8,760)[350]
- Summer off-peak: All other hours between 11 p.m. and 7 a.m., Monday–Friday, weekends, and ISO holidays in the months of June–September (1,552 Hours, 17.7 percent of 8,760)
- Winter on-peak: The 16-hour block from 7 a.m. till 11 p.m., Monday–Friday (except ISO holidays), in the eight months of January–May and October–December (2,720 Hours, 31.0 percent of 8,760)
- Winter off-peak: All other hours between 11 p.m. and 7 a.m., Monday–Friday, all day on weekends, and ISO holidays–in the months of January–May and October–December (3,112 Hours, 35.5 percent of 8,760)

The annual avoided electricity cost for a given year, or set of years, is equal to the hour-weighted average of avoided costs for each of the four costing periods of that year (see Equation 15).

Equation 15. Calculation of annual avoided electricity cost

$$\begin{aligned} &Annual\ avoided\ electricity\ cost \\ &\qquad = (15.7\% \times Summer\ OnPeak) + (17.7\% \times Summer\ OffPeak) \\ &\qquad + (31.0\% \times Winter\ OnPeak) + (35.5\% \times Winter\ OffPeak) \end{aligned}$$

The specific wholesale avoided energy costs included in Appendix B are explained below.

- *Wholesale avoided costs of electricity energy*. Annual wholesale electric energy prices are outputted from the EnCompass simulation runs.[351]
- *Wholesale REC costs to load*. Annual avoided REC costs are specific to each state.
- *Wholesale non-embedded GHG and NO_X costs.* Annual estimates of non-embedded CO_2 and NO_X values are provided for each of the four energy costing periods. Non-embedded costs of NO_X are included in Appendix B for the first time in AESC 2021 and

[349] ISO New England. Last accessed March 10, 2021. "Glossary and Acronyms." *Iso-ne.com.* Available at https://www.iso-ne.com/participate/support/glossary-acronyms/.

[350] ISO New England holidays are New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day, and Christmas.

[351] The avoided energy costs are computed for the aggregate load shape in each zone by costing period as described in more detail in Section 4.3. New *England system demand*.

can be included in a program administrator's cost-effectiveness model if desired. These avoided costs are calculated in the same manner as non-embedded carbon costs.

- *Wholesale energy DRIPE*. Separate projections are provided for wholesale intrastate and rest-of-pool energy DRIPE.[352] Users should apply energy DRIPE values in accordance with relevant state regulations governing treatment of energy DRIPE. For example, Massachusetts only considers intrastate DRIPE benefits, whereas Rhode Island considers both intrastate and rest-of-pool DRIPE benefits.
- *Wholesale cross-DRIPE.* Annual wholesale electric cross-DRIPE values include both electric-gas cross-DRIPE and electric-gas-electric cross-DRIPE, which represents the benefits from a reduction in the quantity of electricity that reduces gas consumption and that subsequently reduces electric prices. Users should treat the avoided costs for electric cross-DRIPE similarly to energy DRIPE.

Capacity-based avoided costs, $ per kW-year

Most capacity-based avoided cost components—including wholesale avoided unit cost of electric capacity, wholesale capacity DRIPE, and reliability—are separated into cleared, uncleared, and weighted average values.

The *cleared* capacity columns provide estimates for FCA capacity prices reported on a calendar year basis. ISO New England generally reports capacity prices based on power-years (June 1 to May 31).

The *uncleared* capacity columns provide estimates for capacity based on uncleared capacity or unbid capacity avoided through energy efficiency measures. The values are multiplied by the capacity price load effect and reserve margin percentages. Because FCA auctions are set three years in advance of the actual delivery year, avoided capacity not bid into an FCA will not impact ISO New England's determination of forecasted peak until 2026 for measures installed in 2021.

Wholesale capacity DRIPE projections are provided for intrastate and rest-of-pool energy DRIPE for installation year 2021. Users should apply capacity DRIPE values in accordance with relevant state regulations governing treatment of capacity DRIPE.

Avoided cost for PTF is based on costs allocated to LSEs from ISO New England. This is the only capacity-based avoided cost that is not separated into cleared, uncleared, and weighted average values, because it is not part of the FCM. Utilities that use avoided PTF costs should include only local transmission investments (those not eligible for PTF treatment) in their own avoided transmission cost analyses.

In the *AESC 2021 User Interface*, users may specify a percentage of measures that are cleared in the FCM. This percentage is then used to calculate a weighted average avoided cost for cleared and uncleared capacity, cleared and uncleared capacity DRIPE, and cleared and uncleared reliability. The weighted average is based on a simplified bidding strategy consisting of *x* percent of demand reductions

[352] DRIPE vintage years are available for 2021 through 2025 within the *AESC 2021 User Interface*.

from measures in each year bid (cleared) into the FCA for that year and the remaining 1-*x* percent not bid (uncleared) into any FCA. The default value for *x* is 50 percent.

How to convert wholesale avoided costs to retail avoided costs

AESC estimates avoided electric costs at the wholesale level, meaning reductions at power plants or energy markets. The *AESC 2021 User Interface* and Appendix B Excel workbooks allow users to convert the wholesale values to retail values. Retail avoided costs represent reductions at the customer meter or end-use level, and they are meant to approximate the price customers see on utility bills.

Depending on the avoided cost, two adjustment factors are applied to convert from wholesale to retail values: (1) a factor for transmission and distribution losses, and (2) a wholesale risk premium. Both factors are described in detail below. These adjustments gross up wholesale values, leading to retail values that are greater than wholesale values.

In general, the formula for converting from wholesale to retail is shown in Equation 16.

Equation 16. Converting from wholesale to retail avoided costs

$$\begin{aligned}&Avoided\ retail\ cost\\&\qquad = (avoided\ wholesale\ cost) \times (1 + losses) \times (1 + wholesale\ risk\ premium)\end{aligned}$$

Wholesale risk premium

The full retail price of electricity is generally greater than the sum of the wholesale market prices for energy, capacity, and ancillary-service. This is because retail suppliers incur various market risks when they set contract prices in advance of supply delivery. In AESC, this premium over wholesale prices is called the *wholesale risk premium*, and the default assumption is that retail prices are 8 percent greater than wholesale prices.

Types of risk

The wholesale risk premium accounts for multiple risks. First, there is the retail supplier's cost to mitigate cost risks. Retail suppliers mitigate some risk by hedging their costs in advance, but there is still uncertainty in the final price borne by the supplier. This includes cost risk from hourly energy balancing, ancillary services, and uplift.

The larger component of the risk is the difference between projected and actual energy requirements under the contract, driven by unpredictable variations in weather, economic activity, and/or customer migration. For example, during hot summers and cold winters, LSEs may need to procure additional energy at shortage prices, while in mild weather they may have excess supply under contract that they need to "dump" into the wholesale market at a loss. The same pattern holds in economic boom and bust cycles.

In addition, the suppliers for utility standard-service offers run risks related to customer migration. Customers may migrate from the utility's standard offer service to competitive supply, presumably at times of low market prices, leaving the supplier to sell surplus into a weak market at a loss. Alternatively, customers may switch from competitive supply to the utility's standard offer service at times of high market prices, forcing the supplier to purchase additional power in a high-cost market.

Estimating the wholesale risk premium

Estimates of the appropriate premium range from less than 5 percent to around 10 percent, based on analyses of confidential supplier bids—primarily in Massachusetts, Connecticut, and Maryland—to which the Synapse Team or sponsors have been privy.[353] Short-term procurements (for six months or a year into the future) may have smaller risk adders than longer-term procurements (upwards to about three years, which appears to be the limit of suppliers' willingness to offer fixed prices). Utilities that require suppliers to maintain higher credit levels tend to see the resulting costs incorporated into the adders in supplier bids.[354] AESC 2021 uses a wholesale risk premium of 8 percent to reflect these dynamics.

AESC 2021 applies the same wholesale risk premium to avoided wholesale energy prices and to avoided wholesale capacity prices.[355]

The risk premium is a separate input to the avoided-cost spreadsheet. Therefore, program administrators will be able to input whatever level of risk premium they feel best reflects their specific experience, circumstances, economic and financial conditions, or regulatory direction.

Members of the Study Group have inquired if a similar wholesale risk premium could be applied for natural gas efficiency programs. Natural gas marketers also undertake contracts of varying durations for future delivery and account for risks in their retail pricing. The current scope of AESC 2021 does not include the development of a wholesale risk premium for natural gas, but such work could be included in future AESC studies or updates to this study.

[353] Note that these bids are confidential and cannot be made public.

[354] The default value for Vermont is set in accordance with guidance from the Vermont PUC, which also specifies a default value for municipal utilities. These utilities typically either procure a basket of generation resources or contract for bundled service from suppliers.

[355] Capacity costs present a different risk profile than energy costs. With the FCM, suppliers have a good estimate of the capacity price three years in advance and of the capacity requirement for customers about one year in advance. Reconfiguration auctions may affect the capacity charges, but the change in average costs is likely to be small. On the other hand, since suppliers generally charge a dollars-per-MWh rate, and energy sales are subject to variation, the supplier retains some risk of under-recovery of capacity costs. There is no way to determine the extent to which an observed risk premium in bundled prices reflects adders on energy, capacity, ancillary services, RPSs, and other factors. Given the uncertainty and variability in the overall risk premium, we do not believe that differentiating between energy and capacity premiums is warranted. We thus apply the retail premium uniformly to both energy and capacity values.

Transmission and distribution losses

There is a loss of electricity between a generating unit and ISO New England's delivery points. Therefore, a kilowatt load reduction at the ISO New England's delivery points reduces the quantity of electricity that a generator has to produce by one kilowatt plus the additional quantity that would have been required to compensate for losses. These losses occur on both the transmission and distribution systems and apply to both energy and capacity avoided costs.[356]

When converting from wholesale to retail values, program administrators can use the default T&D loss value in AESC of 8 percent, or program administrators can use their own custom T&D loss factors.

AESC T&D losses

AESC converts avoided costs from wholesale to retail values assuming marginal losses of 9 percent for energy (i.e., all avoided cost categories that are described in terms of $ per kWh) and 16 percent for peak demand (i.e., all avoided cost categories that are described in terms of $ per kW-year). Table 147 displays the recommended loss factors, along with the average factors from which they are derived. We note that previous editions of AESC have typically recommended a loss factor of 8 percent be applied to all avoided cost categories.[357] However, this loss factor is average (rather than marginal) and focused on peak hours (rather than all hours). As a result, we have updated the recommended loss factors in AESC 2021. See Section 4.3 *New England system demand* for more discussion on deriving marginal loss factors.

Table 147. Loss factors recommended for use in AESC 2021

	Energy	Peak Demand
Average	6% *(a)*	8% *(c)*
Marginal *Recommended in AESC 2021*	9% *(b)*	16% *(d)*

Sources: (a) https://www.iso-ne.com/static-assets/documents/2019/11/p2_transp_elect_fx_update.pdf, slide 25; (b) 1.5 x 6%, per 2011 RAP paper; (c) ISO New England Market Rules, Section III.13.1.4.1.1.6.(a); (d) 2 x 8%, per 2011 RAP paper.

Custom T&D losses

If a program administrator chooses to apply custom T&D loss values, it needs to consider three types of losses: distribution losses, transmission non-PTF losses, and transmission PTF losses. Below, we estimate

[356] The forecast of capacity costs from the FCM do not reflect these losses; therefore forecasted capacity costs should be adjusted to account for them.

[357] Note that this 8 percent value includes both transmission losses (2.5 percent) and distribution losses (5.5 percent). ISO New England. October 10, 2019. *Transmission planning Technical Guide.* Available at https://www.iso-ne.com/static-assets/documents/2017/03/transmission_planning_techincal_guide_rev6.pdf.

PTF losses and describe the need for program administrators to derive their own non-PTF costs. These two components could then be added to custom distribution losses values, perhaps developed using the guidance in Section 10.4: *Localized value of avoided T&D*.

PTF losses

ISO New England does not appear to publish estimates of the losses on the ISO-administered transmission system at system peak. ISO New England does release hourly values for system load and non-PTF demand that enable to us to estimate PTF losses.[358] On average, system PTF losses between 2010 and 2020 are 1.6 percent. This is the same number described in AESC 2018.

PTF losses probably vary among zones, because losses in any zone depend both on loads in that zone and flows into and out of that zone to the rest of the region. However, marginal losses by zone could not be identified using the available data provided by ISO New England in December 2020, and it would be difficult to estimate from historical data anyway. Therefore, we use average losses for AESC 2021.

Non-PTF losses

AESC does not recommend a calculation for non-PTF losses at this time. Utilities who wish to develop a custom T&D factor should examine their own data and formulate their own non-PTF losses as appropriate. These non-PTF losses include losses over the non-PTF transmission substations and lines to distribution substations.

Applying wholesale to retail factors

Table 148 summarizes which retail factors are applied when converting wholesale avoided cost to retail avoided costs. Losses apply to all avoided costs.[359] Losses are applied to avoided capacity costs to be consistent with how generation capacity is procured or avoided.

The wholesale risk premium is applied to energy values except non-embedded values and to uncleared capacity values. The wholesale risk premium does not apply to non-embedded values because, by definition, these costs are not embedded in electricity prices; therefore retail suppliers do not include these costs in supply contracts. The wholesale risk premium does not apply to cleared capacity values because resources cleared in the FCM receive FCM prices.

Avoided PTF costs, represent avoided infrastructure investments, which would not be impacted by line losses or wholesale market risks.

[358] ISO New England defines system load as the sum of generation and net interchange, minus pumping load, and non-PTF demand. ISO New England uses the term "non-PTF demand" for the load delivered into the networks of distribution utilities. Losses on the PTF system are thus the difference between the system load and non-PTF demand.

[359] This includes avoided PTF costs. Avoided PTF costs are calculated on the basis of dollars per *generating* kW. In order to be applied to retail kW savings, they must be increased by a loss factor.

Table 148. Wholesale to retail factors by avoided cost category

Avoided cost categories	Losses	Wholesale Risk Premium
Electric energy, energy DRIPE, cross-DRIPE	✓	✓
Non-embedded GHG, non-embedded NOx	✓	
Cleared capacity, capacity DRIPE, reliability	✓	
Uncleared capacity, capacity DRIPE, reliability	✓	✓
PTF losses	✓	

Guide to applying the avoided costs

AESC 2021 allows users to specify certain inputs as well as to choose which of the avoided cost components to include in their analyses. The retail avoided costs are calculated using the following default values:

1. Wholesale risk premium: 8 percent[360]
2. Losses: 9 percent for dollar-per-kWh values and 16 percent for dollar-per-kW values[361]
3. Real discount rate: 0.81 percent

Users may insert their own values for these input assumptions. If a user wishes to specify a different value for any of the inputs, the user should enter the *new* value directly in the Appendix B Excel workbook. The calculations in the worksheet are linked to these values and new avoided costs will be calculated automatically on the "User Results" page.

[360] The wholesale risk premium for Vermont is 11.1 percent per Vermont DPS. See Appendix A for a more detailed discussion of the wholesale risk premium.

[361] Each program administrator should obtain or calculate the losses applicable to its specific system as described in Chapter 10 on avoided T&D costs.

APPENDIX C: DETAILED NATURAL GAS OUTPUTS

The following appendix provides projections of avoided natural gas costs by year, and by end-use. It also includes projections of natural gas supply DRIPE and natural gas cross-DRIPE values by year, and by end-use. Values are also provided in the standalone Excel workbook titled "Appendix C."

Avoided natural gas costs by end-use

Table 150 through Table 154 include forecasts of avoided natural gas costs by year and end-use for three New England sub-regions: southern New England (Connecticut, Rhode Island, Massachusetts), northern New England (New Hampshire, Maine) and Vermont. The avoided cost by end-use is shown two ways: first, as the avoided cost of the gas sent out by the LDC (i.e., the avoided citygate cost), and second, as the avoided cost of the gas sent out by the LDC plus the avoidable distribution cost (i.e., the avoidable retail margin).

The tables show avoided costs for the following end-uses: Residential non-heating, water heating, heating, and all; Commercial & Industrial non-heating, heating, and all; and all retail end-uses.

- Non-heating columns include values related to year-round end-uses with generally constant gas use throughout the year.
- Heating value columns include values related to heating end-uses in which gas use is high during winter months.
- When determining the cost-effectiveness of a program or measure, users should choose the appropriate column to determine the avoided cost values for each program and/or measure.

As mentioned above, Table 150 through Table 154 contain two types of avoided natural gas costs by end-use and sub-region: the first assumes no avoided retail margin, and the second assumes some amount of avoided retail margins. Program administrators must determine if their LDC has avoidable LDC margins and should pick the appropriate value stream accordingly.

Natural gas supply and cross-fuel DRIPE

Table 155 through Table 160 include forecasts of natural gas supply and cross-fuel DRIPE by end-use and costing period. This is shown by year and by state, as well as for the whole of New England. New in AESC 2021, we also display both zone-on-zone and zone-on-rest-of-pool (ROP) values.[362]

[362] Previous versions of AESC directed users of the study to calculate zone-on-Rest-of-Pool values on their own, by subtracting the state values from the New England-wide value. We now present these values separately and explicitly for the reader's convenience.

Column 1 of each of these tables shows gas supply DRIPE for measures installed in 2021. Program administrators can use the value by year from this column and apply it to the MMBtu of gas reduction from efficiency programs and measures throughout the lifetime of the program or measure. An analogous value for zone-on-Rest-of-Pool DRIPE appears in Column 10.

Columns 2 through 9 show gas-electric (G-E) cross-fuel DRIPE by costing period and load segment for each state. Program administrators can use the value by year from these columns and apply them to the MMBtu of gas reduction from the relevant costing period and load segment. These values are calculating using the end-use share assumptions depicted in Table 149.[363]

Table 149. End-use and sector share assumptions used to calculate G-E cross-DRIPE

Sector	End-Use	Share of Sector	Share of Total Consumption
Residential	Non heating	6%	
Residential	Hot water	27%	40%
Residential	Heating	67%	
Commercial & Industrial	Non heating	27%	60%
Commercial & Industrial	Heating	73%	

Note: DRIPE effects for "Non Heating" and "Hot Water" in residential are identical. They are reported separately to facilitate formulas in many program administrators' benefit-cost models. Conversely, commercial & industrial "Non heating" includes hot water measures, but are combined to facilitate their use in the benefit-cost models.

An analogous set of values are shown for zone-on-Rest-of-Pool DRIPE in Columns 11 through 18.

Avoided natural gas costs by costing period

Avoided natural gas costs are shown in Table 161 and Table 162 for each of the six costing periods. The values for each costing period are the annual cost per MMBtu for the gas supply resource that is the lowest-cost option to supply that type of load. These values are multiplied by the percentage shares for the representative load shapes to derive the avoided costs by end-use that are presented in Table 150 and Table 153. Note, for example, that because the load shape for residential non-heating is 100 percent baseload, the avoided costs for Residential Non-heating in Table 150 and the Baseload values in Table 161 are the same.

The values in Table 161 and Table 162 can be used to calculate the avoided natural gas costs for programs that reduce gas use during specific periods during the year. For example, the Baseload

[363] In AESC 2021, the "share of sector" percentages are calculated by using New England-specific data from EIA's 2015 RECS survey (EIA. Last accessed March 10, 2021. *2015 RECS Survey.* Available at https://www.eia.gov/consumption/residential/data/2015/c&e/ce4.2.xlsx.)

"Share of total consumption" percentages are calculated based on 2014-2019 data for all six New England states obtained from EIA. "Natural Gas Consumption by End Use." *Eia.gov*. Available at https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SME_a.htm.

Note that prior editions of AESC utilized data supplied by National Grid.

avoided cost would be applied to a reduction in gas use (in MMBtu) that is spread equally over all days of the year. The Highest 10 Days avoided cost would be applied to a reduction in gas use that occurs only during the 10 days of highest gas use. The Winter values would be used to calculate the avoided natural gas costs for a program that reduces gas use over the November through March winter season (i.e., more than 90 days, and up to 151 days each year).

Table 150. Avoided cost of gas to retail customers by end-use for southern New England (SNE) assuming no avoidable retail margin (2021 $ per MMBtu)

Year	Residential				Commercial & Industrial			All Retail End-Uses
	Non heating	*Hot Water*	*Heating*	*All*	*Non heating*	*Heating*	*All*	
2021	4.45	5.21	6.92	6.21	5.29	6.42	5.92	6.07
2022	4.24	5.11	7.08	6.26	5.20	6.50	5.93	6.11
2023	4.03	4.90	6.84	6.03	4.98	6.27	5.71	5.88
2024	4.35	5.22	7.17	6.35	5.30	6.60	6.03	6.20
2025	4.41	5.28	7.22	6.41	5.36	6.65	6.09	6.26
2026	4.52	5.38	7.31	6.51	5.46	6.75	6.19	6.36
2027	4.58	5.43	7.36	6.56	5.52	6.80	6.24	6.41
2028	4.72	5.58	7.50	6.70	5.66	6.94	6.38	6.55
2029	4.85	5.70	7.62	6.82	5.79	7.06	6.50	6.67
2030	4.91	5.76	7.67	6.87	5.84	7.11	6.56	6.73
2031	4.92	5.77	7.67	6.88	5.86	7.12	6.57	6.73
2032	4.99	5.84	7.73	6.94	5.92	7.18	6.63	6.80
2033	5.06	5.90	7.79	7.00	5.98	7.24	6.69	6.86
2034	5.08	5.92	7.80	7.02	6.01	7.25	6.71	6.87
2035	5.09	5.93	7.80	7.02	6.01	7.25	6.71	6.88
2036	5.14	5.97	7.83	7.05	6.05	7.29	6.75	6.91
2037	5.18	6.01	7.86	7.09	6.09	7.32	6.78	6.95
2038	5.22	6.05	7.90	7.13	6.13	7.35	6.82	6.98
2039	5.27	6.09	7.93	7.16	6.17	7.39	6.86	7.02
2040	5.31	6.13	7.96	7.20	6.21	7.42	6.89	7.06
2041	5.36	6.17	7.99	7.23	6.25	7.46	6.93	7.09
2042	5.40	6.21	8.03	7.27	6.30	7.49	6.97	7.13
2043	5.45	6.25	8.06	7.31	6.34	7.53	7.01	7.17
2044	5.50	6.29	8.09	7.34	6.38	7.56	7.05	7.20
2045	5.54	6.34	8.13	7.38	6.42	7.60	7.08	7.24
2046	5.59	6.38	8.16	7.42	6.46	7.64	7.12	7.28
2047	5.64	6.42	8.19	7.45	6.51	7.67	7.16	7.32
2048	5.69	6.46	8.23	7.49	6.55	7.71	7.20	7.36
2049	5.73	6.51	8.26	7.53	6.59	7.74	7.24	7.39
2050	5.78	6.55	8.29	7.57	6.64	7.78	7.28	7.43
2051	5.83	6.59	8.33	7.60	6.68	7.82	7.32	7.47
2052	5.88	6.64	8.36	7.64	6.72	7.85	7.36	7.51
2053	5.93	6.68	8.40	7.68	6.77	7.89	7.40	7.55
2054	5.98	6.73	8.43	7.72	6.81	7.93	7.44	7.59
2055	6.03	6.77	8.47	7.76	6.86	7.97	7.48	7.63
Levelized (2021–2030)	4.50	5.35	7.26	6.47	5.44	6.70	6.15	6.32
Levelized (2021–2035)	4.67	5.52	7.42	6.63	5.60	6.86	6.31	6.48
Levelized (2021–2050)	5.03	5.86	7.72	6.94	5.95	7.17	6.64	6.80

Table 151. Avoided cost of gas to retail customers by end-use for southern New England (SNE) assuming some avoidable retail margin (2021 $ per MMBtu)

Year	Residential				Commercial & Industrial			All Retail End-Uses
	Non heating	*Hot Water*	*Heating*	*All*	*Non heating*	*Heating*	*All*	
2021	5.41	6.17	8.30	7.56	6.07	7.82	7.35	7.43
2022	5.20	6.07	8.47	7.63	5.98	7.91	7.39	7.48
2023	4.99	5.86	8.23	7.40	5.76	7.68	7.16	7.26
2024	5.31	6.18	8.55	7.72	6.08	8.00	7.48	7.58
2025	5.37	6.24	8.61	7.78	6.14	8.06	7.54	7.64
2026	5.48	6.34	8.70	7.87	6.24	8.15	7.64	7.73
2027	5.54	6.39	8.75	7.92	6.30	8.20	7.69	7.78
2028	5.68	6.53	8.89	8.06	6.44	8.34	7.83	7.92
2029	5.80	6.66	9.01	8.19	6.57	8.47	7.95	8.05
2030	5.87	6.72	9.06	8.24	6.62	8.52	8.01	8.10
2031	5.88	6.73	9.06	8.25	6.64	8.52	8.01	8.11
2032	5.95	6.79	9.12	8.31	6.70	8.58	8.08	8.17
2033	6.02	6.86	9.18	8.37	6.76	8.64	8.13	8.23
2034	6.04	6.88	9.19	8.38	6.79	8.66	8.15	8.24
2035	6.05	6.89	9.19	8.38	6.79	8.66	8.15	8.25
2036	6.10	6.93	9.22	8.42	6.83	8.69	8.19	8.28
2037	6.14	6.97	9.25	8.45	6.87	8.73	8.22	8.32
2038	6.18	7.01	9.28	8.49	6.91	8.76	8.26	8.35
2039	6.23	7.05	9.31	8.52	6.95	8.80	8.30	8.39
2040	6.27	7.09	9.35	8.56	6.99	8.83	8.33	8.42
2041	6.32	7.13	9.38	8.59	7.03	8.86	8.37	8.46
2042	6.36	7.17	9.41	8.63	7.07	8.90	8.41	8.49
2043	6.41	7.21	9.44	8.66	7.11	8.93	8.44	8.53
2044	6.45	7.25	9.48	8.70	7.16	8.97	8.48	8.57
2045	6.50	7.29	9.51	8.74	7.20	9.00	8.52	8.60
2046	6.54	7.33	9.54	8.77	7.24	9.04	8.55	8.64
2047	6.59	7.38	9.58	8.81	7.28	9.08	8.59	8.68
2048	6.64	7.42	9.61	8.84	7.32	9.11	8.63	8.71
2049	6.69	7.46	9.64	8.88	7.37	9.15	8.67	8.75
2050	6.73	7.50	9.68	8.92	7.41	9.18	8.70	8.79
2051	6.78	7.55	9.71	8.95	7.45	9.22	8.74	8.83
2052	6.83	7.59	9.74	8.99	7.50	9.26	8.78	8.86
2053	6.88	7.64	9.78	9.03	7.54	9.29	8.82	8.90
2054	6.93	7.68	9.81	9.07	7.58	9.33	8.86	8.94
2055	6.98	7.72	9.85	9.10	7.63	9.37	8.89	8.98
Levelized (2021–2030)	5.46	6.31	8.65	7.83	6.22	8.11	7.60	7.69
Levelized (2021–2035)	5.63	6.48	8.81	7.99	6.38	8.27	7.76	7.85
Levelized (2021–2050)	5.99	6.82	9.11	8.31	6.72	8.58	8.08	8.17

Table 152. Avoided cost of gas to retail customers by end-use for northern New England (NNE) assuming no avoidable retail margin (2021 $ per MMBtu)

Year	Residential				Commercial & Industrial			All Retail End-Uses
	Non heating	*Hot Water*	*Heating*	*All*	*Non heating*	*Heating*	*All*	
2021	4.28	5.13	7.04	6.24	5.21	6.48	5.93	6.10
2022	4.07	4.98	7.04	6.18	5.07	6.43	5.84	6.02
2023	3.86	4.76	6.79	5.95	4.85	6.19	5.60	5.79
2024	4.18	5.08	7.12	6.27	5.17	6.51	5.93	6.11
2025	4.25	5.15	7.17	6.33	5.24	6.57	5.99	6.17
2026	4.36	5.25	7.26	6.42	5.34	6.66	6.08	6.26
2027	4.42	5.30	7.30	6.47	5.39	6.71	6.13	6.31
2028	4.56	5.45	7.44	6.61	5.54	6.85	6.27	6.45
2029	4.69	5.57	7.56	6.73	5.66	6.97	6.40	6.57
2030	4.75	5.63	7.61	6.78	5.72	7.02	6.45	6.63
2031	4.77	5.64	7.61	6.79	5.73	7.02	6.46	6.64
2032	4.84	5.71	7.67	6.85	5.80	7.08	6.52	6.70
2033	4.91	5.77	7.72	6.91	5.86	7.14	6.58	6.76
2034	4.94	5.80	7.73	6.93	5.89	7.15	6.60	6.77
2035	4.95	5.80	7.73	6.93	5.89	7.15	6.60	6.78
2036	5.00	5.84	7.76	6.96	5.93	7.19	6.64	6.81
2037	5.04	5.89	7.79	7.00	5.98	7.22	6.68	6.85
2038	5.09	5.93	7.82	7.03	6.02	7.25	6.71	6.88
2039	5.14	5.97	7.85	7.07	6.06	7.29	6.75	6.92
2040	5.18	6.01	7.88	7.10	6.10	7.32	6.79	6.95
2041	5.23	6.05	7.91	7.14	6.14	7.35	6.82	6.99
2042	5.28	6.10	7.94	7.17	6.18	7.39	6.86	7.03
2043	5.33	6.14	7.97	7.21	6.23	7.42	6.90	7.06
2044	5.38	6.18	8.00	7.24	6.27	7.45	6.94	7.10
2045	5.43	6.22	8.03	7.28	6.31	7.49	6.97	7.14
2046	5.48	6.27	8.07	7.32	6.36	7.52	7.01	7.17
2047	5.53	6.31	8.10	7.35	6.40	7.56	7.05	7.21
2048	5.58	6.36	8.13	7.39	6.45	7.59	7.09	7.25
2049	5.63	6.40	8.16	7.43	6.49	7.63	7.13	7.29
2050	5.68	6.45	8.19	7.46	6.53	7.66	7.17	7.33
2051	5.73	6.49	8.22	7.50	6.58	7.70	7.21	7.36
2052	5.79	6.54	8.26	7.54	6.63	7.73	7.25	7.40
2053	5.84	6.58	8.29	7.58	6.67	7.77	7.29	7.44
2054	5.89	6.63	8.32	7.61	6.72	7.81	7.33	7.48
2055	5.95	6.68	8.35	7.65	6.76	7.84	7.37	7.52
Levelized (2021–2030)	4.34	5.22	7.23	6.39	5.31	6.63	6.06	6.24
Levelized (2021–2035)	4.51	5.39	7.38	6.55	5.48	6.79	6.22	6.39
Levelized (2021–2050)	4.89	5.74	7.65	6.86	5.83	7.08	6.53	6.71

Table 153. Avoided cost of gas to retail customers by end-use for northern New England (NNE) assuming some avoidable retail margin (2021 $ per MMBtu)

Year	Residential				Commercial & Industrial			All Retail End-Uses
	Non heating	*Hot Water*	*Heating*	*All*	*Non heating*	*Heating*	*All*	
2021	5.24	6.09	8.43	7.61	5.99	7.89	7.38	7.47
2022	5.03	5.94	8.43	7.56	5.85	7.84	7.30	7.40
2023	4.82	5.72	8.18	7.32	5.63	7.60	7.06	7.17
2024	5.14	6.04	8.50	7.64	5.95	7.92	7.39	7.49
2025	5.21	6.11	8.55	7.70	6.02	7.97	7.45	7.55
2026	5.31	6.21	8.64	7.79	6.12	8.07	7.54	7.64
2027	5.38	6.26	8.69	7.84	6.17	8.12	7.59	7.69
2028	5.52	6.41	8.83	7.98	6.32	8.25	7.73	7.83
2029	5.65	6.53	8.94	8.10	6.44	8.37	7.85	7.95
2030	5.71	6.59	8.99	8.15	6.50	8.42	7.90	8.00
2031	5.73	6.60	8.99	8.16	6.51	8.43	7.91	8.01
2032	5.80	6.67	9.05	8.22	6.58	8.49	7.97	8.07
2033	5.87	6.73	9.11	8.28	6.64	8.55	8.03	8.13
2034	5.90	6.76	9.12	8.29	6.67	8.56	8.05	8.15
2035	5.91	6.76	9.11	8.29	6.67	8.56	8.05	8.15
2036	5.96	6.80	9.14	8.33	6.71	8.59	8.08	8.18
2037	6.00	6.85	9.17	8.36	6.75	8.63	8.12	8.22
2038	6.05	6.89	9.20	8.39	6.80	8.66	8.15	8.25
2039	6.10	6.93	9.23	8.43	6.84	8.69	8.19	8.29
2040	6.14	6.97	9.26	8.46	6.88	8.73	8.23	8.32
2041	6.19	7.01	9.30	8.50	6.92	8.76	8.26	8.36
2042	6.24	7.05	9.33	8.53	6.96	8.79	8.30	8.39
2043	6.28	7.10	9.36	8.57	7.01	8.83	8.33	8.43
2044	6.33	7.14	9.39	8.60	7.05	8.86	8.37	8.46
2045	6.38	7.18	9.42	8.64	7.09	8.89	8.41	8.50
2046	6.43	7.22	9.45	8.67	7.13	8.93	8.44	8.53
2047	6.48	7.27	9.48	8.71	7.18	8.96	8.48	8.57
2048	6.53	7.31	9.51	8.74	7.22	9.00	8.52	8.61
2049	6.58	7.36	9.54	8.78	7.26	9.03	8.55	8.64
2050	6.63	7.40	9.58	8.81	7.31	9.07	8.59	8.68
2051	6.68	7.44	9.61	8.85	7.35	9.10	8.63	8.72
2052	6.73	7.49	9.64	8.89	7.40	9.14	8.67	8.75
2053	6.78	7.53	9.67	8.92	7.44	9.17	8.70	8.79
2054	6.84	7.58	9.70	8.96	7.49	9.21	8.74	8.83
2055	6.89	7.62	9.73	9.00	7.53	9.24	8.78	8.87
Levelized (2021–2030)	5.30	6.18	8.61	7.76	6.09	8.04	7.51	7.61
Levelized (2021–2035)	5.47	6.35	8.76	7.92	6.26	8.19	7.67	7.77
Levelized (2021–2050)	5.85	6.70	9.04	8.22	6.61	8.49	7.98	8.08

Table 154. Avoided cost of gas to retail customers by end-use for Vermont assuming some avoidable retail margin (2021 $ per MMBtu)

Year	Residential			
	Design Day 1	*Peak Days 9*	*Remaining Winter 141*	*Shoulder / Summer 214*
2021	554.38	15.27	3.39	3.03
2022	554.43	15.39	3.43	3.07
2023	554.47	17.05	3.48	3.12
2024	555.04	17.09	4.05	3.68
2025	555.37	17.17	4.37	4.01
2026	555.71	17.28	4.72	4.35
2027	556.03	16.97	5.03	4.67
2028	556.42	17.20	5.43	5.07
2029	556.80	17.31	5.81	5.44
2030	557.10	17.65	6.11	5.75
2031	557.14	17.61	6.15	5.79
2032	557.22	17.65	6.23	5.87
2033	557.30	17.53	6.31	5.95
2034	557.34	17.78	6.35	5.99
2035	557.36	17.57	6.37	6.01
2036	557.42	17.57	6.43	6.07
2037	557.48	17.57	6.49	6.12
2038	557.53	17.57	6.55	6.18
2039	557.59	17.57	6.61	6.24
2040	557.65	17.57	6.67	6.30
2041	557.70	17.57	6.73	6.36
2042	557.76	17.57	6.79	6.43
2043	557.82	17.56	6.85	6.49
2044	557.87	17.56	6.91	6.55
2045	557.93	17.56	6.97	6.61
2046	557.99	17.56	7.04	6.68
2047	558.04	17.56	7.10	6.74
2048	558.10	17.56	7.17	6.81
2049	558.16	17.56	7.23	6.87
2050	558.21	17.56	7.30	6.94
2051	558.27	17.56	7.36	7.01
2052	558.33	17.56	7.43	7.07
2053	558.38	17.56	7.50	7.14
2054	558.44	17.56	7.57	7.21
2055	558.50	17.56	7.63	7.28
Levelized (2021–2030)	555.55	16.82	4.56	4.20
Levelized (2021–2035)	556.10	17.08	5.11	4.75
Levelized (2021–2050)	552.49	17.51	11.15	13.51

Table 155. Intrastate gas supply DRIPE and gas cross-DRIPE for Connecticut (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
2021	0.00	0.24	0.24	0.44	0.38	0.24	0.44	0.39	0.38	0.02	1.21	1.21	2.21	1.88	1.21	1.21	1.21	1.48
2022	0.01	0.36	0.36	0.67	0.57	0.36	0.67	0.59	0.58	0.03	1.82	1.82	3.33	2.84	1.82	1.82	1.82	2.23
2023	0.01	0.44	0.44	0.81	0.68	0.44	0.81	0.71	0.70	0.03	2.08	2.08	3.80	3.24	2.08	2.08	2.08	2.54
2024	0.01	0.35	0.35	0.64	0.55	0.35	0.64	0.56	0.56	0.03	1.68	1.68	3.08	2.62	1.68	1.68	1.68	2.06
2025	0.01	0.24	0.24	0.45	0.38	0.24	0.45	0.39	0.39	0.03	1.43	1.43	2.61	2.23	1.43	1.43	1.43	1.75
2026	0.01	0.17	0.17	0.32	0.27	0.17	0.32	0.28	0.28	0.03	0.98	0.98	1.78	1.52	0.98	0.98	0.98	1.20
2027	0.01	0.12	0.12	0.21	0.18	0.12	0.21	0.19	0.19	0.03	0.61	0.61	1.09	0.93	0.61	0.61	0.61	0.74
2028	0.01	0.09	0.09	0.16	0.14	0.09	0.16	0.14	0.14	0.03	0.43	0.43	0.76	0.65	0.43	0.43	0.43	0.52
2029	0.01	0.06	0.06	0.10	0.08	0.06	0.10	0.08	0.08	0.03	0.27	0.27	0.46	0.39	0.27	0.27	0.27	0.32
2030	0.01	0.03	0.03	0.05	0.04	0.03	0.05	0.04	0.04	0.03	0.12	0.12	0.19	0.17	0.12	0.12	0.12	0.14
2031	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01
2032	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.01	0.21	0.21	0.39	0.33	0.21	0.39	0.34	0.34	0.03	1.08	1.08	1.96	1.67	1.08	1.08	1.08	1.31
2021–2035	0.01	0.15	0.15	0.26	0.23	0.15	0.26	0.23	0.23	0.03	0.73	0.73	1.33	1.13	0.73	0.73	0.73	0.89
2021–2050	0.01	0.08	0.08	0.14	0.12	0.08	0.14	0.12	0.12	0.04	0.39	0.39	0.71	0.60	0.39	0.39	0.39	0.47

Table 156. Intrastate gas supply DRIPE and gas cross-DRIPE for Massachusetts (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
2021	0.01	0.73	0.73	1.33	1.14	0.73	1.33	1.17	1.16	0.01	0.72	0.72	1.32	1.13	0.72	0.72	0.72	0.88
2022	0.02	1.09	1.09	1.99	1.69	1.09	1.99	1.74	1.72	0.02	1.10	1.10	2.01	1.71	1.10	1.10	1.10	1.34
2023	0.02	1.19	1.19	2.18	1.86	1.19	2.18	1.91	1.89	0.02	1.33	1.33	2.43	2.07	1.33	1.33	1.33	1.62
2024	0.02	0.93	0.93	1.70	1.44	0.93	1.70	1.49	1.47	0.02	1.10	1.10	2.02	1.72	1.10	1.10	1.10	1.35
2025	0.02	0.77	0.77	1.41	1.20	0.77	1.41	1.24	1.22	0.02	0.90	0.90	1.65	1.40	0.90	0.90	0.90	1.10
2026	0.02	0.51	0.51	0.93	0.80	0.51	0.93	0.82	0.81	0.02	0.64	0.64	1.17	1.00	0.64	0.64	0.64	0.79
2027	0.02	0.32	0.32	0.57	0.49	0.32	0.57	0.50	0.50	0.02	0.41	0.41	0.73	0.63	0.41	0.41	0.41	0.50
2028	0.02	0.23	0.23	0.40	0.34	0.23	0.40	0.35	0.35	0.02	0.29	0.29	0.52	0.44	0.29	0.29	0.29	0.35
2029	0.02	0.14	0.14	0.24	0.21	0.14	0.24	0.21	0.21	0.02	0.18	0.18	0.31	0.27	0.18	0.18	0.18	0.22
2030	0.03	0.06	0.06	0.10	0.09	0.06	0.10	0.09	0.09	0.02	0.09	0.09	0.14	0.12	0.09	0.09	0.09	0.10
2031	0.03	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2032	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.02	0.61	0.61	1.10	0.94	0.61	1.10	0.97	0.95	0.02	0.68	0.68	1.25	1.06	0.68	0.68	0.68	0.84
2021–2035	0.02	0.41	0.41	0.75	0.64	0.41	0.75	0.66	0.65	0.02	0.47	0.47	0.85	0.72	0.47	0.47	0.47	0.57
2021–2050	0.03	0.22	0.22	0.40	0.34	0.22	0.40	0.35	0.34	0.02	0.25	0.25	0.45	0.38	0.25	0.25	0.25	0.30

Table 157. Intrastate gas supply DRIPE and gas cross-DRIPE for Maine (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2021	0.00	0.17	0.17	0.32	0.27	0.17	0.32	0.28	0.28	0.02	1.28	1.28	2.34	1.99	1.28	1.28	1.28	1.56
2022	0.00	0.26	0.26	0.49	0.41	0.26	0.49	0.43	0.42	0.03	1.92	1.92	3.52	2.99	1.92	1.92	1.92	2.35
2023	0.00	0.32	0.32	0.59	0.50	0.32	0.59	0.52	0.51	0.04	2.20	2.20	4.02	3.42	2.20	2.20	2.20	2.69
2024	0.00	0.28	0.28	0.51	0.43	0.28	0.51	0.45	0.44	0.04	1.76	1.76	3.21	2.73	1.76	1.76	1.76	2.15
2025	0.00	0.24	0.24	0.44	0.38	0.24	0.44	0.39	0.38	0.04	1.44	1.44	2.62	2.23	1.44	1.44	1.44	1.75
2026	0.00	0.17	0.17	0.31	0.27	0.17	0.31	0.28	0.27	0.04	0.99	0.99	1.79	1.53	0.99	0.99	0.99	1.20
2027	0.00	0.11	0.11	0.19	0.16	0.11	0.19	0.17	0.17	0.04	0.62	0.62	1.11	0.95	0.62	0.62	0.62	0.75
2028	0.00	0.08	0.08	0.13	0.11	0.08	0.13	0.12	0.12	0.04	0.44	0.44	0.78	0.67	0.44	0.44	0.44	0.54
2029	0.00	0.05	0.05	0.08	0.07	0.05	0.08	0.07	0.07	0.04	0.27	0.27	0.47	0.41	0.27	0.27	0.27	0.33
2030	0.00	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.13	0.13	0.20	0.18	0.13	0.13	0.13	0.15
2031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.00	0.17	0.17	0.31	0.27	0.17	0.31	0.28	0.27	0.04	1.12	1.12	2.03	1.73	1.12	1.12	1.12	1.36
2021–2035	0.00	0.12	0.12	0.21	0.18	0.12	0.21	0.19	0.19	0.04	0.76	0.76	1.38	1.18	0.76	0.76	0.76	0.93
2021–2050	0.00	0.06	0.06	0.11	0.10	0.06	0.11	0.10	0.10	0.05	0.40	0.40	0.73	0.62	0.40	0.40	0.40	0.49

Table 158. Intrastate gas supply DRIPE and gas cross-DRIPE for New Hampshire (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2021	0.00	0.16	0.16	0.30	0.25	0.16	0.30	0.26	0.26	0.02	1.29	1.29	2.36	2.01	1.29	1.29	1.29	1.57
2022	0.00	0.25	0.25	0.46	0.39	0.25	0.46	0.40	0.40	0.03	1.94	1.94	3.54	3.02	1.94	1.94	1.94	2.37
2023	0.00	0.30	0.30	0.56	0.47	0.30	0.56	0.49	0.48	0.04	2.22	2.22	4.05	3.45	2.22	2.22	2.22	2.71
2024	0.00	0.27	0.27	0.50	0.42	0.27	0.50	0.44	0.43	0.04	1.76	1.76	3.22	2.74	1.76	1.76	1.76	2.16
2025	0.00	0.24	0.24	0.44	0.38	0.24	0.44	0.39	0.38	0.04	1.43	1.43	2.62	2.23	1.43	1.43	1.43	1.75
2026	0.00	0.17	0.17	0.31	0.27	0.17	0.31	0.27	0.27	0.04	0.99	0.99	1.79	1.53	0.99	0.99	0.99	1.20
2027	0.00	0.11	0.11	0.19	0.16	0.11	0.19	0.17	0.17	0.04	0.62	0.62	1.11	0.95	0.62	0.62	0.62	0.75
2028	0.00	0.07	0.07	0.13	0.11	0.07	0.13	0.12	0.12	0.04	0.45	0.45	0.78	0.67	0.45	0.45	0.45	0.54
2029	0.00	0.05	0.05	0.08	0.07	0.05	0.08	0.07	0.07	0.04	0.28	0.28	0.47	0.41	0.28	0.28	0.28	0.33
2030	0.00	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.13	0.13	0.21	0.18	0.13	0.13	0.13	0.15
2031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.00	0.17	0.17	0.30	0.26	0.17	0.30	0.27	0.26	0.04	1.12	1.12	2.04	1.74	1.12	1.12	1.12	1.37
2021–2035	0.00	0.11	0.11	0.21	0.18	0.11	0.21	0.18	0.18	0.04	0.77	0.77	1.39	1.18	0.77	0.77	0.77	0.93
2021–2050	0.00	0.06	0.06	0.11	0.09	0.06	0.11	0.10	0.10	0.05	0.41	0.41	0.74	0.63	0.41	0.41	0.41	0.49

Table 159. Intrastate gas supply DRIPE and gas cross-DRIPE for Rhode Island (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2021	0.00	0.11	0.11	0.20	0.17	0.11	0.20	0.18	0.17	0.02	1.34	1.34	2.46	2.09	1.34	1.34	1.34	1.64
2022	0.00	0.17	0.17	0.31	0.26	0.17	0.31	0.27	0.27	0.03	2.01	2.01	3.70	3.14	2.01	2.01	2.01	2.47
2023	0.00	0.21	0.21	0.37	0.32	0.21	0.37	0.33	0.32	0.04	2.31	2.31	4.24	3.61	2.31	2.31	2.31	2.83
2024	0.00	0.16	0.16	0.28	0.24	0.16	0.28	0.24	0.24	0.04	1.88	1.88	3.44	2.93	1.88	1.88	1.88	2.30
2025	0.00	0.13	0.13	0.23	0.20	0.13	0.23	0.21	0.20	0.04	1.54	1.54	2.83	2.41	1.54	1.54	1.54	1.89
2026	0.00	0.10	0.10	0.17	0.14	0.10	0.17	0.15	0.15	0.04	1.06	1.06	1.94	1.65	1.06	1.06	1.06	1.30
2027	0.00	0.06	0.06	0.10	0.09	0.06	0.10	0.09	0.09	0.04	0.67	0.67	1.20	1.03	0.67	0.67	0.67	0.81
2028	0.00	0.04	0.04	0.07	0.06	0.04	0.07	0.06	0.06	0.04	0.48	0.48	0.85	0.73	0.48	0.48	0.48	0.58
2029	0.00	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.30	0.30	0.51	0.44	0.30	0.30	0.30	0.35
2030	0.00	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.04	0.14	0.14	0.22	0.19	0.14	0.14	0.14	0.16
2031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.00	0.10	0.10	0.18	0.16	0.10	0.18	0.16	0.16	0.04	1.19	1.19	2.16	1.84	1.19	1.19	1.19	1.45
2021–2035	0.00	0.07	0.07	0.12	0.11	0.07	0.12	0.11	0.11	0.04	0.81	0.81	1.47	1.25	0.81	0.81	0.81	0.99
2021–2050	0.00	0.04	0.04	0.07	0.06	0.04	0.07	0.06	0.06	0.05	0.43	0.43	0.78	0.67	0.43	0.43	0.43	0.52

Table 160. Intrastate gas supply DRIPE and gas cross-DRIPE for Vermont (2021 $ per MMBtu)

	Zone-on-Zone									Zone-on-ROP								
	Gas Supply DRIPE	G-E Cross DRIPE								Gas Supply DRIPE	G-E Cross DRIPE							
		Residential				Commercial & Industrial			All end-uses		Residential				Commercial & Industrial			All end-uses
		Non Heating	Hot Water	Heating	All	Non Heating	Heating	All			Non Heating	Hot Water	Heating	All	Non Heating	Heating	All	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2021	0.00	0.03	0.03	0.06	0.05	0.03	0.06	0.05	0.05	0.02	1.42	1.42	2.59	2.21	1.42	1.42	1.42	1.73
2022	0.00	0.05	0.05	0.09	0.08	0.05	0.09	0.08	0.08	0.03	2.14	2.14	3.91	3.33	2.14	2.14	2.14	2.61
2023	0.00	0.06	0.06	0.11	0.09	0.06	0.11	0.09	0.09	0.04	2.46	2.46	4.50	3.83	2.46	2.46	2.46	3.01
2024	0.00	0.05	0.05	0.10	0.08	0.05	0.10	0.08	0.08	0.04	1.98	1.98	3.62	3.09	1.98	1.98	1.98	2.42
2025	0.00	0.04	0.04	0.08	0.07	0.04	0.08	0.07	0.07	0.04	1.63	1.63	2.98	2.54	1.63	1.63	1.63	1.99
2026	0.00	0.03	0.03	0.06	0.05	0.03	0.06	0.05	0.05	0.04	1.13	1.13	2.04	1.74	1.13	1.13	1.13	1.37
2027	0.00	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.71	0.71	1.27	1.09	0.71	0.71	0.71	0.86
2028	0.00	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.04	0.51	0.51	0.89	0.77	0.51	0.51	0.51	0.61
2029	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.31	0.31	0.54	0.46	0.31	0.31	0.31	0.37
2030	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.05	0.15	0.15	0.23	0.20	0.15	0.15	0.15	0.17
2031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2052	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2053	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2054	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2055	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Levelized																		
2021–2030	0.00	0.03	0.03	0.06	0.05	0.03	0.06	0.05	0.05	0.04	1.26	1.26	2.29	1.95	1.26	1.26	1.26	1.54
2021–2035	0.00	0.02	0.02	0.04	0.03	0.02	0.04	0.03	0.03	0.04	0.86	0.86	1.56	1.33	0.86	0.86	0.86	1.05
2021–2050	0.00	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.05	0.45	0.45	0.82	0.70	0.45	0.45	0.45	0.55

Table 161. Avoided natural gas costs by costing period – southern New England (2021 $ per MMBtu)

Years	Baseload	Winter/Shoulder	Winter	Top 90	Top 30	Top 10
Days	*365*	*273*	*151*	*90*	*30*	*10*
2021	$4.45	$5.61	$7.69	$8.67	$16.69	$29.84
2022	$4.24	$5.44	$7.69	$10.19	$19.27	$33.14
2023	$4.03	$5.20	$7.41	$10.03	$18.98	$32.63
2024	$4.35	$5.52	$7.73	$10.35	$19.51	$33.20
2025	$4.41	$5.57	$7.76	$10.42	$19.61	$33.22
2026	$4.52	$5.66	$7.84	$10.54	$19.79	$33.33
2027	$4.58	$5.71	$7.86	$10.61	$19.89	$33.34
2028	$4.72	$5.85	$7.99	$10.76	$20.15	$33.56
2029	$4.85	$5.96	$8.09	$10.91	$20.37	$33.75
2030	$4.91	$6.01	$8.12	$10.97	$20.47	$33.77
2031	$4.92	$6.02	$8.11	$11.00	$20.49	$33.68
2032	$4.99	$6.08	$8.15	$11.08	$20.61	$33.73
2033	$5.06	$6.13	$8.19	$11.15	$20.72	$33.77
2034	$5.08	$6.15	$8.19	$11.18	$20.76	$33.72
2035	$5.09	$6.15	$8.17	$11.20	$20.77	$33.63
2036	$5.14	$6.18	$8.19	$11.25	$20.83	$33.61
2037	$5.18	$6.21	$8.20	$11.30	$20.90	$33.59
2038	$5.22	$6.25	$8.22	$11.35	$20.97	$33.58
2039	$5.27	$6.28	$8.23	$11.40	$21.04	$33.56
2040	$5.31	$6.31	$8.25	$11.45	$21.11	$33.55
2041	$5.36	$6.34	$8.26	$11.50	$21.18	$33.53
2042	$5.40	$6.38	$8.28	$11.55	$21.25	$33.52
2043	$5.45	$6.41	$8.29	$11.60	$21.32	$33.50
2044	$5.50	$6.45	$8.31	$11.66	$21.39	$33.48
2045	$5.54	$6.48	$8.32	$11.71	$21.46	$33.47
2046	$5.59	$6.51	$8.34	$11.76	$21.54	$33.45
2047	$5.64	$6.55	$8.35	$11.81	$21.61	$33.44
2048	$5.69	$6.58	$8.37	$11.87	$21.68	$33.42
2049	$5.73	$6.62	$8.38	$11.92	$21.75	$33.40
2050	$5.78	$6.65	$8.40	$11.97	$21.82	$33.39
2051	$5.83	$6.69	$8.41	$12.03	$21.89	$33.37
2052	$5.88	$6.72	$8.43	$12.08	$21.97	$33.36
2053	$5.93	$6.76	$8.45	$12.13	$22.04	$33.34
2054	$5.98	$6.79	$8.46	$12.19	$22.11	$33.33
2055	$6.03	$6.83	$8.48	$12.24	$22.19	$33.31

Table 162. Avoided natural gas costs by costing period – northern New England (2021 $ per MMBtu)

Years	Baseload	Winter/Shoulder	Winter	Top 90	Top 30	Top 10
Days	*365*	*273*	*151*	*90*	*30*	*10*
2021	$4.28	$5.33	$7.23	$11.55	$19.19	$30.24
2022	$4.07	$5.17	$7.24	$11.65	$21.82	$31.77
2023	$3.86	$4.94	$6.96	$11.30	$21.58	$31.63
2024	$4.18	$5.26	$7.29	$11.60	$22.15	$31.96
2025	$4.25	$5.32	$7.33	$11.60	$22.30	$32.05
2026	$4.36	$5.41	$7.41	$11.63	$22.53	$32.18
2027	$4.42	$5.47	$7.45	$11.63	$22.67	$32.26
2028	$4.56	$5.60	$7.58	$11.71	$22.97	$32.44
2029	$4.69	$5.72	$7.69	$11.78	$23.24	$32.59
2030	$4.75	$5.78	$7.73	$11.78	$23.38	$32.68
2031	$4.77	$5.79	$7.72	$11.73	$23.44	$32.71
2032	$4.84	$5.85	$7.77	$11.74	$23.60	$32.80
2033	$4.91	$5.91	$7.82	$11.75	$23.75	$32.89
2034	$4.94	$5.93	$7.82	$11.71	$23.83	$32.94
2035	$4.95	$5.93	$7.81	$11.66	$23.87	$32.96
2036	$5.00	$5.97	$7.83	$11.64	$23.98	$33.03
2037	$5.04	$6.00	$7.85	$11.63	$24.09	$33.09
2038	$5.09	$6.04	$7.88	$11.61	$24.20	$33.15
2039	$5.14	$6.08	$7.90	$11.59	$24.31	$33.22
2040	$5.18	$6.11	$7.92	$11.57	$24.43	$33.28
2041	$5.23	$6.15	$7.94	$11.55	$24.54	$33.34
2042	$5.28	$6.19	$7.96	$11.54	$24.65	$33.41
2043	$5.33	$6.23	$7.99	$11.52	$24.76	$33.47
2044	$5.38	$6.27	$8.01	$11.50	$24.88	$33.54
2045	$5.43	$6.30	$8.03	$11.48	$24.99	$33.60
2046	$5.48	$6.34	$8.05	$11.46	$25.11	$33.66
2047	$5.53	$6.38	$8.08	$11.45	$25.22	$33.73
2048	$5.58	$6.42	$8.10	$11.43	$25.34	$33.79
2049	$5.63	$6.46	$8.12	$11.41	$25.45	$33.86
2050	$5.68	$6.50	$8.14	$11.39	$25.57	$33.92
2051	$5.73	$6.54	$8.17	$11.37	$25.69	$33.99
2052	$5.79	$6.58	$8.19	$11.36	$25.80	$34.05
2053	$5.84	$6.62	$8.21	$11.34	$25.92	$34.12
2054	$5.89	$6.66	$8.23	$11.32	$26.04	$34.18
2055	$5.95	$6.70	$8.26	$11.30	$26.16	$34.25

APPENDIX D: DETAILED OIL AND OTHER FUELS OUTPUTS

This appendix provides avoided costs for fuel oil and other fuels by year, and by sector. As in the above appendices, annual data is provided alongside levelized costs over three different costing periods: 10-year (2021–2030), 15-year (2021–2035), and 30-year periods (2021–2050). This appendix also details emission values for SO_2, NO_X, CO_2, and CO_2 priced at $100 per ton. Note that these costs and emission values are assumed to be the same for all states and reporting regions in New England.

Table 163 provides the avoided costs for three types of fuel:

- Fuel Oils, which includes distillate fuel oil, residual fuel oil, and a weighted average
- Other Fuels, which includes cord wood, wood pellets, kerosene, and propane
- Transportation fuels, including motor gasoline and motor diesel

Avoided costs for these fuels are shown by year and by applicable sector (residential, commercial, industrial, and/or transportation).

Table 164, Table 165, Table 166, and Table 167 provide information on DRIPE values for specific petroleum products. These tables modify the values shown in Table 104 by multiplying those by the adjustment factors described in Table 105.

All values are also provided in the standalone Excel workbook titled “Appendix D.”

Table 163. Avoided costs of petroleum fuels and other fuels by sector (2021 $ per MMBtu)

Year	Fuel oils							Other Fuels					Transportation	
	Residential	Commercial			Industrial			Residential				Industrial		
	Distillate Fuel Oil	Distillate Fuel Oil	Residual Fuel Oil	Weighted	Distillate Fuel Oil	Residual Fuel Oil	Weighted	Cord Wood	Wood Pellets	Kero-sene	Pro-pane	Kero-sene	Motor Gasoline	Motor Diesel
2021	$19	$21	$15	$21	$20	$15	$20	$17	$18	$24	$34	$17	$20	$20
2022	$19	$20	$14	$20	$19	$14	$19	$17	$18	$24	$34	$16	$21	$20
2023	$21	$21	$15	$21	$20	$15	$20	$19	$20	$26	$36	$17	$21	$21
2024	$23	$21	$15	$21	$21	$15	$20	$20	$21	$28	$37	$17	$21	$22
2025	$23	$22	$15	$21	$21	$15	$20	$20	$22	$29	$38	$18	$21	$22
2026	$24	$22	$15	$21	$21	$15	$20	$21	$23	$30	$39	$18	$21	$22
2027	$25	$22	$15	$22	$21	$15	$21	$21	$23	$30	$39	$18	$21	$23
2028	$25	$22	$16	$22	$22	$16	$21	$22	$23	$31	$40	$18	$22	$23
2029	$25	$23	$16	$22	$22	$16	$21	$22	$24	$31	$40	$18	$22	$23
2030	$26	$23	$16	$23	$22	$16	$22	$22	$24	$32	$40	$19	$23	$24
2031	$26	$23	$16	$23	$22	$16	$22	$22	$24	$32	$41	$19	$23	$24
2032	$26	$23	$17	$23	$23	$17	$22	$23	$24	$32	$41	$19	$24	$24
2033	$26	$24	$17	$23	$23	$17	$22	$23	$25	$32	$41	$19	$24	$24
2034	$26	$24	$17	$23	$23	$17	$22	$23	$25	$32	$41	$19	$24	$25
2035	$27	$24	$17	$24	$23	$17	$23	$23	$25	$33	$41	$19	$24	$25
2036	$27	$24	$17	$24	$23	$17	$23	$23	$25	$33	$41	$20	$25	$25
2037	$27	$24	$17	$24	$23	$17	$23	$23	$25	$33	$42	$20	$25	$25
2038	$27	$24	$17	$24	$24	$17	$23	$23	$25	$33	$42	$20	$25	$25
2039	$27	$25	$17	$24	$24	$17	$23	$24	$25	$33	$42	$20	$25	$25
2040	$27	$25	$18	$25	$24	$18	$23	$24	$26	$34	$42	$20	$26	$26
2041	$28	$25	$18	$25	$24	$18	$24	$24	$26	$34	$42	$20	$26	$26
2042	$28	$25	$18	$25	$24	$18	$24	$24	$26	$34	$42	$21	$26	$26
2043	$28	$25	$18	$25	$25	$18	$24	$24	$26	$34	$43	$21	$27	$26
2044	$28	$26	$18	$25	$25	$18	$24	$24	$26	$35	$43	$21	$27	$26
2045	$28	$26	$18	$25	$25	$18	$24	$25	$26	$35	$43	$21	$27	$26
2046	$28	$26	$18	$26	$25	$18	$25	$25	$27	$35	$43	$21	$28	$27
2047	$29	$26	$19	$26	$25	$19	$25	$25	$27	$35	$43	$21	$28	$27
2048	$29	$26	$19	$26	$26	$19	$25	$25	$27	$35	$44	$22	$28	$27
2049	$29	$27	$19	$26	$26	$19	$25	$25	$27	$36	$44	$22	$29	$27
2050	$29	$27	$19	$26	$26	$19	$25	$25	$27	$36	$44	$22	$29	$27
2051	$29	$27	$19	$27	$26	$19	$26	$25	$27	$36	$44	$22	$29	$28
2052	$30	$27	$19	$27	$26	$19	$26	$26	$28	$36	$44	$22	$30	$28
2053	$30	$27	$19	$27	$27	$19	$26	$26	$28	$37	$44	$22	$30	$28
2054	$30	$28	$20	$27	$27	$20	$26	$26	$28	$37	$45	$23	$30	$28
2055	$30	$28	$20	$28	$27	$20	$26	$26	$28	$37	$45	$23	$31	$28
2021-2029	$23	$22	$15	$21	$21	$15	$20	$20	$22	$28	$38	$18	$21	$22
2021-2035	$24	$22	$16	$22	$21	$16	$21	$21	$22	$30	$39	$18	$22	$23
2021-2050	$26	$24	$17	$23	$23	$17	$22	$22	$24	$32	$41	$19	$24	$24

Note: Assumes a real discount rate of 0.81 percent.

Table 164. Home heating (diesel) fuel DRIPE by state (2021 $ per MMBtu)

Year	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.09	0.02	0.04	0.01	0.01	0.01	0.00	0.07	0.05	0.07	0.08	0.08	0.08
2022	0.09	0.02	0.04	0.01	0.01	0.01	0.01	0.07	0.05	0.08	0.08	0.09	0.09
2023	0.10	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.09	0.09
2024	0.11	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.10	0.10
2025	0.11	0.02	0.05	0.01	0.01	0.01	0.01	0.09	0.06	0.10	0.10	0.10	0.10
2026	0.11	0.03	0.05	0.01	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11
2027	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11
2028	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.11	0.11	0.11
2029	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.11	0.11	0.11
2030	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2031	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2032	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2033	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2034	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2035	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2036	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2037	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.11	0.12	0.12
2038	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2039	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2040	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2041	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2042	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.13
2043	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2044	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2045	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2046	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2047	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2048	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2049	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2050	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2051	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2052	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2053	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.13
2054	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.13
2055	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.13
Levelized (2021–2035)	0.11	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11

Table 165. Residual fuel DRIPE by state (2021 $ per MMBtu)

Year	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.05	0.01	0.02	0.01	0.01	0.00	0.00	0.04	0.03	0.04	0.04	0.05	0.05
2022	0.05	0.01	0.02	0.01	0.01	0.00	0.00	0.04	0.03	0.05	0.05	0.05	0.05
2023	0.06	0.01	0.02	0.01	0.01	0.00	0.00	0.05	0.03	0.05	0.05	0.06	0.06
2024	0.06	0.01	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.05	0.06	0.06	0.06
2025	0.06	0.01	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.06	0.06	0.06	0.06
2026	0.07	0.01	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.06	0.06	0.06	0.06
2027	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.06	0.06	0.06	0.06
2028	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.06	0.06	0.07	0.07
2029	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.06	0.07	0.07
2030	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.06	0.07	0.07
2031	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.07	0.07	0.07
2032	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.07	0.07	0.07
2033	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.07	0.07	0.07
2034	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.07	0.07	0.07
2035	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.06	0.07	0.07	0.07
2036	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.07	0.07	0.07	0.07
2037	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.07	0.07	0.07	0.07
2038	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.07	0.07	0.07	0.07
2039	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.07	0.07	0.07	0.07
2040	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.04	0.07	0.07	0.07	0.07
2041	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.07
2042	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.07
2043	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.07
2044	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.07
2045	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.07
2046	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.07	0.08
2047	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2048	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2049	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2050	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2051	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2052	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2053	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2054	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.06	0.05	0.07	0.07	0.08	0.08
2055	0.08	0.02	0.04	0.01	0.01	0.00	0.00	0.07	0.05	0.07	0.07	0.08	0.08
Levelized (2021–2035)	0.07	0.02	0.03	0.01	0.01	0.00	0.00	0.05	0.04	0.06	0.06	0.06	0.06

Table 166. Motor gasoline DRIPE by state (2021 $ per MMBtu)

Year	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.08	0.02	0.04	0.01	0.01	0.00	0.00	0.07	0.05	0.07	0.08	0.08	0.08
2022	0.09	0.02	0.04	0.01	0.01	0.01	0.01	0.07	0.05	0.08	0.08	0.09	0.09
2023	0.10	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.09	0.09
2024	0.11	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.10	0.10
2025	0.11	0.02	0.05	0.01	0.01	0.01	0.01	0.09	0.06	0.10	0.10	0.10	0.10
2026	0.11	0.03	0.05	0.01	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11
2027	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11
2028	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.11	0.11	0.11
2029	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.11	0.11	0.11
2030	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.11	0.11	0.12	0.12
2031	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2032	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2033	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2034	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2035	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2036	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2037	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2038	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2039	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.11	0.12	0.12
2040	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2041	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2042	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2043	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2044	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2045	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2046	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2047	0.14	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2048	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2049	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2050	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2051	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2052	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2053	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2054	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.13
2055	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.13
Levelized (2021–2035)	0.11	0.03	0.05	0.01	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11

Table 167. Motor diesel DRIPE by state (2021 $ per MMBtu)

Year	Zone-on-Zone DRIPE							Zone on Rest-of-Region DRIPE					
	All	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*	*CT*	*MA*	*ME*	*NH*	*RI*	*VT*
2021	0.10	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.09	0.09
2022	0.11	0.02	0.04	0.01	0.01	0.01	0.01	0.08	0.06	0.09	0.09	0.10	0.10
2023	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.09	0.07	0.10	0.10	0.11	0.11
2024	0.12	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2025	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.07	0.11	0.11	0.12	0.12
2026	0.13	0.03	0.05	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12
2027	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.12	0.12	0.13	0.13
2028	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2029	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.12	0.13	0.13
2030	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.12	0.13	0.13	0.14
2031	0.14	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.08	0.13	0.13	0.14	0.14
2032	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.09	0.13	0.13	0.14	0.14
2033	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.09	0.13	0.13	0.14	0.14
2034	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.09	0.13	0.13	0.14	0.14
2035	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.11	0.09	0.13	0.13	0.14	0.14
2036	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.13	0.14	0.14
2037	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.13	0.14	0.14
2038	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.13	0.14	0.14
2039	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.13	0.14	0.14
2040	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.14	0.14	0.14
2041	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.14	0.14	0.14
2042	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.14	0.14	0.14
2043	0.15	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.14	0.15	0.15
2044	0.16	0.03	0.06	0.02	0.02	0.01	0.01	0.12	0.09	0.13	0.14	0.15	0.15
2045	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2046	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2047	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2048	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2049	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2050	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.12	0.09	0.14	0.14	0.15	0.15
2051	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.13	0.09	0.14	0.14	0.15	0.15
2052	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.13	0.10	0.14	0.14	0.15	0.15
2053	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.13	0.10	0.14	0.15	0.15	0.15
2054	0.16	0.04	0.07	0.02	0.02	0.01	0.01	0.13	0.10	0.14	0.15	0.16	0.16
2055	0.17	0.04	0.07	0.02	0.02	0.01	0.01	0.13	0.10	0.14	0.15	0.16	0.16
Levelized (2021–2035)	0.13	0.03	0.06	0.02	0.01	0.01	0.01	0.10	0.08	0.11	0.12	0.12	0.12

APPENDIX E: COMMON FINANCIAL PARAMETERS

This appendix presents values for converting nominal dollars to constant 2021 dollars (2021 $) as well as a real discount rate for calculating illustrative levelized avoided costs. These values are used throughout the AESC 2021 study, including in calculations that convert constant to nominal dollars and in levelization calculations. Note also that the *AESC 2021 User Interface* workbook allows users to specify their own discount rate in the calculation of levelized costs.

In summary, we present a long-term inflation rate similar to those used in past versions of the AESC study, but a lower real discount rate than has previously been used based on the recent rates for U.S. Treasury Bills. Those values are below:

- The value for converting between future nominal dollars and constant 2021 $ is a long-term inflation rate of 2.00 percent (the same used as in AESC 2018).
- The real discount rate is 0.81 percent (versus 1.34 percent in AESC 2018).

Conversion of nominal dollars to constant 2021 dollars

Unless otherwise stated, all dollar values in AESC 2021 are in 2021 dollars. Therefore, a set of inflators is needed to convert prior year nominal dollars into 2021 $, and a set of deflators to convert future year nominal dollars into 2021$. Those values are presented in Table 168. The inflators are calculated from the GDP chain-type price index published by the U.S. Department of Commerce's Bureau of Economic Analysis.[364] The inflation rate during 2020 has varied from a low of 0.1 percent in May and increased to 1.3 percent in August. Based on this upward trend we model an inflation rate of 1.5 percent for 2020.

Table 168. GDP price index and inflation rate

Year	GDP Chain-Type Price Index	Annual Inflation	Conversion from nominal $ to 2021$
2000	78.08		1.489
2001	79.79	2.19%	1.457
2002	81.05	1.58%	1.434
2003	82.56	1.86%	1.408
2004	84.78	2.69%	1.371
2005	87.42	3.12%	1.330
2006	90.07	3.03%	1.290
2007	92.49	2.69%	1.257
2008	94.29	1.95%	1.233
2009	95.00	0.76%	1.223

[364] U.S. Department of Commerce, Bureau of Economic Analysis, Table 1.1.9 Implicit Price Deflators for Gross Domestic Product, 8/20/20.

Year	GDP Chain-Type Price Index	Annual Inflation	Conversion from nominal $ to 2021$
2010	96.11	1.17%	1.209
2011	98.12	2.09%	1.185
2012	100.00	1.92%	1.162
2013	101.76	1.76%	1.142
2014	103.64	1.85%	1.121
2015	104.62	0.95%	1.111
2016	105.72	1.05%	1.099
2017	107.71	1.88%	1.079
2018	110.30	2.40%	1.054
2019	112.27	1.79%	1.035
2020	113.95	1.50%	1.020
2021	**116.23**	**2.00%**	**1.000**
2022	118.55	2.00%	0.980
2023	120.92	2.00%	0.961
2024	123.34	2.00%	0.942
2025	125.81	2.00%	0.924
2026	128.33	2.00%	0.906
2027	130.89	2.00%	0.888
2028	133.51	2.00%	0.871
2029	136.18	2.00%	0.853
2030	138.90	2.00%	0.837
2031	141.68	2.00%	0.820
2032	144.51	2.00%	0.804
2033	147.41	2.00%	0.788
2034	150.35	2.00%	0.773
2035	153.36	2.00%	0.758
2036	156.43	2.00%	0.743
2037	159.56	2.00%	0.728
2038	162.75	2.00%	0.714
2039	166.00	2.00%	0.700
2040	169.32	2.00%	0.686
2041	172.71	2.00%	0.673
2042	176.16	2.00%	0.660
2043	179.69	2.00%	0.647
2044	183.28	2.00%	0.634
2045	186.95	2.00%	0.622
2046	190.68	2.00%	0.610
2047	194.50	2.00%	0.598
2048	198.39	2.00%	0.586
2049	202.36	2.00%	0.574
2050	206.40	2.00%	0.563

For the years in our analysis, we use a long-term inflation rate of 2.00 percent. This is the same inflation rate used in the AESC 2018 study. The 2 percent inflation rate is also consistent with the 20-year annual average inflation rate from 2001 to 2019 of 1.93 percent, derived from the GDP chain-type price index. We also examined projections of long-term inflation made by the Congressional Budget Office (CBO) in January 2020 which were 2.00 percent for 2025–2030.[365] In both August and September, the Federal Reserve Board indicated its intent of maintaining a long-term average inflation rate of 2.0 percent. The rate may however vary over the shorter term to address employment problems.[366] Note also that the long-term rate used in the 2020 AEO was 2.30 percent.[367]

Real discount rate

The calculation of the real discount rate uses the inflation rate, as discussed above, in conjunction with the long-term nominal discount rate. To develop a real discount rate, we used the calculated nominal rate and the forecast long-term inflation rate (2.00 percent) according to the formula in Equation 17.

Equation 17. Calculating the real discount rate

$$Real\ discount\ rate = \frac{1 + nominal\ discount\ rate}{1 + inflation\ rate} - 1$$

For the nominal discount rate, past AESC studies have generally used 30-year Treasury bills. Because of unusual market conditions (where short-term rates were higher than long-term rates) in AESC 2018 we used a blending of the 10-year and 30-year rates. For this study we return to the use of the 30-year T-Bills. Rates on Treasury bills have declined dramatically in recent years, and have continued to do so to a greater degree during the COVID-19 pandemic (see Figure 62). Through most of 2018, treasury bill rates were about 3 percent, and then declined to about 2.5 percent in 2019. As of July 2020, because of the effects of the COVID-19 pandemic, the 30-year bills were at 1.25 percent and 10-year bills were at 0.62 percent.[368]

Since AESC 2021 requires a long-term value, we use the average of the 30-year T-Bill rates for the two years prior to the COVID-19 pandemic,[369] which is 2.82 percent. This is not greatly different than the

[365] CBO, The Budget and Economic Outlook: Fiscal Years 2020 to 2030, Table 2-1, page 30, January 2020. The same 2025-2030 GDP price index value of 2.0 percent was in the July 2020 update.

[366] Federal Reserve. August 27, 2020. "Federal Open Market Committee Announces Approval of Updates to its Statement on Longer-Run Goals and Monetary Policy Strategy." *Federalreserve.gov.* Available at https://www.federalreserve.gov/newsevents/pressreleases/monetary20200827a.htm.

[367] U.S. EIA. Last accessed March 10, 2021. "Annual Energy Outlook 2020." *Eia.gov.* Available at https://www.eia.gov/outlooks/aeo/data/browser/#/?id=18-AEO2020&cases=ref2020&sourcekey=0.

[368] As of January 2021, 30-year bills were at 1.87 percent and 10-year bills were at 1.12 percent. These are not substantially different enough to warrant altering the results presented here.

[369] From January 2018 through January 2020.

rate of 3.37 percent used In AESC 2018. This results in a nominal discount rate of 2.82 percent. The resultant future nominal price indices are shown in shown in Table 169.

Figure 62. Recent treasury bill rates at the time of AESC 2021's input assumption development

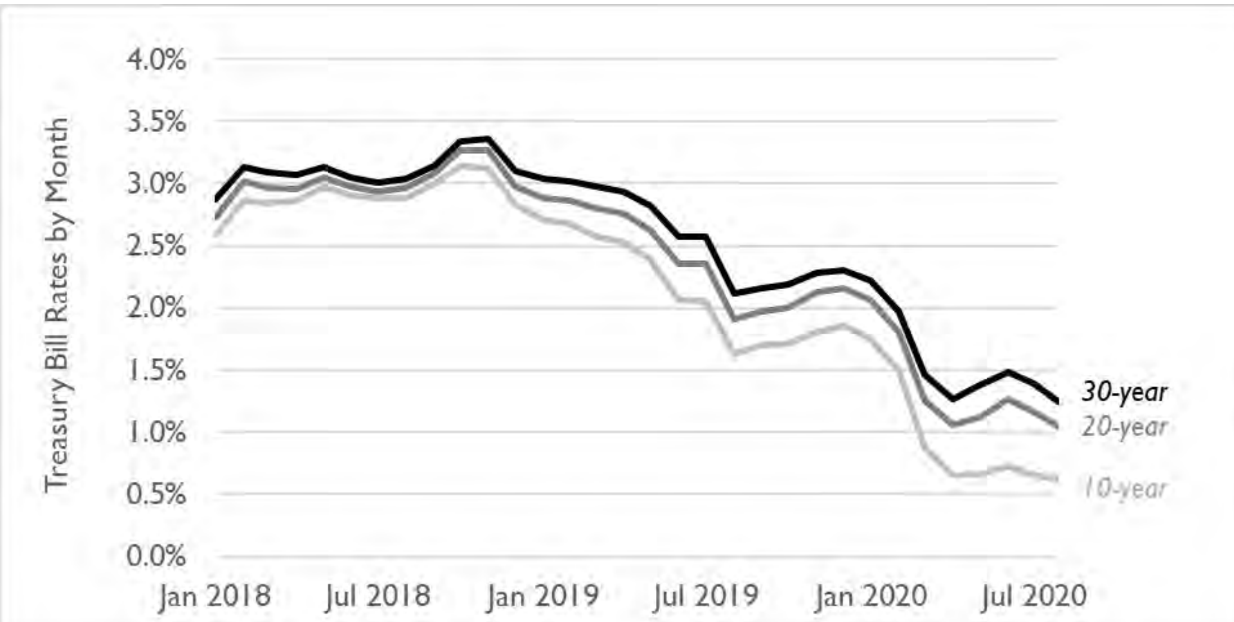


Table 169. Composite nominal rate calculation

Year	Rate	Index	Year	Rate	Index
2021	2.82%	1.000	2039	2.82%	1.650
2022	2.82%	1.028	2040	2.82%	1.697
2023	2.82%	1.057	2041	2.82%	1.745
2024	2.82%	1.087	2042	2.82%	1.794
2025	2.82%	1.118	2043	2.82%	1.845
2026	2.82%	1.149	2044	2.82%	1.897
2027	2.82%	1.182	2045	2.82%	1.950
2028	2.82%	1.215	2046	2.82%	2.005
2029	2.82%	1.249	2047	2.82%	2.062
2030	2.82%	1.285	2048	2.82%	2.120
2031	2.82%	1.321	2049	2.82%	2.180
2032	2.82%	1.358	2050	2.82%	2.242
2033	2.82%	1.397			
2034	2.82%	1.436			
2035	2.82%	1.476			
2036	2.82%	1.518			
2037	2.82%	1.561			
2038	2.82%	1.605			

Notes: A nominal rate of 2.82 percent used throughout the period.

AESC 2021 requires the calculation of illustrative levelized avoided costs expressed in 2021$ for various intervals using the identified real discount rate. Note that the *AESC 2021 User Interface* workbook allows readers of AESC 2021 to input their preferred discount rate to calculate levelized avoided costs.

The real discount rate formula produces a rate of 0.81 percent, which appears reasonable for calculations of levelized costs through periods as long as 30 years.[370] This is lower than the AESC 2018 rate of 1.34 percent and significantly lower than the AESC 2015 rate of 2.43 percent. But as discussed above, the longer-term nominal return rates have declined considerably. We thus rely on a real discount rate of 0.81 percent. A lower discount rate means that future costs and savings will have greater effects on the net present value calculations. Table 170 presents a summary of our findings.

Table 170. Comparison of real discount rate estimates

	AESC 2018	Treasury Bill Method	Congressional Budget Office		AESC 2021
		8/20/2020	*Jan-20*	*Jul-20*	
Long-term nominal rate	3.37%	1.05%	3.00%	2.60%	**2.82%**
Source	Composite of 10 and 30-year Treasury rates	30-year T-Bills with maturities 2030–2049	Forecast: 10-year Treasury notes 2025–2030	Forecast: 10-year Treasury notes 2025–2030	**30 Year T-Bills Jan 2018–Jan 2020**
Inflation Rate	2.00%	2.00%	2.00%	2.00%	**2.00%**
Source	Above historical average of 1.88%, but below AEO 2017 projection of 2.1%; same as CBO forecast	Slightly above historical average, but greater than the long-term rate	Core PCE Price Index 2025–2030	Core PCE Price Index 2025–2030	**Above historical average of 1.88%, but below AEO 2020 projection of 2.3%; same as CBO forecast**
Resulting long-term real discount rate	1.34%	-0.93%	0.98%	0.59%	**0.81%**

Sources: January 2020 CBO rate is taken from "The Budget and Economic Outlook: Fiscal Years 2020 to 2030," Congressional Budget Office, January 2020, Table 2-1. July 2020. CBO rate is taken from An Update to The Budget and Economic Outlook: Fiscal Years 2020 to 2030*, Congressional Budget Office, July 2020, Table 1.*

[370] This is the standard rate conversion equation used widely and in all previous AESC studies.

Considerations given the COVID-19 pandemic

The effects of the COVID-19 pandemic have greatly affected the U.S. economy. The most significant changes have been declines in employment and economic activity. The effects also show up in the near collapse of interest rates as reflected in the T-Bills. The inflation rate has been affected very little.

APPENDIX F: USER INTERFACE

The *Avoided Cost User Interface* is an Excel-based document that allows readers of AESC 2021 to examine hour-by-hour energy prices and DRIPE values for each reporting region for 2021 through 2035. This document serves as a data aggregator; it pulls together energy and DRIPE data for the traditional AESC costing periods and discount rates, allowing users to view—and modify—levelized avoided costs. This document also provides an extrapolation of energy prices and DRIPE values through 2055, using the extrapolation methodology described in Appendix A: *Usage Instructions*.

However, the main purpose of this document is to allow users to develop avoided costs for periods outside the traditional AESC costing periods of summer off-peak, summer on-peak, winter off-peak, and winter on-peak. Within the *AESC 2021 User Interface*, users can develop customized costs using the following selectable options:

- **Time period:** The interface provides energy and DRIPE values modeled from 2021 through 2035 and extrapolated through 2055.
- **Levelization period:** Users can view costs levelized using the standard levelization periods (10-year, 15-year, and 30-year) or develop their own levelization periods over other years.
- **AESC reporting zone:** Users may choose one of 11 reporting regions for which to calculate avoided costs (including reporting regions not included in Appendix B).
- **Costing period:** Users can view the costs under the traditional four costing periods, or define their own, as follows:
  - Peak load (defined as “X” percent of hours exceeding “Y” percentile of load)
  - Load threshold (defined as “X” hours exceeding “Y MW”)
  - Peak price (defined as “X” percent of hours exceeding “Y” percentile of price)
  - Price threshold (defined as “X” hours exceeding “$Y/MWh”)
- **Counterfactuals:** Users may create avoided costs for each of the four AESC counterfactuals.

APPENDIX G: MARGINAL EMISSION RATES AND NON-EMBEDDED ENVIRONMENTAL COST DETAIL

This appendix presents the modeled emission rates for CO_2 and NO_X in the non-electric sectors (Table 171) and in the electric sector (Table 172). We also present the "RE Factor" in Table 173, which is calculated based on the modeling results and the algorithm described in Section 8.3: *Applying non-embedded costs*. This RE Factor may be applied to the marginal emission rates in Table 172 to determine final marginal emission rates for each state.

Users of AESC 2021 must make a determination for which non-embedded costs are most applicable to their own policy context. For illustrative purposes, Table 174 through Table 176 depict the electric and non-electric non-embedded costs assuming the New England marginal abatement cost derived from electric sector technologies (see Section 8.1: *Non-embedded GHG costs*), under Counterfactual #1 for Massachusetts (as an example state). Users of AESC 2021 may utilize the *AESC 2021 User Interface* to generate analogous tables for each of the non-embedded costs described in Section 8.1: *Non-embedded GHG costs*, for each counterfactual, for each state. These tables account for the removal of embedded costs (RGGI for all states, plus costs associated with 310 CMR 7.74 and 7.75 for Massachusetts).

Note that the avoided costs described in Table 174 through Table 176 are already included in Appendix B. These should not be added, and they are shown here for informational purposes only.

Table 171. Marginal emission rates for non-electric sectors

Fuel	Sector	CO_2	NO_X
Natural Gas	Residential	117	0.092
	Commercial	117	0.098
	Industrial	117	0.098
Distillate fuel oil	Residential	161	0.129
	Commercial	161	0.171
	Industrial	161	0.171
B5 Biofuel	All	153	0.129
B20 Biofuel	All	129	0.129
Kerosene	All	159	0.129
LPG	All	139	0.014
RFO	All	173	0.171
Transportation Diesel	All	161	0.717
Gasoline	All	157	0.124
Wood	All	zero	0.341
Wood & Waste	All	zero	0.355

Sources: CO_2 emissions rates from https://www.eia.gov/environment/emissions/co2_vol_mass.php; NOX emissions rates from EPA, AP 42, Fifth Edition, Volume I. Chapter 1: External Combustion Sources, available at https://www3.epa.gov/ttn/chief/ap42/ch01/index.html; Derived from the National Transportation Statistics tables of the Bureau of Transportation Statistics of the US Department of Transportation. Available at https://www.bts.gov/product/national-transportation-statistics. See Tables 1-35, 4-43, and 4-6M.
Notes: Some emissions rates do not vary by sector or geography and are consistent across years. NO_X emission rates for transportation diesel and gasoline are shown for national averages of all vehicles on the road.

Table 172. Modeled short-term electric sector marginal emissions rates (lb per MWh)

	CO_2				NO_X			
	Winter		Summer		Winter		Summer	
	On Peak	*Off Peak*	*On Peak*	*Off Peak*	*On Peak*	*Off Peak*	*On Peak*	*Off Peak*
2021	756	791	779	799	0.09	0.21	0.14	0.11
2022	740	752	729	813	0.10	0.09	0.14	0.11
2023	732	826	663	932	0.09	0.08	0.11	0.09
2024	791	869	767	967	0.10	0.08	0.12	0.10
2025	796	881	812	966	0.07	0.07	0.12	0.10
2026	756	878	772	939	0.07	0.07	0.11	0.09
2027	682	824	760	930	0.07	0.08	0.11	0.10
2028	686	735	764	822	0.08	0.07	0.12	0.09
2029	702	718	753	794	0.08	0.07	0.11	0.08
2030	636	669	732	760	0.06	0.06	0.09	0.07
2031	648	692	723	768	0.06	0.06	0.09	0.07
2032	644	720	686	774	0.06	0.06	0.09	0.07
2033	652	702	737	788	0.06	0.06	0.08	0.07
2034	678	693	752	770	0.06	0.06	0.08	0.07
2035	691	690	761	793	0.06	0.05	0.07	0.06

We assume all four counterfactuals feature the same marginal emission rates.

Table 173. RE Factor

	CT	MA	ME	NH	RI	VT
2021	0%	0%	0%	1%	0%	8%
2022	0%	0%	0%	1%	0%	9%
2023	0%	0%	0%	1%	0%	11%
2024	0%	0%	0%	1%	0%	12%
2025	0%	0%	0%	1%	0%	13%
2026	0%	0%	0%	1%	0%	14%
2027	0%	0%	0%	1%	0%	16%
2028	0%	0%	0%	1%	0%	17%
2029	0%	0%	0%	1%	0%	18%
2030	0%	0%	0%	1%	0%	19%
2031	0%	0%	0%	1%	0%	21%
2032	0%	0%	0%	1%	0%	22%
2033	0%	0%	0%	1%	0%	22%
2034	0%	0%	0%	1%	0%	22%
2035	0%	0%	0%	1%	0%	22%

Notes: See development methodology in Section 8.3: Applying non-embedded costs*. The RE Factor does not change for different scenarios—see discussion in Chapter 7.* Avoided Cost of Compliance with Renewable Portfolio Standards and Related Clean Energy Policies *as to why.*

Table 174. Electric sector non-embedded costs in Counterfactual #1, WCMA (2021 $ per kWh)

	CO_2				NO_X			
	Winter *On Peak*	Summer *Off Peak*	Winter *On Peak*	Summer *Off Peak*	Winter *On Peak*	Summer *Off Peak*	Winter *On Peak*	Summer *Off Peak*
2021	0.0695	0.0728	0.0717	0.0735	0.0007	0.0015	0.0010	0.0008
2022	0.0575	0.0584	0.0567	0.0632	0.0008	0.0006	0.0010	0.0008
2023	0.0582	0.0657	0.0527	0.0741	0.0006	0.0006	0.0008	0.0007
2024	0.0480	0.0527	0.0465	0.0587	0.0007	0.0006	0.0009	0.0007
2025	0.0484	0.0536	0.0494	0.0587	0.0005	0.0005	0.0009	0.0007
2026	0.0444	0.0515	0.0453	0.0551	0.0005	0.0005	0.0008	0.0007
2027	0.0400	0.0483	0.0446	0.0545	0.0005	0.0006	0.0008	0.0007
2028	0.0403	0.0431	0.0449	0.0483	0.0006	0.0005	0.0009	0.0007
2029	0.0384	0.0393	0.0412	0.0434	0.0006	0.0005	0.0008	0.0006
2030	0.0355	0.0374	0.0409	0.0424	0.0004	0.0004	0.0006	0.0005
2031	0.0325	0.0347	0.0362	0.0385	0.0005	0.0004	0.0006	0.0005
2032	0.0293	0.0328	0.0312	0.0353	0.0005	0.0005	0.0006	0.0005
2033	0.0272	0.0293	0.0308	0.0329	0.0004	0.0004	0.0006	0.0005
2034	0.0257	0.0263	0.0285	0.0292	0.0005	0.0004	0.0006	0.0005
2035	0.0235	0.0235	0.0259	0.0270	0.0004	0.0004	0.0005	0.0005
2036	0.0216	0.0214	0.0237	0.0246	0.0004	0.0004	0.0005	0.0005
2037	0.0199	0.0195	0.0217	0.0224	0.0004	0.0004	0.0005	0.0005
2038	0.0183	0.0177	0.0198	0.0205	0.0004	0.0004	0.0005	0.0004
2039	0.0169	0.0162	0.0181	0.0187	0.0004	0.0004	0.0005	0.0004
2040	0.0155	0.0147	0.0166	0.0171	0.0004	0.0004	0.0005	0.0004
2041	0.0143	0.0134	0.0152	0.0156	0.0004	0.0004	0.0005	0.0004
2042	0.0132	0.0122	0.0139	0.0142	0.0004	0.0004	0.0005	0.0004
2043	0.0121	0.0111	0.0127	0.0130	0.0004	0.0004	0.0004	0.0004
2044	0.0112	0.0101	0.0116	0.0118	0.0004	0.0004	0.0004	0.0004
2045	0.0103	0.0092	0.0106	0.0108	0.0004	0.0003	0.0004	0.0004
2046	0.0095	0.0084	0.0097	0.0099	0.0004	0.0003	0.0004	0.0004
2047	0.0087	0.0077	0.0089	0.0090	0.0004	0.0003	0.0004	0.0004
2048	0.0080	0.0070	0.0081	0.0082	0.0004	0.0003	0.0004	0.0004
2049	0.0074	0.0064	0.0075	0.0075	0.0004	0.0003	0.0004	0.0003
2050	0.0068	0.0058	0.0068	0.0068	0.0004	0.0003	0.0004	0.0003
2051	0.0063	0.0053	0.0062	0.0062	0.0004	0.0003	0.0004	0.0003
2052	0.0058	0.0048	0.0057	0.0057	0.0004	0.0003	0.0004	0.0003
2053	0.0053	0.0044	0.0052	0.0052	0.0004	0.0003	0.0003	0.0003
2054	0.0049	0.0040	0.0048	0.0047	0.0004	0.0003	0.0003	0.0003
2055	0.0045	0.0036	0.0044	0.0043	0.0004	0.0003	0.0003	0.0003
Levelized (2021-2030)	0.0482	0.0525	0.0496	0.0574	0.0006	0.0006	0.0009	0.0007
Levelized (2021-2035)	0.0417	0.0451	0.0435	0.0495	0.0005	0.0006	0.0008	0.0006
Levelized (2021-2050)	0.0282	0.0297	0.0295	0.0329	0.0005	0.0005	0.0006	0.0005

Notes: Values are for Counterfactual #1 only. CO_2 price assumes New England marginal abatement cost derived from electric sector technologies. Prices in Massachusetts diverge from other states due to the presence of unique Massachusetts-specific GHG regulations. Other CO_2 prices can be calculated using the AESC 2021 User Interface*. Values shown do not have losses applied.*

Table 175. Non-electric non-embedded costs for CO_2 in Counterfactual #1, all states (2021 $ per MMBtu)

	Natural Gas			Fuel oils							Other Fuels						
				Resi.	Commercial			Industrial			Residential				Industrial	Transportation	
	Residential	Commer-cial	Indus-trial	*Distillate Fuel Oil*	*Distillate Fuel Oil*	*Residual Fuel Oil*	*Weighted Average*	*Distillate Fuel Oil*	*Residual Fuel Oil*	*Weighted Average*	*Cord Wood*	*Pellets*	*Kerosene*	*Propane*	*Kerosene*	*Motor Gasoline*	*Motor Diesel*
2021	$11.15	$11.15	$11.15	$15.34	$15.34	$16.49	$15.39	$15.34	$16.49	$15.44	$0.00	$0.00	$15.15	$13.25	$15.15	$14.96	$15.34
2022	$9.47	$9.47	$9.47	$13.03	$13.03	$14.00	$13.06	$13.03	$14.00	$13.11	$0.00	$0.00	$12.86	$11.25	$12.86	$12.70	$13.03
2023	$9.69	$9.69	$9.69	$13.33	$13.33	$14.33	$13.37	$13.33	$14.33	$13.42	$0.00	$0.00	$13.17	$11.51	$13.17	$13.00	$13.33
2024	$7.51	$7.51	$7.51	$10.33	$10.33	$11.10	$10.36	$10.33	$11.10	$10.39	$0.00	$0.00	$10.20	$8.92	$10.20	$10.07	$10.33
2025	$7.54	$7.54	$7.54	$10.37	$10.37	$11.14	$10.40	$10.37	$11.14	$10.44	$0.00	$0.00	$10.24	$8.95	$10.24	$10.11	$10.37
2026	$7.31	$7.31	$7.31	$10.06	$10.06	$10.81	$10.09	$10.06	$10.81	$10.13	$0.00	$0.00	$9.94	$8.69	$9.94	$9.81	$10.06
2027	$7.33	$7.33	$7.33	$10.09	$10.09	$10.84	$10.12	$10.09	$10.84	$10.15	$0.00	$0.00	$9.96	$8.71	$9.96	$9.83	$10.09
2028	$7.36	$7.36	$7.36	$10.13	$10.13	$10.89	$10.16	$10.13	$10.89	$10.20	$0.00	$0.00	$10.01	$8.75	$10.01	$9.88	$10.13
2029	$6.92	$6.92	$6.92	$9.52	$9.52	$10.23	$9.55	$9.52	$10.23	$9.58	$0.00	$0.00	$9.40	$8.22	$9.40	$9.28	$9.52
2030	$7.07	$7.07	$7.07	$9.73	$9.73	$10.46	$9.76	$9.73	$10.46	$9.79	$0.00	$0.00	$9.61	$8.40	$9.61	$9.49	$9.73
2031	$6.43	$6.43	$6.43	$8.84	$8.84	$9.50	$8.87	$8.84	$9.50	$8.90	$0.00	$0.00	$8.73	$7.63	$8.73	$8.62	$8.84
2032	$5.92	$5.92	$5.92	$8.15	$8.15	$8.75	$8.17	$8.15	$8.75	$8.20	$0.00	$0.00	$8.05	$7.03	$8.05	$7.95	$8.15
2033	$5.50	$5.50	$5.50	$7.57	$7.57	$8.14	$7.59	$7.57	$8.14	$7.62	$0.00	$0.00	$7.48	$6.54	$7.48	$7.38	$7.57
2034	$5.09	$5.09	$5.09	$7.00	$7.00	$7.52	$7.02	$7.00	$7.52	$7.05	$0.00	$0.00	$6.91	$6.05	$6.91	$6.83	$7.00
2035	$4.66	$4.66	$4.66	$6.42	$6.42	$6.89	$6.44	$6.42	$6.89	$6.46	$0.00	$0.00	$6.34	$5.54	$6.34	$6.26	$6.42
2036	$4.29	$4.29	$4.29	$5.91	$5.91	$6.35	$5.93	$5.91	$6.35	$5.94	$0.00	$0.00	$5.83	$5.10	$5.83	$5.76	$5.91
2037	$3.95	$3.95	$3.95	$5.44	$5.44	$5.84	$5.46	$5.44	$5.84	$5.47	$0.00	$0.00	$5.37	$4.70	$5.37	$5.30	$5.44
2038	$3.64	$3.64	$3.64	$5.01	$5.01	$5.38	$5.02	$5.01	$5.38	$5.04	$0.00	$0.00	$4.95	$4.32	$4.95	$4.88	$5.01
2039	$3.35	$3.35	$3.35	$4.61	$4.61	$4.95	$4.62	$4.61	$4.95	$4.64	$0.00	$0.00	$4.55	$3.98	$4.55	$4.50	$4.61
2040	$3.08	$3.08	$3.08	$4.24	$4.24	$4.56	$4.26	$4.24	$4.56	$4.27	$0.00	$0.00	$4.19	$3.66	$4.19	$4.14	$4.24
2041	$2.84	$2.84	$2.84	$3.91	$3.91	$4.20	$3.92	$3.91	$4.20	$3.93	$0.00	$0.00	$3.86	$3.37	$3.86	$3.81	$3.91
2042	$2.61	$2.61	$2.61	$3.60	$3.60	$3.87	$3.61	$3.60	$3.87	$3.62	$0.00	$0.00	$3.55	$3.11	$3.55	$3.51	$3.60
2043	$2.41	$2.41	$2.41	$3.31	$3.31	$3.56	$3.32	$3.31	$3.56	$3.33	$0.00	$0.00	$3.27	$2.86	$3.27	$3.23	$3.31
2044	$2.22	$2.22	$2.22	$3.05	$3.05	$3.28	$3.06	$3.05	$3.28	$3.07	$0.00	$0.00	$3.01	$2.63	$3.01	$2.97	$3.05
2045	$2.04	$2.04	$2.04	$2.81	$2.81	$3.02	$2.82	$2.81	$3.02	$2.83	$0.00	$0.00	$2.77	$2.42	$2.77	$2.74	$2.81
2046	$1.88	$1.88	$1.88	$2.59	$2.59	$2.78	$2.59	$2.59	$2.78	$2.60	$0.00	$0.00	$2.55	$2.23	$2.55	$2.52	$2.59
2047	$1.73	$1.73	$1.73	$2.38	$2.38	$2.56	$2.39	$2.38	$2.56	$2.39	$0.00	$0.00	$2.35	$2.05	$2.35	$2.32	$2.38
2048	$1.59	$1.59	$1.59	$2.19	$2.19	$2.35	$2.20	$2.19	$2.35	$2.20	$0.00	$0.00	$2.16	$1.89	$2.16	$2.14	$2.19
2049	$1.47	$1.47	$1.47	$2.02	$2.02	$2.17	$2.02	$2.02	$2.17	$2.03	$0.00	$0.00	$1.99	$1.74	$1.99	$1.97	$2.02
2050	$1.35	$1.35	$1.35	$1.86	$1.86	$2.00	$1.86	$1.86	$2.00	$1.87	$0.00	$0.00	$1.83	$1.60	$1.83	$1.81	$1.86
2051	$1.24	$1.24	$1.24	$1.71	$1.71	$1.84	$1.72	$1.71	$1.84	$1.72	$0.00	$0.00	$1.69	$1.48	$1.69	$1.67	$1.71
2052	$1.14	$1.14	$1.14	$1.57	$1.57	$1.69	$1.58	$1.57	$1.69	$1.58	$0.00	$0.00	$1.55	$1.36	$1.55	$1.54	$1.57
2053	$1.05	$1.05	$1.05	$1.45	$1.45	$1.56	$1.45	$1.45	$1.56	$1.46	$0.00	$0.00	$1.43	$1.25	$1.43	$1.41	$1.45
2054	$0.97	$0.97	$0.97	$1.33	$1.33	$1.43	$1.34	$1.33	$1.43	$1.34	$0.00	$0.00	$1.32	$1.15	$1.32	$1.30	$1.33
2055	$0.89	$0.89	$0.89	$1.23	$1.23	$1.32	$1.23	$1.23	$1.32	$1.24	$0.00	$0.00	$1.21	$1.06	$1.21	$1.20	$1.23
Levelized																	
2021-2030	$8.16	$8.16	$8.16	$11.23	$11.23	$12.07	$11.26	$11.23	$12.07	$11.30	$0.00	$0.00	$11.09	$9.70	$11.09	$10.95	$11.23
2021-2035	$7.32	$7.32	$7.32	$10.07	$10.07	$10.82	$10.10	$10.07	$10.82	$10.13	$0.00	$0.00	$9.95	$8.69	$9.95	$9.82	$10.07
2021-2050	$5.10	$5.10	$5.10	$7.02	$7.02	$7.54	$7.04	$7.02	$7.54	$7.06	$0.00	$0.00	$6.93	$6.06	$6.93	$6.84	$7.02

Notes: CO_2 price assumes New England marginal abatement cost derived from electric sector technologies. Other CO_2 prices can be calculated using the AESC 2021 User Interface.

Table 176. Non-electric non-embedded costs for NO_X in Counterfactual #1, all states (2021 $ per MMBtu)

	Natural Gas			Fuel oils							Other Fuels						
				Resi.	Commercial			Industrial			Residential				Industrial	Transportation	
	Residential	Commer-cial	Indus-trial	*Distillate Fuel Oil*	*Distillate Fuel Oil*	*Residual Fuel Oil*	*Weighted Average*	*Distillate Fuel Oil*	*Residual Fuel Oil*	*Weighted Average*	*Cord Wood*	*Pellets*	*Kerosene*	*Propane*	*Kerosene*	*Motor Gasoline*	*Motor Diesel*
2021	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2022	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2023	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2024	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2025	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2026	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2027	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2028	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2029	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2030	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2031	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2032	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2033	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2034	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2035	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2036	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2037	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2038	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2039	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2040	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2041	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2042	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2043	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2044	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2045	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2046	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2047	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2048	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2049	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2050	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2051	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2052	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2053	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2054	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2055	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
Levelized																	
2021-2030	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2021-2035	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27
2021-2050	$0.68	$0.72	$0.72	$0.95	$1.26	$1.26	$1.26	$1.26	$1.26	$1.26	$0.00	$0.00	$0.95	$0.10	$0.95	$0.91	$5.27

Appendix H: DRIPE Derivation

This appendix describes the derivation of demand reduction induced price effects (DRIPE). This is the price effect of adding energy efficiency resources or reducing load.

For the supply curve (the price that suppliers will charge for supplying *x* MW):

$$S_0 = b_S + m_s x,$$

and the demand curve (the price set by the VRR curve for *x* MW):

$$D_0 = b_D - m_D x$$

Note that m_D is the magnitude of the slope with the direction noted in the preceding negative sign.

The demand curve meets the supply curve at

$$x \quad = \frac{b_D - b_s}{m_s + m_D}$$

And the market-clearing price is

$$Price \quad = b_D - m_D \left(\frac{b_D - b_s}{m_s + m_D}\right)$$

A positive horizontal shift of α MW to the supply curve shifts the supply y-intercept downward. A negative horizontal shift of the demand curve shifts the demand y-intercept downward as well.

The horizontal shift of the supply curve shifts its y-intercept:

$$b_{supply\ shifted} = b_S - m_S \alpha$$

The Supply function, horizontally shifted + α units, equals:

$$S_{shifted} = m_s x + (b_S - m_s \alpha) = m_s(x - \alpha) + b_S$$

Similarly, applying a negative horizontal shift of α units to the demand curve shifts its y-intercept:

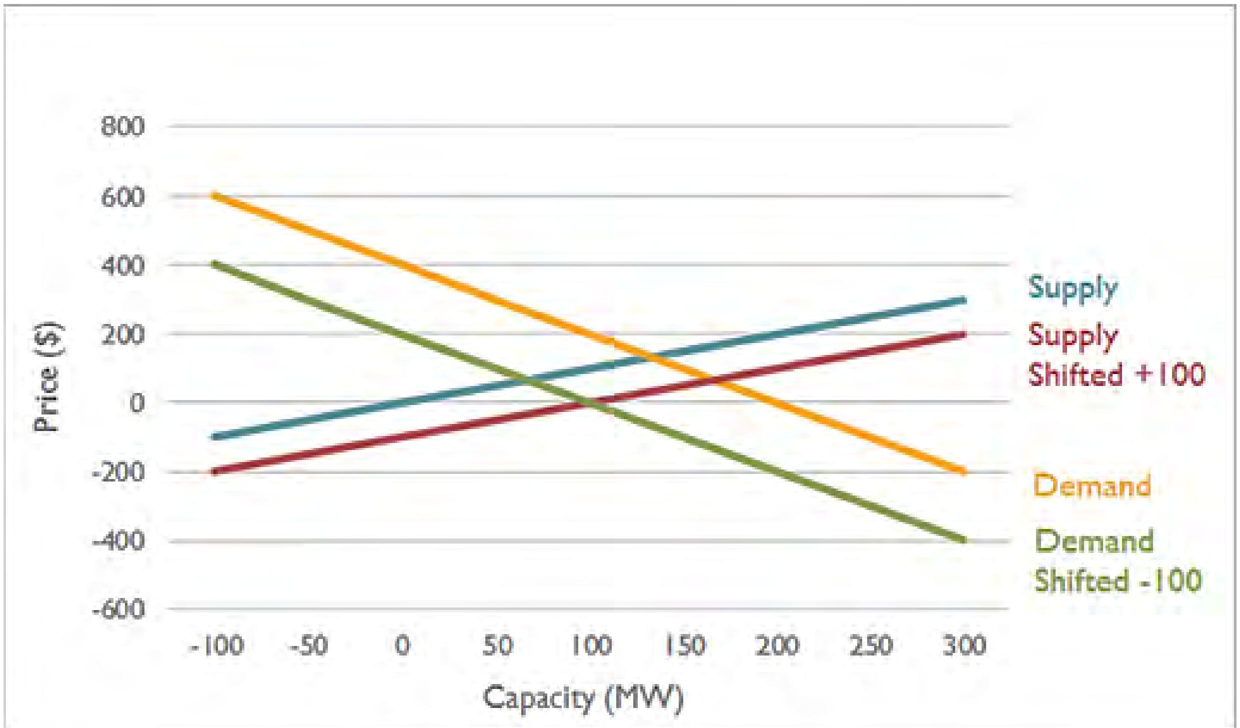
$$b_{demand\ shifted} = b_D - m_D \alpha$$

The shifted Demand function equals:

$$D_{shifted} = b_D - m_D(\alpha + x)$$

Figure 63 provides examples that describe the rationale for the shift in the y-intercept for each function. The supply function is S = x + 0 and the demand function is D = 400–2x. Adding 100 MW at $0 shifts the supply curve right by 100×$m_S = 100$. Subtracting 100 MW from the demand curve likewise shifts that curve left by 100, equivalent to shifting down by 100×m_p = 200.

Figure 63. Example of supply and demand impact



For the intersection of the supply curve S_0 with the VRR $D_{shifted}$ and the intersection of $S_{shifted}$ with D_0, we find the equilibrium quantity x^* and then substitute that into either half to get $Price^*$.

For $\boldsymbol{S_0 = D_{shifted}}$

$$m_s x + b_S = b_D - m_D(\alpha + x)$$

Solve for x

$$x^* = \frac{b_D - b_s + m_s\alpha}{m_s + m_D}$$

$$Substitute\ x^*\ into\ S_0\ or\ D_{shifted}\ to\ get\ Price$$

$$Price^* = b_D - m_D\left(\frac{b_D - b_s + m_s\alpha}{m_s + m_D}\right)$$

The difference between this price and the original price is

$$\Delta Price \quad = m_D\left(\frac{m_s\alpha}{m_s + m_D}\right)$$

Thus, the slope of the clearing price with respect to demand is

$$\left(\frac{m_D \times m_s}{m_s + m_D}\right)$$

The same approach gives the same result, starting with an increment in supply.

APPENDIX I: MATRIX OF RELIABILITY SOURCES

This appendix documents the studies in Chapter 11: *Value of Improved Reliability*.

Table 177. Matrix of reliability sources

Year	Author	Title	Journal or Source	Document Focus
2018	Cambridge Economic Policy Associates Ltd.	*Study on the Estimation of the Value of Lost Load of Electricity Supply in Europe*	Prepare for Agency for the Cooperation of Energy Regulators. Available at https://www.acer.europa.eu/en/Electricity/Infrastructure_and_network%20development/Infrastructure/Documents/CEPA%20study%20on%20the%20Value%20of%20Lost%20Load%20in%20the%20electricity%20supply.pdf	Reliability Value Assessment – VoLL Methods
2017	Makovich, L., Richards, J.	*Ensuring Resilient and Efficiency Electricity Generation: the Value of the Current Diverse US power supply portfolio*	IHS Market, research supported by the Edison Electric Institute available at: https://www.globalenergyinstitute.org/sites/default/files/Value%20of%20the%20Current%20Diverse%20US%20Power%20Supply%20Portfolio_V3-WB.PDF	Reliability Value Assessment – Macroeconomic Metrics
2017	Mills, E., Jones, R.	*An Insurance Perspective on U.S. Electric Grid Disruption Costs*	LBNL-1006392, performed by the Energy Analysis and Environmental Impacts Division Lawrence Berkeley National Laboratory. Available at https://emp.lbl.gov/sites/default/files/lbnl-1006392.pdf	Reliability Value Assessment – VoLL by Sector per Event
2017	North American Electric Reliability Corporation	*Distributed Energy Resources: Connection Modeling and Reliability Considerations*	A report by NERC and the NERC Essential Reliability Services Working Group (ERSWG) Available at http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/DERTF%20Draft%20Report%20-%20Connection%20Modeling%20and%20Reliability%20Considerations.pdf	Alternative Reliability Metrics
2017	U.S. Department of Energy	*Valuation of Energy Security for the United States*	U.S. Department of Energy, Report to Congress. Available at https://www.energy.gov/sites/prod/files/2017/01/f34/Valuation%20of%20Energy%20Security%20for%20the%20United%20States%20%28Full%20Report%29_1.pdf	Reliability Value Assessment – VoLL Methods

Year	Author	Title	Journal or Source	Document Focus
2016	Nateghi, R., Guikema, S.D., Wu, y., Bruss, B.	*Critical Assessment of the Foundations of Power Transmission and Distribution Reliability Metrics and Standards*	Risk analysis, Vol 36, No. 1, 2016: DOI: 10.1111/risa.12401. Available at https://www.researchgate.net/publication/276357284_Critical_Assessment_of_the_Foundations_of_Power_Transmission_and_Distribution_Reliability_Metrics_and_Standards_Foundations_of_Power_Systems_Reliability_Standards	Alternative Reliability Metrics
2016	Diskin, P.T., Washko, D.M.	*Pennsylvania Electric Reliability Report 2015*	Published by Pennsylvania Public Utility Commission. Available at http://www.puc.pa.gov/General/publications_reports/pdf/Electric_Service_Reliability2015.pdf	Reliability Reporting – Outage Causes
2016	GridSolar, LLC	*Final Report Boothbay Sub-Regions Smart Grid Reliability Pilot Project*	Prepared for Docket No. 2011-138, Central Maine Power Co., Request for Approval of Non-Transmission Alternative (NTA) Pilot Project of the Mid-Coast and Portland Areas January 19, 2016	Reliability Metrics – Alternative Reporting
2016	Ponemon Institute Research Center	*Cost of Data Center Outages*	Part of the Data Center Performance Benchmark Series, sponsored by Emerson Network Power. Available at https://planetaklimata.com.ua/instr/Liebert_Hiross/Cost_of_Data_Center_Outages_2016_Eng.pdf	Reliability Value Assessment- VoLL for Data Centers
2015	Schroder, T., & Kuckshinrichs, W.	*Value of Lost Load: An Efficient Economic Indicator for Power Supply Security? A Literature Review*	Institute of Energy and Climate Research – Systems Analysis and Technology Evaluation (IEK-STE), Forschungszentrum Julich BMbH, Julich, Germany. Available at https://juser.fz-juelich.de/record/279293/files/fenrg-03-00055.pdf	Reliability Value Assessment – VoLL Methods
2015	Sullivan, M.J., Schellenber, J., Blundell, M.	*Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States*	LBNL report funded by Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231., LBNL-6941E, January 2015. Available at https://emp.lbl.gov/sites/default/files/lbnl-6941e.pdf	Reliability Value Assessment – VoLL by Sector, Region and Duration
2014	Khujadze, S., Delphia, J.	*A Study of the Value of Lost Load (VOLL) for Georgia*	Report prepared for USAID Hydro Power and Energy Planning Project, Contract Number AID-OAA-I-13-00018/AID-114-TO-13-00006 Deloitte Consulting LLP. Available at https://dec.usaid.gov/dec/content/Detail.aspx?ctID=ODVhZjk4NWQtM2Yy	Reliability Value Assessment- VoLL Country Studies

Year	Author	Title	Journal or Source	Document Focus
			Mi00YjRmLTkxNjktZTcxMjM2NDBmY2Uy&rID=MzQ5MTg3	
2013	Pfeifenberger, J.P., Spees, K.	*Resource Adequacy Requirements: Reliability and Economic Implications*	Report prepared by Brattle for FERC. Available at https://www.ferc.gov/legal/staff-reports/2014/02-07-14-consultant-report.pdf	Reliability Value Assessment - Planning Reserve Margins
2013	London Economics International, LLC	*Estimating the Value of Lost Load*	Briefing paper prepared for the Electric Reliability Council of Texas, Inc. (June 17, 2013). Available at http://www.ercot.com/content/gridinfo/resource/2014/mktanalysis/ERCOT_ValueofLostLoad_LiteratureReviewandMacroeconomic.pdf	Reliability Value Assessment (Literature Review)
2012	Electric Reliability Council of Texas, Inc., Laser, W.	*Resource Adequacy and Reliability Criteria Considerations*	Presented at PUC Workshop: Commission Proceeding Regarding Policy Options on Resource Adequacy, July 27, 2012. Available at http://www.ercot.com/content/gridinfo/resource/2012/mktanalysis/ERCOT%20Presentation%20for%20PUCT%20July%2027%202012%20Workshop.pdf	Reliability Value Assessment - Planning Reserve Margins
2011	Rouse, G., Kelly, J.	*Electricity Reliability: Problems, Progress and Policy Solutions Galvin Electricity Initiative*	Galvin Electricity Initiative. Available at http://galvinpower.org/sites/default/files/Electricity_Reliability_031611.pdf	Reliability Metrics- Outage Reporting Metrics Review
2010	Centolella	*Estimates of the Value of Uninterrupted Service for the Mid-West Independent System Operator*	Available at https://sites.hks.harvard.edu/hepg/Papers/2010/VOLL%20Final%20Report%20to%20MISO%20042806.pdf	Reliability Value Assessment – VoLL Midwest Study
2008	Ventyx	*Analysis of "Loss of Load Probability" (LOLP) at Various Planning Reserve Margins*	Available at https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/PSCo-ERP-2011/Attachment-2.10-1-LOLP-Study.pdf	Reliability Metrics - LOLP and Planning Reserve
2006	LaCommare, K.H., Eto, J.H.	*Cost of Power Interruptions to Electricity Consumers in the United States*	LBNL-58164, Report funded by U.S. Department of Energy under Contract NO. DE-AC02-05CH11231. Available at	Reliability Value VoLL- Annual Total Costs by Sector and Region

Year	Author	Title	Journal or Source	Document Focus
			https://emp.lbl.gov/sites/all/files/report-lbnl-58164.pdf	
2004	LaCammara, K.H., Eto, J.H.	*Understanding the Cost of Power Interruptions to U.S. Electricity Consumers.*	Ernest Orlando LBNL Environmental Energy Technologies Division. LBNL-55718. Report prepared by U.S. Department of Energy under Contract No. DE-AC03-76F00098. Available at https://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Understanding_Cost_of_Power_Interruptions.pdf	Reliability Value Assessment – VoLL by Sector and Duration
2004	Chowdhury, A. A., Mielnik, T.C., Lawion, L.e., Sullivan, M.J., and Katz, A.	*Reliability Worth Assessment in Electric Power Delivery Systems*	Power Engineering Society General Meeting, 2004 (Denver: IEEE), 654-660.	Reliability Value Assessment – VoLL Midwest Study
2003	Lawton, L. Sullivan, M., Van Liere, K., Katz, A., & Eto, J.	*A Framework and Review of Customer Outage Costs: Integration and Analysis of Electric Utility Outage Cost Surveys*	Prepared for Imre Gyuk Energy Storage Program, Office of Electric Transmission and Distribution U.S. Department of Energy. LBNL-54365. Available athttps://emp.lbl.gov/sites/all/files/lbnl-54365.pdf	Reliability Value Assessment – VoLL Sector, Region and Duration

APPENDIX J: GUIDE TO CALCULATING AVOIDED COSTS FOR CLEARED AND UNCLEARED MEASURES

This appendix provides a simplified explanation of the methodologies and applications of capacity and capacity DRIPE.[371] It uses a set of illustrative numbers to more simply describe the calculations underlying cleared and uncleared capacity and capacity DRIPE. It accompanies the "AppdxJ" tab of the *AESC 2021 User Interface*, which provides specific numbers for all years, states, and measure lives for the following avoided cost categories:

- Cleared capacity
- Uncleared capacity
- Cleared capacity DRIPE
- Uncleared capacity DRIPE
- Cleared reliability
- Uncleared reliability

This appendix is not intended to substitute the more in-depth explanations provided, which are provided in Chapter 5: *Avoided Capacity Costs*, Section 9.3: *Electric capacity DRIPE*, and Section 11.2: *Value of reliability: Generation component*. A few caveats about this summary:

- This section uses illustrative values only. We have selected values that superficially resemble Massachusetts' avoided costs.[372]
- We simplify some calculation steps for readability but provide footnotes where these steps are more complex in practice.
- We discuss avoided costs as applied to energy efficiency measures, but the avoided costs apply just as easily to demand increases (e.g., from electrification).
- The approaches below describe wholesale avoided costs. Further steps are needed to convert wholesale values to retail values. See Appendix B: *Detailed Electric Outputs* for additional instructions.

[371] This appendix replaces the 2018 version of Appendix J, which focused on "calculating benefits of uncleared capacity and uncleared capacity DRIPE for short- and medium-duration programs." We note that AESC 2018 described there being two separate LFE schedules for long-duration and shorter-duration measures. This is because for measure lives 10 years or greater, the LFE schedule is effectively same for the first 15 years of a measure lifetime (see the last column in Table 43). In the *AESC 2021 User Interface*, we explicitly calculate the uncleared resource effects for 35 different measure lives for the entire study period (2021 through 2055) and thus no longer need to make this simplifying assumption.

[372] Massachusetts is chosen as an example because it constitutes roughly half of New England's electricity demand.

Cleared capacity

Cleared capacity values in AESC represent the avoided cost associated with energy efficiency resources a program administrator has offered and cleared in ISO New England's FCM.

AESC estimates a capacity price for a future delivery year based on the capacity market (e.g., $2 per kW-month, equivalent to $24 per kW-year) as detailed in Chapter 5: *Avoided Capacity Costs*. This value is the avoided cost of cleared capacity. Program administrators then multiply this avoided cost by energy efficiency savings in that year (e.g., 10 MW) to determine the measure's annual benefit. In this example, the annual benefit is $240,000, after converting units. This is $240,000 that ratepayers would not otherwise spend to procure capacity in the capacity market. If the capacity price did not change year-to-year, this measure would provide $240,000 in benefits for every year the illustrative 10 MW measure is in place. The 10 MW measure would provide $1.2 million in benefits if the savings persisted for five years.[373]

Uncleared capacity

A program administrator may choose not to bid all of its energy efficiency portfolio's capacity savings into the capacity market, or it may be possible that a resource does not receive a capacity obligation but is nonetheless built. As a result, the savings from the "uncleared" amounts do not produce direct savings within the capacity market. However, these measures still provide indirect system benefits by impacting ISO New England's forecast of load, which is one of the inputs used to develop prices in the capacity market. See Section 5.2: *Uncleared capacity calculations* for more detail on this avoided cost category.

Because ISO New England's load forecast is based on 15 years of historical data, uncleared measures will eventually impact future load forecasts. However, it takes a few years of sustained savings before the uncleared measures impact the load forecast directly. At that point, the measure's impact can be generally described as a "ramp up" followed by a "fade out." We have created the "load forecast effect" (LFE) schedule to account for this market dynamic. The LFE schedule is a percentage factor that scales a measure's impact on future load forecasts. The percentage varies by calendar year and with the length of time an efficiency measure provides savings (i.e., measure life year).

Importantly, unlike cleared capacity, benefits from uncleared resources must be summed over the <u>study period</u>, rather than the measure life. This is because benefits do not accrue until after the measure has been in effect for a few years, and because benefits continue to accrue for several years after the measure ceases to be active, as the load reduction moves through the 15 years of data used in the ISO load-forecast regression. In AESC we calculate the stream of annual avoided uncleared capacity costs for each measure life within the study period.

[373] This is a simplified example. In practice, program administrators typically discount future benefits and apply transmission and distribution losses to convert wholesale avoided costs to retail costs. Capacity values also typically differ year-to-year. Similar caveats apply to the subsequent sections.

To calculate benefits from uncleared capacity resources, AESC uses the same capacity price calculated in "Cleared capacity," above. We then scale up this capacity price by the reserve margin (e.g., 15 percent) because, by reducing load, uncleared resources avoid the need to purchase additional supply reserves.[374] We further adjust the resulting value to account for the delayed impact on the load forecast (i.e., the LFE). If we now assume that the 10 MW measure from our above example is uncleared, then the uncleared capacity avoided cost is equal to the product of (a) the capacity price at $24 per kW-year, (b) one plus the reserve margin or 1.15, and (c) the LFE (which varies by year and measure life). For years when the LFE is 100 percent, the resulting avoided cost is $27.6 per kW-year. For a 10 MW measure, this implies benefits in that year of $276,000. Because the LFE varies over time, undiscounted lifetime benefits are $1.4 million.

Viewed in isolation, uncleared capacity resources have a larger value than cleared capacity resources. This is because the cleared resources only provide benefits in the years that the measure is active and participating in the capacity market, whereas uncleared resources provide benefits (even at a reduced level) for several years after the measure ceases to provide savings. Uncleared capacity resources are also larger because they include an avoided reserve margin. Because many of the uncleared capacity benefits accrue in the mid- to far-future, but the cleared capacity benefits accrue in the near-term, applying a discount rate could cause the uncleared capacity benefit (in this hypothetical example, $1.4 million) to be equal to or perhaps less than the cleared capacity benefit (here, $1.2 million).

Cleared capacity DRIPE

DRIPE describes the phenomenon wherein 1 MW of savings not only avoids a purchased quantity, but also changes the price that all purchasers in the capacity market pay for capacity. Cleared capacity DRIPE, specifically, represents the price effects on the capacity market from measures bid into the capacity market. These effects can be further subdivided into two categories: benefits to consumers within the state where the measure is installed (intrazonal effects) and benefits to consumers outside of the state where the measure is installed (interzonal effects). AESC translates these price effects (which describe how the system's prices change as demand changes) into DRIPE values (which describe the benefits that accrue to any one measure due to this price effect). See Chapter 9: *Demand Reduction Induced Price Effect* for more background on the concept of DRIPE and Section 9.3: *Electric capacity DRIPE* for more details about capacity DRIPE in particular.

Cleared capacity DRIPE is calculated as follows: first, the "price shift" is estimated. The price shift represents how the capacity price would change if 1 fewer MW of capacity were required. It is calculated by examining the supply curves observed by ISO New England, and calculating the slope of

[374] Uncleared measures are effectively "counted" in the demand side of the capacity auction (i.e., within the load forecast). In contrast, cleared measures are effectively treated the same as conventional power plants (i.e., supply), and through the auction require the purchase of some extra amount of capacity to act as a reserve margin. We increase the uncleared capacity benefit by a value equal to one plus the reserve margin to reflect changes on the demand side of the market.

each line segment between each auction round.[375] This price shift is measured in terms of capacity price per unit demand, or $/kW-month per MW. These price shifts are generally very small numbers. For example, the price shift might be $0.001/kW-month per MW, or $0.012/kW-year per MW.[376]

Second, we multiply these price shifts by the capacity requirement for each state because the price effect impacts resources throughout in the FCM, not just the efficiency resources responsible for the price shift. However, we assume that only a subset of these resources are subject to the price shift. Load-serving utilities purchase some amount of their capacity outside of the FCM to mitigate the risk of price volatility in the capacity market—i.e., as a financial hedge. In AESC, we only consider the "unhedged" portion of the capacity requirement that is bought via the capacity market would be impacted by DRIPE effects.[377]

Finally, we apply an annual decay schedule. AESC assumes the price effect fades out over time as retail prices fall (encouraging higher load), existing resources retire, and new potential resources are abandoned. As a result, price effects are fully realized in the year of installation, but completely phased out six years later. The benefit of cleared capacity DRIPE decays over time, but that decay does not change with the efficiency resource's measure life (unlike the LFE schedule used for uncleared capacity and uncleared capacity DRIPE, which changes with the measure life).

If we assume that our example state has 10,000 MW in unhedged capacity requirement, multiplying this by the $0.012/kW-year per MW price effect from above yields a value of $120 per kW-year. Scaled by the decay effect, this value will be $120 per kW-year in years with no decay and $0 per kW-year in subsequent years with full decay. This is then the avoided cost for cleared capacity DRIPE.

As with cleared capacity, the effects of cleared capacity DRIPE should be summed over the measure lifetime, rather than the study period. As our 10 MW measure lasts for five years, we find that it produces undiscounted intrazonal DRIPE benefits of $4.0 million. Assuming our example state's 10,000 MW of unhedged demand is exactly half of the regional unhedged capacity requirement, the interzonal DRIPE benefits are also $4.0 million, without discounting. Total cleared capacity DRIPE benefits are the sum of these two values, or $8.0 million.

Uncleared capacity DRIPE

Uncleared capacity DRIPE is the price-shifting benefit that accrues to measures not bid into ISO New England's FCM. Even though these measures are outside the capacity market, they impact the load

[375] We assume that all future supply curves have the same shape as the most recent capacity auction, but shifted to account for changes in supply. In AESC 2021, this is FCA 15.

[376] Price shifts may change year-to-year as the corresponding year's capacity price changes position on the supply curve.

[377] In practice, over a long enough period, prices paid for hedged capacity ought to converge to the market price. Because our estimates of DRIPE exclude this hedged amount, they can be considered a conservative estimate.

forecast inputs, and thus provide uncleared capacity DRIPE benefits. As with cleared capacity DRIPE, there are both intrazonal and interzonal benefits.

For the most part, uncleared capacity DRIPE is calculated the same as cleared capacity DRIPE. We begin with a price shift observed from the latest FCA (e.g., $0.0012/kW-year per MW), which is then multiplied by a zone's unhedged capacity requirement (e.g., 10,000 MW). This $120 per kW-year result is the avoided cost. But there are two key differences compared to cleared capacity DRIPE.

1. First, uncleared capacity DRIPE utilizes an LFE schedule. For uncleared capacity DRIPE, we assume the load forecast and thus the capacity market gradually incorporates the impacts of uncleared load reductions (just like with uncleared capacity). This effect persists for some period before the market readjusts, and the DRIPE benefit fades out. This LFE schedule is based on the one used for uncleared capacity, but is adjusted to reflect a decay in DRIPE benefits over time. This is the same decay schedule used for capacity DRIPE. As with uncleared capacity, this LFE schedule varies depending on measure lifetime.
2. Second, because uncleared capacity DRIPE results from a reduction in the load forecast rather than the addition of capacity, we multiply these benefits by a factor of one plus the reserve margin.

The annual intrazonal uncleared capacity DRIPE is equal to the product of (a) the price shift in that year, (b) the zone's unhedged capacity requirement for that year, (c) one plus the reserve margin, and (d) that year's LFE value. Interzonal uncleared capacity DRIPE is calculated the same way but uses the regional unhedged capacity requirement, less the unhedged capacity requirement for the zone in question.

As with uncleared capacity, uncleared capacity DRIPE benefits are summed over the study period (rather than the measure life), as benefits continue to accrue years after the measure has been installed and expires.

In our continued example, undiscounted intrazonal uncleared capacity DRIPE benefits are $3.7 million, while interzonal uncleared capacity DRIPE benefits are also equal to $3.7 million. Total uncleared capacity DRIPE benefits are $7.5 million.

Cleared reliability

The operation of the ISO New England capacity market increases the amount of capacity acquired as the price falls. To the extent that energy efficiency programs reduce the capacity clearing price, reserve margins and reliability will increase.

To calculate cleared reliability benefits, we first estimate four values:

- First, VoLL is the cost experienced by customers during an outage. It is determined through a review of the literature. In AESC 2021, we estimate this value at $73 per kWh.

- Second, we estimate the change in MWh of reliability benefits per megawatt of reserve. This is calculated by observing the slope of the demand curve used in the FCA at the point of the clearing price. A typical value might be 0.2 MWh per MW.
- Third, we derate reliability benefits based on the fact that bidding in an additional MW into the FCA at $0 per kW-month price shifts the supply curve to the right and shifts out some smaller amount of capacity that would otherwise have cleared. As a result, the amount of cleared supply increases by just a fraction of the additional supply. This value is determined by examining the percentage difference in slopes of the demand curve and supply curve at the point of the clearing price. A typical value might be 20 percent.
- Finally, we assume a decay effect. We use the same decay effect that is applied to cleared capacity and uncleared capacity due to similar expected dynamics in market response.

We then multiply these four values against one another to estimate the avoided cleared reliability cost in each year the resource is active. Cleared reliability benefits do not differ based on measure life.

Using the same example as above (a 10 MW measure with a five-year lifetime), we would expect cleared reliability benefits of about $0.01 million. Reliability benefits are much smaller than benefits provided by other avoided cost categories.

Uncleared reliability

Resources that do not clear in the capacity market may still provide a reliability benefit. Some resources that do not clear the FCA will continue to operate as energy-only resources, adding to available reserves. While not obligated to do so, these resources are likely to operate at times of tight supply and high energy prices. They may also be available to assume the capacity obligations of resources that unexpectedly retire or otherwise become unavailable. In addition, resources that do not clear in the capacity market or immediately affect the load forecast will increase reserve margins and contribute to improved reliability.

To calculate uncleared reliability benefits, we first estimate five values:

- First, just as with cleared reliability, we utilize a VoLL. The VoLL in AESC 2021 is $73 per kWh.
- Second, just as with cleared reliability, we estimate the change in MWh of reliability benefits per megawatt of reserve. A typical value might be 0.2 MWh per MW.
- Third, we gross up benefits to reflect the reserve margin, as these resources are not resources bid into the capacity market and thus reduce supply.
- Fourth, we assume that reliability has a phased effect. Measures provide a reliability benefit as soon as they are installed. This benefit persists for a period of time then fades out.

- Fifth, we assume a separate decay effect that reflects the fact that after a period of time, all the of the reliability benefits will have been captured in the load forecast.

We then multiply these five values against one another to estimate avoided uncleared reliability costs. Uncleared reliability differs from the other uncleared avoided cost categories in two ways:

- Unlike uncleared capacity and uncleared capacity DRIPE, uncleared reliability benefits are summed over the years in which the measure is active, rather than the entire study period. This is similar to how avoided costs are summed for cleared reliability and most other avoided cost categories.
- Uncleared reliability benefits do not differ based on measure life.

Using the same example as above (a 10 MW measure with a five-year lifetime), we would expect cleared reliability benefits of about $0.8 million. Generally speaking, uncleared effects are greater than cleared effects because they are not impacted by the net increase in cleared supply variable (which only affects resources that clear the market).

Applying these values

For a portfolio of measures, a program administrator may bid only a share of its capacity savings into the capacity market. In these situations, the program administrator should split the cleared and uncleared savings and calculate benefits accordingly. In our example, if a program administrator bids into the capacity market 50 percent of its 10 MW portfolio of measures, it would provide $600,000 in undiscounted cleared capacity benefits and $690,000 in uncleared capacity benefits (e.g., each of the values calculated above is halved). Likewise, the portfolio of measures provides $4.0 million in cleared capacity DRIPE benefits and $3.7 million in uncleared capacity DRIPE benefits (again, the above values are halved). Reliability benefits are much smaller: this example would yield cleared reliability benefits of $0.05 million and uncleared reliability benefits of $0.4 million.

In practice, (a) measures have different measure lives, (b) each of these avoided cost categories have different decay or LFE schedules, (c) values change over time, and (d) program administrators utilize a discount rate. As a result, program administrators must take a weighted average by measure-life year over the study period, not calendar year. Separate cost streams for cleared capacity, uncleared capacity, cleared capacity DRIPE, uncleared capacity DRIPE, cleared reliability, and uncleared reliability should be calculated independently for each cleared or uncleared MW (or share of MW).

Capacity vs. capacity DRIPE

At first glance, capacity DRIPE benefits may appear surprisingly large relative to capacity benefits. But, changing the price of capacity is a high-value action, because it reduces the cost of procuring capacity for <u>all</u> resources in the system, not just the energy efficiency resources instigating the price change.

For example, assume total unhedged capacity cleared in New England is 20,000 MW, all of which clears at $2 per kW-month. This implies a total annual market value is $480 million. If our 10 MW measure were entirely bid into the capacity market, it would produce $0.24 million in capacity benefits in one year. This is about 0.05 percent of the market's total value, and represents a one-for-one switch between one type of capacity (energy efficiency) for another kind (e.g., a conventional fossil resource).

But, because of price-shifting effects, the cleared measure also lowers the price that other market participants pay for the 20,000 MW. By lowering the price for all 20,000 MW, this measure produces annual cleared capacity DRIPE benefits of $2.4 million, or 0.5 percent of the $480 million total market value (e.g., one order of magnitude larger than the capacity benefit).

These are both small numbers, relative to the size of the market. But because the DRIPE effect is multiplied across 20,000 MW, rather than just 10 MW, the final benefit is larger.

Scaling factor for uncleared resources

Energy efficiency measures generally save energy according to a consistent pattern throughout a year (i.e., its load shape) because they perform the same functions as the less efficient technology while using less energy. Alternatively, demand response resources are designed to provide savings during specific time periods depending on grid characteristics that vary by year, day, and hour. Demand response resources are often subject to customer responsiveness, which can fluctuate with a customer's annual participation in a demand response program and with each demand response event called. As a result, demand response resources typically have shorter and more variable durations, both in terms of measure lives and annual hours of operation. Because of this variability, uncleared measures may not have a "full" effect on the load forecast. This implies that their uncleared benefits should be scaled according to how frequently the measure is expected to operate (and, as a result, impact the load forecast).

To account for demand response's limited impact on the load forecast, AESC recommends that program administrators apply a scaling factor that adjusts uncleared capacity, uncleared capacity DRIPE, and uncleared reliability benefits. The scaling factor is a measure-specific percentage multiplier that should be estimated based on a demand response program's design, implementation, and participant responsiveness. See text in the following section, Appendix K: *Scaling Factor for Uncleared Resources*, and the accompanying workbook titled "Appendix K.xlsx" for more information on how to calculate this scaling factor for different measures.

We note that the scaling factor should not be applied to reliability values.

APPENDIX K: SCALING FACTOR FOR UNCLEARED RESOURCES

This appendix repeats text originally found in the April 2019 report titled, "The Effect of Uncleared Capacity Load Reductions on Peak Forecasts." This report was authored by Resource Insight, Inc. with assistance from Synapse Energy Economics, Inc., and was originally commissioned by National Grid as a supplemental study to AESC 2018.[378] This document was accompanied by a "DR Coefficient Calculator" workbook, which program administrators can use to evaluate how uncleared capacity DRIPE benefits should be adjusted for measures that operate in only some hours of the year.[379]

Text and analysis in this appendix have not been updated, with the following exceptions:

- The addition of a "Purpose" section summarizing the intended use of this appendix
- Some edits to text to improve readability and consistency with the rest of the AESC 2021 text
- Cross-references to parts of the main AESC 2021 text
- Several modifications and corrections to the DR calculator

Analytical updates to this document were not scoped within AESC 2021; however, we do not expect these values to be substantially different than those calculated in the original 2019 report because ISO New England's load forecasting techniques have not changed substantially.

Purpose

This document describes the methodology for creating a scaling factor that adjusts the benefits provided by uncleared resources. It also provides a calculator workbook so that program administrators may create this scaling factor for themselves. This workbook is the file titled "Appendix K.xlsx."

It is only for resources that are not expected to provide a capacity benefit throughout the summer period (we focus on summer, because it is summer demand that drives the capacity market). For example, this factor is useful for demand response measures that may only be active some summer days. But it is not applicable to resources like energy efficiency that are assumed to provide savings at a more-or-less consistent level throughout the summer.

Program administrators wishing to use this appendix will want to use the Appendix K workbook to estimate the appropriate scaling factor for their DSM resource. This factor is then multiplied by the

378 Chernick, P., P. Knight, M. Chang. April 22, 2019. *The Effect of Uncleared Capacity Load Reductions on Peak Forecasts.* Synapse Energy Economics prepared for National Grid. Available at https://www.synapse-energy.com/sites/default/files/The_effect_of_load_reductions_on_peak_forecasts.pdf.

379 See original version at https://www.synapse-energy.com/sites/default/files/DR_Coefficient_Calculator%20%282%29.pdf.

uncleared capacity or uncleared capacity DRIPE avoided cost (calculated using the *AESC 2021 User Interface*) and the measure's capacity savings and seasonal coincidence factor to provide the final benefit value.[380]

This scaling factor is not applicable to cleared capacity, cleared capacity DRIPE, cleared reliability, uncleared reliability, or any other avoided cost category.

Introduction

This appendix describes our analysis of the effects of load reductions on a varying number of days per year over a varying number of years. This analysis included the construction of a regression model to mimic the ISO New England forecast model and the variation of the historical data to determine the effect of targeted load reductions for the FCAs. We interpret these effects as having an impact on the future value of uncleared capacity and uncleared capacity DRIPE.

Our modeling indicates that a load reduction program that occurs on even a single peak day each summer can affect the load forecast used in the FCA. In most situations, the load forecast will fall more if the historical load is reduced for more days per year or for more years. Regardless of the number of days that a program reduces load annually, the reduction in the load forecast rises steadily for at least eight years. If the program reduces load on less than 55 days, the forecast reduction continues to increase until the program has been running for 12 days. For programs that reduce load on less than 13 days annually, running the program for more years continues to depress the load forecast further, up to the 15 years' worth of historical data that ISO New England uses to develop each load forecast.

This implies that resources that do not provide load reductions on every day of the summer period should have reduced values for uncleared capacity and uncleared capacity DRIPE, relative to the values estimated in the *AESC 2021 User Interface*.

Background

This issue is specific only to uncleared resources.[381] For example, these may include demand response programs, behavioral programs, or rate-design initiatives that are not eligible capacity resources. Although uncleared resources do not receive capacity payments, they reduce the aggregate amount of

[380] We note that there may be certain situations when a dispatchable resource (such as demand response or storage) is cleared in the capacity market, but also performs in such a way that creates uncleared capacity benefits. These additional uncleared benefits are likely to be small, as the most likely the way for them to occur is for a resource to operate for a limited number of hours, during periods that are less important to the formulation of ISO New England's load forecast regression. Calculations to estimate these benefits are complex, dependent on the specific program being analyzed, and may be impossible to calculate without obtaining more specific load regression data from ISO New England. As a result, we do not perform this estimate in AESC 2021. Future editions of this study or follow-up supplemental studies may examine this issue in closer detail.

[381] This includes any resources or portions of resources that are not bid into the FCA or are bid into FCAs but do not clear the auction.

capacity that is required, and hence the price of that capacity, by reducing the ISO New England peak load forecast used in the FCA for that year (see Section 5.2: *Uncleared capacity calculations* for a longer discussion of this dynamic).

The quantity and price of the capacity obligations acquired in the FCA of a particular year (year *t*) depend on the forecast prepared in the previous year (*t* – 1). That forecast is built upon a regression analysis constructed from daily historical data from each of the 62 days in July and August for the previous 15 years (*t* – 16 to *t* – 2), which consists of 930 data points.[382] The regression formulation for the forecast may vary from year to year, but appears to consistently include multiple independent variables computed from a weighted temperature-humidity index (WTHI), including an annual time trend times WTHI and the gross energy forecast (before energy efficiency and BTM solar PV).

Although we consulted with ISO New England on its forecast data, ISO New England did not provide us with its proprietary demand model data or any details on the functional form of its regression model, beyond those in the Forecast Data summaries provided on the ISO New England web site.[383] As a result, our analysis reconstructs a proxy ISO New England load forecast. We then use this to quantify the impact different load reductions over different time periods and under different conditions.

The reference regression model

We constructed our proxy for the ISO New England forecast model based on the data used in the 2017 CELT forecast, which was used in FCA 12 to procure capacity for the summer of 2021.[384] Importantly, all of the effects described below for the reference regression model are for load reductions of various numbers of years that would have been used in producing the 2017 CELT forecast for summer 2021, which was the basis for the demand curve used in FCA 12. Other regressions performed using data for other years could provide different results. A one-year load reduction would affect only the 2016 summer peak day(s), a two-year reduction would affect 2015 and 2016, a three-year reduction would affect 2014–2016, and a 15-year reduction would reduce peaks in 2002–2016.

Input data

Since we did not have ISO New England's exact data, we needed to develop a proxy dataset. As a result, our analysis should be interpreted as an estimate of load reduction effects *based upon data and using a model similar* to that currently used by ISO New England. We do not claim that our model is a precise

[382] Discussions with ISO New England after the completion of this supplemental study confirmed that the forecast is solely built on summer peak hours. Winter peak hours are not included.

Knight, P., M. Chang, J. Hall. May 1, 2020. *AESC Supplemental Study Part I: Considering Winter Peak Benefits*. Synapse Energy Economics for Massachusetts Electric Energy Efficiency Program Administrators. Available at https://www.synapse-energy.com/sites/default/files/AESC_Supplemental_Study_Part_I_Winter_Peak.pdf.

[383] This data includes ISO New England's computation of daily WTHI and reconstitution of load for peak-hour energy-efficiency reductions, demand response and OP #4 measures, and behind-the-meter solar output.

[384] FCA 12 was conducted in February 2018 and was the most recent FCA conducted at the time of this analysis.

prediction of future ISO New England forecasts. Since ISO New England's data and its model structure change (at least a little) every year, we cannot anticipate the exact form of the ISO New England load forecast model for any specific future year.

Development of proxy data

First, we made a number of assumptions to generate our proxy historical dataset, which may not necessarily match ISO New England's past and future sources and methodology.

The dependent variable in the regression analysis is the daily gross peak demand. This is the actual daily peak demand, plus the effects of BTM solar PV and energy efficiency programs (referred to as PDR by ISO New England) for both peak demand and energy, as well as the effects of Operation Procedure #4 (OP #4) events and load management on peak (which is available only for the summer and winter peaks). [385, 386] Our understanding is that ISO New England uses a proprietary data service to estimate the output of installed solar capacity in each historical hour, while assuming that every hour's PDR reduction is equal to the PDR resource cleared in that capacity delivery year.

We estimated historical daily gross peak load as the sum of (a) the maximum hourly demand for the day in ISO New England's hourly load data files and (b) the summer peak PV and PDR reported in the ISO New England's 2017 Forecast Data spreadsheet for the year. [387, 388] We computed the gross monthly net energy for load (NEL) by multiplying the historical monthly sum of actual load by the ratio of gross annual energy to net annual energy from the ISO New England 2017 Forecast Data.[389]

We computed the ISO New England temperature-humidity index (THI) for each day (0.5 × dry-bulb temperature + 0.3 × wet-bulb temperature + 15) as the weighted average of the THI's (the "WTHI") from

[385] Actual daily peak demand is available from the ISO New England website.

[386] ISO New England. March 4, 2021. "ISO New England Operating procedure No. 4 – Action During a Capacity Deficiency" Iso-ne.com. Available at https://www.iso-ne.com/static-assets/documents/rules_proceds/operating/isone/op4/op4_rto_final.pdf

[387] ISO New England. Last accessed March 10, 2021. "Energy, Load, and Demand Reports." *ISO-ne.com.* Available at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/sys-load-eei-fmt.

[388] CELT 2017 Forecast Data File, Tab 5, WN. CELT 2017 was analyzed, as it was the projection used as the basis of the 2018 AESC Study.

[389] CELT 2017 Forecast Data File, Tab 1, History, Gross ISO-NE Coincident Summer Peak.

eight weather stations around the region.[390] We then computed the WTHI for each day using ISO New England's formula (weights of 10 for today's THI, 5 for yesterday's THI, and 2 for the previous day).[391]

Model specification

We estimated the historical relationship of gross load to WTHI, time, NEL and other variables with an ARIMAX (Auto-Regressive Integrated Moving-Average model with eXogenous variables) regression model.[392] This model incorporates both exogenous variables (e.g., net energy for load, weather) and the autoregressive error terms that ISO New England uses in its regression model. These are summarized in Table 178.

Table 178. Variables used in summer peak model

Variable	Definition
Intercept	Constant Term
PEAK	Daily Peak Load, MW
MA_NEL	12-month Moving Sum Annual Net Energy for Load, GWh
WTHI_SQ	The square of [the 3-day Weighted Temperature-Humidity Index at Peak– 55°]
TIME_WTHI	Year indicator; (2002=11, …, 2016=25) × WTHI
Weekend_WTHI	WTHI for a weekend day, else 0
July_04WTHI	WTHI for July_4, else 0
HOLWTHI	WTHI for a Holiday, else 0
Yr2005	1 if Year=2005; 0 otherwise
Yr2012	1 if Year=2012; 0 otherwise
AR(1)	Correction for autocorrelated error from the previous year
AR(2)	Correction for autocorrelated error from the two years previously

Note: This reproduces the description of the summer peak model in the Peak Definitions in ISO New England's 2017 Regional and State Energy & Peak Model Details, corrected to reflect conversations with the ISO forecasters and the specific model described in the Summer Peak Models tab of the Model Details.[393]

[390] The Notes sheet of the annual *SMD Hourly.xlsx* file provide the following weights for the weather stations: Windsor Locks CT (27.7 percent); Bridgeport CT (7 percent); Boston MA (20.1 percent); Burlington VT (4.6 percent); Concord NH (5.8 percent); Worcester MA (21.4 percent); Providence RI (4.9%); Portland ME (8.5 percent). We used the same weights for all years; we have not been able to confirm whether ISO New England has changed the weights over time, as load (especially summer peak) has increased in northern New England compared to the southern portion of the region.
Iowa State University. March 11, 2021. "Dry Line Over Iowa." *Iastate.org*. Available at https://mesonet.agron.iastate.edu/.

[391] Forecast Modeling Procedure for the 2018 CELT, May 1, 2018, page 9. https://www.iso-ne.com/static-assets/documents/2018/04/modeling_procedure_2018fcst.pdf. Note that this document contains all citations for coefficients and weights used in this analysis.

[392] Statmodels. Last accessed March, 10, 2021. *Statsmodels.org*. Available at https://www.statsmodels.org/devel/generated/statsmodels.tsa.statespace.sarimax.SARIMAX.html.

[393] The ISO New England forecast documentation sometimes refers to gross loads as net of PV and PDR, and the Forecast Modeling Procedure for 2017 CELT describes the composite time variable as using WTHI–55º, while the 2017 Regional and State Energy & Peak Model Details file suggests that WTHI is not reduced by 55º.

Independent variables included:

- Net Energy for Load, grossed up for PV and energy efficiency, over the 12 months ending in the current month (July or August, depending on the data point).
- The 3-day weighted temperature-humidity index (WTHI) for the eight cities used in ISO New England's own modeling of weather (see footnote 390). In our analysis, following the treatment in the ISO New England model, the WTHI variable is used as the square ($[\text{WTHI}–55]^2$), and as various cross terms, such as WTHI × weekend dummies.
- Year × (WTHI–55), where the year index is the calendar year minus 1991.
- Boolean flags (i.e., dummies) for holidays, July 4th, weekends, the years 2005 and 2012, and WTHI times the dummy variables for weekends, holidays and July 4th.[394]

These variables were defined for each July and August day in 2002 through 2016.

Forecast data

Once we developed the regression equation, we required forecast input values for the equation. One such input is a forecast of gross energy for load, which ISO New England provides in its forecast.[395] A second set of inputs entails time trend and binary variables: for time trend, we observe that 2017 is year 26, 2018 is year 27, and so on. For binary variables, the weekend binary equals WTHI on future Saturdays and Sundays, the July 4 and holiday binaries equal WTHI on July 4 each year.

ISO New England's forecasting method does not use a single WTHI value, but instead identifies the highest load for a variety of input conditions:

> Weekly peak load forecast distributions are developed by combining output from the daily peak load models with energy forecasts and weekly distributions of weather variables over 40 years.
>
> The expected weather associated with the seasonal peak is considered to be the 50th percentile of the top 10% of the pertinent week's historical weather distribution. The monthly peak load is expected to occur at the weather associated with the 20th percentile of the top 10% of the pertinent week's weather distribution. The "pertinent week" is the week of the month or season with the most extreme weather distribution. For resource adequacy purposes, peak load distributions are developed for each week of the forecast horizon.[396]

[394] It is unclear why ISO New England included variables for both holidays and July 4th, since the only holiday in the two summer months is July 4th. We used the two redundant variables; collectively, the two dummies should capture the effect of July 4th. It is also not unclear why the years 2005 and 2012 featured Boolean flags.

[395] 2017 Forecast Data File, Tab 6, Monthly NEL.

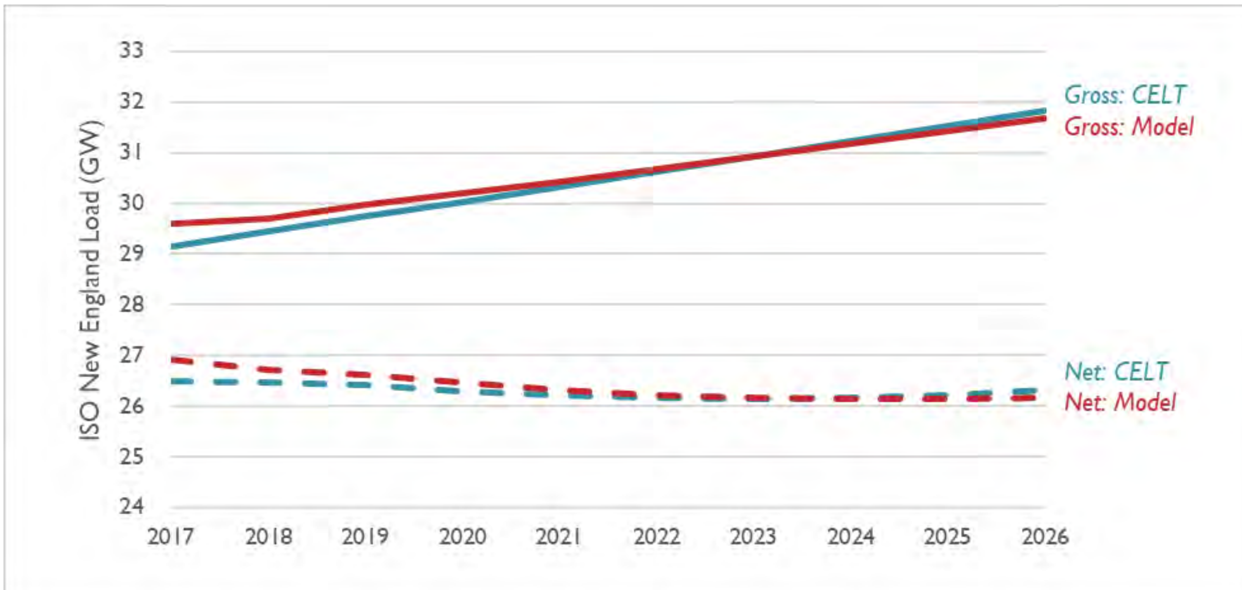
[396] Forecast Modeling Procedure for the 2018 CELT, May 1, 2018, p. 6.

We do not have access to the distributions that ISO New England used in this method, nor do we have a clear operational description of the method. Therefore, we performed a calculation to estimate a value of WTHI that best reproduced the 2017 CELT peak forecast, which turned out be 81.4°.

Base forecast benchmarking

Figure 64 summarizes our modeled Gross and NET 2017 forecast against the 2017 reported Gross and NET CELT forecast. Our modeled forecasted peak demands closely match the ISO's 2017 CELT forecast. Our forecasts for gross peak are within 0.2 percent of the 2017 CELT forecast for 2021, the year for which the 2017 forecast determined the installed capacity requirement.

Figure 64. Comparison of forecasts of gross and net Summer Peak, 2017 CELT and Resource Insight modeled proxy



The effect of load reductions on the forecast

The following sections describe our methodology and findings. We also describe a set of sensitivities that were analyzed to provide robustness for our results.

Structure of reductions

Using our constructed base forecast, we estimated how various load reductions in 2002 through 2016 would have affected the ISO New England load forecast for 2021. Each sensitivity run for the analysis consisted of four steps:

1. Reduce historical gross peak demands on a specified number of summer event days (*d*) for a specified number of years (*y*) by a constant number of MW (Δ*L*).

2. Estimate new regression model coefficients using the same functional form and the modified historical data.

3. Develop peak demand forecasts for the years 2017–2026 (and most importantly, 2021) using the new coefficients.

4. Compute the ratio (*R)* of the change between forecast peak (Δ*F*) to the load reduction (Δ*L*).

The ratio *R* can be thought of as a measure of the efficiency of load reduction in reducing the forecast.

For *ΔL*, we tested load reductions of 250 MW, 500 MW, and 1,000 MW. We used the same reduction in all the days and all the years adjusted in any particular run.

For *d*, we reduced load on the highest days, from one event day to all 62 summer days per affected year. We tested reductions on the highest-load days and the highest-WTHI days and looked at the effect of imperfect forecasting of peak days.

For *y*, we reduced load on the most recent years, from just one year (2016) to all 15 years 2002–2016.

The effect of lower input values on regression forecasts

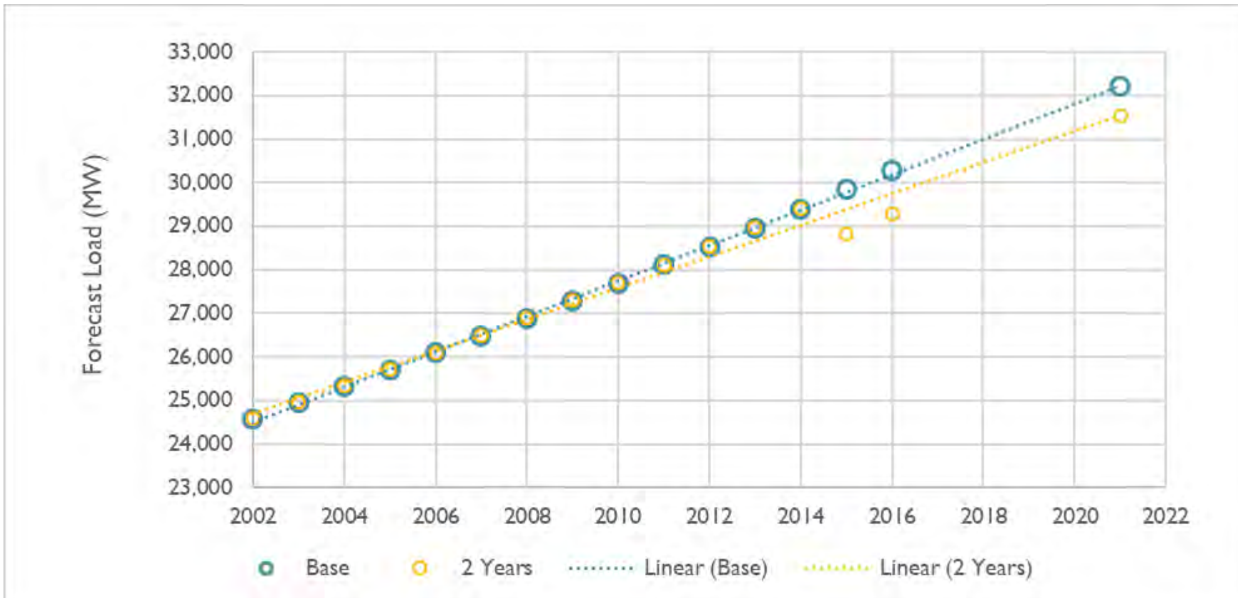
When we began this analysis, we expected that reductions on more days, and reductions in more years, would consistently push down the forecast further. As we discuss in the next section, that is not what we found. Before presenting our results, we will explain how they can arise.

The next four figures show a regression through 15 years of base data. In these examples, we assume a constant 1.5 percent annual growth.[397] In each figure, we show the base historical data, the linear trend line with the base data, the historical data that would have been observed with 1,000 MW reductions in some years, and the regression trend line with the modified data. For each figure, we identify how the change in load impacts the regression and the projection of 2021 load in particular.

The first figure, Figure 65, shows the effect of load reductions in the last two years of data, representing a demand response program operating in 2015 and 2016. The trend line tilts so that the trend is higher than the actual load in the first few years and in the last two years (the two years with demand response reductions), but lower than the input data for 2008–2014. The projection for 2021 is about 700 MW lower than in the base case.

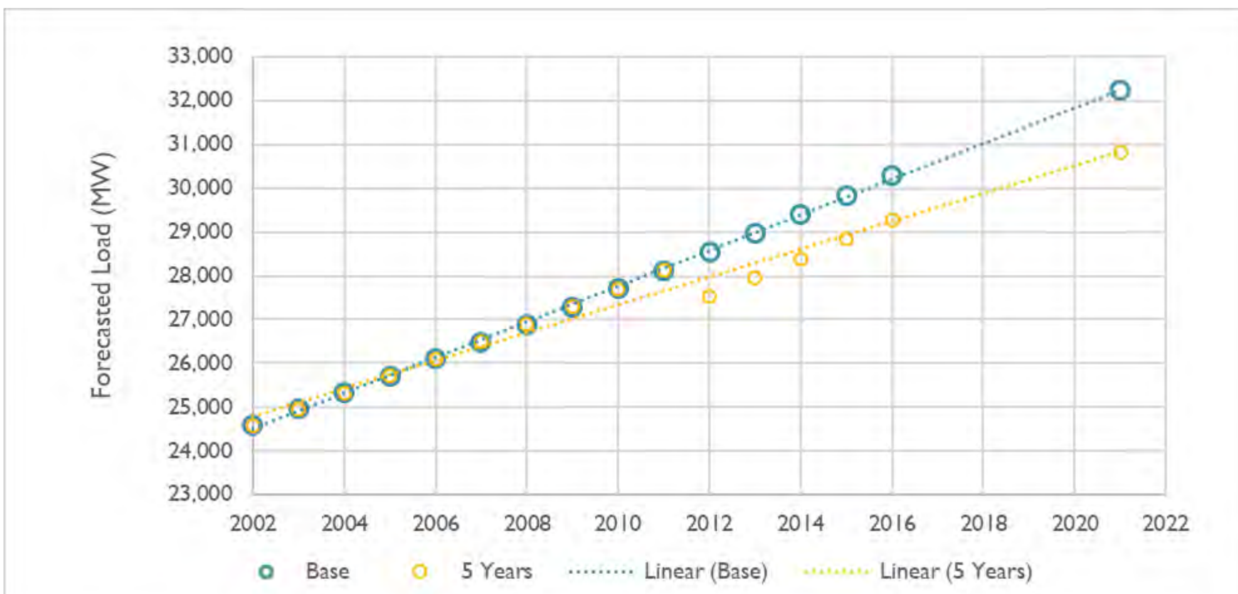
[397] A comparable analysis using weather-normalized loads before PDR and PV for 2002 through 2016 produced very similar results. But, due to a drop in load associated with the 2009-10 Great Recession, it is more difficult to read. We use a simplified example here.

Figure 65. Effect of two years of demand response on the forecast



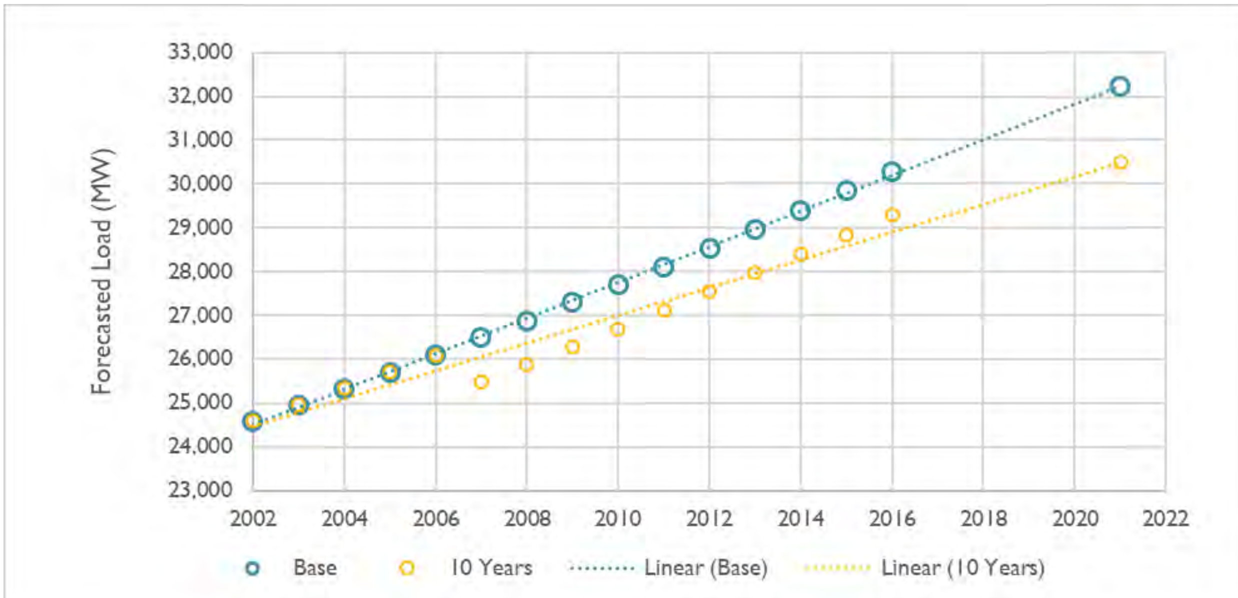
Next, Figure 66 shows the effect of five years of demand response reductions. The trend line with the demand response has tilted further, so that it is almost 1,000 MW below the base-case trend by 2016, and 1,400 MW below the base-case forecast for 2021. The trend line mostly rotates clockwise, rather than moving down, so the change from the base case increases over time and the reduction in the 2021 forecast is substantially larger than the reduction in loads in the five years affected by demand response.

Figure 66. Effect of five years of demand response on the forecast



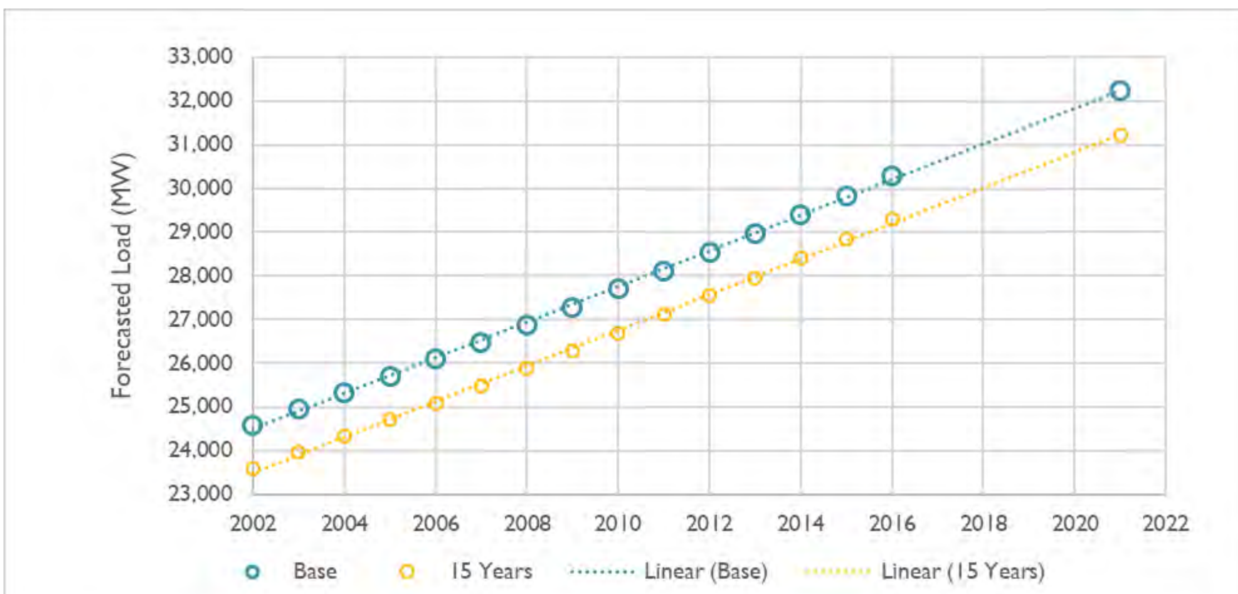
Third, Figure 67 shows the effects of nine years of demand response, which continues the pattern in Figure 66; the forecast for 2021 would be almost 1,800 MW below the base case.

Figure 67. Effect of nine years of demand response on the forecast



Finally, Figure 68 shows that 15 years of 1,000-MW load reductions lowers the trend line by 1,000 MW, while leaving the slope the same as in the base case. The forecast for 2021 is thus 1,000 MW lower than in the base case.

Figure 68. Effect of 15 years of demand response on the forecast



Thus, demand response in some number of the latest years will tend to produce forecast reductions that exceed the annual reductions in the historical data. Beyond some point, additional years of demand response will result in smaller forecast reductions, and once the demand response effect has been in effect for the entire study period, the forecast reduction will equal the reduction in the annual input data.

The same pattern would be expected as the reductions are extended to more of the highest-load days in each year.

Results for reductions on highest-load days

Not surprisingly, we found that the decreases in the forecast peaks based on load reductions varied with (a) the number of days on which load was reduced each year and (b) the number of years of load reductions in the historical load data. Interestingly, we found that the size of the load reduction had essentially no effect on the ratio of forecasted load reduction to historical load reduction, or as we have named it, the ratio *R*. For example, we observe that if load is reduced 100 MW on the five highest-load days in each of the last five summers in the modeling dataset (2012–2016), the forecast for 2021 would be reduced by 24 MW; if the reductions in the historical load were 1,000 MW, the forecast would be reduced by 240 MW.

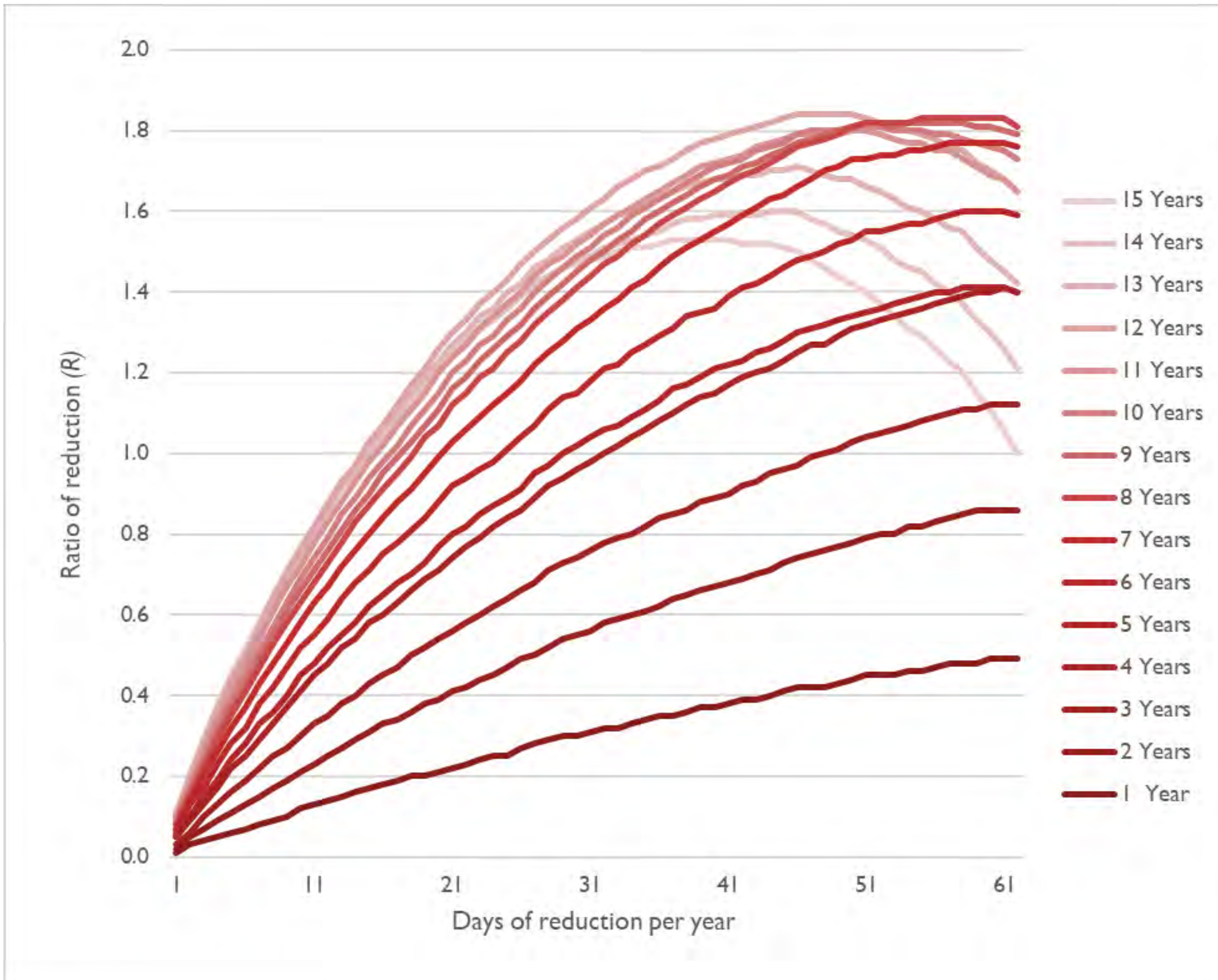
For any duration of a load reduction program, the value of *R* rises with the number of days in which load is reduced, up to at least 35 days. For load reduction programs lasting more than eight years, the value of *R* begins to fall if the number of days reduced exceeds some threshold; at about 55 days for a 9-year program and at about 40 days for a 15-year program.

However, the value of *R* did not vary monotonically with respect to either the number of days or the number of years, and *R* could be more than 1.0, as shown in Figure 69.

For a load reduction program lasting more than two years, reducing load on a large number of days results in $R > 1$, such that the reduction in the load forecast is larger than the reported reduction in the historical load. For a three-year program, *R* peaks at about 1.1 with reductions in 60 days; programs lasting 8 to 12 years have peak *R* above 1.8 for about 50 days of reductions; and a program that reduces load in all 15 years used in the forecast would have a value of *R* over 1.5 for 31 to 46 days of reduction, with *R* falling rapidly for any additional days.

A program that reduces load for all 62 summer days each year for 15 years has an *R* value of exactly 1.0. In effect, such a program would look, for peak-forecasting purposes, like a cleared energy efficiency measure.

Figure 69. Ratio of forecasted load reduction to historical load reduction, various durations

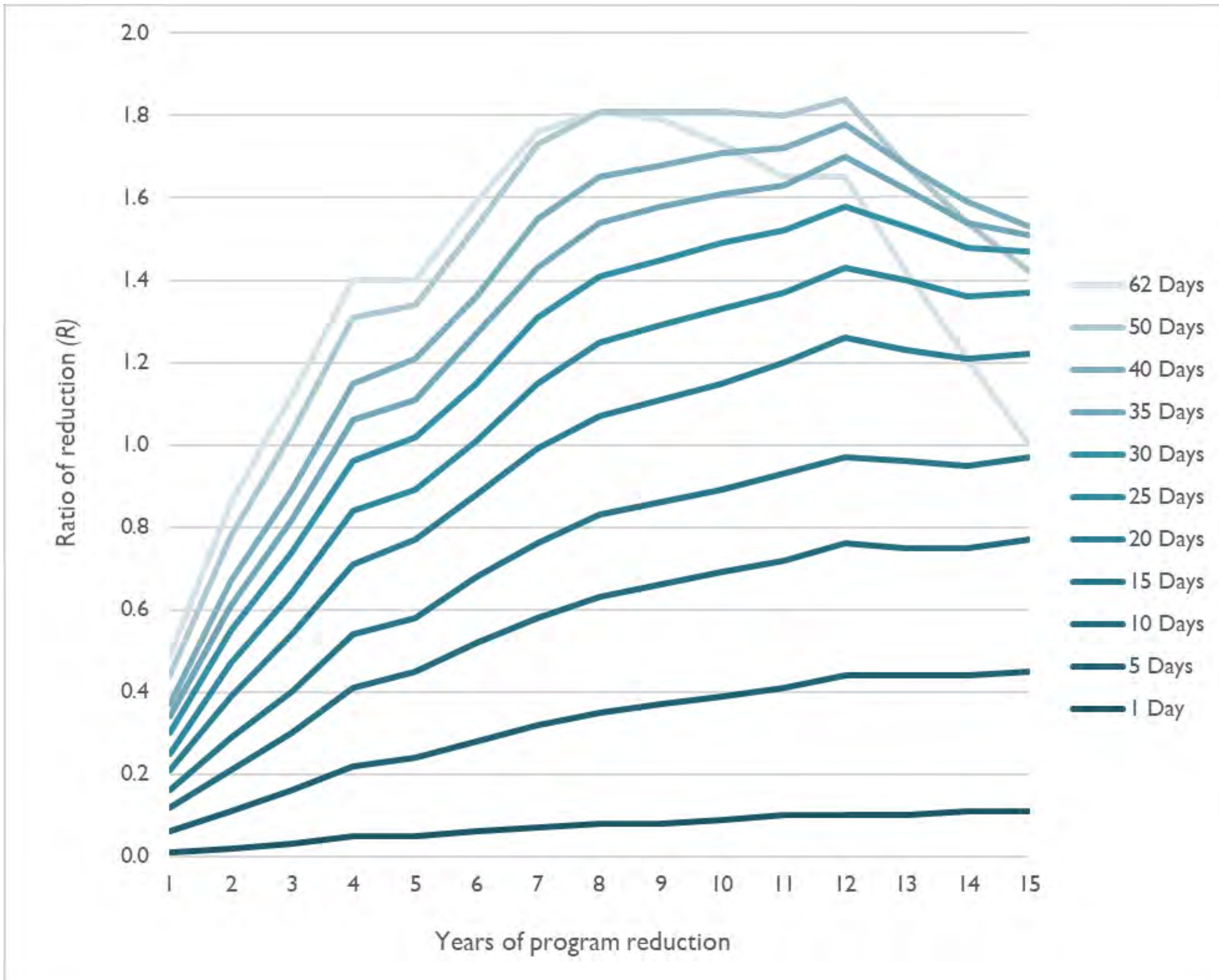


Note: Ratios are shown for 2021 forecasted year.

Figure 70 provides the same data, but with the duration of the reduction in years on the *x* axis and each line representing a number of days of load reduction in each year (essentially swapping the *x* axis and legend in Figure 69). For readability, we present only a subset of days, rather than the full 62.

The horizontal axis in Figure 70 is the number of years that a load reduction has been in place, as of the last year of historical data for the forecast (year *t* – 2). See Subappendix A. Ratio of forecast reduction to load reduction for the *R* values from Figure 69 and Figure 70 numerically.

Figure 70. Ratio of forecast reduction to load reduction, various numbers of peak days per year



Applying the results to demand response screening and valuation

The results in Figure 69 and Figure 70 can be used in at least two ways.

First, they can be used to screen potential demand response programs by modifying the values used for uncleared capacity and capacity DRIPE. For example, a new program that would first reduce load in 2020, for the top ten summer days, would be a one-year reduction in the data for the 2021 forecast, which would be used in the 2022 FCA 16 for the summer of 2025. Since we find that a 10-day program has an *R* value of 0.12, a 200 MW load reduction in 2021 would reduce the forecast peak by 24 MW and produce the DRIPE benefits of that size load reduction. Once the program has run for three years (e.g., 2020–2022), it would create a three-year reduction for the 2023 forecast used in 2024 for FCA 18 for the summer of 2027. The program would have an *R* value of 0.30, so the FCA forecast for 2027 would be reduced by 60 MW. Similarly, if the program continues to run for 15 years, the reduction in the forecast used for FCA 30 would be 154 MW.

Second, the results can be used retrospectively, to evaluate the effect of a program that has been operating. In 2019, a Program Administrator might file results for a 100 MW program that it ran in 2014–2018, reducing load on the top 15 days of each summer. From Subappendix A. Ratio of forecast reduction to load reduction, we would use the 15-day row and estimate that the program reduced the load used in the FCA forecasts by 17 MW in 2018 (for which 2014 was the last year of data used in the forecast), 31 MW in 2019, 43 MW in 2020, and 58 MW in 2021. The sum of the avoided capacity and DRIPE from those years would be benefits of the program.

Sensitivity analysis: Other demand response dispatch approaches

This section describes the results of our analysis under a variety of dispatch and implementation sensitivities, including situations in which demand response is dispatched according to weather or in line with day-ahead forecasts. We also examine situations in which the dispatch of demand response misses some peak days, is performed according to some forecast of load distribution, and in which demand response is dispatched for only a single day each year.

Dispatching according to weather, rather than load

Our main analysis assumes that a demand response program identifies the highest-load days and achieves load reduction on those days. We find that the results are essentially identical for a program that concentrates on reducing load on the days with the worst weather (the highest WTHI values), even though those are slightly different from the highest load days.

Dispatching demand response with day-ahead forecasts

We find that the results are also very similar if targeting of the demand response is imperfect, such that the program is activated on some days that are not in the *d* highest days.[398] For example, the program administrator may call an event on a day that looks like it will be one of the top *d* days for the summer, but it may turn out to have an actual load lower than expected. Or, it may turn out that there are more higher-load days that occur later in that summer, after the program administrator has called as many days as is allowed by the tariff or contracts.[399]

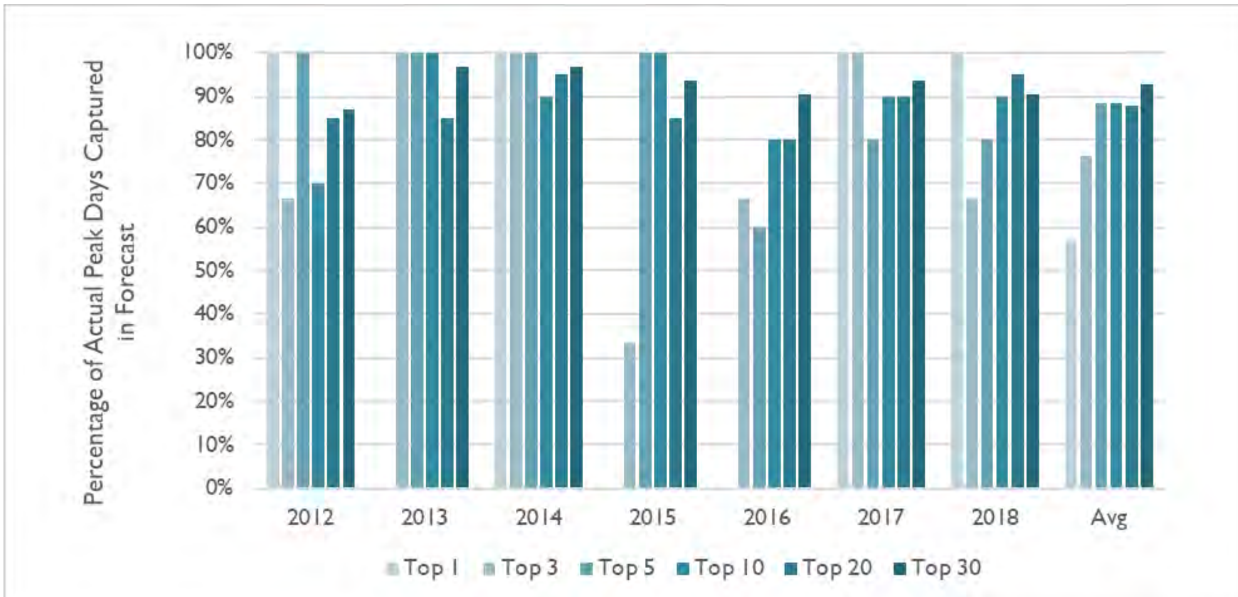
Figure 71 shows the accuracy of demand response program dispatch that is called when the day-ahead peak load is expected to be one of the highest *d* days. These results factor in the optimistic assumption that the program administrator has perfect information about the highest loads for the current summer but not when those highest load days will occur. With this assumption, programs allowing for 5 to 20 days of load reductions would catch 90 percent of the intended control days.

[398] Results are similar, but the curves are less smooth.

[399] The ISO New England day-ahead forecasts are actually quite accurate, correctly flagging the highest *d* days of the summer, if the load of the lowest of those days is known.

Where the day-ahead load would result in activation of a day outside the targeted group, it is almost always close to the intended group. For example, a program targeted at the top 10 days might miss day six, but that unused activation would likely be present on day 11 or 12.

Figure 71. Percentage of highest days flagged by day-ahead load forecast, by year



Dispatching demand response, missing some days

Figure 71 shows the targeting errors if the program administrator somehow knew what the load would be on day d, the lowest load day for which the administrator should activate the program. A more realistic simulation recognizes that the program administrator does not know in early July whether the rest of the summer will be hot or mild, and thus will not know whether a particular day-ahead load forecast is likely to be one the *d* highest days.

Table 179 shows how close the load reductions would be to the perfect-information case with typical substitution of peak days with days just outside the targeted period. For example, Sensitivity Case 4 tests the effect on load reductions of calling an event on the 14th highest day rather than the 9th day of a 10-day per year program, while Sensitivity Case 5 models the effect of calling an event on the 14th highest day rather than the 6th day. Other than Sensitivity Case 1 (an unlikely single-day program calling an event on the second-highest day, rather than the highest-load day), the effect of the imperfect dispatch is within 6 percent of the effect of perfect dispatch, and sometimes the dispatch error actually increases the reduction in forecast load.

Table 179. Ratios of forecast reduction with minor dispatch errors, as a percentage of forecast reduction from perfect dispatch

Sensitivity Case	Event Days	Changes from Optimal Dispatch		Years of Operation			
		Top Days Missed	*Non-Top Days added*	*1*	*5*	*10*	*15*
1	1	#1	#2	67%	92%	92%	81%
2	3	#3	#4	99%	105%	99%	98%
3	5	#5	#7	101%	101%	98%	98%
4	10	#9	#14	99%	97%	98%	98%
5	10	#6	#14	99%	96%	98%	97%
6	20	#14, #17	#25, #30	100%	99%	98%	96%
7	20	#11, #12	#22, #23	98%	97%	97%	96%
8	20	#16, #20	#27, #32	103%	100%	98%	97%
9	31	#18, #24, #27, #30	#34, #37, #40, #43	96%	96%	96%	94%
10	31	#18, #27, #31	#34, #37, #40	98%	97%	97%	95%

Table 180 shows the results for poorly targeted dispatch of a load reduction program in the top 30 days of the summer, either 10 events per year on every third day (starting with day 1 or day 2) or 15 events per year on every second day (either the even-numbered days or the odd-numbered). These dispatch choices represent nearly the worst cases for 10 or 15 annual events, yet they still produce 62 percent to 92 percent of the forecast reduction due to load reductions perfectly targeted to the 10 or 15 days with highest loads.

Table 180. Ratios of forecast reduction with even more imperfect dispatch, as a percentage of forecasted reduction from perfect dispatch

Event Days	Dispatch Days, Ranked by Load	Years of Operation			
		1	*5*	*10*	*15*
10	Every 3rd day: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28	85%	78%	75%	68%
10	Every 3rd day: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	73%	72%	71%	62%
15	Odd days: 1,3, 5, 7, 9, 11,13,15,17,19,21, 23,25, 27, 29	92%	84%	82%	76%
15	Even days: 2, 4, 6, 8, 10,12,14, 16, 18, 20, 22, 24, 26, 28, 30	84%	78%	76%	68%

Dispatching demand response with forecast load distribution

To examine dispatch errors more systematically, we tested a case in which the program was activated and load was curtailed when the day-ahead forecast was within *k*% of ISO New England's forecast of the summer peak, where *k* is the percentage of peak that, on average over the historical data, was exceeded for *d* days per year.

This is a simplified example of a typical demand response program (such as dynamic peak pricing), in which the program administrator tries to foresee peak days and curtail load on those days. In some low-load years, the program will miss some days that later turn out to have been in the top *d* days, while in other years, the program will operate on days that turn out not to be in the top *d* days.

Demand response program administrators are likely to be more sophisticated than the simple algorithm that we used. For example, the program administrator will know how much of the summer remains, how many event days are left for the year, whether the remainder of the summer is forecast to be warmer or cooler than usual, and what a more detailed forecast for the next week or more shows.

Assuming that the program administrator has no information about the loads for the particular year, dispatching with this simple algorithm results in forecast load savings of 80 percent to 100 percent of the perfect-information dispatch, from about four to fifty event days annually. The detailed pattern of differences between the values shown in Subappendix A and Subappedix B may well be due to the different performance of the algorithm in the specific historical years. Overall, a reasonably thoughtful program administrator should be able to achieve about 95 percent of the benefits shown in Subappendix A.

Daily dispatch values

Finally, we estimated the effects of load reductions in just a single day each year, from the highest-load day to the lowest-load day of the summer, and for one to fifteen years of program operation. The specific effect of reductions in any particular day is probably very sensitive to the specific historical pattern of daily loads and weather, so the detailed differences in the daily values (for example, between the 18^{th} and 19^{th} days, or between seven years and eight years) may not be significant. See Appendix C for our estimate of the R value (reduction in the 2021 forecast as a fraction of the annual historical load reductions), for various number of years and various numbers of days per year.

These daily values, if summed up for the top *d* days, produce load reductions lower than those we found for reductions in the top *d* days. This is illustrated in Figure 72, Figure 73, and Figure 74, for programs lasting 1, 5, and 15 years, respectively. In each figure, we plot the sum of the daily contributions to reducing the load forecast (the sum of days) as compared to the reduction from the top days as a group (the optimal dispatch results). The latter is always larger.

Figure 72. Reduction ratio (R) for 1-year program, various numbers of days

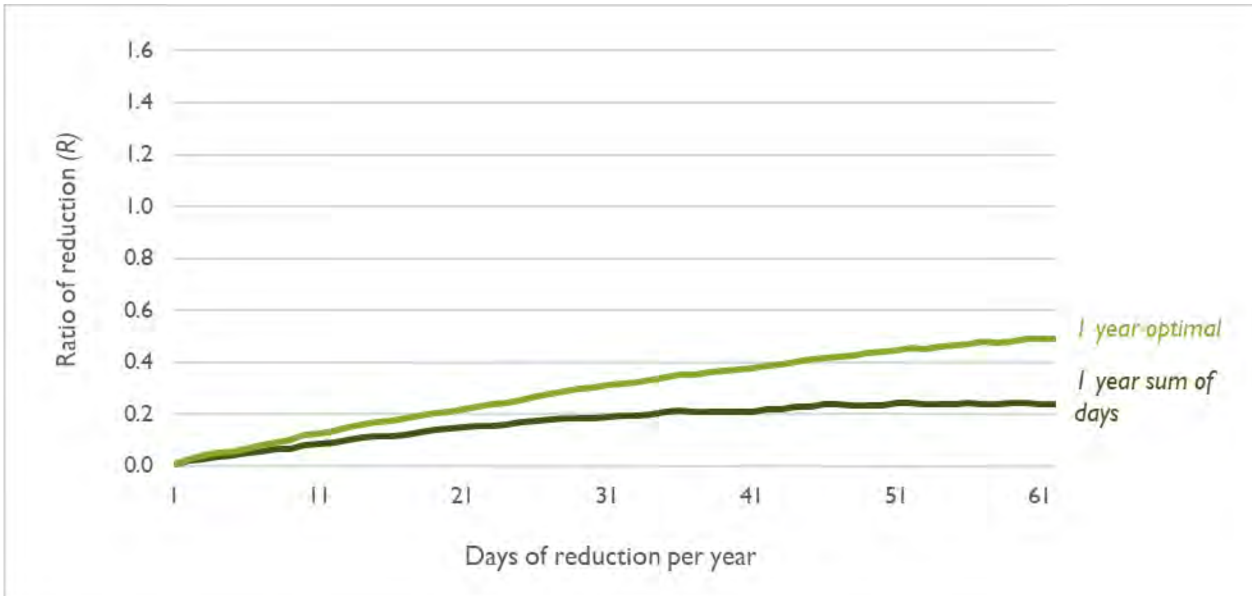


Figure 73. Reduction ratio (R) for 5-year program, various numbers of days

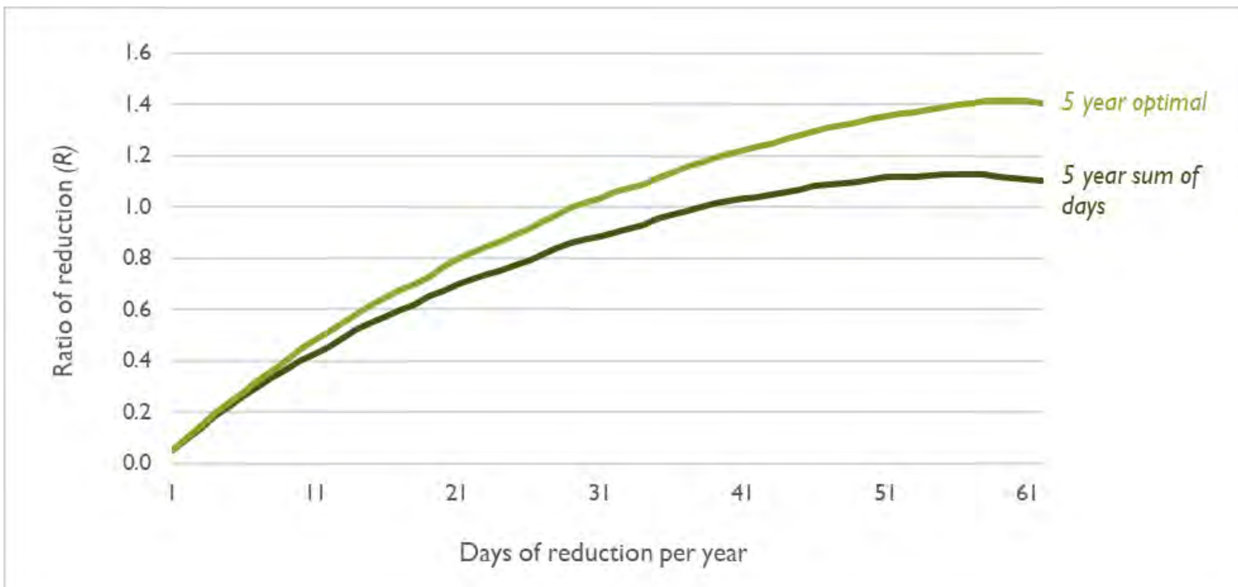
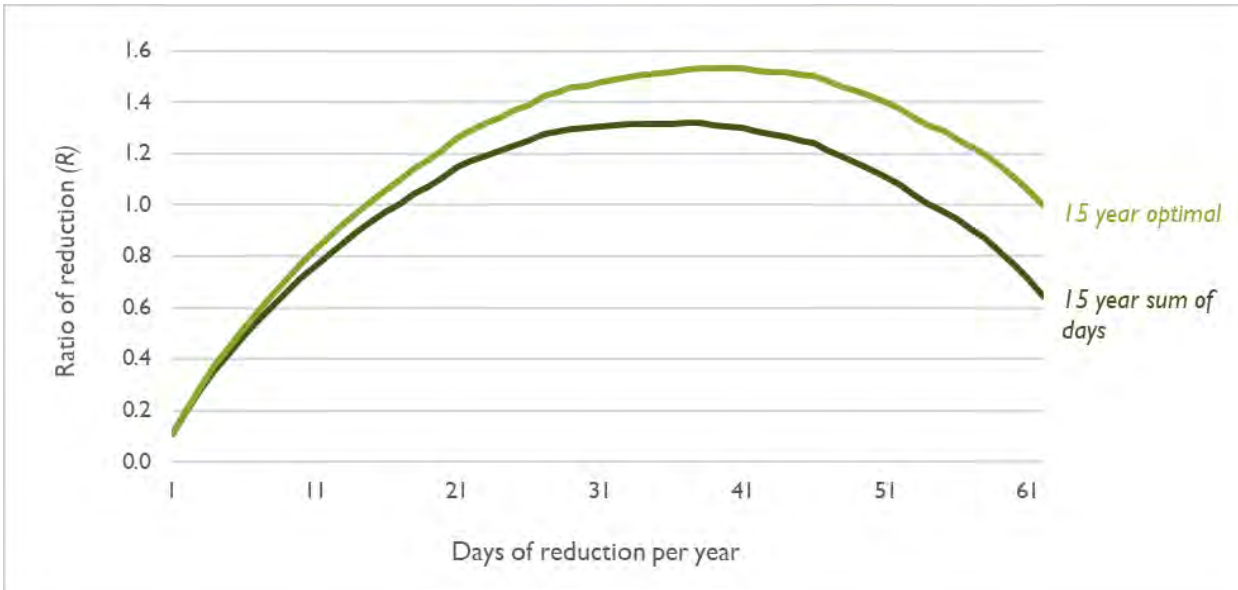


Figure 74. Reduction ratio (R) for 15-year program, various numbers of days



The question then arises, without computing the effects of reductions on all the possible combinations of days (on the order of 10^{18} possibilities), how can the effect of some set of load reductions on uncleared capacity and capacity DRIPE be estimated?

We propose that the load effect (R) for reductions on a set of days *S*, for which the lowest-load day in *S* is the D^{th} highest load day of the summer, be estimated as the average of

1. The sum of the R values for the days in S (from Table 183, Subappendix C), and
2. The R value for D days (from Table 181, Subappendix A), minus the sum of the R values for the days less than D that are not in S (from Table 183, Subappendix C).

For days 1, 4, and 5 of a one-year program (or a program that has only been running for a year), the value would be the average of

The sum of 0.009, 0.013 and 0.005, or 0.027, and

0.06 minus (0.010 + 0.006), or 0.044.

(0.027 + 0.044) ÷ 2 = 0.036.

If greater precision is necessary, or for more complex situations, for example to estimate the effect of different amounts of load reduction on different days over multiple years, we recommend repeating the regressions we describe above for the specific situation.

Subappendix A. Ratio of forecast reduction to load reduction

Table 181 displays the values behind Figure 69 and Figure 70. These values can be applied to uncleared capacity and capacity DRIPE values from AESC 2021 to determine new capacity DRIPE values that are specific to a demand response program.

Table 181. Ratio of forecast reduction to load reduction, by years and days per year

	Years of Reductions														
Days	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	0.01	0.02	0.03	0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.10	0.10	0.11	0.11
2	0.03	0.05	0.06	0.09	0.10	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.20	0.20
3	0.04	0.07	0.10	0.13	0.15	0.17	0.20	0.22	0.23	0.25	0.26	0.28	0.28	0.29	0.29
4	0.05	0.09	0.13	0.17	0.19	0.23	0.26	0.29	0.30	0.32	0.34	0.36	0.36	0.37	0.37
5	0.06	0.11	0.16	0.22	0.24	0.28	0.32	0.35	0.37	0.39	0.41	0.44	0.44	0.44	0.45
6	0.07	0.13	0.19	0.25	0.28	0.32	0.37	0.41	0.43	0.45	0.48	0.50	0.50	0.50	0.52
7	0.08	0.15	0.22	0.29	0.33	0.38	0.43	0.47	0.49	0.51	0.54	0.57	0.57	0.57	0.58
8	0.09	0.17	0.25	0.33	0.36	0.42	0.48	0.53	0.55	0.57	0.61	0.64	0.64	0.63	0.65
9	0.10	0.19	0.27	0.37	0.40	0.47	0.53	0.58	0.61	0.63	0.67	0.70	0.70	0.69	0.71
10	0.12	0.21	0.30	0.41	0.45	0.52	0.58	0.63	0.66	0.69	0.72	0.76	0.75	0.75	0.77
11	0.13	0.23	0.33	0.45	0.48	0.55	0.63	0.68	0.71	0.74	0.78	0.82	0.81	0.80	0.82
12	0.14	0.25	0.35	0.48	0.52	0.59	0.67	0.73	0.76	0.79	0.83	0.87	0.86	0.86	0.88
13	0.15	0.27	0.38	0.52	0.55	0.64	0.72	0.78	0.81	0.85	0.88	0.93	0.92	0.91	0.93
14	0.16	0.29	0.40	0.54	0.58	0.68	0.76	0.83	0.86	0.89	0.93	0.97	0.96	0.95	0.97
15	0.17	0.31	0.43	0.58	0.62	0.71	0.80	0.87	0.90	0.94	0.98	1.03	1.01	1.00	1.02
16	0.18	0.33	0.45	0.60	0.65	0.75	0.84	0.91	0.95	0.98	1.02	1.07	1.06	1.04	1.06
17	0.19	0.34	0.47	0.63	0.68	0.78	0.88	0.95	0.99	1.02	1.07	1.12	1.10	1.08	1.10
18	0.20	0.36	0.50	0.66	0.70	0.81	0.91	0.99	1.03	1.07	1.11	1.17	1.15	1.13	1.14
19	0.20	0.38	0.52	0.69	0.73	0.84	0.95	1.04	1.07	1.11	1.15	1.21	1.19	1.17	1.18
20	0.21	0.39	0.54	0.71	0.77	0.88	0.99	1.07	1.11	1.15	1.20	1.26	1.23	1.21	1.22
21	0.22	0.41	0.56	0.74	0.80	0.92	1.03	1.12	1.16	1.20	1.24	1.30	1.27	1.25	1.26
22	0.23	0.42	0.58	0.77	0.82	0.94	1.06	1.15	1.19	1.23	1.27	1.33	1.30	1.28	1.29
23	0.24	0.44	0.60	0.79	0.85	0.96	1.09	1.19	1.23	1.27	1.31	1.37	1.34	1.31	1.32
24	0.25	0.45	0.62	0.82	0.87	0.98	1.12	1.21	1.26	1.29	1.34	1.40	1.36	1.33	1.34
25	0.25	0.47	0.64	0.84	0.89	1.01	1.15	1.25	1.29	1.33	1.37	1.43	1.40	1.36	1.37
26	0.27	0.49	0.66	0.86	0.91	1.04	1.18	1.28	1.32	1.36	1.40	1.47	1.42	1.39	1.39
27	0.28	0.50	0.68	0.89	0.95	1.07	1.22	1.32	1.36	1.40	1.44	1.50	1.46	1.42	1.42
28	0.29	0.52	0.71	0.92	0.97	1.11	1.25	1.35	1.39	1.43	1.47	1.53	1.48	1.44	1.44
29	0.30	0.54	0.73	0.94	1.00	1.14	1.28	1.38	1.42	1.46	1.49	1.56	1.51	1.46	1.46
30	0.30	0.55	0.74	0.96	1.02	1.15	1.31	1.41	1.45	1.49	1.52	1.58	1.53	1.48	1.47
31	0.31	0.56	0.76	0.98	1.04	1.18	1.33	1.44	1.48	1.51	1.54	1.61	1.55	1.49	1.48
32	0.32	0.58	0.78	1.00	1.06	1.21	1.36	1.47	1.50	1.54	1.57	1.63	1.57	1.51	1.49
33	0.32	0.59	0.79	1.02	1.07	1.22	1.38	1.49	1.53	1.56	1.59	1.66	1.59	1.52	1.50
34	0.33	0.60	0.80	1.04	1.09	1.25	1.41	1.52	1.55	1.59	1.61	1.68	1.60	1.53	1.51
35	0.34	0.61	0.82	1.06	1.11	1.27	1.43	1.54	1.58	1.61	1.63	1.70	1.62	1.54	1.51
36	0.35	0.62	0.84	1.08	1.13	1.29	1.46	1.57	1.60	1.63	1.65	1.71	1.63	1.55	1.52
37	0.35	0.64	0.85	1.10	1.16	1.31	1.49	1.59	1.62	1.65	1.67	1.73	1.65	1.57	1.53
38	0.36	0.65	0.86	1.12	1.17	1.34	1.51	1.61	1.64	1.67	1.69	1.75	1.66	1.58	1.53
39	0.37	0.66	0.88	1.14	1.19	1.35	1.53	1.63	1.66	1.69	1.71	1.77	1.67	1.58	1.53
40	0.37	0.67	0.89	1.15	1.21	1.36	1.55	1.65	1.68	1.71	1.72	1.78	1.68	1.59	1.53
41	0.38	0.68	0.90	1.17	1.22	1.39	1.57	1.67	1.69	1.72	1.73	1.79	1.68	1.59	1.53
42	0.39	0.69	0.92	1.19	1.23	1.41	1.59	1.69	1.71	1.73	1.74	1.80	1.69	1.59	1.52

	Years of Reductions														
Days	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
43	0.39	0.70	0.93	1.20	1.25	1.42	1.61	1.70	1.72	1.75	1.76	1.81	1.69	1.59	1.52
44	0.40	0.71	0.95	1.21	1.26	1.44	1.63	1.72	1.74	1.76	1.77	1.82	1.70	1.60	1.52
45	0.41	0.73	0.96	1.23	1.28	1.46	1.64	1.74	1.75	1.77	1.78	1.83	1.70	1.60	1.51
46	0.42	0.74	0.97	1.25	1.30	1.48	1.66	1.76	1.77	1.79	1.79	1.84	1.71	1.60	1.50
47	0.42	0.75	0.99	1.27	1.31	1.49	1.68	1.77	1.78	1.80	1.79	1.84	1.70	1.58	1.48
48	0.42	0.76	1.00	1.27	1.32	1.50	1.70	1.78	1.79	1.80	1.79	1.84	1.69	1.57	1.46
49	0.43	0.77	1.01	1.29	1.33	1.52	1.71	1.79	1.80	1.80	1.79	1.84	1.68	1.55	1.44
50	0.44	0.78	1.03	1.31	1.34	1.53	1.73	1.81	1.81	1.81	1.80	1.84	1.68	1.54	1.42
51	0.45	0.79	1.04	1.32	1.35	1.55	1.73	1.82	1.82	1.81	1.80	1.83	1.66	1.53	1.40
52	0.45	0.80	1.05	1.33	1.36	1.55	1.74	1.82	1.82	1.81	1.79	1.82	1.65	1.51	1.37
53	0.45	0.80	1.06	1.34	1.37	1.56	1.74	1.82	1.81	1.80	1.78	1.81	1.63	1.48	1.34
54	0.46	0.82	1.07	1.35	1.38	1.57	1.75	1.82	1.82	1.80	1.77	1.80	1.61	1.46	1.31
55	0.46	0.82	1.08	1.36	1.39	1.57	1.75	1.83	1.82	1.80	1.77	1.79	1.60	1.45	1.29
56	0.47	0.83	1.09	1.37	1.40	1.58	1.76	1.83	1.82	1.79	1.75	1.78	1.58	1.42	1.26
57	0.48	0.84	1.10	1.38	1.40	1.59	1.77	1.83	1.82	1.79	1.75	1.76	1.56	1.40	1.23
58	0.48	0.85	1.11	1.39	1.41	1.60	1.77	1.83	1.82	1.78	1.73	1.75	1.55	1.37	1.20
59	0.48	0.86	1.11	1.40	1.41	1.60	1.77	1.83	1.81	1.77	1.71	1.72	1.51	1.33	1.15
60	0.49	0.86	1.12	1.40	1.41	1.60	1.77	1.83	1.81	1.76	1.69	1.70	1.48	1.30	1.11
61	0.49	0.86	1.12	1.41	1.41	1.60	1.77	1.83	1.80	1.75	1.68	1.68	1.45	1.26	1.06
62	0.49	0.86	1.12	1.40	1.40	1.59	1.76	1.81	1.79	1.73	1.65	1.65	1.42	1.21	1.00

Subappendix B. Ratio of forecast reduction to load reduction, with forecast load distribution

Table 182 displays a modified version of the values in Subappendix A, assuming imperfect dispatch. See the main body of Appendix K, subsection “Dispatching demand response with forecast load distribution” for more information.

Table 182. Ratio of forecast reduction to load reduction, imperfect dispatch

	Years of Reductions														
Days	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
2	0.02	0.02	0.02	0.05	0.06	0.07	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.12
3	0.03	0.06	0.08	0.11	0.13	0.15	0.17	0.17	0.17	0.19	0.20	0.21	0.21	0.21	0.21
4	0.04	0.09	0.13	0.17	0.19	0.21	0.25	0.26	0.26	0.27	0.28	0.30	0.30	0.30	0.30
5	0.05	0.11	0.15	0.20	0.22	0.25	0.29	0.30	0.31	0.33	0.34	0.36	0.36	0.36	0.36
6	0.06	0.13	0.17	0.23	0.25	0.29	0.34	0.36	0.37	0.39	0.40	0.42	0.42	0.42	0.42
7	0.07	0.14	0.20	0.27	0.29	0.33	0.38	0.40	0.41	0.44	0.45	0.47	0.47	0.46	0.46
8	0.08	0.16	0.23	0.30	0.32	0.37	0.42	0.45	0.46	0.48	0.50	0.52	0.52	0.51	0.51
9	0.09	0.18	0.25	0.32	0.35	0.40	0.46	0.49	0.50	0.52	0.54	0.57	0.56	0.55	0.55
10	0.10	0.20	0.27	0.35	0.39	0.44	0.51	0.54	0.55	0.58	0.60	0.62	0.62	0.61	0.60
11	0.12	0.22	0.29	0.38	0.42	0.49	0.56	0.59	0.60	0.63	0.65	0.68	0.68	0.66	0.66
12	0.12	0.23	0.31	0.41	0.45	0.53	0.60	0.64	0.65	0.68	0.70	0.73	0.73	0.71	0.71
13	0.13	0.24	0.32	0.44	0.47	0.55	0.64	0.67	0.69	0.71	0.74	0.77	0.77	0.75	0.75
14	0.14	0.25	0.34	0.47	0.51	0.60	0.68	0.71	0.73	0.76	0.79	0.82	0.82	0.80	0.80
15	0.15	0.29	0.38	0.52	0.57	0.66	0.75	0.79	0.82	0.85	0.88	0.91	0.91	0.88	0.88
16	0.15	0.30	0.40	0.55	0.59	0.69	0.78	0.83	0.85	0.88	0.92	0.96	0.94	0.92	0.91
17	0.17	0.32	0.43	0.58	0.62	0.73	0.82	0.88	0.90	0.94	0.98	1.02	1.00	0.98	0.97
18	0.17	0.34	0.45	0.60	0.64	0.75	0.85	0.92	0.94	0.98	1.02	1.06	1.04	1.00	0.99
19	0.18	0.35	0.46	0.62	0.67	0.78	0.88	0.95	0.98	1.01	1.05	1.09	1.07	1.03	1.02
20	0.19	0.37	0.48	0.64	0.69	0.80	0.91	0.98	1.01	1.05	1.09	1.14	1.11	1.06	1.06
21	0.19	0.38	0.49	0.66	0.71	0.82	0.93	1.00	1.03	1.07	1.10	1.15	1.13	1.08	1.07
22	0.20	0.39	0.50	0.68	0.73	0.84	0.96	1.03	1.06	1.10	1.13	1.19	1.16	1.10	1.09
23	0.21	0.41	0.54	0.71	0.76	0.88	1.00	1.07	1.11	1.14	1.18	1.24	1.20	1.14	1.13
24	0.22	0.43	0.56	0.74	0.78	0.90	1.02	1.10	1.13	1.17	1.21	1.26	1.23	1.16	1.15
25	0.23	0.44	0.58	0.76	0.81	0.93	1.06	1.14	1.18	1.21	1.25	1.31	1.27	1.21	1.19
26	0.23	0.45	0.58	0.78	0.82	0.95	1.08	1.16	1.20	1.23	1.27	1.33	1.30	1.23	1.22
27	0.24	0.47	0.60	0.80	0.84	0.97	1.10	1.18	1.22	1.26	1.30	1.36	1.33	1.26	1.25
28	0.25	0.48	0.61	0.81	0.86	0.99	1.13	1.21	1.25	1.29	1.32	1.38	1.34	1.27	1.26
29	0.26	0.50	0.63	0.84	0.88	1.02	1.16	1.25	1.29	1.32	1.36	1.42	1.38	1.31	1.29
30	0.26	0.50	0.63	0.85	0.89	1.03	1.17	1.26	1.30	1.34	1.37	1.43	1.39	1.31	1.29
31	0.27	0.52	0.66	0.87	0.92	1.06	1.21	1.29	1.34	1.37	1.40	1.46	1.42	1.33	1.32
32	0.28	0.53	0.68	0.90	0.94	1.08	1.24	1.32	1.36	1.40	1.43	1.49	1.44	1.35	1.33
33	0.29	0.55	0.71	0.93	0.98	1.12	1.28	1.37	1.41	1.44	1.47	1.53	1.48	1.39	1.35
34	0.30	0.56	0.72	0.95	1.00	1.15	1.31	1.39	1.44	1.47	1.49	1.56	1.50	1.41	1.37
35	0.31	0.58	0.74	0.98	1.03	1.18	1.34	1.43	1.47	1.50	1.53	1.58	1.53	1.44	1.40
36	0.33	0.60	0.78	1.01	1.06	1.21	1.37	1.47	1.51	1.54	1.56	1.62	1.56	1.46	1.43
37	0.34	0.62	0.80	1.04	1.09	1.24	1.41	1.50	1.54	1.57	1.59	1.65	1.58	1.48	1.44
38	0.35	0.63	0.82	1.06	1.11	1.27	1.44	1.53	1.57	1.60	1.62	1.68	1.59	1.50	1.44
39	0.35	0.64	0.83	1.09	1.13	1.29	1.46	1.55	1.60	1.63	1.64	1.69	1.60	1.50	1.45
40	0.36	0.66	0.85	1.10	1.15	1.31	1.48	1.58	1.62	1.65	1.66	1.71	1.62	1.52	1.46
41	0.37	0.67	0.87	1.12	1.17	1.33	1.51	1.61	1.64	1.67	1.68	1.73	1.61	1.50	1.43
42	0.37	0.67	0.88	1.13	1.17	1.34	1.52	1.61	1.65	1.67	1.69	1.73	1.60	1.48	1.41
43	0.38	0.68	0.89	1.15	1.19	1.35	1.53	1.63	1.67	1.69	1.70	1.75	1.61	1.50	1.42
44	0.39	0.69	0.90	1.15	1.20	1.37	1.55	1.64	1.68	1.70	1.71	1.75	1.62	1.50	1.41

	Years of Reductions														
Days	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
45	0.39	0.70	0.92	1.18	1.21	1.39	1.57	1.67	1.70	1.73	1.73	1.77	1.64	1.52	1.42
46	0.40	0.71	0.93	1.19	1.23	1.40	1.59	1.70	1.73	1.75	1.75	1.79	1.66	1.54	1.44
47	0.40	0.72	0.94	1.20	1.24	1.41	1.60	1.71	1.74	1.76	1.76	1.79	1.65	1.53	1.43
48	0.41	0.73	0.95	1.21	1.24	1.41	1.60	1.71	1.73	1.76	1.75	1.78	1.63	1.50	1.40
49	0.41	0.74	0.96	1.22	1.26	1.43	1.62	1.73	1.75	1.78	1.77	1.80	1.65	1.51	1.40
50	0.42	0.75	0.97	1.23	1.27	1.44	1.64	1.74	1.76	1.79	1.78	1.80	1.64	1.50	1.38
51	0.42	0.76	0.98	1.25	1.28	1.46	1.65	1.76	1.78	1.81	1.79	1.82	1.65	1.51	1.38
52	0.43	0.78	1.01	1.28	1.31	1.49	1.68	1.79	1.81	1.82	1.80	1.82	1.66	1.51	1.38
53	0.45	0.79	1.02	1.30	1.33	1.51	1.70	1.81	1.83	1.85	1.82	1.84	1.67	1.52	1.38
54	0.45	0.80	1.03	1.31	1.34	1.52	1.71	1.82	1.84	1.85	1.83	1.84	1.68	1.52	1.37
55	0.46	0.81	1.05	1.32	1.34	1.52	1.71	1.82	1.83	1.84	1.80	1.82	1.64	1.47	1.32
56	0.46	0.82	1.06	1.33	1.35	1.53	1.73	1.83	1.84	1.84	1.80	1.81	1.63	1.46	1.30
57	0.47	0.83	1.07	1.34	1.36	1.54	1.73	1.83	1.84	1.84	1.79	1.80	1.62	1.44	1.27
58	0.47	0.84	1.08	1.35	1.37	1.56	1.75	1.84	1.85	1.85	1.80	1.81	1.62	1.44	1.26
59	0.47	0.83	1.08	1.35	1.36	1.54	1.73	1.81	1.80	1.76	1.72	1.72	1.53	1.34	1.16
60	0.48	0.85	1.09	1.37	1.37	1.56	1.73	1.81	1.80	1.77	1.72	1.72	1.52	1.34	1.14
61	0.48	0.85	1.10	1.38	1.39	1.57	1.73	1.81	1.79	1.76	1.71	1.71	1.48	1.28	1.08
62	0.49	0.86	1.12	1.39	1.39	1.58	1.75	1.82	1.80	1.76	1.69	1.69	1.45	1.26	1.04

Subappendix C. Impact of individual day load reductions

Table 183 shows our estimate of the R value (reduction in the 2021 forecast as a fraction of the annual historical load reductions), for various number of years and various numbers of days per year. See the main body of Appendix K, subsection “Daily dispatch values” for more information.

Table 183. Effect of individual day load reductions on reduction ratios

Days	Years of Reductions														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	0.009	0.021	0.032	0.046	0.051	0.063	0.072	0.079	0.082	0.089	0.096	0.102	0.104	0.106	0.108
2	0.010	0.021	0.031	0.040	0.046	0.056	0.064	0.073	0.078	0.081	0.081	0.086	0.086	0.086	0.087
3	0.006	0.016	0.025	0.036	0.040	0.047	0.056	0.062	0.065	0.069	0.074	0.080	0.080	0.080	0.083
4	0.013	0.024	0.035	0.046	0.050	0.056	0.063	0.069	0.070	0.067	0.081	0.083	0.075	0.075	0.077
5	0.005	0.016	0.026	0.036	0.038	0.044	0.050	0.055	0.058	0.060	0.064	0.067	0.066	0.066	0.068
6	0.011	0.014	0.020	0.038	0.041	0.046	0.052	0.050	0.052	0.053	0.057	0.061	0.059	0.058	0.060
7	0.005	0.013	0.022	0.033	0.034	0.040	0.047	0.052	0.054	0.054	0.056	0.060	0.059	0.058	0.059
8	0.007	0.022	0.024	0.035	0.036	0.045	0.052	0.055	0.056	0.059	0.060	0.062	0.062	0.061	0.063
9	0.004	0.013	0.021	0.031	0.034	0.039	0.044	0.049	0.053	0.054	0.055	0.057	0.055	0.054	0.053
10	0.012	0.014	0.021	0.032	0.030	0.038	0.043	0.047	0.048	0.050	0.050	0.052	0.051	0.051	0.053
11	0.006	0.014	0.020	0.027	0.027	0.032	0.038	0.042	0.043	0.046	0.048	0.050	0.048	0.047	0.047
12	0.004	0.013	0.020	0.027	0.029	0.035	0.040	0.045	0.047	0.049	0.050	0.051	0.050	0.048	0.049
13	0.013	0.022	0.027	0.033	0.036	0.041	0.045	0.049	0.049	0.052	0.045	0.048	0.047	0.046	0.045
14	0.009	0.010	0.017	0.023	0.031	0.028	0.033	0.037	0.038	0.038	0.039	0.042	0.039	0.037	0.043
15	0.004	0.013	0.018	0.024	0.027	0.032	0.036	0.039	0.040	0.041	0.044	0.046	0.044	0.042	0.041
16	0.002	0.010	0.016	0.022	0.023	0.029	0.033	0.036	0.037	0.039	0.039	0.041	0.039	0.036	0.036
17	0.004	0.011	0.016	0.021	0.023	0.027	0.031	0.033	0.035	0.036	0.038	0.041	0.038	0.034	0.033
18	0.009	0.012	0.023	0.024	0.023	0.027	0.031	0.036	0.036	0.037	0.037	0.039	0.040	0.038	0.037
19	0.010	0.017	0.023	0.023	0.031	0.026	0.032	0.036	0.037	0.037	0.036	0.038	0.033	0.031	0.030
20	0.006	0.012	0.012	0.018	0.020	0.023	0.029	0.031	0.034	0.036	0.037	0.039	0.037	0.034	0.035
21	0.004	0.011	0.017	0.023	0.025	0.029	0.033	0.036	0.038	0.037	0.037	0.039	0.039	0.035	0.037
22	0.004	0.010	0.014	0.021	0.019	0.022	0.025	0.028	0.027	0.028	0.026	0.027	0.024	0.024	0.026
23	0.001	0.009	0.015	0.020	0.021	0.024	0.027	0.030	0.030	0.029	0.028	0.032	0.028	0.024	0.022
24	0.007	0.012	0.010	0.015	0.014	0.016	0.019	0.022	0.022	0.022	0.028	0.023	0.019	0.016	0.019
25	0.008	0.015	0.018	0.021	0.023	0.024	0.028	0.030	0.027	0.028	0.026	0.027	0.024	0.023	0.021
26	0.006	0.013	0.018	0.016	0.018	0.021	0.026	0.028	0.027	0.026	0.026	0.027	0.023	0.019	0.018
27	0.005	0.012	0.017	0.024	0.025	0.027	0.030	0.032	0.031	0.031	0.031	0.031	0.028	0.027	0.025
28	0.003	0.009	0.021	0.021	0.025	0.024	0.026	0.032	0.025	0.024	0.021	0.021	0.017	0.013	0.009
29	0.001	0.008	0.013	0.017	0.017	0.023	0.026	0.026	0.025	0.025	0.023	0.023	0.022	0.016	0.012
30	0.002	0.009	0.012	0.015	0.015	0.017	0.021	0.021	0.020	0.020	0.018	0.017	0.013	0.008	0.003

Days	Years of Reductions														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
31	0.002	0.013	0.016	0.014	0.013	0.016	0.019	0.021	0.020	0.020	0.019	0.019	0.014	0.009	0.005
32	0.008	0.007	0.010	0.015	0.015	0.016	0.020	0.021	0.021	0.020	0.017	0.018	0.014	0.010	0.005
33	0.000	0.005	0.007	0.011	0.012	0.015	0.018	0.020	0.020	0.019	0.018	0.018	0.012	0.009	0.005
34	0.006	0.005	0.013	0.018	0.018	0.021	0.024	0.025	0.024	0.023	0.013	0.013	0.008	0.005	-0.001
35	0.009	0.015	0.018	0.022	0.021	0.017	0.019	0.018	0.016	0.016	0.013	0.013	0.008	0.005	0.000
36	0.002	0.006	0.010	0.015	0.015	0.016	0.019	0.018	0.016	0.015	0.013	0.012	0.008	0.004	0.002
37	-0.001	0.006	0.009	0.014	0.015	0.018	0.020	0.018	0.016	0.015	0.014	0.014	0.009	0.007	0.002
38	-0.001	0.005	0.007	0.018	0.018	0.015	0.016	0.016	0.016	0.015	0.013	0.012	0.009	0.005	-0.001
39	0.000	0.005	0.008	0.011	0.010	0.012	0.014	0.012	0.012	0.011	0.010	0.008	0.002	0.000	-0.006
40	-0.001	0.005	0.009	0.012	0.010	0.010	0.013	0.013	0.012	0.010	0.008	0.008	0.002	-0.002	-0.008
41	0.001	0.006	0.009	0.011	0.011	0.014	0.015	0.014	0.012	0.012	0.010	0.008	0.002	-0.002	-0.006
42	0.008	0.005	0.008	0.010	0.008	0.010	0.012	0.010	0.008	0.005	0.003	0.002	-0.004	-0.008	-0.015
43	0.001	0.005	0.006	0.007	0.008	0.012	0.013	0.013	0.010	0.008	0.006	0.004	0.000	-0.003	-0.010
44	0.008	0.013	0.007	0.016	0.011	0.013	0.015	0.012	0.011	0.010	0.007	0.006	0.003	-0.001	-0.008
45	0.001	0.005	0.007	0.009	0.009	0.011	0.012	0.009	0.006	0.003	0.003	-0.001	-0.007	-0.009	-0.016
46	0.007	0.005	0.008	0.011	0.012	0.012	0.015	0.014	0.011	0.009	0.008	0.005	-0.001	-0.006	-0.011
47	0.001	0.005	0.009	0.010	0.009	0.011	0.011	0.008	0.005	0.001	-0.004	-0.007	-0.013	-0.019	-0.026
48	-0.001	0.003	0.004	0.005	0.002	0.004	0.009	0.007	0.005	0.001	-0.002	-0.004	-0.011	-0.018	-0.026
49	-0.002	0.003	0.008	0.011	0.008	0.009	0.008	0.006	0.003	-0.001	-0.005	-0.007	-0.013	-0.018	-0.023
50	0.001	0.004	0.007	0.008	0.007	0.009	0.007	0.005	0.004	-0.001	-0.004	-0.008	-0.012	-0.018	-0.026
51	0.007	0.011	0.014	0.013	0.010	0.012	0.009	0.006	0.004	-0.005	-0.008	-0.011	-0.018	-0.023	-0.031
52	-0.001	0.002	0.003	0.003	0.000	0.001	-0.001	-0.001	-0.004	-0.009	-0.011	-0.013	-0.019	-0.024	-0.029
53	-0.002	0.001	0.002	0.003	0.001	0.001	-0.001	-0.005	-0.008	-0.013	-0.018	-0.021	-0.026	-0.033	-0.041
54	0.000	0.004	0.004	0.005	0.003	0.002	0.000	-0.003	-0.007	-0.010	-0.015	-0.019	-0.024	-0.027	-0.034
55	-0.002	0.002	0.003	0.006	0.003	0.005	0.003	0.003	0.001	-0.005	-0.008	-0.010	-0.016	-0.021	-0.027
56	0.004	0.001	0.003	0.004	0.001	0.000	-0.001	-0.005	-0.007	-0.013	-0.019	-0.023	-0.021	-0.027	-0.034
57	-0.001	0.001	0.003	0.003	0.000	0.000	0.000	-0.003	-0.005	-0.010	-0.013	-0.018	-0.024	-0.030	-0.038
58	-0.002	0.001	0.002	0.003	0.000	-0.001	-0.003	-0.008	-0.010	-0.013	-0.018	-0.021	-0.025	-0.029	-0.036
59	0.004	-0.001	-0.001	-0.001	-0.006	-0.007	-0.009	-0.011	-0.014	-0.021	-0.028	-0.032	-0.039	-0.045	-0.051
60	0.002	0.004	-0.002	-0.001	-0.004	-0.003	-0.004	-0.008	-0.011	-0.017	-0.024	-0.028	-0.035	-0.042	-0.050
61	-0.005	-0.003	0.006	-0.001	-0.005	0.002	-0.007	-0.009	-0.004	-0.018	-0.025	-0.029	-0.038	-0.047	-0.055
62	0.000	-0.001	-0.002	-0.003	-0.009	-0.013	-0.014	-0.018	-0.022	-0.029	-0.037	-0.040	-0.048	-0.058	-0.068

NEW HAMPSHIRE TECHNICAL REFERENCE MANUAL

for Estimating Savings from Energy Efficiency Measures, 2024 Program Year

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Table of Contents

Introduction

This *New Hampshire Technical Reference Manual for Estimating Savings from Energy Efficiency Measures* ("TRM") documents for regulatory agencies, customers, and other stakeholders how the New Hampshire Utilities consistently, reliably, and transparently calculate savings from the installation of efficient equipment, collectively called "measures." This reference manual provides methods, formulas and default assumptions for estimating energy, peak demand and other resource impacts from efficiency measures.

Within this document, efficiency measures are organized by the sector for which the measure is eligible and by the primary energy source associated with the measure. The three sectors are Residential, Income Eligible, and Commercial & Industrial ("C&I"). The primary energy sources addressed in this technical reference document are electricity and natural gas, and savings from delivered fuels such as oil and propane are also addressed where appropriate.

Each measure is presented in its own section as a measure characterization. The measure characterizations provide mathematical equations for determining savings (algorithms), as well as default assumptions and sources, where applicable. In addition, any descriptions of calculation methods or baselines are provided as appropriate. The parameters for calculating savings are listed in the same order for each measure. The measure calculations and assumptions provided in the TRM will match those found in the Benefit Cost Models ("BC Models") created by utilities. There are some measures in the BC models that we do not currently anticipate incentivizing, and therefore have not been reflected in the TRM. If the opportunity arises to offer them in a cost-effective way, we will update the TRM with entries for these measures at that time.

Algorithms are provided for estimating annual energy and peak demand impacts for primary and secondary energy sources if appropriate. In addition, algorithms or calculated results may be provided for other nonenergy impacts (such as water savings or operation and maintenance cost savings). Inputs and assumptions are based on New Hampshire-specific evaluations or data where available Other factors being equal, New Hampshire jurisdiction-specific results will be favoured over results from other jurisdictions in order to account for differences in climate, hours of use, program design and delivery, market conditions, and evaluation frameworks. However, when relevant results exist both from New Hampshire and from other states, it may be necessary to balance the desirable attributes of state-specificity and data reliability. When considering whether to apply results from a study originating in another jurisdiction to New Hampshire programs, the EM&V Working Group (with support from independent evaluation firms as needed), will make the determination based on (1) the similarity of evaluated program/measures to those offered in NH; (2) the similarity of relevant markets and customers base; (3) the recency of the study relative to the recency of any applicable NH results; and (4) the quality of the study's methodology and sample size. In addition to third-party evaluations, inputs may also be based on sources including manufacturer and industry data, data from government agencies such as the U.S. Department of Energy or Environmental Protection Agency, or credible and realistic factors developed using engineering judgment.

This document will be reviewed and updated annually to reflect changes in technology, baselines and evaluation results.

Reference Tables

PROGRAM ABBREVIATIONS

Commercial	
Energy Rewards RFP Program	RFP
Large Business Energy Solutions	LBES
Municipal Energy Solutions	Muni
Small Business Energy Solutions	SBES
Residential	
ENERGY STAR Homes	ES Homes
ENERGY STAR Products	ES Products
Home Energy Assistance	HEA
Home Energy Reports	HER
Home Performance	

CATEGORIES

Appliances
Building Shell
Compressed Air
Custom
Food Service
Heating Ventilation and Air Conditioning (HVAC)
Hot Water
Lighting
Motors and Drives
Whole Home

Measure Characterization Structure

This section describes the common entries or inputs that make up each measure characterization. A formatted template follows the descriptions of each section of the measure characterization. A single device or behavior is defined as a measure within each program and fuel. The source of each assumption or default parameter value will be referenced in the endnotes section of each measure chapter.

Measure Code	A unique way to identify a measure where the first set of characters indicates the market, the second set of characters indicates the category, and the third set is an abbreviated code for the measure name.
Market	This is the sector for which the measure is applicable and can be Residential, Income Eligible or C&I.
Program Type	The type of baseline used (i.e., retrofit, lost opportunity).
Category	The category of measure type, based on list above.

Description:

This section will include a plain text description of the energy efficiency measure, including the benefit(s) of its installation.

Baseline Efficiency:

This section will include a statement of the assumed equipment/operation efficiency in the absence of program intervention. Multiple baselines will be provided as needed, e.g., for different markets. Baselines may refer to reference tables or may be presented as a table for more complex measures.

High Efficiency:

This section will describe the high efficiency case from which the energy and demand savings are determined. The high efficiency case may be based on specific details of the measure installation, minimum requirements for inclusion in the program, or an energy efficiency case based on historical participation. It may refer to tables within the measure characterization or in the appendices or efficiency standards set by organizations such as ENERGY STAR® and the Consortium for Energy Efficiency.

Algorithms for Calculating Primary Energy Impact:

This section will describe the method for calculating electric savings and electric demand savings in appropriate units.

The savings algorithm will be provided in a form similar to the following:

$$\Delta kWh = \Delta kW \times Hours$$

Similarly, the method for calculating electric demand savings will be provided in a form similar to the following:

$$\Delta kW = \left(Watts_{BASE} - Watts_{EE}\right)/1000$$

This section also describes any non-electric (gas, propane, oil) savings in appropriate units, i.e., MMBtu associated with the energy efficiency measure, including all assumptions and the method of calculation.

This section will, as appropriate, summarize electric and non-electric savings in a table that contains the following information:

> **Measure Name:** <Name used in utilities' Benefit-Cost models >
> **Program:** <Defined by utilities, also referred to as Program Name>
> **Savings:** <Measure savings in units of kWh, kW, MMBtu, or other as applicable; this information may be contained in multiple fields>

Measure Life:

This section will provide the measure life for each measure and describe the measure life basis, e.g., effective useful life (EUL) or adjusted measure life (AML). It will note any adjustments made, such as for LED market trends.

BC Measure ID	Measure Name	Program	Measure Life
[Unique ID for measures in the utilities' Benefit-Cost model]	[Measure Name]	[Program Abbreviation from list above]	XX

Other Resource Impacts:

If applicable, this section describes any water or ancillary savings associated with the energy efficiency measure, including all assumptions.

Impact Factors for Calculating Adjusted Gross Savings:

The section includes a table of impact factor values for calculating adjusted gross savings. These include in-service rates, realization rates, and coincidence factors. Further descriptions of the impact factors and the sources on which they are based are described below.

ISR	=	In-Service Rate
CF_{SP}	=	Peak Coincidence Factor (summer peak)
CF_{WP}	=	Peak Coincidence Factor (winter peak)
RR_{E}	=	Realization Rate, electric(kWh)
RR_{NE}	=	Realization Rate, non-electric (MMBtu)
RR_{SP}	=	Realization Rate for summer peak kW
RR_{WP}	=	Realization Rate for winter peak kW

Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
[Measure Name]	[Program abbreviation]	X.XX	X.XX	n/a	X.XX	X.XX	X.XX	X.XX

In-Service Rates:

Actual portion of efficient units that are installed. For example, efficient lamps may have an in-service rate less than 1.00 since some lamps are purchased as replacement units and are not immediately installed. The ISR is 1.00 for most measures.

Realization Rates:

Used to adjust the gross savings (as calculated by the savings algorithms) based on impact evaluation studies. The realization rate is equal to the ratio of measure savings developed from an impact evaluation to the estimated measure savings derived from the savings algorithms. The realization rate does not include the effects of any other impact factors, unless explicitly noted. Depending on the impact evaluation study, there may be separate Realization Rates for electric energy (kWh), peak demand (kW), or non-electric energy (MMBtu).

Coincidence Factors:

Adjusts the connected load kW savings derived from the savings algorithm. A coincidence factor represents the fraction of the connected load reduction expected to occur at the same time as a particular system peak period. The coincidence factor includes both coincidence and diversity factors combined into one number, thus there is no need for a separate diversity factor in this TRM.

Energy Load Shape:

The section includes a table or reference with the time-of-use pattern of a typical customer's electrical energy consumption for each segment and end use. Because the value of avoided energy varies throughout the year, load shapes are used to allocate energy savings into specific time periods in order to better reflect its time-dependent value. Load shapes are defined as follows based on ISO-NE definitions:

- Summer On-Peak: 7 am to 11 pm, weekdays, during the months of June through September, except ISO-NE holidays;
- Summer Off-Peak: All other hours during the months of June through September (includes weekends and holidays);
- Winter On-Peak: 7 am to 11 pm, weekdays, during the months of October through May, except ISO-NE holidays; and
- Winter Off-Peak: All other hours during the months of October through May (includes weekends and holidays).

Impact Factors for Calculating Net Savings:

The amount of savings attributable to a program or measure. Net savings differs from "Gross Savings" because it includes adjustments from impact factors, such as free-ridership or spillover. The ratio of net savings to gross savings in known as the Net-to-Gross ratio and is usually expressed as a percent.

This section would only apply to midstream and upstream offerings, which are known to have greater levels of free-ridership than other programs as an inherent part of their program design. For other programs, the utilities will prioritize designing programs and putting mechanisms in place to minimize free-riders, in line with precedent from the 1999 NH EE Working Group report, which stated that "program designs should attempt to minimize free-riders" but "the methodological challenges and associated costs of accurately assessing free-riders no longer justifies the effort required".

Non-Energy Impacts:

As discussed with the NH Benefit/Cost Working Group, and per Commission Order,[1] the NH Utilities are applying non-energy impacts (NEIs) in cost-effectiveness screening as follows:

The **Primary Granite State Test** reflects low-income participant NEIs, based on New Hampshire-specific primary research on the Home Energy Assistance program. Specifically, based on the HEA evaluation,[2] a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project for 21 years, the weighted average measure life of air sealing and insulation, pipe insulation. These NEIs are reflected in the measure chapters for insulation and air sealing.

The **Secondary Granite State Test** reflects sector-level percentage adders for participant NEIs for the residential (non-low-income) and C&I sectors, based on a review of secondary NEI research from similar jurisdictions, adjusted for New Hampshire-specific economic and other factors and matched to New Hampshire's programs and measures.[3] The test also reflects environmental externality NEIs, based on non-embedded avoided cost values from the AESC. These NEI values are not reflected in the TRM measure chapters. For HEA, the same primary research NEI value is applied in the Secondary Granite State Test as in the Primary Granite State Test.

Both the **Primary and Secondary Granite State Tests** reflect other resource impacts for water and delivered fuels, as reflected in the TRM measure chapters.

[1] Docket No. DE 17-136, Order Approving Benefit Cost Working Group Recommendations, No. 26,322, December 30, 2019; Order Approving 2020 Update Plan, No. 26,323, December 31, 2019.

[2]Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf

[3]DNV-GL. New Hampshire Non-Energy Impacts Database Methodology Memo, April 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Final-NH-NEI-Methodology-Memo-20200409.pdf; New Hampshire Non-Energy Impacts Database, July 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200722-NH-NEI-Draft-Database-NHML-core.xlsm

Impact Factors for Calculating Adjusted Gross and Net Savings

The New Hampshire Utilities use the algorithms in the Measure Characterization sections to calculate the gross savings for energy efficiency measures. Impact factors are then applied to make various adjustments to the gross savings estimates to account for the performance of individual measures or energy efficiency programs as a whole in achieving energy reductions as assessed through evaluation studies. Impact factors address both the technical performance of energy efficiency measures and programs, accounting for the measured energy and demand reductions realized compared to the gross estimated reductions, as well as in certain cases the programs' effect on the market for energy efficient products and services.

This section describes the types of impact factors used to make such adjustments, and how those impacts are applied to gross savings estimates.

Types of Impact Factors

The impact factors used to adjust savings fall into one of two categories:

Impact factors used to adjust gross savings:
- In-Service Rate ("ISR")
- Realization Rate ("RR")
- Summer and Winter Peak Demand Coincidence Factors ("CF")

Impact factors used to calculate net savings:
- Free-Ridership ("FR") and Spillover ("SO") Rates
- Net-to-Gross Ratios ("NTG")

The **in-service rate** is the actual portion of efficient units that are installed. For example, efficient lamps may have an in-service rate less than 1.00 since some lamps are purchased as replacement units and are not immediately installed. The ISR is 1.00 for most measures.

The **realization rate** is used to adjust the gross savings (as calculated by the savings algorithms) based on impact evaluation studies. The realization rate is equal to the ratio of measure savings developed from an impact evaluation to the estimated measure savings derived from the savings algorithms. The realization rate does not include the effects of any other impact factors. Depending on the impact evaluation study, there may be separate Realization Rates for electric energy (kWh), peak demand (kW), or non-electric energy (MMBtu).

A **coincidence factor** adjusts the connected load kW savings derived from the savings algorithm. A coincidence factor represents the fraction of the connected load reduction expected to occur at the same time as a particular system peak period. The coincidence factor includes both coincidence and diversity factors combined into one number, thus there is no need for a separate diversity factor in this TRM. Coincidence Factors are provided for the on-peak period as defined by the ISO New England for the Forward Capacity Market ("FCM"), and are calculated consistently with the FCM methodology. Electric demand reduction during the ISO New England peak periods is defined as follows:

On-Peak Definition (applicable definition for NH):
- Summer On-Peak: average demand reduction from 1:00-5:00 PM on non-holiday weekdays in June July, and August
- Winter On-Peak: average demand reduction from 5:00-7:00 PM on non-holiday weekdays in December and January

Seasonal Peak Definition (not applied in NH):

- Summer Seasonal Peak: demand reduction when the real-time system hourly load is equal to or greater than 90% of the most recent "50/50" system peak forecast for June-August
- Winter Seasonal Peak: demand reduction when the real-time system hourly load is equal to or greater than 90% of the most recent "50/50" system peak load forecast for December-January

The values described as Coincidence Factors in the TRM are not always consistent with the strict definition of a Coincidence Factor (CF). It would be more accurate to define the Coincidence Factor as "the value that is multiplied by the Gross kW value to calculate the average kW reduction coincident with the peak periods." For example, a coincidence factor of 1.00 may be used because the coincidence is already included in the estimate of Gross kW; this is often the case when the "Max kW Reduction" is not calculated and instead the "Gross kW" is estimated using the annual kWh reduction estimate and a load shape model.

The **net savings** value is the final value of savings that is attributable to a measure or program. Net savings differs from gross savings because it includes the effects of the free-ridership and/or spillover rates. Net savings currently apply to midstream and upstream offerings, which are known to have greater levels of free-ridership than other programs as an inherent part of their program design. For other programs, the utilities will prioritize designing programs and putting mechanisms in place to minimize free-riders, in line with precedent from the 1999 NH EE Working Group report, which stated that "program designs should attempt to minimize free-riders" but "the methodological challenges and associated costs of accurately assessing free-riders no longer justifies the effort required".

A **free-rider** is a customer who participates in an energy efficiency program (and gets an incentive) but who would have installed some or all of the same measure(s) on their own, with no change in timing of the installation, if the program had not been available. The free-ridership rate is the percentage of savings attributable to participants who would have installed the measures in the absence of program intervention.

The **spillover rate** is the percentage of savings attributable to a measure or program, but additional to the gross (tracked) savings of a program. Spillover includes the effects of 1) participants in the program who install additional energy efficient measures outside of the program as a result of participating in the program, and 2) non-participants who install or influence the installation of energy efficient measures as a result of being aware of the program. These two components are the participant spillover (SOP) and nonparticipant spillover (SONP).

The **net-to-gross ratio** is the ratio of net savings to the gross savings adjusted by any impact factors (i.e., the "adjusted" gross savings). Depending on the evaluation study, the NTG ratio may be determined from the free-ridership and spillover rates, if available, or it may be a distinct value with no separate specification of FR and SO values.

1. Residential

1.1. Active Demand Response

Measure Code	RES-BE-ADR
Markets	Residential
Program Types	Custom
Categories	Active Demand Response

Measure Description:

Residential Direct Load Control is focused on reducing electrical demand during summer peak load periods by controlling equipment inside a building, such as via wi-fi connected thermostats, communicating domestic hot water heaters and pool pumps, and other controlled energy-using devices.

Residential Storage Daily Dispatch involves customers receiving incentives to decrease demand by discharging energy from storage in response to a signal or communication from the Program Administrators. Residential Storage Daily Dispatch demand response periods may occur during peak hours in summer months.

Summer peak load control periods for both Residential Direct Load Control and Residential Storage Daily Dispatch are three-hour events that may occur between 2:00 p.m. and 7:00 p.m. on non-holiday weekdays between June 1 and September 30.

Baseline Efficiency:

For Direct Load Control, evaluators determined baseline conditions using an experimental design methodology (randomly assigned treatment and control groups), or a within-subject methodology or savings adjustment factor for demand reduction events where experimental design was not possible.

For thermostat controls in the Residential Direct Load Control program, vendor-supplied baselines may use one of several baseline methodologies to determine savings. The assumption in this document is that either the ISO-NE[1] or PJM[2] demand response customer baseline operation models are used by the vendor.

The baseline case for Residential Storage Daily Dispatch is an equivalent residential home with onsite energy storage, including any onsite solar PV production, but without peak demand response control.[3]

High Efficiency:

The high efficiency case is a residential building with devices that are equipped to communicate with the utility to reduce demand during curtailment periods. This could include communicating thermostats, residential storage equipment, or other types of residential demand response equipment.

Note that active demand response is not intended to reduce energy use, but rather to reduce power consumption during demand response periods. As a result, little energy savings are available for Residential Direct Load Control. A small amount of energy savings per demand response event is provided in the section below.

For Residential Storage Daily Dispatch, a negative net kWh impact should be assessed to account for round-trip efficiency losses during the charging and discharging periods.

Algorithms for Calculating Primary Energy Impact:

Thermostat control programs are the most widely implemented, and therefore have the most well-supported savings findings.

For vendors that use ISO-NE or PJM baselines to calculate demand savings for central air conditioners controlled by wi-fi connected thermostats, an adjustment to vendor-claimed demand savings based on evaluation results[4] is applied:

$$\Delta kW_{Pre-event} = \left(\Delta kW_{Pre-event,vendor}\right) \times \left(F_{pre-event}\right)$$
$$\Delta kW_{Post-event} = \left(\Delta kW_{Post-event,vendor}\right) \times \left(F_{post-event}\right)$$
$$\Delta kW_{Event} = (\Delta kW_{vendor}) \times (F_{event})$$
$$F_{event} = -3.06 + (0.05 \times Temp_{avg})$$

Where,

Unit = one dispatched thermostat

$\Delta kW_{Pre-event}$ = demand adjustment for pre-cooling before event

$\Delta kW_{post-event}$ = demand adjustment for recovery cooling after event

$\Delta kW_{pre/post/event,vendor}$ = vendor demand savings in the period of interest (i.e. pre-event, during event, or post-event), typically calculated relative to ISO-NE or PJM baseline

$F_{pre-event}$ = savings adjustment factor in the pre-event period = 0.72

$F_{post-event}$ = savings adjustment factor in the post-event period = 0.68

$F_{event} = -3.06 + (0.05 \times Temp_{avg})$

$Temp_{avg}$ = average outdoor air temperature during the event period

For demand response events that affect central air conditioners controlled by a wi-fi connected thermostat: a deemed energy savings of 0.60 kWh[4.] per event.

For Residential Storage Daily Dispatch, energy savings are measured directly at the device, on a site-by-site basis, as reported by the vendor:

$$\Delta kW_{Event} = \Delta kW_{vendor}$$

More detailed savings algorithms for Residential Storage Daily Dispatch and other types of residential active demand response measures, with pre-, during-, and post-event savings adjustments, may be developed as additional program evaluations are conducted.

Measure Life:

As all residential active demand response measures are based on Program Administrators calling demand reduction events each year, the deemed measure life is 1 year.[5]

BC Measure ID	Measure Name	Program	Measure Life
EA5a001	Residential Direct Load Control	Residential ADR	1
EA5a002	Residential Storage Daily Dispatch P4P (savings) Summer	Residential ADR	1
EA5a003	Residential Storage Daily Dispatch P4P (consumption) Summer	Residential ADR	1

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA5a001	Residential Direct Load Control	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00
EA5a002	Residential Storage Daily Dispatch P4P (savings) Summer	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00
EA5a003	Residential Storage Daily Dispatch P4P (consumption) Summer	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00

In-Service Rates:

All installations are assumed to have 100% in-service-rates pending program evaluation. Event opt-outs and attrition during events are captured in the gross impact algorithm above.

Realization Rates:

Savings adjustment factors and deemed energy savings provided in the Algorithms section above represent an evaluation adjustment to vendor-reported reported gross savings.

Coincidence Factors:

Summer coincidence factors are assumed to be 100% reflecting the timing of demand response events.

Winter coincidence factors are assumed to be 0%.

Scaling Factors:

A scaling factor is used to account for the fact that the benefits of an active demand response resource depend on how often it performs. The greater the frequency of demand response events, the more that the active demand resource reduces the installed capacity requirement, and therefore the greater its value. For planning the utilities use a scaling factor of 10% for direct load control and 100% for storage, reflecting the AESC 2018 review of sensitivity analyses run by PJM load forecasters. For reporting utilities will use scaling factor values based on the most recent evaluation timing of events that are called in 2021..

Energy Load Shape:

All savings for Active Demand Response take place in the summer on-peak period.

Revision History:

Revision Number	Date	Description
7	5/3/2021	The deemed savings number for thermostat ADRs was updated to 0.60 kwh from 0.67 kwh.
8	5/3/2021	Fixed broken links in references

Endnotes:

1 : ISO New England (2014). ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources (Manual M-MVDR). Revision 6, June 1, 2014 https://www.iso-ne.com/static-assets/documents/2017/02/mmvdr_measurement-and-verification-demand-reduction_rev6_20140601.pdf

2 : Day-Ahead and Real-Time Market Operations (2019). PJM Manual 11: Energy & Ancillary Services

Market Operations, Revision 108. Effective Date: December 3, 2019. https://www.pjm.com/~/media/documents/manuals/m11.ashx
3 : Navigant Consulting (2020). 2019 Residential Energy Storage Demand Response Demonstration Evaluation, Summer Season. Prepared for National Grid and Unitil. MA. http://ma-eeac.org/wordpress/wp-content/uploads/MA19DR02-E-Storage_Res-Storage-Summer-Eval_wInfographic_2020-02-10-final.pdf
4 : Navigant Consulting (2020). 2019 Residential Wi-Fi Thermostat Direct Load Control Offering Evaluation. Prepared for Eversource, National Grid, and Unitil. MA and CT. https://ma-eeac.org/wp-content/uploads/2019-Residential-Wi-Fi-Thermostat-DLC-Evaluation-Report-2020-04-01-with-Infographic.pdf
5 : The PA program evaluation plan and the measure life for behavioural measures are as published in the 2019-2021 Massachusetts Three-Year Energy Efficiency Plan. https://ma-eeac.org/wp-content/uploads/2019-2021-Three-Year-Energy-Efficiency-Plans-DPU-Order_01.29.19.pdf

1.2. Advanced Power Strip

Measure Code	RES-APP-APS
Markets	Residential
Program Types	Lost Opportunity
Categories	Appliances

Measure Description:

Advanced power strips can automatically eliminate standby power loads of electronic peripheral devices that are not needed (DVD player, computer printer, scanner, etc.) either automatically or when an electronic control device (typically a television or personal computer) is in standby or off mode.

Baseline Efficiency:

The baseline efficiency case is the customers' electronic peripheral devices as they are currently operating.

High Efficiency:

The high efficiency case is the installation of an Advanced Power Strip.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on referenced study results.[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EA3b001	Advanced Power Strip, Tier I	ES Products	105.00	0.010
EA3b002	Advanced Power Strip, Tier II	ES Products	207.00	0.024

Measure Life:

The measure life is 5 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b001	Advanced Power Strip, Tier I	ES Products	0.83	0.92	n/a	0.92	0.92	0.58	0.86
EA3b002	Advanced Power Strip, Tier II	ES Products	0.83	0.92	n/a	0.92	0.92	0.58	0.86

In-Service Rates:

In-service rates are based on consumer surveys, as found in the referenced study[3] .

Realization Rates:

Realization rates account for the savings lost due to improper customer set-up/use of devices, as found in the referenced study[1].

Coincidence Factors:

Programs use a summer coincidence factor of 58% and a winter coincidence factor of 86%[2].

Energy Load Shape:

See Appendix 1 – “Primary TV and Peripherals”[2].

Revision History:

Revision Number	Date	Description
9	5/3/2021	Fixed broken links in references
131	12/1/2022	Updated kWh, kW savings for Tiers 1 and 2 to match referenced study. Updated ISR based on recent MA study.

Endnotes:

1 : NMR Group, Inc. (2018). Advanced Power Strip Metering Study. Prepared for Massachusetts Program Administrators and EEAC.
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
3 : NMR Group Inc. (2021). Residential Products In Service Rates Memo. 2021_NMR_Products_ISR

1.3. Clothes Dryer

Measure Code	RES-APP-CD
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Appliances

Measure Description:

Clothes dryers exceeding minimum qualifying efficiency standards established as ENERGY STAR® or most efficient.

Baseline Efficiency:

For lost opportunity applications, the baseline efficiency case is a new electric resistance dryer that meets the federal standard as of January 1, 2015 which is a Combined Energy Factor (EF) of 3.73 for a vented standard dryer[1]. Different testing procedures were used in setting the federal standard (DOE Test Procedure Appendix D1) and the Energy Star standard (DOE Test Procedure Appendix D2). To enable comparison a baseline CEF of 3.11 is used. This was derived from ENERGY STAR Version 1.0 Estimated Baseline which multiplies the 2015 federal standard by the average change in electric dryers' assessed CEF between Appendix D1 and Appendix D2: 3.73-(3.73*0.166).

For retrofit applications, the baseline efficiency case is the existing electric resistance dryer.

High Efficiency:

The high efficiency case is a clothes dryer that meets the ENERGY STAR standard as of May 19, 2014. For a new standard vented or ventless electric resistance dryer the minimum CEF is 3.93[2].

For Heat Pump and Hybrid technology clothes dryers, CEFs are based on an average of Northwest Energy Efficiency Alliance qualified product testing as of October 2019. For Heat Pump technology dyers, the average CEF is 6.83. For Hybrid technology clothes dryers, the average CEF is 4.30.

Algorithms for Calculating Primary Energy Impact:

HEA savings are calculated using the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data.

Home Performance uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

Unit savings are deemed based on EPA ENERGY STAR list and Northwest Energy Efficiency Alliance lab testing results. Demand savings are derived from the Navigant Demand Impact Model.[3, 9]

$\Delta kWh = (lbs/YEAR \div CEF_{Base}) - (lbs/YEAR \div CEF_{EFF})$

Where:

Lbs/YEAR = Typical pounds of clothing dried per year (based on 8.45 lbs/load and 283 loads/yr)

CEF_{BASE} = Baseline Combined Energy Factor (lbs/kWh)

CEF_{EFF} = Efficient Combined Energy Factor (lbs/kWh)

Unit savings[4 ,5 ,6]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔMMBtu
EB1a052	Clothes Dryer (Retrofit)	HEA	Calculated	Calculated	n/a
EA2a055	Clothes Dryer (Retrofit)	Home Performance	Calculated	Calculated	n/a
EA1a027	Clothes Dryer (New Construction)	ES Homes	160.4	0.047	n/a
EA3b010	Clothes Dryer (ENERGY STAR)	ES Products	160.4	0.047	n/a
EA3b012	Clothes Dryer (ENERGY STAR + Hybrid technology)	ES Products	213.3	0.063	n/a
EA3b011	Clothes Dryer (ENERGY STAR + Heat Pump technology)	ES Products	421.1	0.124	n/a

Measure Life:

The measure life is 12 years.[6]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EB1a052	Clothes Dryer (Retrofit)	HEA	1.00	0.91	n/a	0.91	0.91	0.45	0.58
EA2a055	Clothes Dryer (Retrofit)	Home Performance	0.99	0.96	n/a	0.96	1.00	0.45	0.58
EA1a027	Clothes Dryer (New Construction)	ES Homes	1.00	1.00	n/a	1.00	1.00	0.45	0.58
EA3b010	Clothes Dryer (ENERGY STAR + Hybrid technology)	ES Products	1.00	1.00	n/a	1.00	1.00	0.45	0.58
EA3b012	Clothes Dryer (ENERGY STAR + Heat Pump technology)	ES Products	1.00	1.00	n/a	1.00	1.00	0.45	0.58

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[7], and 99% for Home Performance[8] .

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[7], and 96% for Home Performance[8].

Coincidence Factors:

Programs a summer coincidence factor of 45% and a winter coincidence factor of 58%.[9]

Energy Load Shape:

See Appendix 1 – "Clothes Dryer – Electric"[9]

Revision History:

Revision Number	Date	Description
10	1/14/22	Added savings values for retrofit clothes dryers. Previously were vendor calculated.
113	12/1/2022	Updated to vendor calculated for HEA and Home Performance and now includes information on software used for the vendor calculated savings
124	12/1/22	Corrected Home Performance Realization Rate verbiage to 96% from 100% to align with table, study, and model.

Endnotes:

1 : DOE (accessed July 2020). Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers. https://www.energy.gov/sites/prod/files/2015/03/f20/Clothes%20Dryer%20Standards_RFI.pdf
2 : EnergyStar Energy Efficient Products (accessed July 2020): https://www.energystar.gov/products/appliances/clothes_dryers/key_product_criteria
3 : Environmental Protection Agency (2018). Savings Calculator for ENERGY STAR Qualified Appliances. Energy_Star_2018_Consumer_Appliance_Calculator
4 : Northwest Energy Efficiency Alliance (2019). Dryers - QPL October 2019.
5 : Department of Energy (2015). 10 CFR Part 431 March 27, 2015. Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers. Table II.7.
6 : Department of Energy (2013). 10 CFR Parts 429 and 430 August 14, 2013. Energy Conservation Program: Test Procedures for Residential Clothes Dryers; Final Rule. Table 11.1.
7 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
8 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL, https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
9 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.4. Clothes Washer

Measure Code	RES-APP-CW
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Appliances

Measure Description:

Clothes washers exceeding minimum qualifying efficiency standards established as ENERGY STAR® or Most Efficient. The measure saves electric energy used by the washer itself, as well as heating energy (in the form of electricity or fossil fuel) associated with the heating of the domestic hot water (DHW) consumed during the wash cycles. DHW heating efficiency is assumed to be code-compliant.

Baseline Efficiency:

For lost opportunity baseline, the base efficiency case is a residential clothes washer that meets the federal standard for front-loading washers effective 3/7/2015 which requires an IMEF (Integrated Modified Energy Factor) no less than 1.84 and an IWF (Integrated Water Factor) no greater than 4.7, and for top-loading washers effective 1/1/18 which requires an IMEF no less than 1.57 and an IWF no greater than 6.5. For retrofit baseline, the base efficiency case is the existing residential clothes washer.

High Efficiency:

The high efficiency case is a residential clothes washer that meets the ENERGY STAR standard as of February 5, 2018. For a new front-loading clothes washer the minimum IMEF is 2.76 and the maximum IWF is 3.2. For a new top-loading clothes washer the minimum IMEF is 2.06 and the maximum IWF is 4.3.

Algorithms for Calculating Primary Energy Impact:

HEA savings are calculated using the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data.

Home Performance uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

If TREAT software is unavailable, retrofit savings for HEA and Home Performance can be calculated using the Energy Star Appliance Calculator, available on the Energy Star website.

All other unit electric savings are based on weighted averages by efficiency class presented in the 2018 Efficiency Vermont TRM[1]. Demand savings are derived from the Navigant Demand Impact Model[2]. Fossil fuel DHW savings are based on NH-specific water heating fuel types.

Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔGas MMBtu	ΔOil MMBtu	ΔPropane MMBtu
EB1a051	Clothes Washer (Retrofit)	HEA	Calculated	Calculated	Calculated	Calculated	Calculated
EA2a054	Clothes Washer (Retrofit)	Home Performance	Calculated	Calculated	Calculated	Calculated	Calculated
EA1a026	Clothes Washer (New Construction)	ES Homes	89.9	0.279	0.000	0.000	0.050
GA1a009	Clothes Washer (New Construction) – Gas	ES Homes	24.1	0.075	0.290	0.000	0.000
EA3b017	Clothes Washer (ENERGY STAR)	ES Products	88.1	0.274	0.024	0.042	0.003
EA3b018	Clothes Washer (ENERGY STAR Most Efficient)	ES Products	137.6	0.427	0.166	0.291	0.023

Measure Life:

The measure life is 11 years[1, 3]

Other Resource Impacts:

Annual water savings are deemed.

Measure Name	Program	Annual Water Savings (gallons)
Clothes Washer (Retrofit)	HEA/Home Performance	Calculated
Clothes Washer (New Construction)	ES Homes	823
Clothes Washer (ENERGY STAR)	ES Products	823

Clothes Washer (ENERGY STAR Most Efficient)	ES Products	2,020

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a051	Clothes Washer (Retrofit)	HEA	1.00	0.91	0.91	0.91	0.91	0.49	0.52
EA2a054	Clothes Washer (Retrofit)	Home Performance	0.99	0.96	0.96	0.96	0.96	0.49	0.52
EA1a026	Clothes Washer (New Construction)	ES Homes	1.00	1.00	1.00	1.00	1.00	0.49	0.52
GA1a009	Clothes Washer (New Construction) – Gas	ES Homes	1.00	1.00	1.00	1.00	1.00	0.49	0.52
EA3b017	Clothes Washer (ENERGY STAR)	ES Products	1.00	1.00	1.00	1.00	1.00	0.49	0.52
EA3b018	Clothes Washer (ENERGY STAR Most Efficient)	ES Products	1.00	1.00	1.00	1.00	1.00	0.49	0.52

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[4], and 99% for Home Performance[5].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[4], and 96% for Home Performance[5].

Coincidence Factors:

All electric programs use a summer coincidence factor of 49% and a winter coincidence factor of 52%[2].

Energy Load Shape:

See Appendix 1 – "Clothes Washer"[2].

Revision History:

Revision Number	Date	Description
11	1/14/2022	Added option to use EPA calculator for retrofit savings values
112	12/1/2022	Included additional information on software used for the vendor calculated savings
125	12/1/2022	Corrected Home Performance Realization Rate verbiage to 96% from 100% to align with table, study, and model. Corrected kWh, kW, and water savings to align referenced TRM.

Endnotes:

1 : Energy Efficiency Vermont (2018) Technical Reference User Manual. Efficient Clothes Washers.
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
3 : Appliance Magazine. U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels. Jan. 2010. p. 10
4 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

1.5. Dehumidifier

Measure Code	RES-APP-DEH
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Appliances

Measure Description:

Dehumidifiers exceeding minimum qualifying efficiency standards established as ENERGY STAR.

Baseline Efficiency:

The lost opportunity baseline efficiency case is a dehumidifier that meets the federal standard effective June 13, 2019. Specific baseline Energy Factors (EFs) by product capacity found in the Code of Federal Regulations, 10 CFR 430.32(v)(2). The retrofit baseline efficiency case is the existing dehumidifier.

High Efficiency:

The high efficiency case is a dehumidifier that meets the ENERGY STAR standard as of October 31, 2019[1]. For a new dehumidifier with a capacity less than 25 pints/day the minimum EF is 1.57 liters/kWh. For a new dehumidifier with a capacity between 25.01 and 50 pints/day the minimum EF is 1.8 liters/kWh. For a new dehumidifier with a capacity greater than or equal to 50 pints/day the minimum EF is 3.3 liters/kWh.

Capacity (pints)	Energy Factor (2019 Federal Standard)	Energy Factor (ENERGY STAR)
≤ 25	1.30	1.57
25.01-50	1.60	1.80
≥ 50	2.80	3.30

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated as below. Demand savings are derived from the Navigant Demand Impact Model[1].

$\Delta kWh = Load \times [(1 \div Eff_{BASE}) - (1 \div Eff_{ES})] \times Hours$

Where:

Load = Typical dehumidification load, 1520 Liters/year[1]

Eff_{BASE} = Average efficiency of model meeting the federal standard, in Liters/kWh

Eff_{ES} = Efficiency of ENERGY STAR® model, in Liters/kWh

Hours = Dehumidifier annual operating hours, site-specific if available, or deemed 2,851 hour/year[2]

Table: Measure Energy Impact[3]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EB1a053	Dehumidifier (Retrofit)	HEA	407.1	0.10
EA2a056	Dehumidifier (Retrofit)	Home Performance	407.1	0.10
EA3b019	Dehumidifier (ENERGY STAR)	ES Products	82.3	0.02

Measure Life:

The measure life is 12 years[3].

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a053	Dehumidifier (Retrofit)	HEA	1.00	0.91	n/a	0.91	0.91	0.82	0.17
EA2a056	Dehumidifier (Retrofit)	Home Performance	0.99	0.96	n/a	0.96	0.96	0.82	0.17
EA3b019	Dehumidifier (ENERGY STAR)	ES Products	1.00	1.00	n/a	1.00	1.00	0.82	0.17

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[4], and 99% for Home Performance[5].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[4,] and 96% for Home Performance[5.]

Coincidence Factors:

All programs use a summer coincidence factor of 82% and a winter coincidence factor of 17%[1.]

Energy Load Shape:

See Appendix 1 – "Dehumidifier"[1.]

Endnotes:

1 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
2 : Environmental Protection Agency (2019). Dehumidifier Key Efficiency Criteria. https://www.energystar.gov/products/appliances/dehumidifiers/key_efficiency_criteria
3 : Environmental Protection Agency (2014). Savings Calculator for Energy Star Qualified Appliances. ENERGY_STAR_2015_Appliance_Calculator
4 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

1.6. Freezer

Measure Code	RES-APP-FZR
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Appliances

Measure Description:

Freezers exceeding minimum qualifying efficiency standards established as ENERGY STAR®.

Baseline Efficiency:

For lost-opportunity, the baseline efficiency case is a freezer that meets the Federal standard effective September 15, 2014. Specific baseline coefficients and constants by product class found in the Code of Federal Regulations, 10 CFR 430.32(a). For retrofit, the baseline efficiency case is the existing freezer.

High Efficiency:

The high efficiency case is a freezer that meets the ENERGY STAR standard as of September 15, 2014. For a new freezer the measured energy use must be 10% less than the minimum federal efficiency standards.

Algorithms for Calculating Primary Energy Impact:

Retrofit unit energy and demand savings are based on project-specific calculations. Lost-opportunity unit energy and demand savings are based on calculations from the 2018 Vermont TRM[1].

$\Delta kWh = kWh_{BASE} - kWh_{ES}$

Where:

kWh_{BASE} = Average usage of a baseline freezer
kWh_{ES} = Average usage of a new freezer meeting ENERGY STAR® standards

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EB1a050	Freezer (Retrofit)	HEA	Calculated	Calculated
EA2a053	Freezer (Retrofit)	Home Performance	Calculated	Calculated
EA3b021	Freezer (ENERGY STAR®)	ES Products	31.2	0.004

Measure Life:

The measure life is 12 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a050	Freezer (Retrofit)	HEA	1.00	0.91	n/a	0.91	0.91	0.91	0.68
EA2a053	Freezer (Retrofit)	Home Performance	0.99	0.96	n/a	0.96	0.96	0.91	0.68
EA3b021	Freezer (ENERGY STAR®)	ES Products	1.00	1.00	n/a	1.00	1.00	0.91	0.68

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[3], and 99% for Home Performance[4].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[3,] and 96% for Home Performance[4.]

Coincidence Factors:

Summer and winter coincidence factors are estimated using the demand allocation methodology described in the referenced study.[5]

Energy Load Shape:

See Appendix 1 – "Freezer"[5.]

Endnotes:

1 : Vermont TRM (2018): ENERGY STAR Retail Products Platform, page 178 of 313.
2 : Environmental Protection Agency (2018). Savings Calculator for Energy Star Qualified Appliances.
3 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
4 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

5 : Navigant Consulting,2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.7. Recycling

Measure Code	RES-APP-RCL
Markets	Residential
Program Types	Retrofit
Categories	Appliances

Measure Description:

The retirement of old, inefficient refrigerators, freezers, dehumidifiers, and room air conditioners. In cases when these appliances are replaced by a homeowner, the existing unit is retained, sold or donated for use elsewhere, representing additional load on the grid. This measure covers recycling of the existing, functional equipment, thereby eliminating the consumption associated with that equipment. Appliance recycling programs receive energy savings credit for permanently removing inefficient, functional equipment from the electric grid.

Baseline Efficiency:

The baseline efficiency case is an old, inefficient working refrigerator, freezer, dehumidifier or room air conditioner.

High Efficiency:

The high efficiency case assumes no replacement of the recycled unit.

Algorithms for Calculating Primary Energy Impact:

Unit energy and demand savings are deemed based on MA study results.[1] [2]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EA3b027 EA3b028	Refrigerator Recycling	ES Products	1,005	0.18
EA3b029	Freezer Recycling	ES Products	753	0.14
EA3b030	Room Air Conditioner Recycling	ES Products	113	0.18
EA3b037	Dehumidifier Recycling	ES Products	500	0.12

Measure Life:

The measure life is 5 years for refrigerators, 4 years for freezers and dehumidifiers, and 3 years for room air conditioners.[3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

4

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b027	Refrigerator Recycling	ES Products	1	1	n/a	1	1	0.79	0.65
EA3b028	Secondary Refrigerator Recycling	ES Products	1	1	n/a	1	1	0.86	0.52
EA3b029	Freezer Recycling	ES Products	1	1	n/a	1	1	0.91	0.68
EA3b030	Room Air Conditioner Recycling	ES Products	1	1	n/a	1	1	0.46	0
EA3b037	Dehumidifier Recycling	ES Products	1	1	n/a	1	1	0.82	0.17

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

Coincidence factors are based on the Navigant Demand Impact Model.[2]

Energy Load Shape:

See Appendix 1 – "Primary Refrigerator" for primary refrigerator recycling, "Secondary Refrigerator" for secondary refrigerator recycling, "Freezer" for secondary freezer recycling, "Dehumidifier" for dehumidifier recycling, "Room or Window Air Conditioner" for room air conditioner recycling.

Revision History:

Revision Number	Revision Date	Description
84	12/1/2022	Dehumidifier recycling measure added.

Endnotes:

1 : Appliance Recycling 2019 Impact Evaluation (MA21R33-E-ARI). Appliance Recycling Report. Prepared for MA Joint Utilities. https://ma-eeac.org/wp-content/uploads/MA21R33-E-ARI-Appliance-Recycling-2019-Impact-Report_FINAL_01Sep2021.pdf
2 : Room air conditioning recycling savings are based on the early replacement savings value found in The Cadmus Group, Inc. (2015). Massachusetts Low-Income Multifamily Initiative Impact Evaluation. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488566996f243947df72a/view?authToken=c96dfc4ba7e5a1eff6a0c681bf04b9217045512d3d8e55ffd27c4cf342a49ec612f6eea038713700c3a86a029c32536a5bae9f2c31701d4d6f33b518ce13f5bad3faaa0686d9ee
3 : California Public Utilities Commission, 2014 Database for Energy-Efficient Resources, Feb. 4, 2014. https://www.caetrm.com/
4 : Navigant Consulting, 2018. RES1 Demand Impact Model Update https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee4885e6996f2535f7df752/view?authToken=58af7f0cad776e9018ab4083ba902e56a2696b34573082c56be97ec0257ddc4d9614bc48c4d768a36562f202b58926c28662912865efce181c66650b782852feff21eef8df6b7f

1.8. Refrigerator

Measure Code	RES-APP-RFG
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Appliances

Measure Description:

Refrigerators exceeding minimum qualifying efficiency standards established as ENERGY STAR®.

Baseline Efficiency:

The new product baseline efficiency case is a refrigerator that meets the Federal standard effective September 15, 2014. Specific baseline coefficients and constants by product class found in the Code of Federal Regulations, 10 CFR 430.32(a). The retrofit baseline efficiency case is an existing refrigerator. It is assumed that income eligible customers would otherwise replace their refrigerators with a used inefficient unit.

High Efficiency:

The high efficiency case is a refrigerator that meets the ENERGY STAR standard as of September 15, 2014. For a new refrigerator the measured energy use must be 10% less than the minimum federal efficiency standards.

Algorithms for Calculating Primary Energy Impact:

Unit energy savings are based on consumption values from New Hampshire evaluation results[1]. Demand savings are derived from the Navigant Demand Impact Model[2].

$\Delta kWh = (kWh_{BASE} - kWh_{ES}) \times SLF$

Where:

kWh_{BASE} = Average baseline usage: a new refrigerator meeting federal standards, average energy consumption assumed to be 502 kWh for lost-opportunity, site-specific for retrofit

kWh_{ES} = Average usage of a new refrigerator meeting ENERGY STAR® standards with an average energy consumption of 452 kWh for ENERGY STAR refrigerators, or 393 kWh for Most Efficient refrigerator

SLF = Site/Lab adjustment factor (an adjustment for real-world performance (site) versus testing (lab)) = 0.881[3]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EB1a049	Refrigerator (Retrofit)	HEA	Calculated	Calculated
EA2a049 EA2a104	Refrigerator (Retrofit)	Home Performance	Calculated	Calculated
EA1a025	Refrigerator (New Construction)	ES Homes	44.2	0.01
EA3b022	Refrigerator (ENERGY STAR®)	ES Products	44.2	0.01
EA3b023	Refrigerator (Most Efficient)	ES Products	96.4	0.02

Measure Life:

The measure life is 12 years.[4]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a049	Refrigerator (Retrofit)	HEA	1.00	0.91	n/a	0.91	0.91	0.79	0.65
EA2a049 EA2a104	Refrigerator (Retrofit)	Home Performance	0.99	0.96	n/a	0.96	0.96	0.79	0.65
EA1a025	Refrigerator (New Construction)	ES Homes	1.00	1.00	n/a	1.00	1.00	0.79	0.65
EA3b022	Refrigerator (ENERGY STAR®)	ES Products	1.00	1.00	n/a	1.00	1.00	0.79	0.65
EA3b023	Refrigerator (Most Efficient)	ES Products	1.00	1.00	n/a	1.00	1.00	0.79	0.65

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[5] , and 99% for Home Performance[1].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[5] , and 96% for Home Performance[1].

Coincidence Factors:

A summer coincidence factor of 79% and a winter coincidence factor of 65% are based on the Navigant Demand Impact Model[2].

Energy Load Shape:

See Appendix 1 – "Primary Refrigerator".[2]

Endnotes:

1 : Opinion Dynamics (2019). Home Performance with Energy Star Program Evaluation Report 2016-2017. Prepared for NH Utilities. ES standard energy consumption values and savings methodology extracted from supporting analysis.
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.
3 : Connecticut Program Savings Document (PSD) (2019).
4 : Environmental Protection Agency (2018). Savings Calculator for Energy Star Qualified Appliances.
5 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.9. Room Air Purifier

Measure Code	RES-APP-RAP
Markets	Residential
Program Types	Lost Opportunity
Categories	Appliances

Measure Description:

Room air purifiers exceeding minimum qualifying efficiency standards established as ENERGY STAR®.

Baseline Efficiency:

The baseline efficiency case is a unit with 1.0 CADR/$Watt_{dust}$[1]

High Efficiency:

The current EnergyStar specification requires a minimum of 2.0 CADR/$Watt_{dust}$. However, the ENERGY STAR average CADR/Watt (Dust) of models available in their US market database (approximately 170 models) is approximately 3.5 CADR/$Watt_{dust}$. Therefore it is assumed that the high efficiency unit has a 3.0 CADR/$Watt_{dust}$

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on averaged inputs.[2] The weight is based on 2019 - Aug 2020 National Grid rebated units.

CADR Range	CADR Value in Calculator	Baseline Consumption (kWh)	High Efficiency Consumption (kWh)	Energy Savings (kWh)	Weight
51-100	75	441	148	293	11%
101-150	125	733	245	488	33%
151-200	175	1025	342	683	15%
201-250	225	1317	440	877	22%
Over 250	300	1755	586	1169	19%

kW savings are based on a 24 hour operation.

BC Measure ID	Measure Name	Program	kWh	kW
EA3b025	Room Air Purifier	ES Products	713	0.08

Measure Life:

The measure life is 9 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b025	Room Air Purifier	ES Products	0.97	1.00	n/a	1.00	1.00	1.00	1.00

In-Service Rates:

In-service rate is based on evaluation results. [3]

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are 100% for both summer and winter peaks, since the air purifiers are expected to operate continuously during peak hours.

Energy Load Shape:

See Appendix 1 – "24 hour operation".[4]

Revision History:

Revision Number	Date	Description
134	12/1/2022	Updated savings values to align with the most recent MA study.

Endnotes:

1 : Guidehouse (2021). Comprehensive TRM Review. https://ma-eeac.org/wp-content/uploads/MA19R17-B-TRM_Final_Report_2021-04-12_clean.pdf
1 : The Clean Air Delivery Rate is voluntary standard made available for comparing the performance of portable air filters in a room at steady-state conditions during a controlled laboratory test: ANSI/AHAM AC-1-2015 (AHAM 2015). It was developed by the Association of Home Appliance Manufacturers (AHAM), a private voluntary standard-setting trade association, and is recognized by the American National Standards Institute (ANSI).
2 : Guidehouse (2021) Comprehensive TRM Review. https://ma-eeac.org/wp-content/uploads/MA19R17-B-TRM_Final_Report_2021-04-12_clean.pdf
3 : NMR Group, Inc. (2018). Products Impact Evaluation of In-Service and Short Term Retention Rates Study.
4 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.

1.10. Whole Home - Energy Report

Measure Code	RES-BE-ER
Markets	Residential
Program Types	Custom
Categories	Behaviour

Measure Description:

Residential home energy report (“HER”) programs levereage behavior science to influence customers’ energy use practices. The program strategy involves sending customer-specific energy use reports to a sample of electric and / or natural gas customers. The implementation vendor calculates savings results based on statistical analysis of the differences in energy usage for the treatment group when compared to the energy usage of a control group.

Baseline Efficiency:

The baseline efficiency case is a control-group customer who does not receive home energy reports.

High Efficiency:

The high efficiency case is a customer who receives periodic mailed and/or emails home energy reports tailored and has access to a web-based dashboard that includes tailored messaging regarding ways of reducing energy use.

Algorithms for Calculating Primary Energy Impact:

Unit savings for Home Energy Reports are based on calculations from vendor results.

A lagged-dependent variable (LDV) model (sometimes also referred to as a post-period regression with pre-period controls) utilizes a panel data set (a cross-sectional time-series) to estimate energy savings from a randomized control trial (RCT) using pre-treatment (lagged) energy consumption value(s) as an independent control.

$$ADU_{k,t} = \alpha + \beta_1 treatment_k + \sum_j \beta_{2j} Month_t + \sum_i \beta_{3i} ADUlag_{k,t,i} + \varepsilon_{k,t}$$

Where:

1. $ADU_{k,t}$ is average daily consumption of kWh by household k in month t,
2. α is the model intercept,
3. $treatment_k$ is a binary variable with a value of 0 if household k is assigned to the control group and 1 if assigned to the treatment group,

4. $Month_j$ is a binary variable with a value of 1 when t=j, and is 0 otherwise,
5. $ADUlag_{k,t,i}$ is a vector of i baseline usage control variables. An evaluator may choose the form of these control values, as pre-treatment data availability may allow. A suggested formulation for this vector is the following three (i=3) LDV terms:

A. avg_preusage$_k$ is the average daily usage across household k's available pre-treatment meter reads for the year prior to the start of treatment,

B. avg_preusage_winter$_k$ is the average daily usage over the months of December through March across household k's available pre-treatment meter reads for the year prior

to the start of treatment and,

C. avg_preusage_winter$_k$ is the average daily usage over the months of June through September across household k's available pre-treatment meter reads for the year prior to the start of treatment.

A simpler, alternative, formulation of this $ADUlag_{k,t,i}$ term can be a single (i=1) LDV representing household k's average daily energy use in the same calendar month as t in year immediately preceding the program.

6. $\varepsilon_{k,t}$ is the cluster-robust idiosyncratic error term for household k in month t.

The coefficient β_1 is the coefficient of interest; it is the estimate of average daily energy savings for a household in the treatment group.

Measure Life:

The measure life for Home Energy Reports is 1 year[1] . As a behavioral measure, the intervention of regularly receiving a Home Energy Report is required to claim savings.

BC Measure ID	Measure Name	Program	Measure Life
EA4a001 GA4a001	Residential Whole Home Energy Report	Residential Behaviour	1

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EA4a001	Residential Whole Home Energy Report	Residential Behaviour	1.00	1.00	NA	1.00	1.00	0.547	0.848
GA4a001	Residential Whole Home Energy Report	Residential Behaviour	1.00	NA	1.00	NA	NA	NA	NA

In-Service Rates:

All installations have 100% in-service-rates since reports are sent out regularly to participants.[1.]

Realization Rates:

Realization rates from Navigant's 2016 evaluation of Eversource New Hampshire Home Energy Report pilot program found that the realization rate for the normative behavior program design was 99.9%.[1.]

Coincidence Factors:

Summer and winter coincidence factors are based on a residential lighting loadshape.[2]

Energy Load Shape:

See Appendix 1.

Revision History:

Revision Number	Issue Date	Description
41	1/14/2022	Fixed broken link in references

Endnotes:

1 : Navigant Consulting (2016). Home Energy Report Pilot Program Evaluation Final Report, Feb 2014-Feb 2015. Prepared for Eversource New Hampshire.
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
2018_Navigant_Baseline_Loadshape_Comprehensive_Report

1.11. Air Sealing

Measure Code	RES-BS-AS
Markets	Residential
Program Types	Retrofit
Categories	Building Shell

Measure Description:

The reduction of a home's conditioned air loss (leakage) resulting from the sealing of a home's cracks and air gaps. Home air leakage is measured in air loss in Cubic Feet per Minute (CFM), measured at 50 pascals.

Baseline Efficiency:

The baseline efficiency case is an existing home before it is air sealed.

High Efficiency:

The high efficiency case is an existing home after it has been air sealed.

Algorithms for Calculating Primary Energy Impact:

The programs use vendor-calculated energy savings for air sealing measures in the Residential Home Performance and Home Energy Assistance programs. The HEA uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performance program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

To calculate savings in TREAT or Surveyor, the user inputs a minimum set of technical data about the house and the software calculates building heating and cooling loads and other key parameters. The software's building model is based on thermal transfer, building gains, and a variable-based heating and cooling degree day (or hour) climate model. This provides an initial estimate of energy use that may be compared with actual billing data to adjust as needed for existing conditions. Then, specific recommendations for improvements are added and savings are calculated using measure-specific heat transfer algorithms.

Rather than using a fixed degree day approach, the building model estimates both heating degree days and cooling degree hours based on the actual characteristics and location of the house to determine the heating and cooling balance point temperatures. Infiltration savings use site-specific seasonal N-factors to convert measured leakage to seasonal energy impacts. HVAC savings are estimated based on changes in system and/or distribution efficiency improvements, using ASHRAE 152 as their basis. Interactivity between architectural and mechanical measures is always included, to avoid overestimating savings due to incorrectly “adding” individual measure results.

Should the vendor software be unavailable or unable to estimate a home’s energy savings from air sealing, the following savings algorithm should be used.

$\Delta MMBtu = \Delta CFM * MMBtu/CFM$

Where:

ΔCFM = Reduced air loss, in Cubic Feet per Minute (CFM) in a treated home.

MMBtu/CFM = Deemed savings per reduced CFM of 0.012787 MMBtu per CFM. This represents a blended savings value, applicable for all heating fuel types and cooling equipment scenarios in Home Performance, based on evaluation results, exclusive of ancillary heating and cooling savings.[1]

Measure Life:

The effective useful life (EUL) for air sealing, which assumes retrofit installation, is 15 years.[2]

Other Resource Impacts:

In addition to the primary heating fuel savings, the following deemed values are applied to Home Performance program measures to reflect ancillary electric savings for heating and cooling load reductions, depending on the equipment used in the home. Heating ancillary savings result from both reduced furnace fan runtime, or reduced boiler pump operation due to the HVAC Load reductions resulting from weatherizing homes.[1] Ancillary cooling savings are derived from the average cooling system runtime reduction.. [1] The values are based on evaluation results for weatherized homes and are applied once per home for homes receiving air sealing and/or insulation (rather than separately applying the savings for each measure. Ancillary savings would only be applied once for a house that received insulation in addition to air sealing.)

BC Measure ID	Measure Name	Measure Life[3]	Equipment	Savings/unit[1]	Description of Impact	CF_{SP}	CF_{WP} [5]
EA2b023 GA2b009	HVAC Ancillary, heating	18	Furnace fan	86.00 kWh/Home	Per home value reflecting reduced fan operation based on heating load reduction from	0.00	0.46

					weatherization measures		
EA2b022 GA2b008	HVAC Ancillary, heating	19	HW boiler circulation pump(s)	9.00 kWh/Home	Per circulator pump value reflecting reduced pump operation based on heating load reduction from weatherization measures	0.00	0.53
EA2b024 GA2b010	HVAC Ancillary, cooling.	18	Central HVAC - Cooling system fan, blower door test completed	4.28 kWh/ 100 CFM	Per CFM savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.35
EA2b024	HVAC Ancillary, cooling	18	Central HVAC - Cooling system fan, blower door test not completed.	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.35
EA2b025	HVAC Ancillary, cooling.	18	Room/Window AC - Cooling system fan, blower door test completed	4.28 kWh/ 100 CFM	Per CFM savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.33
EA2b025	HVAC Ancillary, cooling	18	Room/Window AC - Cooling system fan, blower door test not completed	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.33
EA2b026	HVAC Ancillary, cooling.	18	Mini- Split AC/ HP - Cooling system fan, blower door test completed	4.28 kWh/ 100 CFM	Per CFM savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.29
EA2b026	HVAC Ancillary, cooling	18	Mini- Split AC/ HP - Cooling system fan,	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime	0.00	.29

			blower door test not completed.		reduction due to air sealing.		

*Ancillary heating savings are applicable when air sealing and/or envelope insulation measures are implemented in a home and are dependent on the heating system distribution motor (furnace fan or boiler pump). Savings are only applicable once per home. [1]

**Ancillary cooling savings are applicable when air sealing and/or envelope insulation measures are implemented in a home with cooling. When air sealing is completed in a home and CFM reductions are verified through a blower door test, use the 0.0146 MMBtu/100 CFM reduction savings value. When a blower door is not completed, or only envelop insulation measures are implemented, apply the 0.178 MMBtu/Home savings value. Savings are only applicable once per home. [1]

Impact Factors for Calculating Adjusted Gross Savings:

[1,4]

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a001	Air Sealing	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EA2a001	Air Sealing	Cord Wood	Home Performance	0.99	n/a	1.14	n/a	n/a	.35	0.0
EB1a002	Air Sealing	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.34	0.20
EA2a002 EA2a091	Air Sealing	Electric	Home Performance	0.99	0.96	n/a	0.96	0.96	0.34	0.20
EB1a003 GB1a001	Air Sealing	Gas	HEA	1.00	n/a	1.04	n/a	n/a	.35	0.0
EA2a003 EA2a092 GA2a001	Air Sealing	Gas	Home Performance	0.99	n/a	1.04	n/a	n/a	.35	0.0
EB1a004	Air Sealing	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EA2a004	Air Sealing	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	.35	0.0
EB1a005	Air Sealing	Oil	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0

EA2a005 EA2a093	Air Sealing	Oil	Home Performance	0.99	n/a	1.14	n/a	n/a	.35	0.0
EB1a006	Air Sealing	Propane	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EA2a006 EA2a094	Air Sealing	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	.35	0.0
EB1a007	Air Sealing	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EA2a007	Air Sealing	Wood Pellets	Home Performance	0.99	n/a	1.14	n/a	n/a	.35	0.0

In-Service Rates:

In-service rates for Home Performance programs are 99% and are 100% HEA programs based on evaluation results[1, 4]

Realization Rates:

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%.[1,4]

Coincidence Factors:

For primary savings in electric heated homes with AC, a summer coincidence factor of 34% and a winter coincidence factor of 20% is used, based on the “Weighted Whole Home HVAC” load shape. [5]

For primary savings in fossil fuel heated homes with AC, a summer coincidence factor of 35% and a winter coincidence factor of 0% is used, based on the “Central Air Conditioner/ Heat Pump (Cooling)” load shape. [5]

Energy Load Shape:

For air sealing, in electric heated homes, see Appendix 1. – “Wighted Whole Home HVAC”

For air sealing in fossil fuel heated homes, see Appendix 1 “ Central Air Conditioner/Heat Pump (Cooling)”

For ancillary heating savings in a home with a furnace, see Appendix 1 – “Furnace Fan”

For ancillary heating savings in a home with a boiler, see Appendix 1 – “Boiler distributor”

For ancillary cooling savings in a home with central or a heat pump, see Appendix 1 “Central Air Conditioner/ Heat pump (cooling)”.

For ancillary cooling savings in a home with room or window AC, see Appendix 1 – "Room or Window Air Conditioner"

For ancillary cooling savings in a home with a mini-split AC or heat pump, see Appendix 1 – "Mini-split AC/ Heat Pump (Cooling)".

Non-Energy Impacts for Secondary Cost Test:

For HEA programs, a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project over its 15-year measure life[4].

Revision History:

Revision Number	Issue Date	Description
12	1/14/2022	Updated to reference the "Weighted Whole Home HVAC" load shape for air sealing, rather than the hardwired electric heat load shape.
13	1/14/2022	Added ancillary heating and cooling savings and separate BC measure ID's
14	1/14/2022	Updated the air sealing load shape to "Weighted Whole Home HVAC" and added load shapes for ancillary savings.
116	12/1/2022	Included additional information on software used for the vendor calculated savings and
199	1/1/2024	Corrected HVAC loads shape CF for electric homes and added cooling CF for FF heated homes.

Endnotes:

1 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
2 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf
3 : Measure life of ancillary savings for each equipment type, corresponds to the measure life cited in the

corresponding TRM chapter. For example, the HVAC ancillary measure savings for a furnace fan correspond the measure life of a Furnace in the Residential – HVAC- furnaces Chapter.
4 : Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf

5: Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org /wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.12. Door Replacement

Measure Code	RES-BS-DR
Markets	Residential
Program Types	New, Retrofit
Categories	Building Shell

Measure Description:

Installation of insulated exterior doors.

Baseline Efficiency:

The baseline condition is an existing un-insulated or damaged exterior door.

High Efficiency:

The high efficiency case is an insulated exterior door.

Algorithms for Calculating Primary Energy Impact:

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data.

The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

Deemed Savings:

BC Measure ID	Measure Name	ΔkWh	ΔkW	Δtherms
EB1a070 EB1a071 EB1a072 EB1a073 EB1a074 EB1a075	Insulated door	Calculated	Calculated	Calculated

EB1a076				

Measure Life:

The measure life for an efficient door is 25 years.[1]

Other Resource Impacts:

For HEA programs, a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project over its 15-year measure life.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a070	Insulated Door	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EB1a071	Insulated Door	Electric	HEA	1.00	0.91	n/a	0.91	0.91	.34	0.20
EB1a072	Insulated Door	Gas	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EB1a073	Insulated Door	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EB1a074	Insulated Door	Oil	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EB1a075	Insulated Door	Propane	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0
EB1a076	Insulated Door	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	.35	0.0

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%.[2]

Coincidence Factors:

For primary savings in electric heated homes with AC, a summer coincidence factor of 34% and a winter coincidence factor of 20% is used, based on the "Weighted Whole Home HVAC" load shape. [3]

For primary savings in fossil fuel heated homes with AC, a summer coincidence factor of 35% and a winter coincidence factor of 0% is used, based on the "Central Air Conditioner/ Heat Pump (Cooling)" load shape.[3]

Energy Load Shape:

See Appendix 1. – "Weighted Whole Home HVAC"

See Appendix 1. – "Central Air Conditioner/ Heat Pump (cooling)

Revision History:

Revision Number	Issue Date	Description
19	1/14/2022	Omitted measure added
114	12/1/2022	Updated to vendor calculated for HEA and Home Performance and now includes information on software used for the vendor calculated savings.
203	1/1/2024	Corrected CF's and load shape

Endnotes:

1 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf
2 : Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
3 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org /wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.13. Duct Sealing

Measure Code	RES-BS-DS
Markets	Residential
Program Types	New, Retrofit
Categories	Building Shell

Measure Description:

For existing ductwork in non-conditioned spaces, seal ductwork. This could include sealing leaky fixed ductwork with mastic or aerosol.

Baseline Efficiency:

The baseline efficiency case is existing, non-sealed (leaky) ductwork in unconditioned spaces (e.g. attic or basement).

High Efficiency:

The high efficiency condition is air sealed ductwork in unconditioned spaces.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results. [1] [2]

BC Measure ID	Measure Name	ΔkWh	ΔkWh\[3]	Δmmbtu
EB1a084 EA2a070	Duct Sealing, Cord Wood			3.9
EB1a085 EA2a071	Duct Sealing, Electric	442.00	0.31	
EB1a086 EA2a072	Duct Sealing, Gas			3.9
EB1a087 EA2a073	Duct Sealing, Kerosene			3.9
EB1a088 EA2a074	Duct Sealing, Oil			4.0
EB1a089 EA2a075	Duct Sealing, Propane			3.9

EB1a090 EA2a076	Duct Sealing, Wood Pellets			3.9

Measure Life:

The measure life for duct sealing is 20 years.[4]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a084	Duct Sealing, Cord Wood	HEA	1.00	.91	.91	.91	.35	0.0	.35
EB1a085	Duct Sealing, Electric	HEA	1.00	.91	.91	.91	.91	0.34	0.20
EB1a086	Duct Sealing, Gas	HEA	1.00	.91	.91	.91	.91	.35	0.0
EB1a087	Duct Sealing, Kerosene	HEA	1.00	.91	.91	.91	.91	.35	0.0
EB1a088	Duct Sealing, Oil	HEA	1.00	.91	.91	.91	.91	.35	0.0
EB1a089	Duct Sealing, Propane	HEA	1.00	.91	.91	.91	.91	.35	0.0
EB1a090	Duct Sealing, Wood Pellets	HEA	1.00	.91	.91	.91	.91	.35	0.0
EA2a070	Duct Sealing, Cord Wood	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0
EA2a071	Duct Sealing, Electric	Home Performance	0.99	0.96	1.00	0.96	0.96	0.34	0.20
EA2a072	Duct Sealing, Gas	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0
EA2a073	Duct Sealing, Kerosene	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0
EA2a074	Duct Sealing, Oil	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0
EA2a075	Duct Sealing, Propane	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0

EA2a076	Duct Sealing, Wood Pellets	Home Performance	0.99	0.96	1.00	0.96	0.96	.35	0.0

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%[5] .[6]

Coincidence Factors:

For primary savings in electric heated homes with AC, a summer coincidence factor of 34% and a winter coincidence factor of 20% is used, based on the "Weighted Whole Home HVAC" load shape. [3]

For primary savings in fossil fuel heated homes with AC, a summer coincidence factor of 35% and a winter coincidence factor of 0% is used, based on the "Central Air Conditioner/ Heat Pump (Cooling)" load shape.[3]

Energy Load Shape:

See Appendix 1. – "Weighted Whole Home HVAC"

See Appendix 1. – "Central Air Conditioner/ Heat Pump (cooling)

Revision History:

Revision Number	Issue Date	Description
58	1/14/2022	Omitted Measure Added
204	1/1/2024	Corrected CF's and load shape

Endnotes:

1 : The 84% AFUE baseline is based on the New Hampshire Potential Study Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Volume III: Residential Market Baseline Study, June 11, 2020, p. 3-17. The 85% AFUE baseline represents value negotiated in MA for new boilers.
2 : Connecticut Program Savings Document, 2021. https://energizect.com/sites/default/files/2021-03/Final%202021%20PSD%20(Filed%203-01-2021).pdf - ESF 2% value was used compared to 5% used in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multifamily, and Commercial/Industrial Measures, Version 3, Issue Date – Jun. 1, 2015, p. 98.
3 : Guidehouse (2020). Residential Baseline Study Phase 4 2020_Guidehouse_Residential_Baseline_Phase_4v
4 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. Weighted CF by end use (Table 3).

http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

1.14. Insulation

Measure Code	RES-BS-INS
Markets	Residential
Program Types	Retrofit
Categories	Building Shell

Measure Description:

The installation of high efficiency insulation in an existing home.

Baseline Efficiency:

The baseline efficiency case is the pre-installation average R-value for an insulation type in an existing home before installation of new insulation.

High Efficiency:

The high efficiency case is the post-installation average R-value for an insulation type in an existing home.

Algorithms for Calculating Primary Energy Impact:

The programs currently use vendor calculated energy savings for these measures in the Residential Home Performance and Home Energy Assistance programs.

The HEA uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performance program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

These savings values are calculated using vendor proprietary software where the user inputs a minimum set of technical data about the house and the software calculates building heating and cooling loads and other key parameters. The proprietary building model is based on thermal transfer, building gains, and a variable-based heating/cooling degree day/hour climate model. This provides an initial estimate of energy use that may be compared with actual billing data to adjust as needed for existing conditions. Then, specific recommendations for improvements are added and savings are calculated using measure-specific heat transfer algorithms.

Rather than using a fixed degree day approach, the building model estimates both heating degree days and cooling degree hours based on the actual characteristics and location of the house to determine the heating and cooling balance point temperatures. Savings from shell measures use standard U-value, area, and degree day algorithms. HVAC savings are estimated based on changes in system and/or distribution efficiency improvements, using ASHRAE 152 as their basis. Interactivity between architectural and mechanical measures is always included, to avoid overestimating savings due to incorrectly "adding" individual measure results. Should the vendor software be unavailable or unable to estimate a home's energy savings from insulation, the following savings algorithm should be used.[1]

$\Delta MMBtu = HSqFt * (MMBtuheating)$

$\Delta kWh = (HSqFT * (MMBtucooling)) * 293.017$

Where:

HSqFt = Hundred square feet of installed insulation in a treated home (represented by installed sq ft / 100 sq ft).

MMBtuheating = Deemed savings per square foot of installed insulation, using appropriate value for basements, walls, or attics in the tables developed by Opinion Dynamics and program implementers.

MMBtucooling = If cooling is present in treated home, use appropriate value for basements, walls, or attics the table developed by Opinion Dynamics and program implementers. Otherwise set to 0.1

293.017 = kWh conversion factor.

In addition to heating fuel savings, the following deemed values are applied to reflect ancillary electric savings for heating load reductions, depending on the home heating equipment. The values are based on evaluation results for weatherized homes, and are applied once per home for homes receiving air sealing and/or insulation (rather than separately applying for air sealing and insulation):[2]

Measure Life:

The effective useful life (EUL) for insulation, which assumes retrofit installation, is 25 years.[3]

Other Resource Impacts:

In addition to heating fuel savings, the following deemed values are applied to Home Performance program measures to reflect ancillary electric savings for heating and cooling load reductions, depending on the equipment used in the home. The values are based on evaluation results for weatherized homes, and are applied once per home for homes receiving air sealing and/or insulation (rather than separately applying for air sealing and insulation):

BC Measure ID	Measure Name	Measure Life[4]	Equipment	Savings/unit[5]	Description of Impact	CF_{SP}	CF_{WP}[6]

EA2b023	HVAC Ancillary, heating	18	Furnace fan	86.00 kWh/Home	Per home value reflecting reduced fan operation based on heating load reduction from weatherization measures	0.00	0.46
EA2b022	HVAC Ancillary, heating	19	HW boiler circulation pump(s)	9.00 kWh/Home	Per circulator pump value reflecting reduced pump operation based on heating load reduction from weatherization measures	0.00	0.45
EA2b024	HVAC Ancillary, cooling	18	Central HVAC - Cooling system fan, blower door test not completed.	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.47
EA2b025	HVAC Ancillary, cooling	18	Room/Window AC - Cooling system fan, blower door test completed	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime reduction due to air sealing.	0.00	.48
EA2b026	HVAC Ancillary, cooling	18	Mini- Split AC/ HP - Cooling system fan, blower door test not completed.	52.17 kWh/Home	Per home savings value reflecting reduced average system fan runtime	0.00	.43

					reduction due to air sealing.		

*Ancillary heating savings are applicable when air sealing and/or envelope insulation measures are implemented in a home and are dependent on the heating system distribution motor (furnace fan or boiler pump). Savings are only applicable once per home. [7]

**Ancillary cooling savings are applicable when air sealing and/or envelope insulation measures are implemented in a home. When air sealing is completed in a home and CFM reductions are verified through a blower door test, use the 0.0146 MMBtu/100 CFM reduction savings value. When a blower door is not completed, or only envelop insulation measures are implemented, apply the 0.178 MMBtu/Home savings value. Savings are only applicable once per home.[8]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	ISR	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a022	Insulation	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0
EA2a022	Insulation	Cord Wood	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EB1a023	Insulation	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.34	0.20
EA2a023 EA2a095	Insulation	Electric	Home Performance	0.99	0.96	n/a	0.96	0.96	0.34	0.20
EB1a024 GB1a004	Insulation	Gas	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0
EA2a024 EA2a096 GA2a004	Insulation	Gas	Home Performance	0.99	n/a	1.04	n/a	n/a	0.35	0.0
EB1a025	Insulation	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0
EA2a025	Insulation	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EB1a026	Insulation	Oil	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0
EA2a026 EA2a097	Insulation	Oil	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EB1a027	Insulation	Propane	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0

EA2a027 EA2a098	Insulation	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EB1a028	Insulation	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	0.35	0.0
EA2a028	Insulation	Wood Pellets	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EA2a063	Duct Insulation	Cord Wood	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EA2a064	Duct Insulation	Electric	Home Performance	0.99	0.96	n/a	0.96	0.96	0.35	0.0
EA2a065	Duct Insulation	Gas	Home Performance	0.99	n/a	1.04	n/a	n/a	0.35	0.0
EA2a066	Duct Insulation	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EA2a067	Duct Insulation	Oil	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EA2a068	Duct Insulation	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0
EA2a069	Duct Insulation	Wood Pellets	Home Performance	0.99	n/a	1.14	n/a	n/a	0.35	0.0

In-Service Rates:

In-service rates are 99% for Home Performance programs and are 100% HEA programs based on evaluation results.[9] [10]

Realization Rates:

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%..[10] [11]

Coincidence Factors:

For primary savings in electric heated homes with AC, a summer coincidence factor of 34% and a winter coincidence factor of 20% is used, based on the “Weighted Whole Home HVAC” load shape. [5]

For primary savings in fossil fuel heated homes with AC, a summer coincidence factor of 35% and a winter coincidence factor of 0% is used, based on the “Central Air Conditioner/ Heat Pump (Cooling)” load shape. [5]

Energy Load Shape:

For air insulation, in electric heated homes, see Appendix 1. – “Wighted Whole Home HVAC”

For insulation in fossil fuel heated homes, see Appendix 1 “ Central Air Conditioner/Heat Pump (Cooling)”

For ancillary heating savings in a home with a furnace, see Appendix 1 – “Furnace Fan”

For ancillary heating savings in a home with a boiler, see Appendix 1 – “Boiler distributor”

For ancillary cooling savings in a home with central or a heat pump, see Appendix 1 “Central Air Conditioner/ Heat pump (cooling)”.

For ancillary cooling savings in a home with room or window AC, see Appendix 1 – “Room or Window Air Conditioner”

For ancillary cooling savings in a home with a mini-split AC or heat pump, see Appendix 1 – “Mini-split AC/ Heat Pump (Cooling)”.

Non-Energy Impacts for Secondary Cost Test:

For HEA programs, a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project over its 15-year measure life.

Revision History:

Revision Number	Issue Date	Description
15	1/14/2022	Updated to reference the “Weighted Whole Home HVAC” load shape for air sealing, rather than the hardwired electric heat load shape.
16	1/14/2022	Added ancillary heating and cooling savings and separate BC measure ID’s
17	1/14/2022	Updated the air sealing load shape to “Weighted Whole Home HVAC” and added load shapes for ancillary savings.
18	1/14/2022	Updated to include duct insulation measures
91	12/1/2022	Fixed broken citation links.

117	12/1/2022	Included additional information on software used for the vendor calculated savings.
205	1/1/2024	Corrected CF's and load shape

Endnotes:

1 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. Excel file associated with report with calculations, https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
2 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. Excel file associated with report with calculations, https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
3 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007.
4 : Measure life of ancillary savings for each equipment type, corresponds to the measure life cited in the corresponding TRM chapter. For example, the HVAC ancillary measure savings for a furnace fan correspond the measure life of a Furnace in the Residential – HVAC- furnaces Chapter.
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
6 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
7 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
8 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
9 : Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
10 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
11 : Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf

12 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.15. Window Inserts

Measure Code	RES-BS-WI
Markets	Residential
Program Types	Retrofit
Categories	Building Shell

Measure Description:

The installation of an interior storm window.

Baseline Efficiency:

Baseline efficiency for single and double pane windows are defined below. If unsure of baseline window type, use the "Blended Baseline" below.

Storm Window Type	Weighting[1]	UFactor*	SHGC*	VT*	Air Leakage*
Double Pane	.6	0.59	0.59	0.64	1.0
Single Pane	.4	0.98	0.65	0.69	3.0
Blended Baseline	1	0.75	0.61	0.66	1.8

*Values are averages using inputs from Energy Savings of Low-E Storm Windows and Panels Across US Climate Zones [2] Please see window inserts calculations spreadsheets for detailed calculations of baselines. [3]

High Efficiency:

The high efficiency case is the existing window with an interior window insert installed.

Algorithms for Calculating Primary Energy Impact:

Window inserts save energy by improving the thermal performance of the existing window system in a home during the heating season. Window inserts are typically removed during the summer, cooling savings are not claimed. The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. Please see https://psdconsulting.com/ for more information.

Should the TREAT software be unavailable, deemed household energy savings for electric heat and non-electric heated homes were developed using the Resfen software. Deemed kwh savings in Resfen are based on an electric heat pump of HSPF 6.8. To provide electric resistance savings in the table below, it is assumed the heat pump HSPF of 6.8 is equivalent to a COP of 2. Electric heat pump kWh savings are multiplied by 2 to provide the electric resistance savings. Please see attached spread sheet for details of the Resfen inputs and calculations. [4]

Savings are shown per square foot of window inserts installed and by HVAC system type.

Deemed savings [5] :

		Electric Heat Pump	Electric Resistance	Gas
Baseline	**High Efficiency**	**ΔkWh/ sqft of window insert**	**ΔkWh/sqft of window insert**	**ΔMbtu/sqft of window insert**
Blended	Low_E window	20.06	10.03	0.10
Blended	Clear Interior window	16.83	8.42	0.08
Single Pane	Low_E window	31.16	15.58	0.15
Single Pane	Clear Interior window	27.93	13.97	0.13
Double Pane	Low_E window	12.14	6.07	0.06
Double Pane	Clear Interior window	8.92	4.46	0.04

Measure Life:

The measure life of window inserts is 4 years.[6]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
	Window Insert	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a101 EB1a100 EB1a102 EB1a103	Window Insert	Electric	HEA	1.00	0.91	n/a	0.91	0.91	n/a	0.20

EB1a104 EB1a105 EB1a106										

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

Realization rates are 91% for HEA programs based on evaluation results. [7]

Coincidence Factors:

A winter coincidence factor of 20% is used, based on the “Weighted Whole Home HVAC” load shape. [8]

Energy Load Shape:

See Appendix 1 "Weighted Whole Home HVAC".

Revision History:

Revision History

Revision Number	Date	Description
89	12/1/2022	New measure added.
206	1/1/2024	Corrected CF’s and load shape

Endnotes:

1 : "Storm Windows V1: Criteria Analysis Report July 2017_Final.pdf" ENERGY STAR Page 7, table 4, climate zones 5& https://www.energystar.gov/sites/default/files/Storm%20Windows%20V1%20Criteria%20Analysis%20Report%20July%202017_final.pdf
2 : PNNL (2015) Energy Savings of Low-E Storm Windows and Panels across US climate Zones, Page 4, table 1 and paragraph 2, page 5 table 2. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24826.pdf
3 : Window Inserts Savings 11
4 : Document provides and overview of inputs used in Resfen to calculate the window inserts savings and their sources. Window Inserts Savings 11
5 : Window Inserts Savings 11
6 : Efficiency Maine, Residential TRM (2020) https://www.efficiencymaine.com/docs/EMT-

TRM_Retail_Residential_v2020_2.pdf
7 : Opinion Dynamics (2020) Home Energy Assistance PRogram Evaluation Report https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
8 : Guidehouse (2020) Massachusetts Residential Baseline Study, Demand impact model. https://ma-eeac.org/wp-content/uploads/RES-1-Residential-Baseline-Study-Ph4-Comprehensive-Report-2020-04-02.pdf

1.16. Window Replacement

Measure Code	RES-BS-WR
Markets	Residential
Program Types	New, Retrofit
Categories	Building Shell

Measure Description:

Replacement of single pane windows or Jalosie mobile home windows.

Baseline Efficiency:

Baseline efficiency is defined as a single pane of Jalosie mobile home window.

High Efficiency:

The high efficiency case are energy efficient double pane window replacements.

Algorithms for Calculating Primary Energy Impact:

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. Please see https://psdconsulting.com/ for more information.

BC Measure ID	Measure Name	ΔkWh	ΔkW	Δtherms
EB1a055 EB1a064 EB1a065 EB1a066 EB1a067 EB1a068 EB1a069	Window Replacement	Calculated	Calculated	Calculated

Measure Life:

The measure life for an efficient window is 25 years. [1]

Other Resource Impacts:

For HEA programs, a per-project value of $406 reflecting participant NEIs—including increased comfort, decreased noise, and health-related NEIs—will be applied annually to each weatherization project over its 15-year measure life.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_{E}	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a055	Window Replacement	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a064	Window Replacement	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.34	0.20
EB1a065	Window Replacement	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a066	Window Replacement	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a067	Window Replacement	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a068	Window Replacement	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a069	Window Replacement	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

Realization rates are 91% for HEA programs based on evaluation results. [2]

Coincidence Factors:

For primary savings, a summer coincidence factor of 34% and a winter coincidence factor of 20% is used, based on the "Weighted Whole Home HVAC" load shape. [3]

Energy Load Shape:

See Appendix 1. – "Weighted Whole Home HVAC"

Revision History:

Revision Number	Issue Date	Description
20	1/14/2022	Omitted measure added
115	12/1/2022	Included additional information on software used for the vendor calculated savings.
207	1/1/2024	Corrected CF's and load shape

Endnotes:

1 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf
2 : Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
3 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.17. Swimming Pool Heater

Measure Code	RES-CSM-SPH
Markets	Residential
Program Types	Lost Opportunity
Categories	Custom

Measure Description:

The installation of a high efficiency heat pump pool heater in residential applications.

Baseline Efficiency:

The base case is a new, standard efficiency electric resistance pool heater with a COP of 1.00.

High Efficiency:

The high efficiency case is a heat pump pool heater with a COP of 5.[1]

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated using the following algorithm:

Measure ID	Measure Name	Program	ΔkWh	ΔkW
EA3b009	Heat Pump Swimming Pool Heater, COP 5.00	ES Products	Calculated	Calculated
EA3b009	Heat Pump Swimming Pool Heater COP 5.00	ES Products	Calculated	Calculated

Annual Electric Savings:

$$\Delta kWh = \frac{(BTU_{Surface} + BTU_{Reheat} + BTU_{Evap})}{3{,}412} X \left(\frac{F_{elec,baseline}}{COP_{baseline}} - \frac{1}{COP_{ee}}\right)$$

Where:

$BTU_{Surface}$[2] $= (T_{pool} - T_{amb}) \times A_{pool} \times U \times [hrs - (hrs_{cover} \times ESF_{cover,surface})]$

BTU_{Reheat}[3] $= V_{pool} \times 8.33 \times (T_{pool} - T_{main}) \times F_{Reheat}$

BTU_{Evap} [4] $= 0.1 \times AF \times A_{pool} \times (P_{\omega} - P_{dp}) \times (T_{pool} - T_{main}) \times [hrs - (hrs_{cover} \times ESF_{cover,evap})]$

Where:

ΔkWh = Annual electricity energy savings
ΔkW = Peak coincident demand electric savings
$BTU_{Surface}$ = Annual heating energy load contributed by convection and radiation heat losses via pool surface, (BTU)
BTU_{Reheat} = Annual heating energy load contributed by heating the full volume of pool water, (BTU)
BTU_{Evap} = Annual heating energy load contributed by evaporation, (BTU)
$F_{elec,baseline}$ = Baseline electric pool heater factor; used to account for the presence or absence of an electric pool heater. Set equal to 1.00
$COP_{baseline}$ = Coefficient of performance, ratio of output energy/input energy of baseline electric resistance pool heater, set to 1.00.
COP_{ee} = Coefficient of performance, ratio of output energy/input energy of heat pump pool heater. Set equal to 5.00

T_{pool} = Pool temperature set point, (ºF)
T_{amb} = Average temperature of surrounding ambient air, (ºF). If outdoor pool looking up in Outdoor Pool table below. If indoor pool, use temperature of the room.
T_{main} = Supply water temperature in water main, (ºF) See cold water inlet temperature in table below based on the nearest town.
A_{pool} = Surface area of pool, (ft2)[5]
V_{pool} = Volume of pool water, (gallons)
F_{Reheat} = Factor capturing annual number of times full pool volume is heated to the desired temperature, whether as the result of refill or heating of pool water from ground water temperature at start of season. If pool is filled by delivery service providing preheated water, set FReheat equal to 0. Otherwise F_{Reheat} shall default to 1.
U = Surface heat loss coefficient, (BTU/hr-ft2 -ºF) set as follows: Indoor pool: 3.9 Outdoor pool, sheltered: 5.3 Outdoor pool, unsheltered: 6.6[6]
AF = Activity Factor, consideration of activity within pool,, allowing for splashing and a limited area of wetted deck. set to .5[7]
P_{ω} = Saturation vapor pressure taken at surface water temperature, (in. Hg) See "saturation vapor pressure" table below.
P_{dp} = Saturation pressure at dew point, (in. Hg).See "Ambient Air Temperature and Pressure" table below.
hrs = Total annual swimming season hours.
hrs_{cover} = Total annual hours pool covered during the swimming season. set equal to 0 if pool is uncovered throughout season
$ESF_{cover,surface}$ = Energy Savings Factor of pool cover to insulate from convective and radiation heat losses. Set to .8 based on cost savings for gas and heat pump pool heater savings. [8]
$ESF_{cover,evap}$ = Energy Savings Factor of pool cover to insulate from evaporative heat loss. Set to .95 based on effectiveness of pool covers to reduce evaporation from swimmping pools [9]
0.1 = Simplified empirically derived evaporation factor considering latent heat and air flow; assumes 1,000 BTU/lb of latent heat required to change water to vapor at surface water temperature and air velocity over water surface ranging from 10 to 30 fpm, (lb/hr-ft2 -in. hg)
8.33 = Energy required (BTU) to heat one gallon of water by one degree Fahrenheit
3,412 = Conversion factor, one kWh equals 3,412 BTU

Cold Water Inlet Temperature (T_{main})

Supply water main temperatures vary according to climate and are approximately equal to the annual average outdoor temperature ply 6ºF.[10] Supply main temperatures are based on the annual outdoor temperature shown below.

Town	Annual Average Outdoor Temperature (°F)[11]	T_{main}(°F)
Berlin	42.5	48.5
Meredith	46.5	52.5
Lebanon	46.0	52.0
Concord	47.2	53.2
Keen	45.4	51.4
Epping	47.4	53.4
Manchester	50.1	56.1

Saturation and Vapor Pressure (P_{ω})

Look up saturation vapor pressur taken at surface water temperature for indoor and outdoor pools from the table below, based on pool temperature. [12]

Pool Temperature, T_{pool} (°F)	P_{ω} (in. Hg)
72	0.79
74	0.85
76	0.91
78	0.97
80	1.03
82	1.10
84	1.18

Ambient Air Temperature and Pressure (T_{amb} and P_{dp})

Indoor pools shall apply ambient air temperature based on facility set point temperature. Lookup saturation vapor pressure based on facility set point temperature and relative humidity (RH) from the table below, based on psychrometric analysis. Interpolation may be performed for indoor pool ambient temperatures not listed.

Indoor Pool Temperature, Tamb (°F)	Indoor Pool, Pdp (in. Hg)		
	RH 50%	RH 55%	RH 60%
72	0.40	0.44	0.47
74	0.42	0.47	0.51
76	0.45	0.50	0.54
78	0.48	0.53	0.58
80	0.52	0.56	0.62
82	0.55	0.61	0.66
84	0.59	0.65	0.71
86	0.63	0.69	0.75

For outdoor pools, lookup T_{amb} and P_{dp} from the table below based on location. Ambient temperature averages for outdoor pools apply a 4-month swimming season.

Climate Zone	Outdoor Pool Temperature Tamb (°F)[13]	Outdoor Pool Pdp (in. Hg)[14]
Berlin	61.53	0.43
Lebanon	63.6	0.46
Concord	66.42	0.49
Meredith	64.13	0.48
Epping	65.48	0.49
Keene	65.52	0.48
Manchester	66.6	0.49

Measure Life:

The measure life is 15 years[15] .

Other Resource Impacts:

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b009	Heat Pump Swimming Pool Heater	ES Products	1.00	1.00	n/a	1.00	0.00	0.00	0.00
GA3b016	Gas Swimming Pool Heater	ES Products	1.00	n/a	1.00	1.00	0.00	0.00	0.00

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

The programs assume no summer or winter peak savings because it is assumed heaters are not used during summer peak periods and do not operate during the winter.

Energy Load Shape:

See Appendix 1 "Pool Pump".

Endnotes:

1 : Energy.gov states the COP of heat pump water heaters range from 3.00-7.00. 5.00 has been chosen as an median of the stated range. For additional context, CA code requires a COP of 3.5 and FL code requires a COP of 4.0. https://www.energy.gov/energysaver/heat-pump-swimming-pool-heaters
2 : ASHRAE Handbook: HVAC Applications, 2019, Ch 51 Service Water Heating, Swimming Pools/Health Clubs. eqn 15
3 : ASHRAE Handbook: HVAC Applications, 2019, Ch 51 Service Water Heating, Swimming Pools/Health Clubs. eqn 14
4 : ASHRAE Handbook: HVAC Applications, 2019, Ch 6 Indoor Swimming Pools, eqn. 3, multiplied by required heating temperature difference
5 : Guidance for determining surface area of common pool shapes can be found at ASHRAE Handbook: HVAC Applications, 2019.
6 : ASHRAE Handbook: HVAC Applications, 2019, Ch 51, eqn. 15. Surface heat loss coefficient adjusted from ASHRAE Handbook rolled up surface heat transfer conservations by discounting contribution of evaporation (50-60%) and applying the following assumption for wind velocity: Indoor pools experience average wind speeds less than 3.5 mph (10.5x0.5x0.75), outdoor sheltered pools experience wind speeds between 3.5 and 5 mph (10.5x0.5), and outdoor unsheltered pools experience

wind speeds above 5 mph (10.5x0.5x1.25).
7 : ASHRAE Handbook, Applications, 2019, Ch 6, Table 1
8 : U.S. D.O.E., Swimming Pool Covers.
9 : National Plasterers Council, Effectiveness of Pool Covers to Reduce Evaporation from Swimming Pools, prepared by California Polytechnic State University, January 2016. https://rightscape.com/images/PDFs/Evaporation-Study-Final-Report_2.pdf
10 : Burch, Jay and Christensen, Craig, "Towards Development of an Algorithm for Mains Water Temperature." National Renewable Energy Laboratory. https://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/AlgorithmForMainsWaterTemperature.pdf
11 : Average annual outdoor temperatures taken from NCDC 1981-2010 climate normals. https://www.ncdc.noaa.gov/cdo-web/datatools/normals
12 : ASHRAE Handbook: Fundamentals 2017, Ch 1 Psychrometrics, Table 3 Thermodynamic Properties of Water at Saturation
13 : DOE Weather Data, TMY3 (Typical Meteorological Year), developed by NREL. Adjusted to apply to outside air temperature from June 1 to September 30 in each climate zone.
14 : Brice, Tim; Hall, Todd. "Vapor Pressure Calculator." Weather.gov. Accessed Date November, 20, 20222. https://www.weather.gov/epz/wxcalc_vaporpressure
15 : Database for Energy Efficient Resources (DEER). "2014 DEER Update Study." July 17, 2013. http://www.deeresources.com/files/home/download/DEER2014UpdatePlan-July2013-v1.pdf

1.18. Boiler

Measure Code	RES-HVAC-BLR
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of a new high efficiency forced hot water boiler for space heating.

Baseline Efficiency:

For Home Energy Assistance (HEA), the baseline efficiency is the existing system, consistent with the TREAT model used by the state Weatherization Assistance Program. For Home Performance and Energy Star Products, the baseline reflects a bended value based on past baseline research. The blended value uses an 84% AFUE rated boiler (77.4% AFUE actual) for early replacement and an 85% AFUE boiler (79.3% AFUE actual) for lost opportunity.[1]

High Efficiency:

The high efficiency case is a boiler with an AFUE rating of 90% or greater (i.e. a condensing boiler).Based on evaluation results the actual AFUE is 87.2% for a 90% AFUE rated boiler and 89.4% for a 95% AFUE rated boiler.

Algorithms for Calculating Primary Energy Impact:

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data.

The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

For Energy Star Products, unit savings are calculated based on deemed inputs and have been adjusted to reflect the mix of replace on failure and early replacement. Statewide average heating system size in Climate Zone 5 (Southern NH) is 92 kBTU/h; Climate Zone 6 (Northern NH) is 106 kBTU/h.[1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu/unit
EB1b001 GB1b001	Boiler Replacement	Gas	HEA	Calculated
EA2b001 GA2b001	Boiler Replacement	Gas	Home Performance	Calculated
EB1b003	Boiler Replacement	Oil	HEA	Calculated
EA2b003	Boiler Replacement	Oil	Home Performance	Calculated
EB1b004 EB1b002	Boiler Replacement	Propane/Kerosene	HEA	Calculated
EA2b004 EA2b002	Boiler Replacement	Propane/Kerosene	Home Performance	Calculated
GA3b006	Condensing Boiler >=90% AFUE (Up to 300 MBh)	Gas	ES Products	12.1
GA3b007	Condensing Boiler >=95% AFUE (Up to 300 MBh)	Gas	ES Products	14.8

Measure Life:

The measure life for all boilers is 19 years.[1.]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1b001 GB1b001	Boiler Replacement	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a

EA2b001 GA2b001	Boiler Replacement	Gas	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a
EB1b003	Boiler Replacement	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b003	Boiler Replacement	Oil	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a
EB1b004	Boiler Replacement	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b004	Boiler Replacement	Propane	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a
EB1b002	Boiler Replacement	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b002	Boiler Replacement	Kerosene	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

ES Products uses a 100% in-service rate unless an evaluation finds otherwise. In-service rates are 99% for Home Performance and are 100% for HEA based on evaluation results.[2] [3]

Realization Rates:

ES Products uses a 100% realization rate unless an evaluation finds otherwise. All PAs use a realization rate of 96% for Home Performance and a realization rate of 91% for HEA.[2, 3.]

Coincidence Factors:

No electric impacts are claimed.

Energy Load Shape:

No electric impacts are claimed.

Revision History:

Revision Number	Issue Date	Description
28	1/14/2022	Added omitted measures for Kerosene Boiler Replacements for HEA and Home Performance
122	12/1/2022	Updated Home Performance savings to reflect they are now calculated using Surveyor software. Added additional verbiage

		about the TREAT software used to calculate savings. Removed "Forced Hot Water" text and added avg system sizing for reference from Baseline study.

Endnotes:

1 : The 84% AFUE baseline is based on the New Hampshire Potential Study Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Volume III: Residential Market Baseline Study, June 11, 2020, p. 3-17. The 85% AFUE baseline represents value negotiated in MA for new boilers.
2 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
3 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.19. Boiler Reset Control

Measure Code	RES-HVAC-BRC
Markets	Residential
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of reset controls to automatically control boiler water temperature based on outdoor temperature or return water temperature in case of condensing boilers.

Baseline Efficiency:

The baseline efficiency case is a boiler without reset controls.

High Efficiency:

The high efficiency case is a boiler with reset controls.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu/unit
GA3b005	Boiler Reset Control	Gas	ES Products	5.1

Measure Life:

The measure life of reset controls installed on a new boiler is 15 years.[2]

BC Measure ID	Measure Name	Fuel	Program	EUL
GA3b005	Boiler Reset Control	All	All	15

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GA3b005	Boiler Reset Control	Gas	ES Products	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service-rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Not applicable for this measure since no electric savings are claimed

Energy Load Shape:

See Appendix 1 "Non-Electric Measures".

Revision History:

Revision Number	Date	Description
29	1/14/2021	Removed copy and paste formatting error. Baseline verbiage was originally in red text, change to black text.
88	12/1/2022	Updated evaluation references to latest versions; removed LS table and refer to Appdx 1.

Endnotes:

1 : https://ma-eeac.org/wp-content/uploads/RES34_HES-Impact-Evaluation-Report-with-ES_FINAL_29AUG2018.pdf
2 : ACEEE, 2006. Emerging Technologies Report: Advanced Boiler Controls. Prepared for ACEEE.

1.20. Central Air-source Heat Pump

Measure Code	RES-HVAC-HPAS
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure includes the installation of a high-efficiency, central air-source heat pump unit (ASHP) to serve the heating and cooling loads of a residential unit. The electric savings for this measure are realized through the increased nameplate efficiency between the baseline and installed equipment. If a fossil-fuel based heating system is being partially or completely displaced by the new heat pump unit, fossil fuel savings and increased electric consumption will be realized.

Baseline Efficiency:

The baseline efficiency varies as a function of replacement scenario.

For lost opportunity or replace on failure, the baseline is a code-compliant SEER 15 (SEER2 14.3) , HSPF 8.8 (HSPF2 7.5) heat pump unit.

For retrofit installations in homes with electric resistance heating, the baseline is an electric heating system with COP = 1, which converts to an HSPF value of 3.412 Btu/w-h.[1] The cooling baseline is project-specific based on the existing equipment.

For retrofit installations in oil or propane-heated homes, the utilities are proposing a limited pilot offering starting in 2021. The heating and cooling baselines are project-specific. Estimated savings have been developed based on secondary research,[2] and will be updated with primary research on pilot participants, pending pilot approval.

High Efficiency:

The high efficiency case is an ENERGY STAR Certified central air source heat pump that meets Eligibility Criteria Version 6.1, revised January 2022. [3]

ENERGY STAR PROGRAM REQUIREMENTS VERSION 6.1

Product Type	SEER2	HSPF2
HP Split Systems (Ducted)	≥15.2	≥8.1

Algorithms for Calculating Primary Energy Impact:

The savings for this measure are attributable to the increase in nameplate efficiency between the baseline and installed units. The savings are based on the energy efficient heat pump serving both the cooling and heating loads of the house.

The algorithm for calculating electric demand savings is:

$\Delta kW = \max(\Delta kW_{cool} \text{ or } \Delta kW_{heaet})$

$\Delta kW_{cool} = Cap_{cool} \times (1/EER_{Base} - 1/EER_{EE})$

For retrofit applications where cooling is absent in the preexisting case, the term $(1/EER_{BASE}) = 0$

if unit is a cold climate air-source heat pump:

$Cap_{heat}(5) = Cap_{cool} \times 0.87$

$\Delta kW_{heat} = Cap_{heat}(5) \times (1 - 1/COP_{EE}(5))/3.412$

for all other air-source heat pump

$\Delta kW_{heat} = 0$

Where:

$\Delta kW_{cool} =$ Gross annual cooling demand savings for air-source heat pump unit

$\Delta kW_{heat} =$ Gross annual heating demand savings for air-source heat pump unit

$Cap_{cool} =$ Cooling capacity (in kBtu/h) of the energy efficient air-source heat pump unit, from equipment specifications

$Cap_{heat}(5) =$ Heating capacity (in kBtu/h) of the energy efficient air-source pump unit at 5F rating point, from equipment specifications. Use equation to convert from cooling capacity value if standard equipment literature does not provide this value.

$EER_{BASE} =$ Energy Efficiency Ratio of the baseline cooling equipment

$EER_{EE} =$ Energy Efficiency Ratio of the energy efficient air-source heat pump unit, from equipment specifications

$COP_{EE}(5) =$ Heating coefficient of performance of energy efficient air-source heat pump unit at 5F rating point, from equipment specifications

The algorithm for calculating annual electric energy savings is:

$\Delta kWh_{cool} = Cap_{cool} \times (1/SEER_{Base} - 1/SEER_{EE}) \times EFLH_{cool}$

For retrofit applications where cooling is absent in the preexisting case, the term $(1/SEER_{BASE}) = 0$

$$\Delta kWh\ \text{heat} = Cap_{heat} \times (1/HSPF_{Base} - 1/HSPF_{EE}) \times EFLH\ heat$$

If fossil fuel heating baseline, the term $(1/HSPF_{BASE}) = 0$ and the fossil fuel savings are:

$$\Delta MMBtu_{heat} = (Cap_{heat} / AFUE) \times EFLH_{heat} \times 10^{-3}$$

if unit is a cold climate air-source heat pump

$$Cap_{heat} = Cap_{cool} \times 1.0$$

for all other air-source heat pump

$$Cap_{heat} = Cap_{cool} \times 0.9$$

Where:

$\Delta kWh_{cool} =$ Gross annual cooling savings for air-source heat pump unit

$\Delta kWh_{heat} =$ Gross annual heating savings for air-source heat pump unit

$\Delta MMBtu_{heat} =$ Gross annual heating savings resulting from the decrease in fuel consumption due to the partial or complete displacement of the heating load by the energy efficient air-source heat pump unit.

$Cap_{cool} =$ Cooling capacity (in kBtu/h) of the energy efficient air-source heat pump unit, from equipment specifications

$Cap_{heat} =$ Heating capacity (in kBtu/h) of the energy efficient air-source pump unit, from equipment specifications. Use equation to convert from cooling capacity value if standard equipment literature does not provide this value.

$SEER_{BASE} =$ Seasonal Energy Efficiency Ratio of baseline cooling equipment

$SEER_{EE} =$ Seasonal Energy Efficiency Ratio of energy efficient air-source heat pump unit, from equipment specifications

$HSPF_{BASE} =$ Heating Seasonal Performance Factor of baseline heat pump equipment

$HSPF_{EE} =$ Heating Seasonal Performance Factor of energy efficient air-source heat pump unit, from equipment specifications

$EFLH_{cool}$ = Equivalent Full Load Hours for cooling. See Table below

$EFLH_{heat}$ = Equivalent Full Load Hours for heating. See Table below

AFUE = Annual fuel utilization efficiency of replaced fossil fuel heating system

0.9 = Conversion factor[4] to convert cooling capacity to heating capacity for non-cold climate, air-source heat pump units not meeting standards similar to NEEP's cold climate air source heat pump (ccASHP) product list. The conversion factor for ccASHP meeting standards similar to NEEP's is 1.0.

10^{-3} = Conversion factor from kBtu to MMBtu

Heat Pump Type	**Cooling Capacity Range**	**Parameter**	**Value**			**Units**
			1.Lost Opportunity	**2. Retrofit - Resistance**	**3. Retrofit – Fossil Fuel**	
Air-source Heat Pump	All sizes	EER_{BASE}	12.3[5]	-	-	Btu/W-h
		$SEER_{BASE}$	15.00[1.]	-	-	Btu/W-h
		$HSPF_{BASE}$	8.80[1.]	3.412[2.]	-	Btu/W-h
		AFUE	N/A	N/A	75% [6]	
		$EFLH_{cool}$	280[7]			Hours
		$EFLH_{heat}$	1020[8]			Hours

Federal Standards require heat pump cooling seasonal efficiency rated as SEER2 beginning January 2023. SEER2 is converted to SEER using the table below[9] :

SEER2	SEER
13.4	14
14.3	15
15.2	16
16	17
17	18
18	19
19	20

20	21
21	22
22	23

Federal Standards require heat pump heating seasonal efficiency rated as HSPF2 beginning January 2023. HSPF2 is converted to HSPF using the table[10] below:

HSPF2	HSPF
6.7	8
7.1	8.5
7.5	8.8
7.8	9.2
8	9.5
8.4	10
8.5	10.2
8.9	10.8
9.1	11
9.3	11.3
9.7	11.9
10	12.4
10.4	12.9

Measure Life:

The measure life of a new heat pump unit is 18 years.[11]

BC Measure ID	Measure Name	Program	Measure Life

EA3b003	Air-source Heat Pump – Lost Opportunity (Cooling)	ES Products	18
EA3b004	Air-source Heat Pump – Lost Opportunity (Heating)	ES Products	18
EA3b034	Air-source Heat Pump – Retrofit Resistance	ES Products	18
EB1b021	Ductless Mini-split Heat Pump (Cooling)	HEA	18
EB1b022	Ductless Mini-split Heat Pump (heating)	HEA	18

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b003	Air-source Heat Pump – Lost Opportunity (Cooling)	ES Products	1.00	1.00	1.00	1.00	1.00	0.346	0.00
EA3b004	Air-source Heat Pump –Lost Opportunity (Heating)	ES Products	1.00	1.00	1.00	1.00	1.00	0.00	0.620
EA3b034	Air-source Heat Pump – Retrofit Resistance	ES Products	1.00	1.00	1.00	1.00	1.00	0.346	0.620
EB1B021	Ductless Mini-split Heat Pump (cooling)	HEA	1.00	0.91	0.91	0.91	0.91	0.346	n/a
EB1B022	Ductless Mini-split Heat Pump (heating)	HEA	1.00	0.91	0.91	0.91	0.91	n/a	0.620

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

ES Products use a 100% realization, HEA programs use a realization rate of .91. [12]

Coincidence Factors:

A coincidence factor of 34.60% during cooling season and a coincidence factor of 62.0% for the heating season should be applied.[13]

Energy Load Shape:

See Appendix 1 – "Central Heat Pump"

Revision History:

Revision Number	Issue Date	Description
35	1/14/2022	Updated SEER to EER conversion factor used.
36	1/14/2022	Added omitted ductless mini split heating only and cooling only measures
67	3/1/2022	Added values for EFLH
94	12/1/2022	Updated high efficiency requirements to align with Energy Star Criteria.
95	12/1/2022	Updated baseline values to align with federal energy standards, effective 1/1/2023.

Endnotes:

1 : Electric heating system has COP = 1, which converts to an HSPF value of 3.412 Btu/w-h
2 : Navigant, Energy Optimization. Sep. 12, 2019. See https://puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOSTARIFFS/17-136_2019-10-31_STAFF_NH_ENERGY_OPTIMIZATION_STUDY.PDF and https://puc.nh.gov/Electric/Reports/20190805-PUCElectric-NH-Energy-Optimization-Model.xlsx.
3 : ENERGY STAR Program Requirements Product Specification and Central Air Conditioner and Heat Pump Equipment. Eligibility Criteria Version 6.1 January, 2022. https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%206.1%20Central%20Air%20Conditioner%20and%20Heat%20Pump%20Final%20Specification%20%28Rev.%20January%20%202022%29.pdf

4 : Conversion factor is based on internal ERS analysis of Mass Save and NEEP ccASHP product data.
5 : Since IECC does not provide EER requirements for heat pumps <65kBtu/h, the following conversion is used: $EER = -0.02 \times SEER^2 + 1.12 \times SEER$. Source for the calculation is https://www.nrel.gov/docs/fy11osti/49246.pdf
6 : MA TRM DMSHP measure. This value in the MA TRM has been agreed upon by EEAC consultants and represents actual fossil fuel heating equipment efficiencies which include efficiency degradation over the age of the equipment. MA TRM DMSHP.
7 : Cooling hours from NY TRM v7 Appendix G for Single family

homes. The average of cooling hour values for the cities of Albany and Massena are assumed to be representative of NH, because they lie roughly along the same latitudes as endpoints of NH.
8 : Heating hours from NY TRM v7 Appendix G for Single family homes. The average of heating hour values for the cities of Albany and Massena are assumed to be representative of NH, because they lie roughly along the same latitudes as the endpoints of NH.
9 : SEER2 to SEER table from Michigan Energy Measures Database. https://www.michigan.gov/mpsc/regulatory/ewr/michigan-energy-measures-database Accessed 11/17/22
10 : HSPF2 to HSPF table from Michigan Energy Measures Database. https://www.michigan.gov/mpsc/regulatory/ewr/michigan-energy-measures-database Accessed 11/17/22
11 : GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group; Page 1-3, Table 1.
12 : Opinion Dynamics (2020) Home Energy Assistance Program Evaluation 2016-2017 Final https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
13 : Coincidence Factors obtained from Navigant Consulting (2018), Demand Impact Model Update (for Central Air Conditioner/Heat Pump (Cooling) and Ductless Mini Split Heat Pumps (Heating)). The calculation of Coincidence Factors can be found in MA PAs' 2019-2021 Plan Electric Heating and Cooling Savings Workbook (2018)

1.21. Ductless Mini-Split Heat Pump

Measure Code	RES-HVAC-HPDL
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure includes the installation of a cold climate, high-efficiency, ductless, mini-split heat pump unit (DMSHP) to serve the heating and cooling loads of a residential unit. The savings for this measure are realized through the increased nameplate efficiency between the baseline and installed equipment. If a fossil-fuel based heating system is being partially or completely displaced by the new heat pump unit, fossil fuel savings and electric consumption increases will be realized.

Baseline Efficiency:

The baseline efficiency varies as a function of replacement scenario.

For lost opportunity or replace on failure, the baseline is a code-compliant SEER 15 (SEER2 14.3) , HSPF 8.8 (HSPF2 7.5) heat pump unit.

For retrofit installations in homes with electric resistance heating, the baseline is an electric heating system with COP = 1, which converts to an HSPF value of 3.412 Btu/w-h. [1] The cooling baseline is project-specific based on the existing equipment.

For retrofit installations in oil or propane-heated homes, the utilities are proposing a limited pilot offering starting in 2021. The heating and cooling baselines are project-specific. Estimated savings have been developed based on secondary research,[2] and will be updated with primary research on pilot participants, pending pilot approval.

High Efficiency:

The high efficiency case is an ENERGY STAR certified cold climated ductless air source heat pump that meets Eligibility Criteria Version 6.1, revised January 2022. [3]

ENERGY STAR PROGRAM REQUIREMENTS VERSION 6.1

Product Type	SEER2	HSPF2
HP Split Systems (Non-Ducted)	≥15.2	≥8.5

Algorithms for Calculating Primary Energy Impact:

The savings for this measure are attributable to the increase in nameplate efficiency between the baseline and installed units. The savings are based on the energy efficient heat pump serving both the cooling and heating loads of the house.

The algorithm for calculating electric demand savings is:

$$\Delta kW = \max(\Delta kW_{cool} \text{ or } \Delta kW_{heaet})$$

$$\Delta kW_{cool} = Cap_{cool} \times (1/EER_{Base} - 1/EER_{EE})$$

For retrofit applications where cooling is absent in the preexisting case, the term ($1/EER_{BASE}$) = 0

if unit is a cold climate mini-split heat pump:

$$Cap_{heat}(5) = Cap_{cool} \times 0.94$$

$$\Delta kW_{heat} = Cap_{heat}(5) \times (1 - 1/COP_{EE}(5))/3.412$$

for all other ductless mini split heat pump:

$$\Delta kW_{heat} = 0$$

Where:
ΔkW_{cool} = Gross annual cooling demand savings for ductless, mini-split heat pump unit
ΔkW_{heat} = Gross annual heating demand savings for ductless, mini-split heat pump unit
Cap_{cool} = Cooling capacity (in kBtu/h) of the energy efficient ductless, mini-split heat pump unit, from equipment specifications
$Cap_{heat}(5)$ = Heating capacity (in kBtu/h) of the energy efficient air-source pump unit at 5F rating point, from equipment specifications. Use equation to convert from cooling capacity value if standard equipment literature does not provide this value.
EER_{BASE} = Energy Efficiency Ratio of the baseline cooling equipment
EER_{EE} = Energy Efficiency Ratio of the energy efficient ductless, mini-split heat pump unit, from equipment specifications
$COP_{EE}(5)$ = Heating coefficient of performance of energy efficient air-source heat pump unit at 5F rating point, from equipment specifications
0.94 = conversion factor from rated cooling output to rated heating output at 5F rating point from the Michigan Energy Measures Database[1]

The algorithms for calculating annual cooling and heating electric energy savings are as follows:

$$\Delta kWh_{cool} = Cap_{cool} \times (1/SEER_{Base} - 1/SEER_{EE}) \times EFLH_{cool}$$

For retrofit applications where cooling is absent in the preexisting case, the term ($1/SEER_{BASE}$) = 0

$$\Delta kWh_{heat} = Cap_{heat} \times (1/HSPF_{Base} - 1/HSPF_{EE}) \times EFLH_{heat}$$

If fossil fuel heating baseline, the factor ($1/HSPF_{BASE}$) = 0 and the fossil fuel savings are:

$\Delta MMBtu_{heat} = (Cap_{heat} / AFUE) \times EFLH_{heat} \times 10^{1}3$

if unit is a cold climate ductless mini split heat pump:
$Cap_{heat} = Cap_{cool} \times 1.0$

for all other ductless mini split heat pump:

$Cap_{heat} = Cap_{cool} \times 0.9$

Where:
ΔkWh_{cool} = Gross annual cooling savings for ductless, mini-split heat pump unit
ΔkWh_{heat} = Gross annual heating savings for ductless, mini-split heat pump unit
$\Delta MMBtu_{heat}$ = Gross annual heating savings resulting from the decrease in fuel consumption due to the partial or complete displacement of the heating load by the energy efficient ductless, mini-split heat pump unit.
Cap_{cool} = Cooling capacity (in kBtu/h) of the energy efficient ductless, mini-split heat pump unit, from equipment specifications
Cap_{heat} = Heating capacity (in kBtu/h) of the energy efficient ductless, mini-split pump unit, from equipment specifications. Use equation to convert from cooling capacity value if standard equipment literature does not provide this value.
$SEER_{BASE}$ = Seasonal Energy Efficiency Ratio of baseline cooling equipment
$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of energy efficient ductless, mini-split heat pump unit, from equipment specifications
$HSPF_{BASE}$ = Heating Seasonal Performance Factor of baseline heat pump equipment
$HSPF_{EE}$ = Heating Seasonal Performance Factor of energy efficient ductless, mini-split heat pump unit, from equipment specifications
$EFLH_{cool}$ = Equivalent Full Load Hours for cooling, see Table below
$EFLH_{heat}$ = Equivalent Full Load Hours for heating (Note: The algorithm assumes higher heating hours for full displacement scenarios, where heat pump meets over 90 percent of annual space heating needs and meets cold climate heat pump standards). See Table below.
$AFUE$ = Annual fuel utilization efficiency of replaced fossil fuel heating system
0.9 = Conversion factor [2], to convert cooling capacity to heating capacity for non-cold climate, ductless heat pump units not meeting standards similar to NEEP's cold climate air source heat pump (ccASHP) product list. The conversion factor for ccASHP meeting standards similar to NEEP's is 1.0.
10^{-3} = Conversion factor from kBtu to MMBtu

		Parameter	**Value**	**Units**

Heat Pump Type	**Cooling Capacity Range**		**1. Lost Opportunity**	**2. Retrofit - Resistance**	**3. Retrofit – Fossil Fuel**	Units
Ductless Mini Split	All sizes	EER_{BASE}	12.3 [3]	-	-	Btu/W-h
		$SEER_{BASE}$	15.00 [1.]	-	-	Btu/W-h
		$HSPF_{BASE}$	8.80 [1.]	3.412 [2.]	-	Btu/W-h
		AFUE	N/A	N/A	75% [4]	
		$EFLH_{cool}$	218 [5]			Hours
		$EFLH_{heat, partial}$	535 [6]			Hours
		$EFLH_{heat, full}$	1,117 [8.]			Hours

Federal Standards require heat pump cooling seasonal efficiency rated as SEER2 beginning January 2023. SEER2 is converted to SEER using the following relationships for ductless mini-split heat pumps:[2]

SEER2 = SEER

HSPF2 = 0.95 x HSPF

Measure Life:

The table below lists the measure life of the ductless mini-split heat pump equipment. [5]

BC Measure ID	**Measure Name**	**Program**	**Measure Life**
EA3b005	Ductless Mini-split Heat Pump (cooling) - Lost Opportunity	ES Products	18
EA3b006	Ductless Mini-split Heat Pump (heating) - Lost Opportunity	ES Products	18
EA3b031	Ductless Mini-split Heat Pump - Retrofit Resistance	ES Products	18

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b005	Ductless Mini-split Heat Pump (cooling) - Lost Opportunity	ES Products	1.00	1.00	1.00	1.00	1.00	0.29	0.00
EA3b006	Ductless Mini-split Heat Pump (heating) - Lost Opportunity	ES Products	1.00	1.00	1.00	1.00	1.00	0.00	0.62
EA3b031	Ductless Mini-split Heat Pump - Retrofit Resistance	ES Products	1.00	1.00	1.00	1.00	1.00	0.29	0.62

In-Service Rates:
All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:
All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors :
Coincidence factor of 29% during cooling season and a coincidence factor of 62% for the heating season should be applied.[6]

Energy Load Shape:

For cooling, see Appendix 1 – Mini-Split Air Conditioner/Heat Pump (Cooling)

For heating, see Appendix 1 – Mini-Split Heat Pump (Heating)

Revision History:

Revision Number	Issue Date	Description
37	1/14/2022	Updated SEER to EER Conversion factor used

68	3/1/2022	Added Values for EFLH
96	12/1/2022	Updated high efficiency case to align with updated Energy Star Criteria Version 6.1
97	12/1/2022	Updated baseline values to align with federal energy standards, effective 1/1/2023.
176	7/1/2023	Updated verbiage to show the offering is specific to cold climate heat pumps.

Endnotes:

1 : Electric heating system has COP = 1, which converts to an HSPF value of 3.412 Btu/w-h
2 : Navigant, Energy Optimization. Sep. 12, 2019. See https://puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOSTARIFFS/17-136_2019-10-31_STAFF_NH_ENERGY_OPTIMIZATION_STUDY.PDF and https://puc.nh.gov/Electric/Reports/20190805-PUCElectric-NH-Energy-Optimization-Model.xlsx.
3 : ENERGY STAR® Program Requirements Product Specification for Central Air Conditionerand Heat Pump Equipment Version 6.1, Revised January 2022 (https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%206.1%20Central%20Air%20Conditioner%20and%20Heat%20Pump%20Final%20Specification%20%28Rev.%20January%20%202022%29.pdf
4 : Consortium for Energy Efficiency (CEE), Testing, Testing, M1, 2, 3, Transitioning to New Federal Minimum Standards, CEE Summer Program Meeting, June 10, 2022.
5: GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group; Page 1-3, Table 1.
6 : Coincidence factors come from the Navigant Demand Impact model analysis spreadsheet – MA, Aug 2018. https://ma-eeac.org/wp-content/uploads/RES-1-Residential-Baseline-Study-Ph4-Comprehensive-Report-2020-04-02.pdf

1.22. ENERGY STAR Central Air Conditioning

Measure Code	RES-HVAC-ESCAC
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The installation of a high efficiency ENERGY STAR central air conditioning (AC) system.

Baseline Efficiency:

For lost opportunity and replace on failure the baseline efficiency case is is NH state building code of 14 SEER (13.4 SEER 2). For early retirement, if values are known, then baseline is the existing air-conditioning unit SEER over its remaining life, and a SEER 14 (13.4 SEER2) central air-conditioning unit for the remaining life of the new unit. If baseline values are unknown, the baseline case over its remaining life should be the average efficiency levels of units replaced in the previous calendar year.

High Efficiency:

The high efficiency case is a program an air conditioning unit meeting the ENERGY STAR Elibability Criteria version 6.1, revised january 2022.. The minimum ENERGY STAR SEER2 requirement for the program is 15.2, the minimum EER2 is 12. [1] The following table can be used to convert SEER, EER or HSPF to SEER2, EER2, or HSPF2. To use, multiply a products SEER, EER or HSPF by the number indicated in the cross walk.

Crosswalk M to M1

	SEER2	EER2	HSPF2
Ducted	.95	.95	.85
Non-Ducted	1.00	1.00	.90
Packaged	.95	.95	.84

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = Tons \times 12\ kBtu/hr / Ton \times (1/SEER_{BASE} - 1/SEER_{EE}) \times Hours$

$\Delta kW = \Delta kWh \times$ Annual Maximum Demand Factor

Where:

Tons = Cooling capacity of the central AC equipment in tons. Use actual rebated tons or if unknown assume previous year average program rebated tonnage (for 2019, was 2.85 tons).[2]

$SEER_{BASE}$ = Seasonal Energy Efficiency Ratio (SEER).

1. For lost opportunity and replace on failure retrofit installation, baseline AC equipment should be SEER 14 equipment.
2. For early replacement retrofit, baseline AC equipment is divided into two components
    1. For the remaining useful life of the replaced AC equipment:
        1. if known, use the replaced (old) AC SEER value.
        2. if unknown, assume SEER 12.4[2]
    2. For the remaining useful life of the new AC equipment: baseline AC equipment should be 14 SEER

$SEER_{EE}$ = Seasonal Energy Efficiency Ratio (SEER) of new efficient AC equipment. Use actual rebated SEER, or if unknown, assume previous calendar year average (for 2020-2021 was 17.16 SEER).[3]

Savings Assumptions for Calculating Residential Central Air Conditioners:

BC Measure ID	Measure Name	Program	Tons	$SEER_{BASE}$	$SEER_{EE}$	Hours	Annual Max Demand Factor[4]
EA3b015	ENERGY STAR Central AC	ENERGY STAR Products	Use actual if unknown use 2.85	14	Use actual if unknown use 17.1	385	0.001594
EA2b021 EB1b023	ENERGY STAR Central AC, Early Retirement	Home Performance HEA	Use actual if unknown use 2.85	Use actual, if unknown use 10 for remaining useful life of replaced AC, 14 for remaining useful life of new AC	Use actual if unknown use 17.1	385	0.001594

Measure Life:

The table below includes the effective useful life (EUL) for central air-conditioning units which assumes a lost opportunity installation. Retrofit installations that meet early retirement criteria should receive a remaining useful life of 6 years for a total of 18-year life[5] [6] .To calculate lifetime savings for lost opportunity and replace on failure retrofit installations, use the full EUL of 18 years with the first row of savings assumptions (ENERGY STAR Central AC) above. For retrofit installations that meet early retirement criteria, lifetime savings are based on the sum of two components: 6 years with savings from the second row of savings assumptions above (ENERGY STAR Central AC, Early Retirement) and the remaining 12 years using the lost opportunity savings assumptions (ENERGY STAR Central AC).

BC Measure ID	Measure Name	Program	Measure Life (EUL)	Measure Life (RUL)
EA3b015	ENERGY STAR Central AC	ES Products	18	n/a
EA2b021 EB1b023	ENERGY STAR Central AC, Early Retirement	Home Performance/HEA	18	6

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b015	ENERGY STAR Central AC	ES Products	1.00	1.00	n/a	1.00	1.00	0.35	0.00
EB1b023	ENERGY STAR Central AC, Early Retirement	HEA	1.00	0.91	n/a	0.91	0.91	0.35	0.00
EA2b021	ENERGY STAR Central AC, Early Retirement	Home Performance	0.99	0.96	n/a	0.96	0.96	0.35	0.00

In-Service Rates:

In-service rates are 100% for ES Products unless an evaluation finds otherwise, 100% for HEA[7] , and 99%% for Home Performance[8].

Realization Rates:

Realization rates are 100% for ES Products, 91% for HEA[8], and 96% for Home Performance[9].

Coincidence Factors:

Summer coincidence factors are estimated using the RES1 Demand Impact Model Update[5].The winter coincidence factor is assumed to be zero

Energy Load Shape:

See Appendix 1 – “Central Air Conditioner/Heat Pump (Cooling)”.

Revision History:

Revision Number	Issued Date	Revision
31	1/14/2022	*Formatting, added correct BC MEASURE ID’s*
32	1/14/2022	*Updated baseline for lost opportunity to reflect NH Building code.*
66	3/1/2022	*Updated EFLH value used*
98	12/1/2022	Updated baseline values to align with federal energy standards, effective 1/1/2023. Updated high efficiency case to align with Energy Star 6.1. Corrected algorithms to align with updated baseline and high efficiency cases and added a conversion table for M to M1 ratings. Corrected Home Performance RR value in verbiage to align with table.
177	1/1/2024	Updated $SEER_{ee}$ to most recent available annual average of rebated units, 2020-2021.

Endnotes:

1 : Itron (2020) New Hampshire Residential Baseline Study. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200826-Electric-MER-NHSaves-Res-Baseline-Report-Final.pdf
2 : ENERGY STAR Program Requirements Product Specification for Central Air Conditioner and Heat Pump Equipment https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%206.1%20Central%20Air%20Conditioner%20and%20Heat%20Pump%20Final%20Specification%20%28Rev.%20January%20%202022%29.pdf
3: Itron (2020) New Hampshire Residential Baseline Study. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200826-Electric-MER-NHSaves-Res-Baseline-Report-Final.pdf
2 : Itron (2020) New Hampshire Residential Baseline Study. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200826-Electric-MER-NHSaves-Res-Baseline-Report-Final.pdf
3 : Average SEER for Eversource 2019 rebated ENERGY STAR central AC according to tracking database summary report. Pulled February 10, 2020
4 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-

content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
5 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007.
https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf
6 : RUL is based on the 2019 MA TRM, Illinois TRM version 9.0, and NEEP TRM version 9.0, which all assume an RUL of one-third the EUL, or six years.
7 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL
8 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
9 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL
10 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

1.23. ENERGY STAR Room Air Conditioning

Measure Code	RES-HVAC-ESRAC
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The installation of a high efficiency room air conditioning (AC) unit.

Baseline Efficiency:

The lost opportunity baseline efficiency case is a room AC unit meeting current federal standard, effective June 1, 2014, as stated in the Code of Federal Regulations, 430.32 Energy and Water conservation Standards and their Compliance dates, section b, Room Air Conditioners.[1] . The early replacement baseline is the existing inefficient unit.

Product class	Energy efficiency ratio, effective from Oct. 1, 2000, to May 31, 2014	Combined energy efficiency ratio, effective as of June 1, 2014
1. Without reverse cycle, with louvered sides, and less than 6,000 Btu/h	9.7	11.0
2. Without reverse cycle, with louvered sides, and 6,000 to 7,999 Btu/h	9.7	11.0
3. Without reverse cycle, with louvered sides, and 8,000 to 13,999 Btu/h	9.8	10.9
4. Without reverse cycle, with louvered sides, and 14,000 to 19,999 Btu/h	9.7	10.7
5a. Without reverse cycle, with louvered sides, and 20,000 to 27,999 Btu/h	8.5	9.4
5b. Without reverse cycle, with louvered sides, and 28,000 Btu/h or more	8.5	9.0
6. Without reverse cycle, without louvered sides, and less than 6,000 Btu/h	9.0	10.0

7. Without reverse cycle, without louvered sides, and 6,000 to 7,999 Btu/h	9.0	10.0
8a. Without reverse cycle, without louvered sides, and 8,000 to 10,999 Btu/h	8.5	9.6
8b. Without reverse cycle, without louvered sides, and 11,000 to 13,999 Btu/h	8.5	9.5
9. Without reverse cycle, without louvered sides, and 14,000 to 19,999 Btu/h	8.5	9.3
10. Without reverse cycle, without louvered sides, and 20,000 Btu/h or more	8.5	9.4
11. With reverse cycle, with louvered sides, and less than 20,000 Btu/h	9.0	9.8
12. With reverse cycle, without louvered sides, and less than 14,000 Btu/h	8.5	9.3
13. With reverse cycle, with louvered sides, and 20,000 Btu/h or more	8.5	9.3
14. With reverse cycle, without louvered sides, and 14,000 Btu/h or more	8.0	8.7
15. Casement-Only	8.7	9.5
16. Casement-Slider	9.5	10.4

High Efficiency:

The high efficiency case is a program-qualified ENERGY STAR room AC unit meeting the draft version 4.2 Eligibility criteria, amended December 23 2020.[2]

Units without Reverse Cycle

Capacity (BTU/hour)	CEERBASE (units with louvered sides)	CEERBASE (units without louvered sides)
< 6,000	12.1	11.0
6,000 to 7,999		
8,000 to 10,999	12.0	10.6
11,000 to 13,999		10.5
14,000 to 19,999	11.8	10.2
20,000 to 27,999	10.3	10.3

=28,00	9.9		

Algorithms for Calculating Primary Energy Impact:

Savings Assumptions for Calculating Residential ENERGY STAR Room Air Conditioners:

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW[3]
EA3b016	ENERGY STAR Room AC	ES Products	36.01*	0.06
EB1a054	ENERGY STAR Room AC	HEA	113	0.18
EA2a057	ENERGY STAR Room AC	Home Performance	113	0.18

Measure Life:

The table below includes the effective useful life (EUL) for room air-conditioning units which assumes lost opportunity installation. The 3 year remaining useful life (RUL) for early replacement units is multiplied by the early replacement annual savings value above, and the remaining 6 years of the EUL for those units is multiplied by the lost opportunity savings value above.

BC Measure ID	Measure Name	Program	Measure Life (EUL)[6]	Measure Life (RUL)[7]
EA3b016	ENERGY STAR Room AC	ES Products	9	n/a
EB1a054	ENERGY STAR Room AC	HEA	9	3
EA2a057	ENERGY STAR Room AC	Home Performance	9	3

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EA3b016	ENERGY STAR Room AC	ES Products	1.00	1.00	n/a	1.00	1.00	0.33	0.00
EB1a054	ENERGY STAR Room AC	HEA	1.00	0.91	n/a	0.91	0.91	0.33	0.00
EA2a057	ENERGY STAR Room AC	Home Performance	0.99	0.96	n/a	0.96	0.96	0.33	0.00

<u>In-Service Rates:</u>

In-service rates are 100% for ES Products unless an evaluation finds otherwise, 100% for HEA[6] , and 99%% for Home Performance[9]

<u>Realization Rates:</u>

Realization rates are 100% for ES Product program until the measure is evaluated. Realization rates for all HEA programs are 91%[8] and for all Home Performance programs are 96%[9] per evaluation results.

<u>Coincidence Factors:</u>

Summer coincidence factors is estimated using the RES1 Demand Impact Model Update.[10.] The winter coincidence factor is assumed to be zero

Energy Load Shape:

See Appendix 1 – "Room or Window Air Conditioner".

Revision History:

Revision Number	Issue Date	Description
33	1/14/2022	Updated Home Performance RR in 'Realization Rate' sub section. The RR was correct in the table, but incorrect in the verbiage.
133	12/1/2022	Added references for baseline federal code and energy star. Updated algorithm verbiage for vendor calculated savings in HEA and Home Performance. Updated ES products savings from 33 kwh to 36 kwh based on VT TRM.

Endnotes:

1 : Code of Federal Regulations, 430.32 Energy and Water conservation Standards and their Compliance dates, section b, Room Air Conditioners. https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-C/section-430.32
2 : Energy Star (2020) Energy Star Program Requirements Product Specification for Room Air Conditioners, Eligibility Criteria Draft Version 4.2.
https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Draft%20Version%204.2%20Room%20Air%20Conditioners%20Specification_0_0.pdf
3: Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.
4 : Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Room Air Conditioner. EPA_2009_Lifecycle_Cost_Estimate_for_ENERGY_STAR_Room_Air_Conditione
5 : California Public Utilities Commission, 2014 Database for Energy-Efficient Resources, Feb. 4, 2014. Available at: http://www.deeresources.com/files/DEER2013codeUpdate/download/DEER2014-EUL-table-update_2014-02-05.xlsx last accessed Sep 3, 2020.
6 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
7 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
8 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
9 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
10: Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.

1.24. Furnace

Measure Code	Res-HVAC-FUR
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of a new high efficiency space heating furnace with an electronically commutated motor (ECM) for the fan.

Baseline Efficiency:

For Home Energy Assistance (HEA), the baseline efficiency is the existing system, consistent with the TREAT model used by the state Weatherization Assistance Program. For Home Performance and Energy Star Products, the baseline reflects a bended value based on past baseline research, specifically a 83.2% AFUE furnace . The blended value uses an 83% AFUE rated furnace for early replacement and an 85% AFUE furnace for lost opportunity.[1]

High Efficiency:

The high efficiency case is a new furnace with AFUE ≥ 95%.

Algorithms for Calculating Primary Energy Impact:

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data.

The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

For Energy Star Products, unit savings are calculated based on deemed inputs based on a blended Early Retirement/Replace on Failure baseline that reflects the historical project mix. Statewide average heating system size in Climate Zone 5 (Southern NH) is 92 kBTU/h; Climate Zone 6 (Northern NH) is 106 kBTU/h. [1]

Unit savings for Furnace ancillary savings measure are based on the 2020 Home Performance study results.[2] Ancillary electric savings for furnace replacement measure are based on the 2018 ES Products evaluation study.[3]

BC Measure ID	Measure Name	Fuel	Program	ΔkWh	ΔkW	ΔMMBtu
EB1b005 GB1b002 EA2b005 GA2b002	Furnace Replacement	Gas	HEA Home Performance	130.6 168	0.064	Calculated
EB1b006 EA2b006	Furnace Replacement	Kerosene	HEA Home Performance	87.6 168	0.064	Calculated
EB1b008 EA2b008	Furnace Replacement	Propane	HEA Home Performance	130.6 168	0.064	Calculated
EB1b007 EA2b007	Furnace Replacement	Oil	HEA Home Performance	130.6 168	0.064	Calculated
GA3b008	Furnace 95+ AFUE (<150) w/ECM Motor	Gas	ES Products	104.2	0.07	9.8
GA3b009	Furnace 97+ AFUE (<150) w/ECM Motor	Gas	ES Products	104.2	0.07	10.3

Measure Life:

Measure life is 17 years based on MA study results[3].

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

[2, 4]

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EB1b005 GB1b002	Furnace Replacement	Gas	HEA	1.00	n/a	0.91	0.91	0.91	0.00	0.45
EA2b005 GA2b002	Furnace Replacement	Gas	Home Performance	0.99	n/a	1.00	1.00	1.00	0.00	0.45
EB1b006	Furnace Replacement	Kerosene	HEA	1.00	n/a	0.91	0.91	0.91	0.00	0.45
EA2b006	Furnace Replacement	Kerosene	Home Performance	0.99	n/a	1.00	1.00	1.00	0.00	0.45
EB1b008	Furnace Replacement	Propane	HEA	1.00	n/a	0.91	0.91	0.91	0.00	0.45
EA2b008	Furnace Replacement	Propane	Home Performance	0.99	n/a	1.00	1.00	1.00	0.00	0.45
EB1b007	Furnace Replacement	Oil	HEA	1.00	n/a	0.91	0.91	0.91	0.00	0.45
EA2b007	Furnace Replacement	Oil	Home Performance	0.99	n/a	1.00	1.00	1.00	0.00	0.45

In-Service Rates:

ES Products installations have a 100% in-service-rate unless an evaluation finds otherwise. In-service rates are 99% for Home Performance and are 100% for HEA based on evaluation results[2,4]

Realization Rates:

All PAs use a realization rate of 100% for Home Performance program and a realization rate of 91% for HEA program [2,4]. ES Products installations have a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

The summer coincidence factor for ancillary electric savings is 0.00 and winter coincidence factor is 0.45. [5]

Energy Load Shape:

See Appendix 1 “Furnace Fan”.

Revision History:

Revision Number	Issue Date	Description

34	1/14/2022	Corrected typo in EB1b007 delta kWh savings. Originally read 6.700, should instead match the propane savings.
123	12/1/2022	Updated Home Performance savings to reflect they are now calculated using Surveyor software. Added additional verbiage about the TREAT softwares used to calculate savings.

Endnotes:

1 : The 83% AFUE baseline is based on the New Hampshire Potential Study Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Volume III: Residential Market Baseline Study, June 11, 2020, p. 3-14. The 85% AFUE baseline represents value negotiated in MA for new boilers, which is applied to furnaces in this case.
2 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
3 : Guidehouse, Inc (2020). Massachusetts Comprehensive TRM Review - MA19R17-B-TRM. Prepared for the electric and gas program administrators of Massachusetts part of the residential evaluation program area.
4 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
5 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.25. HVAC Repair and Cleaning

Measure Code	RES-HVAC- RC
Markets	Residential
Program Types	New, Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Undertaking of cleaning, tuning and repairs to heating systems.

Baseline Efficiency:

Existing heating system operating unsafely or one that has not been cleaned in greater than one year.

High Efficiency:

The high efficiency case is a heating system cleaned or repaired within the last year.

Algorithms for Calculating Primary Energy Impact:

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

Savings are based on equipment tune-ups by adjusting the burner and cleaning the heat exchanger; therefore, the efficiency improves.

BC Measure ID	Measure Name	Program	ΔTherms/kWh
GB1b005	Gas HVAC Repair: Boiler - Condensing, Water	HEA	Calculated
GB1b006	Gas HVAC Repair: Boiler - Steam	HEA	Calculated

GB1b007	Gas HVAC Repair: Boiler -Water	HEA	Calculated
GB1b008	Gas HVAC Repair: Furnace - Condensing, Ducted	HEA	Calculated
GB1b009	Gas HVAC Repair: Furnace - Ducted	HEA	Calculated
EB1b025	Gas LP HVAC Repair or Cleaning	HEA	Calculated
EB1b024	Oil K1 HVAC Repair or Cleaning	HEA	Calculated
EB1b026	GSHP HVAC Repair or Cleaning	HEA	Calculated
EB1b027	ASHP HVAC Repair or Cleaning	HEA	Calculated

Where the software is unavailable, savings can be calculated using the following algorithms:

Gross Energy Savings, Fossil Fuel

$$ABTU_H = A \times HF \times (\frac{1}{AFUE_E}) \times ESF$$

$$ABTU_H = 2{,}000 \times 42600 \times \left(\frac{1}{.80}\right) \times 0.02 = 2{,}13{,}0000 Btu$$

Savings by heating fuel:

$$ACCF_H = \frac{2{,}1300000}{102{,}900} = 20.69 CCF$$

$$AOG_H = \frac{2{,}130000}{138{,}690} = 15.35 Gal$$

5Gal

$$APG_H = \frac{2,13,0000}{91,330} = 23.32Gal$$

Peak Day Savings Natural Gas

$PD_H = ACCF \times PDF_H$

$$PD_H = 2220.69\ ccf \times 0.00977 = 0.219\ ccf\ 202ccf$$

Where:

Symbol	Description	Units	Values
A	Heated area served by boiler or furnace[1]	ft2	2000 MF = 876
$ABTU_H$	Annual Btu savings - heating	Btu/yr	
ACCF	Annual natural gas savings	ccf/yr	
$ACCF_H$	Annual natural gas savings - heating	ccf/yr	
$AFUE_E$	Annual fuel utilization efficiency, existing[2]	%	For single family: 80% for unknown, 78% for natural gas, 76% for oil furnace For multifamily: boiler AFUE = 88%, furnace AFUE = 92%
HF	Average heating factor based on home's heat load[3]	Btu/ ft[5]	38,750 for furnaces 42,600 for boilers MF = 20,300
ESF	Energy savings factor[4]		0.02

Measure Life:

The measure life for a HVAC cleaning and repairs is 1 year.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

GB1b005	HVAC Repair: Boiler - Condensing, Water	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
GB1b006	HVAC Repair: Boiler - Steam	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
GB1b007	HVAC Repair: Boiler -Water	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
GB1b008	HVAC Repair: Furnace - Condensing, Ducted	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
GB1b009	HVAC Repair: Furnace - Ducted	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
EB1b025	Gas LP HVAC Repair or Cleaning	Gas	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
EB1b024	Oil K1 HVAC Repair or Cleaning	Oil	HEA	1.00	0.91	0.91	0.91	0.91	n/a	n/a
EB1b026	GSHP HVAC Repair or Cleaning	Electric	HEA	1.00	0.91	0.91	0.91	0.91		
EB1b027	ASHP HVAC Repair or Cleaning	Electric	HEA	1.00	0.91	0.91	0.91	0.91		

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All PAs use a realization rate of 96% for Home Performance for electric, 114% for oil, propane, and wood fuel types, 104% for gas fuel types and a realization rate of 91% for HEA.[5] [6]

Coincidence Factors:

Coincidence Factors are not applicable.

Energy Load Shape:

See Appendix 1 – "Central Heat Pump"

For cooling, see Appendix 1 – Mini-Split Air Conditioner/Heat Pump (Cooling)

For heating, see Appendix 1 – Mini-Split Heat Pump (Heating)

Revision History:

Revision Number	Issue Date	Description
30	1/14/2022	Omitted Measure Added
74	6/1/2022	Added omitted gas measures IDs to the TRM, updated electric measures to correspond with electric utility names.
118	12/1/2022	Included additional information on software used for the vendor calculated sav align with 2022 CT PSD.

Endnotes:

1: Default value selected based on recent data from Cadmus Group, "High Efficiency Heating Equipment Impact Evaluation Final Report", Mar. 2015. Massachusetts. This evaluation reported an average size of 2,000 sq. ft. for homes with boilers in Massachusetts. Default multifamily value selected based on recent data from Energy & Resource Solutions, "R1705 R1609 Multifamily Baseline and Weatherization Opportunity Study", Oct. 2019. Connecticut. https://www.energizect.com/sites/default/files/R1705-1609%20MF%20Baseline%20Weatherization%20Study_Final%20Report_10.10.19.pdf. . This evaluation reported an average size of 876 sq. ft for multifamily units
2 : The value of 80% and 78% is based on verified data from Cadmus Group, "High Efficiency Heating Equipment Impact Evaluation Final Report", Mar. 2015. Massachusetts., Table 4, and Multifamily defaults are based on data from Energy & Resource Solutions, "R1705 R1609 Multifamily Baseline and Weatherization Opportunity Study", Oct. 2019. Connecticut. https://www.energizect.com/sites/default/files/R1705-1609%20MF%20Baseline%20Weatherization%20Study_Final%20Report_10.10.19.pdf. , see Table 4-27. Defaults should be used except in situations where either actual nameplate ratings or actual efficiency test data are available.
3 : Default value selected based on recent data from Cadmus Group, "High Efficiency Heating Equipment Impact Evaluation Final Report", Mar. 2015. Massachusetts.. This evaluation reported increased heating loads for homes with boilers in Massachusetts, and the previous default assumption of 38,700 Btu/ft2 has correspondingly been increased by 20%. Default multifamily value calculated by scaling single-family Heating Factor and associated square footage by cited multifamily dwelling unit square footage fromEnergy & Resource Solutions, "R1705 R1609 Multifamily Baseline and Weatherization Opportunity Study", Oct. 2019. Connecticut. https://www.energizect.com/sites/default/files/R1705-1609%20MF%20Baseline%20Weatherization%20Study_Final%20Report_10.10.19.pdf.
4 : ESF 2% value was used compared to 5% used in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multifamily, and Commercial/Industrial Measures, Version 3, Issue Date – Jun. 1, 2015, p. 98.
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

6 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.26. Heat Recovery Ventilator

Measure Code	RES-HVAC-HRV
Markets	Residential
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Heat recovery ventilators (HRVs) can help make mechanical ventilation more cost effective by reclaiming energy from exhaust airflows.

Baseline Efficiency:

The baseline efficiency case is an ASHRAE 62.2-compliant exhaust fan system with no heat recovery.

High Efficiency:

The high efficiency case is an exhaust fan system with heat recovery.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[1]

BC Measure ID	Measure Name	Program	Δmmbtu
GA3b010	Heat Recovery Ventilator	ES Products	7.7

Measure Life:

The measure life is 20 years[1].

Other Resource Impacts:

An electric penalty results due to the electricity consumed by the system fans[1].

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh/Unit	ΔkW/Unit

GA3b010	Heat Recovery Ventilator	Electric	ES Products	-133	-0.10

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GA3b010	Heat Recovery Ventilator	ES Products	1.00	1.00	1.00	1.00	1.00	0.34	0.21

In-Service Rates:

All installations have a 100% in-service-rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Summer and winter coincidence factors are estimated using demand allocation methodology described by the Cadmus Demand Impact Model (2012) prepared for MA Program Administrators.

Energy Load Shape:

See Appendix 1.

Revision History:

Revision Number	Issue Date	Description
128	12/1/2022	Removed reference to ERVs and updated reference to Appdx 1 for Load Shapes

Endnotes:

1 : Guidehouse, August 2020. Comprehensive TRM Review MA19R17-B-TRM. Prepared for The Electric and Gas Program Administrators of Massachusetts.

1.27. Programmable Thermostat

Measure Code	RES-HVAC-PGM
Markets	Residential
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of a programmable thermostat, which gives the ability to adjust heating or air-conditioning operating times according to a pre-set schedule.

Baseline Efficiency:

The baseline efficiency case is an HVAC system without a programmable thermostat.

High Efficiency:

The high efficiency case is an HVAC system that has a programmable thermostat installed.

Algorithms for Calculating Primary Energy Impact:

Unit kwh are deemed based on the 2018 MA Residential HES Impact Evaluation .[1] Fossil fuel savings are based on the MA Residential Wi-Fi and Programmable Thermostat Impact Evaluation. [2] Demand savings are derived from the demand impact model which is developed as part of the Residential Baseline Study. [3] Thermostats that control both heating and central cooling may claim savings for both cooling (27.0 kWh/yr) and heating impacts (by fuel).

BC Measure ID	Measure Name	Energy Type	Program	ΔkWh	ΔkW	ΔMMbtu
EB1b009	Programmable Thermostat, Electric Heat	Electricity	HEA	251.0	0.19	n/a
EB1b010 GB1b003	Programmable Thermostat, Gas	NG - Res Heating	HEA	27		2.07
EB1b011	Programmable Thermostat, Kerosene	Kerosene	HEA	n/a		2.06

EB1b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	HEA	n/a		2.07
EB1b013	Programmable Thermostat, Propane	Propane	HEA	n/a		2.06
EB1b014	Programmable Thermostat, Wood Pellets	Pellet Wood	HEA	n/a		2.06
EA2b009	Programmable Thermostat, Electric	Electricity	Home Performance	251.0	0.19	n/a
EA2b010 GA2b003	Programmable Thermostat, Gas	NG - Res Heating	Home Performance	n/a		2.07
EA2b011	Programmable Thermostat, Kerosene	Kerosene	Home Performance	n/a		2.06
EA2b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	Home Performance	n/a		2.07
EA2b013	Programmable Thermostat, Propane	Propane	Home Performance	n/a		2.06
EA2b014	Programmable Thermostat, Wood Pellets	Pellet Wood	Home Performance	n/a		2.06
TBD	Programmable Thermostat, AC only	Electricity	HEA, ES Products, Home Performance	27.0	0.04	n/a
GA3b011	Programmable Thermostat, Gas	Gas	ES Products	27.0		2.07

Measure Life:

The measure life is 15 years.[4]

Other Resource Impacts:

No other resource impacts are included.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1b009	Programmable Thermostat, Electric	Electricity	HEA	1.00	0.91	0.00	0.91	0.91	0.00	1.00
EB1b010 GB1b003	Programmable Thermostat, Gas	NG - Res Heating	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1b011	Programmable Thermostat, Kerosene	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1b013	Programmable Thermostat, Propane	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1b014	Programmable Thermostat, Wood Pellets	Pellet Wood	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b009	Programmable Thermostat, Electric	Electricity	Home Performance	0.99	0.96	n/a	0.96	0.96	0.00	1.00
EA2b010	Programmable Thermostat, Gas	NG - Res Heating	Home Performance	0.99	n/a	1.04	n/a	n/a	n/a	n/a
EA2b011	Programmable Thermostat, Kerosene	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2b013	Programmable Thermostat, Propane	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a

EA2b014	Programmable Thermostat, Wood Pellets	Pellet Wood	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
TBD	Programmable Thermostat, AC only	Electricity	TBD	1.00	1.00	1.14	1.00	1.00	1.00	0.00

Programmable thermostats that control both cooling and heating equipment should claim both the 27 kWh of electric energy savings associated with the cooling equipment at the impact factors listed above and any heating savings.

In-Service Rates:

All HEA installations have a 100% in-service rate and all Home Performance installations have a 99% in-service rate based on evaluation results.[7] [8]

Realization Rates:

All HEA installations have a 100% in-service rate and all Home Performance installations have a 99% in-service rate based on evaluation results[5] [6].

Coincidence Factors:

Summer and winter coincidence factors are estimated using demand allocation methodology described the Navigant Demand Impact Model prepared for MA Program Administrators.[9]

Energy Load Shape:

See Appendix 1 “Weighted HVAC- All Homes” and "Central Air Conditioner/Heat Pump (Cooling)"

Revision History:

Revision Number	Issue Date	Description
38	1/14/2022	Corrected EA2b010 GA2b003 to reflect kWh savings.
39	1/14/2022	Corrected realization rate verbiage to reflect the correct data shown in the table.
101	12/1/2022	Added KW savings. Updated mmbtu savings reflect a more recent follow up study from MA. Added load shape for cooling.

Endnotes:

1 : Navigant Consulting, August 2018. Home Energy Services (HES) Impact Evaluation. https://ma-eeac.org/wp-content/uploads/RES34_HES-Impact-Evaluation-Report-with-ES_FINAL_29AUG2018.pdf
2 : Guidehouse Inc (2021) Residential Wi-Fi and Programmable Thermostat Impacts https://ma-eeac.org/wp-content/uploads/MARES24-Final-Report-2021-09-29.pdf
3 : Guidehouse Inc (2020) Massachusetts Residential Baseline Study https://ma-eeac.org/wp-content/uploads/RES-1-Residential-Baseline-Study-Ph4-Comprehensive-Report-2020-04-02.pdf
4 : Environmental Protection Agency, 2010. Life Cycle Cost Estimate for ENERGY STAR Programmable Thermostat.
7 : Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
8 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
7 : Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
8 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
9 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.28. Thermostat - Wi-Fi Communicating

Measure Code	RES-HVAC-CMG
Markets	Residential
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

A communicating Wi-Fi enabled thermostat which allows remote set point adjustment and control via remote application. System requires an outdoor air temperature algorithm in the control logic to operate heating and cooling systems.

Baseline Efficiency:

The baseline efficiency case is an HVAC system with either a manual or a programmable thermostat.

High Efficiency:

The high efficiency case is an HVAC system that has a Wi-Fi thermostat installed.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based primarily on impact evaluation results. [1]. ES Products savings are deemed based on statewide data on saturation of residential cooling equipment and heating fuel types. [2] For fuels that were not included in the impact evaluation (i.e. kerosene and wood pellets), unit savings are instead based on secondary research recommendations.[3]

Direct install thermostats that control both heating and cooling systems should claim savings using the Cooling measure in the last line of the table below in addition to the relevant heating savings measure line.

The utilities are not claiming any peak kW demand reductions until impact evaluation results are available, as savings are driven by runtime reductions rather than demand reductions.

BC Measure ID	Measure Name	Energy Type	Program	ΔkWh	ΔkW	ΔMMbtu
EB1b015 EA2b015	Wi-Fi Thermostat, Electric Heating	Electricity	HEA Home Performance	419.0	0	n/a

EB1b016 GB1b004 EA2b016 GA2b004	Wi-Fi Thermostat, Gas	NG - Res Heating	HEA Home Performance	46.0	n/a	5.80
EB1b017 EA2b017	Wi-Fi Thermostat, Kerosene	Kerosene	HEA Home Performance	n/a	n/a	3.10
EB1b018 EA2b018	Wi-Fi Thermostat, Oil	Fuel Oil - Residential Distillate	HEA Home Performance	n/a	n/a	5.90
EB1b019 EA2b019	Wi-Fi Thermostat, Propane	Propane	HEA Home Performance	n/a	n/a	5.80
EB1b020 EA2b020	Wi-Fi Thermostat, Wood Pellets	Pellet Wood	HEA Home Performance	n/a	n/a	3.10
EA3b026	Wi-Fi Thermostat (Heating & Cooling)	Fuel Blind	ES Products	46.00	n/a	4.92
GA3b019	Wi-Fi Thermostat (Heating Only)	NG - Res Heating	ES Products	n/a	n/a	5.80
GA3b020	Wi-Fi Thermostat (Heating & Cooling)	NG - Res Heating	ES Products	46.0	n/a	5.80

Measure Life:

The measure life is 15 years.[4]

Other Resource Impacts:

No other impacts are reported.

Impact Factors for Calculating Adjusted Gross Savings:

3. 2. 1.

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1b015	Wi-Fi Thermostat, Electric	Electricity	HEA	1.00	0.91	n/a	0.91	0.91	n/a	n/a
EA2b015	Wi-Fi Thermostat, Electric	Electricity	Home Performance	0.99	0.96	n/a	0.96	0.96	n/a	n/a
EB1b016 GB1b004	Wi-Fi Thermostat, Gas	NG - Res Heating	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b016 GA2b004	Wi-Fi Thermostat, Gas	NG - Res Heating	Home Performance	0.99	n/a	1.04	n/a	n/a	n/a	n/a
EB1b017	Wi-Fi Thermostat, Kerosene	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b017	Wi-Fi Thermostat, Kerosene	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EB1b018	Wi-Fi Thermostat, Oil	Fuel Oil - Residential Distillate	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b018	Wi-Fi Thermostat, Oil	Fuel Oil - Residential Distillate	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EB1b019	Wi-Fi Thermostat, Propane	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b019	Wi-Fi Thermostat, Propane	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EB1b020	Wi-Fi Thermostat, Wood Pellets	Pellet Wood	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2b020	Wi-Fi Thermostat, Wood Pellets	Pellet Wood	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a

EA3b026 GA3b019 GA3b020	Wi-Fi Thermostat (Heating Only; Cooling Only; Heating & Cooling)	NG- Res Heating; Fuel Blind	ES Products	1.00	1.00	1.04	n/a	n/a	n/a	n/a

In-Service Rates:

All HEA installations have a 100% in-service-rate and all Home Performance installations have a 99% in-service rate based on evaluation results.[5] [6] All ES Products installations use a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All HEA installations have a 91% realization rate and all Home Performance installations have a 100% realization rate based on evaluation results.[5, 6] All ES Products installations use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

The utilities are not claiming any peak kW demand reductions until impact evaluation results are available, as savings are driven by runtime reductions rather than demand reductions.

Energy Load Shape:

See Appendix 1 "Weighted HVAC- All Homes"

Endnotes:

2 : WiFi tStat WorkSheet 2021
3 : Navigant Consulting, September 2018. Wi-Fi Thermostat Impact Evaluation--Secondary Research Study Memo. http://ma-eeac.org/wordpress/wp-content/uploads/Wi-Fi-Thermostat-Impact-Evaluation-Secondary-Literature-Study_FINAL.pdf
4 : Environmental Protection Agency, 2010. Life Cycle Cost Estimate for ENERGY STAR Programmable Thermostat. Assumed to have the same lifetime as a regular programmable thermostat
5 : Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
6 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

1.29. Faucet Aerator

Measure Code	RES-HW-FA
Markets	Residential
Program Types	Retrofit
Categories	Hot Water

Measure Description:

Installation of aerators meeting the EPA WaterSense specification to replace Federal Standard or higher flow faucet aerators.

Baseline Efficiency:

The baseline efficiency case is the existing faucet aerators with Federal Standard[1] flow rate of 2.2 gallons per minute (GPM) or higher.

High Efficiency:

The high efficiency case is a low flow faucet aerator with EPA WaterSense[2] specified maximum flow rate of 1.5 GPM.

Algorithms for Calculating Primary Energy Impact:

The programs use vendor calculated energy savings for measures in the Residential Home Performance and Home Energy Assistance programs.

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

These savings values are calculated using vendor proprietary software where the user inputs a minimum set of technical data about the house and the software calculates domestic hot water loads and other key parameters. Should the vendor software be unavailable or unable to estimate a home's energy savings from faucet aerators, the following deemed savings should be used, based on evaluation results.[3] [4]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW[4]	ΔMMBtu
EB1a009	Faucet Aerator	Electric	HEA	46.863	0.011	
EB1a010 GB1a002	Faucet Aerator	Gas	HEA			0.156
EB1a011	Faucet Aerator	Kerosene	HEA			0.156
EB1a012	Faucet Aerator	Oil	HEA			0.156
EB1a013	Faucet Aerator	Propane	HEA			0.156
EA2a009	Faucet Aerator	Electric	Home Performance	46.863	0.011	
EA2a010 GA2a002	Faucet Aerator	Gas	Home Performance			0.156
EA2a011	Faucet Aerator	Kerosene	Home Performance			0.156
EA2a012	Faucet Aerator	Oil	Home Performance			0.156
EA2a013	Faucet Aerator	Propane	Home Performance			0.156

Measure Life:

The measure life is 7 years.[5]

Other Resource Impacts:

Residential annual water savings for faucet aerators is 586 gallons per unit.[3]

Impact Factors for Calculating Adjusted Gross Savings:

3, 6

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a009	Faucet Aerator	Electric	HEA	1	0.91	n/a	0.91	0.91	0.31	0.81
EB1a010 GB1a002	Faucet Aerator	Gas	HEA	1	n/a	0.91	n/a	n/a	n/a	n/a
EB1a011	Faucet Aerator	Kerosene	HEA	1	n/a	0.91	n/a	n/a	n/a	n/a
EB1a012	Faucet Aerator	Oil	HEA	1	n/a	0.91	n/a	n/a	n/a	n/a
EB1a013	Faucet Aerator	Propane	HEA	1	n/a	0.91	n/a	n/a	n/a	n/a
EA2a009	Faucet Aerator	Electric	Home Performance	0.99	0.96	n/a	0.96	0.96	0.31	0.81
EA2a010 GA2a002	Faucet Aerator	Gas	Home Performance	0.99	n/a	1.04	n/a	n/a	n/a	n/a
EA2a011	Faucet Aerator	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a012	Faucet Aerator	Oil	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a013	Faucet Aerator	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a

In-Service Rates:

In-service rates are 99% for Home Performance programs and are 100% HEA programs based on evaluation [6] [7]

results.[3, 6]Realization Rates:

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%..[8] [9]

Coincidence Factors:

A summer coincidence factor of 31% and a winter coincidence factor of 81% are utilized for faucet aerators with electric fuel type.[10]

Energy Load Shape:

See Appendix 1 "Water Heater – Electric"[4]

Revision History:

Revision Number	Date	Revision
119	12/1/2022	Included additional information on software used for the vendor ca table.

Endnotes:

1 : In 1998, the Department of Energy adopted a maximum flow rate standard of 2.2 gpm at 60 psi for all faucets: 63 Federal Register 13307; March 18, 1998. https://www.epa.gov/sites/production/files/2017-02/documents/ws-specification-home-final-suppstatement-v1.0.pdf
2: WaterSense: Bathroom Faucets. https://www.epa.gov/watersense/bathroom-faucets
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
4: Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
5: Faucet aerator is an add on measure. Measure life assumes 1/3 the life of the host equipment (faucet).
6: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
7: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
8: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
9: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
10: Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdfn 1998, the Department of Energy adopted a maximum flow rate standard of 2.2 gpm at 60 psi for all faucets: 63 Federal Register 13307; March 18, 1998. https://www.epa.gov/sites/production/files/2017-02/documents/ws-specification-home-final-suppstatement-v1.0.pdf

1.30. Heat Pump Water Heater

Measure Code	RES-HW-HPWH
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Hot Water

Measure Description:

Installation of an Energy Star ® certified heat pump storage water heater, either through direct installation programs to replace an electric resistance storage water heater, or as a lost opportunity retail offering.

Baseline Efficiency:

The direct install baseline efficiency case is a standard efficiency electric resistance storage hot water heater. The lost opportunity baseline is a blended mix of electric and fossil fuel water heating based on study results, used for retail offerings where customer-specific baselines are unknown. [1]

High Efficiency:

The high efficiency case is a high efficiency Energy Star ® certified heat pump storage water heater.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[2]

BC Measure ID	Measure Name	Program	ΔkWh	Summer kW	Winter kW	ΔMMBtu
EB1a043 EA3b008 EA3b035	Heat Pump Water Heater, 55 gallons or less, Energy Star, UEF	HEA, Home Performance, ES Products	961	0.175	0.134	2.149
EA3b008	Heat Pump Water Heater, greater than 55 gallons, Energy Star, UEF	ES Products	565	0.04	0.035	2.149

Measure Life:

The measure life is 15 years.[3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a043	Heat Pump Water Heater	HEA	1.00	0.91	n/a	0.91	0.91	0.41	0.74
EA2a043	Heat Pump Water Heater	Home Performance	0.99	0.96	n/a	0.96	0.96	0.41	0.74
EA3b007 EA30b035	Heat Pump Water Heater, <55 gallons	ES Products	1.00	1.00	n/a	1.00	1.00	0.41	0.74
EA3b008 EA30b036	Heat Pump Water Heater, > 55 gallons	ES Products	1.00	1.00	n/a	1.00	1.00	0.41	0.74

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA, and 99% for Home Performance [4] [5]

Realization Rates:

All PAs use a realization rate of 96% for Home Performance program and a realization rate of 91% for HEA program.The ES Homes and ES Products programs use a 100% realization rate unless an evaluation finds otherwise.[7] [8]

Coincidence Factors:

Coincidence factors are based on the Demand Impact Model which is developed based on the Residential Baseline Study. [8]

Energy Load Shape:

See Appendix 1 – “Water Heater – Heat Pump”.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

For HPWH delivered through midstream channels, the following factors apply. [9]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EA3b007	Heat Pump Water Heater, 55 gallons or less, Energy Star, UEF	ES Products	0.23	0.00	0.00	0.77
EA3b008	Heat Pump Water Heater, greater than 55 gallons, Energy Star, UEF	ES Products	0.23	0.00	0.00	0.77

Revision History:

Revision Number	Issue Date	Description
21	1/14/2022	Measure names of the residential ES products heat pump water heater offerings updated to match implementation's naming conventions.
22	1/14/2022	Added BC Measure IDs to encompass all measures in BC model.
92	12/1/2022	Updated measure savings to reflect a lost opportunity offering, as this most closely reflects the currently offerings.
93	12/1/2022	Updated measure life based on latest measure life study from CT.

Endnotes:

1 : R1614/R1613 CT HVAC and Water Heater Process and Impact Evaluation, West Hill Energy and Computing, EMI Consulting & Lexicon Energy Consulting, Jul. 19, 2018. pp. 8.6-8.8. https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports; also see 2020 CT Program Savings Document, chapter 4.5.4 for savings for 80-gallon water heaters.
2 : R1614/R1613 CT HVAC and Water Heater Process and Impact Evaluation, West Hill Energy and Computing, EMI Consulting & Lexicon Energy Consulting, Jul. 19, 2018. pp. 8.6-8.8. https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports; also see 2020 CT Program Savings Document, chapter 4.5.4 for savings for 80-gallon water heaters.
3 : Michaels Energy (2022) x2001A CT Measure Life/EUL Update Study- Residential Measures CT X2001A EUL Res Measure Report FINAL060522
4: Opinion Dynamics (2020) Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
5 : Opinion Dynamics (2020) Home Energy Assistance Program Evaluation Report 2016-2017 - FINAL

https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
6 : Opinion Dynamics (2020) Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
7 : Opinion Dynamics (2020) Home Energy Assistance Program Evaluation Report 2016-2017 - FINAL
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
8 : Guidehouse Inc (2020) Residential Baseline Study Phase 4 https://ma-eeac.org/wp-content/uploads/RES-1-Residential-Baseline-Study-Ph4-Comprehensive-Report-2020-04-02.pdf
9 : Michael's Energy, June 26, 2020. Efficiency Maine HPWH Free-ridership and Baseline Assessment Results Memo. https://www.efficiencymaine.com/docs/Heat-Pump-Water-Heater-Free-ridership-and-Baseline-Assessment.pdf

1.31. Pipe Insulation

Measure Code	RES-HW-PI
Markets	Residential
Program Types	Retrofit
Categories	Hot Water

Measure Description:

Installation of insulation on domestic hot water pipes.

Baseline Efficiency:

The baseline efficiency case is the existing uninsulated domestic hot water piping system located in non-conditioned spaces.

High Efficiency:

The high efficiency case is the domestic hot water piping system in unconditioned spaces with insulation installed.

Algorithms for Calculating Primary Energy Impact:

The programs use vendor calculated energy savings for these measures in the Residential Home Performance and Home Energy Assistance programs. These savings values are calculated using vendor proprietary software where the user inputs a minimum set of technical data about the house and the software calculates domestic hot water loads and other key parameters.The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

Should the vendor software be unavailable or unable to estimate a home’s energy savings from pipe insulation, the following savings algorithm should be used. The calculations are borrowed from the 2022 Connecticut Program Savings Document. T The savings values are per foot of hot pipe coming from the water heater in unconditioned space and are based on the outputs of NAIMA, 3E Plus software tool, based on the3E Plus Inputs for DHW. , also recommended in the 2011 Nexant, Home Energy Solutions Evaluation: Final Report.[1] The savings should be limited to the first 6 linear feet of installed pipe insulation per water heater.[2]

Nomenclature

Symbol	Description	Units	Values
$ACCF_H$	Annual natural gas savings per linear foot, heating	ccf/ft	
$ACCF_W$	Annual natural gas savings per linear foot, DHW	ccf/ft	
AKW_H	Annual kWh energy savings coefficient, heating	kWh/ft	
AKW_W	Annual kWh energy savings coefficient, DHW	kWh/ft	
$AKWH_H$	Annual energy savings, heating	kWh	Calculated
$AKWH_W$	Annual energy savings, DHW	kWh	Calculated
AOG_H	Annual oil savings, heating	Gal/ft	
AOG_W	Annual oil savings, DHW	Gal/ft	
AOG_H	Annual propane savings, heating	Gal/ft	
APG_W	Annual propane savings, DHW	Gal/ft	
PD_W	Peak day savings, DHW		
PDF_H	Peak day factor, heating		0.00977
PDF_W	Peak day factor, DHW		0.00321
PF_S	Summer seasonal peak factor	W/kWh	0.1147[3]
PF_W	Winter seasonal peak factor	W/kWh	0.1747[4]
SKW_H	Summer seasonal peak demand savings, heating	kW	
SKW_W	Summer seasonal Peak demand savings, DHW	kW	
WKW_H	Winter seasonal peak demand savings, heating	kW	
WKW_W	Winter seasonal peak demand savings, DHW	kW	

Retrofit Gross Energy Savings, Electric

Annual Electrical Savings per Linear Foot of Domestic Hot Water Pipe Insulation

Pipe Diameter (inches)	AKWW (kWh/ft)
0.50	12.1
0.75	18.1

Annual electric DHW savings can be calculated using the formula below, and using the values for AKWW from Table 4-FFFFF:

$AKWH_w = AKW_w \times L$

Annual Electrical Savings per Linear Foot of Heating Pipe Insulation:

Pipe Diameter (inches)	AKWH (kWh/ft)
0.75	12.9
1.00	16.0
1.25	19.6
1.50	22.2
2.00	57.74

Annual electric heating savings can be calculated using the formula below,

$AKW_H = AKW_H \times L$

Retrofit Gross Energy Savings, Fossil Fuel

Annual Fossil Fuel Savings per Linear Foot of Domestic Hot Water Pipe Insulation

Pipe Diameter (inches)	ACCFW (Ccf/ft)	AOGW (Gallons/ft)	APGW (Gallons/ft)
0.50	0.55	0.40	0.60
0.75	0.81	0.58	0.88

Annual natural gas DHW savings can be calculated using the formula below :

$ACCF = ACCF_W \times L$

Annual oil DHW savings can be calculated using the formula below :
$AOG = AOG_W \times L$

Annual propane DHW savings can be calculated using the formula below :
$APG = APG_W \times L$

Annual Fossil Fuel Savings per Linear Foot of Heating Pipe Insulation

Pipe Diameter (inches)	ACCFH (Ccf/ft)	AOGH (Gallons/ft)	APGH (Gallons/ft)
0.75	0.5	0.4	0.6
1.00	0.6	0.5	0.7

1.25	0.8	0.6	0.9
1.50	0.9	0.7	1.0
2.00	1.91	1.42	2.16

Annual natural gas heating savings can be calculated using the formula below
$ACCF = ACCF_H \times L$

Annual oil heating savings can be calculated using the formula below
$AOG = AOG_H \times L$

Annual propane DHW savings can be calculated using the formula below
$APG = APG_H \times L$

Retrofit Gross Seasonal Peak Demand Savings, Electric (winter and summer)
For DHW, the summer seasonal peak demand savings is:
$SKW_w = (AKWH \text{ X } PF_s)/1000$

For DHW, the winter seasonal peak demand savings is:
$WKW_w = (AKWH \text{ X } PF_s)/1000$

For heating, summer seasonal peak demand:
$SKW_H = 0$
$WKW_w = (AKWH \text{ X } 0.57)/1000$

Retrofit Gross Peak Day Savings, Natural Gas
For DHW:
$PD_w = ACCF \times PDF_w$

For heating:
$PD_H = ACCF \text{ X } PDF_H$

Measure Life:

The measure life is 15 years.[5]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

[6] [7]

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a037	Pipe Insulation	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.31	0.81
EB1a038 GB1a011	Pipe Insulation	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a039	Pipe Insulation	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a040	Pipe Insulation	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a041	Pipe Insulation	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2a037	Pipe Insulation	Electric	Home Performance	0.99	0.96	n/a	0.96	0.96	0.31	0.81
EA2a038 GA2a011	Pipe Insulation	Gas	Home Performance	0.99	n/a	1.04	n/a	n/a	n/a	n/a
EA2a039	Pipe Insulation	Kerosene	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a040	Pipe Insulation	Oil	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a041	Pipe Insulation	Propane	Home Performance	0.99	n/a	1.14	n/a	n/a	n/a	n/a

<u>In-Service Rates:</u>

In-service rates are 99% for Home Performance programs and are 100% for HEA programs based on evaluation

results. [8] [9]

<u>Realization Rates:</u>

Realization rate for Home Performance programs are 96% for electric, 104% for gas and 114% for delivered fuels. Realization rates for HEA are 91%.[10] [11]

<u>Coincidence Factors:</u>

A summer coincidence factor of 31% and a winter coincidence factor of 81% are utilized for pipe insulation with electric fuel type.[12]

Energy Load Shape:

See Appendix 1 – "Water Heater - Electric"

Revision History:

Revision Number	Date	Description
136	12/1/2022	Updated RR verbiage to align with table values for Home Performance. Updated back up calculations to align with 2022 CT PSD.

Endnotes:

1 : Nexant, Home Energy Solutions Evaluation: Final Report, submitted to Connecticut Energy Efficiency Board, Mar. 2011.
2: Cadmus, Draft Impact Evaluation: Home Energy Services—Income-Eligible and Home Energy Services Programs: Volume 2 (R16), Jun. 2, 2014.
3: KEMA, Evaluation of the Weatherization Residential Assistance Partnership (WRAP) and Helps Programs, Final Report, Sep. 10, 2010.
4: KEMA, Evaluation of the Weatherization Residential Assistance Partnership (WRAP) and Helps Programs, Final Report, Sep. 10, 2010.
5: Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf https://energy.mo.gov/sites/energy/files/measure-life-report-2007.pdf
6: Nexant, Home Energy Solutions Evaluation: Final Report, submitted to Connecticut Energy Efficiency Board, Mar. 2011.
7: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
8: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf
9: Opinion Dynamics (2020) Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
10: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf

11: Opinion Dynamics (2020) Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
12: Cadmus, Draft Impact Evaluation: Home Energy Services—Income-Eligible and Home Energy Services Programs: Volume 2 (R16), Jun. 2, 2014.

1.32. Setback

Measure Code	RES-HW-SB
Markets	Residential
Program Types	Retrofit
Categories	Hot Water

Measure Description:

Manual setback of the thermostat on a water heating device to reduce energy consumption.

Baseline Efficiency:

The baseline efficiency case is a water heater with a standard water temperature of 140°F.

High Efficiency:

The high efficiency case is a water heater with an adjusted water temperature of 125°F.

Algorithms for Calculating Primary Energy Impact:

The programs use vendor calculated energy savings for measures in the Residential Home Performance and Home Energy Assistance programs. The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

These savings values are calculated using TREAT or Surveyor software, where the user inputs a minimum set of technical data about the house and the software calculates domestic hot water loads and other key parameters. Should the vendor software be unavailable or unable to estimate a home's energy savings from hot water setback, the following deemed savings should be used, based on evaluation results.[1] Note: Savings are due to reduced standby losses, which are assumed to be constant over the year, so $\Delta kW = \Delta kWh / 8760$ hours.

BC Measure ID	Measure Name	Program	Fuel Type	ΔkWh/unit	ΔkW	ΔMMBtu/unit

	Hot Water Setback (both dishwasher and clothes washer configuration)	Home Performance HEA	Electricity	51.0	0.006	n/a
EB1a042 EA2a042	Hot Water Setback (clothes washer only)	Home Performance HEA	Electricity	78.6	0.009	n/a
EA2a062 EB1a063	Hot Water Setback (clothes washer only)	Home Performance HEA	Propane	n/a	n/a	0.411
EA2a059 EB1a060 GB1a019 GA2a019	Hot Water Setback (clothes washer only)	Home Performance HEA	Gas	n/a	n/a	0.411
EB1a062 EA2a061	Hot Water Setback (clothes washer only)	Home Performance HEA	Oil	n/a	n/a	0.411
EB1a061 EA2a060	Hot Water Setback (clothes washer only)	Home Performance HEA	Kerosene	n/a	n/a	0.411

Measure Life:

The measure life of hot water setbacks for existing units and new equipment is two years. [2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

1

BC Measure ID	Measure Name	Program	Fuel	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a042	Hot Water Setback, Electric	HEA	Electric	1.00	0.91	n/a	0.91	0.91	1.00	1.00
EB1a063	Hot Water Setback, Propane	HEA	Propane	1.00	n/a	0.91	n/a	n/a	n/a	n/a

EB1a062	Hot Water Setback, Oil	HEA	Oil	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a060	Hot Water Setback, Gas	HEA	Gas	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EB1a061	Hot Water Setback, Kerosene	HEA	Kerosene	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2a042	Hot Water Setback, Electric	Home Performance	Electric	0.99	0.96	n/a	0.96	0.96	1.00	1.00
EA2a062	Hot Water Setback, Propane	Home Performance	Propane	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a061	Hot Water Setback, Oil	Home Performance	Oil	0.99	n/a	1.14	n/a	n/a	n/a	n/a
EA2a059	Hot Water Setback, Gas	Home Performance	Gas	0.99	n/a	1.04	n/a	n/a	n/a	n/a
EA2a060	Hot Water Setback, Kerosene	Home Performance	Kerosene	0.99	n/a	1.14	n/a	n/a	n/a	n/a

In-Service Rates:

In-service rates are 99% for Home Performance programs and are 100% for HEA programs based on evaluation

results.1[, 4]

Realization Rates:

All PAs use a realization rate of 96% for the Home Performance program for electric, 114% for oil propane and wood fuel types, 104% for gas fuel types, and a realization rate of 91% for the HEA program.[1, 4]

Coincidence Factors:

Coincidence factors for electric hot water are assumed to be 100% because savings are from reduced standby losses, which are assumed to be constant over the year.

Energy Load Shape:

See Appendix 1 – "24 Hour Operation"[4]

Revision History:

Revision Number	Issue Date	Description
23	1/14/2022	Added BC MEASURE ID's and HEA and Home Performance measures for the Kerosene fuel type.
121	12/1/2022	Included additional information on software used for the vendor calculated savings and a

Endnotes:

1 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
2 : Illinois TRM Version 9.0, measure 5.4.6 water heater temperature setback.
3 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
4 : Savings are from reduced standby losses, which are assumed to be constant over the year.

1.33. Showerhead

Measure Code	RES-HW-SH
Markets	Residential
Program Types	Retrofit
Categories	Hot Water

Measure Description:

An existing shower head with high flow rate is replaced with a new low flow shower head.

Baseline Efficiency:

The baseline efficiency case is the existing showerhead with a baseline flow rate of 2.5 gallons per minute (GPM).

High Efficiency:

The high efficiency case is a low flow shower head having a maximum flow rate of 2.0 GPM or less.

Algorithms for Calculating Primary Energy Impact:

The programs use vendor calculated energy savings for measures in the Residential Home Performance and Home Energy Assistance programs.

The Home Energy Assistance program uses the Targeted Retrofit Energy Analysis Tool (TREAT) Energy Audit Software to model energy savings specific to each installation. TREAT is nationally certified by the Department of Energy for use in Weatherization Assistance Projects for all building classes. It is the only modeling software vendors may use to calculate HEA savings for New Hampshire Saves. TREAT models building energy usage and predicts the impact of improvements to various components on building energy consumption based on user inputs of spaces, walls, surfaces, heating and cooling data. The Home Performace with Energy Star Savings program uses the Surveyor software to calculate energy savings. Surveyor is an energy modeling and data collection software designed by PSD that runs on the TREAT software. Surveyor is the only modeling software vendors may use to calculate Home Performance savings for New Hampshire Saves. Please see https://psdconsulting.com/ for more information.

These savings values are calculated using TREAT and Surveyor software, where the user inputs a minimum set of technical data about the house and the software calculates domestic hot water loads and other key parameters. Should the vendor software be unavailable or unable to estimate a home's energy savings from low flow showerheads, the following deemed savings should be used, based on evaluation results.[1] kW savings are calculated using the demand impact model.[2]

BC Measure ID	Measure Name	Hot Water Fuel	Program	ΔkWh	ΔkW	ΔMMBtu

		Type				
EB1a016	Handheld Showerhead	Electric	HEA	145.226	0.050	
EB1a017 GB1a003	Handheld Showerhead	Gas	HEA			0.633
EB1a018	Handheld Showerhead	Kerosene	HEA			0.633
EB1a019	Handheld Showerhead	Oil	HEA			0.633
EB1a020	Handheld Showerhead	Propane	HEA			0.633
EA2a016	Handheld Showerhead	Electric	Home Performance	145.226	0.050	
EA2a017 GA2a003	Handheld Showerhead	Gas	Home Performance			0.633
EA2a018	Handheld Showerhead	Kerosene	Home Performance			0.633
EA2a019	Handheld Showerhead	Oil	Home Performance			0.633
EA2a020	Handheld Showerhead	Propane	Home Performance			0.633
EB1a030	Low flow Showerhead	Electric	HEA	145.226	0.050	
EB1a031 GB1a010	Low flow Showerhead	Gas	HEA			0.633
EB1a032	Low flow Showerhead	Kerosene	HEA			0.633
EB1a033	Low flow Showerhead	Oil	HEA			0.633
EB1a034	Low flow Showerhead	Propane	HEA			0.633
EA2a030	Low flow Showerhead	Electric	Home Performance	145.226	0.050	
EA2a031 GA2a010	Low flow Showerhead	Gas	Home Performance			0.633
EA2a032	Low flow Showerhead	Kerosene	Home Performance			0.633
EA2a033	Low flow Showerhead	Oil	Home Performance			0.633
EA2a034	Low flow Showerhead	Propane	Home Performance			0.633

Measure Life:

The measure life is 15 years.[3]

Other Resource Impacts:

Annual water savings are 1,246 gallons per unit.[1]

Impact Factors for Calculating Adjusted Gross Savings:

[1] [4]

BC Measure ID	Measure Name	Hot Water Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EB1a016	Handheld showerhead	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.31	0.81
EB1a017 GB1a003 EB1a018 EB1a019 EB1a020	Handheld showerhead	Gas Kerosene Oil Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2a016	Handheld showerhead	Electric	Home Performance	0.99	1.00	n/a	1.00	1.00	0.31	0.81
EA2a017 GA2a003 EA2a018 EA2a019 EA2a020	Handheld showerhead	Gas Kerosene Oil Propane	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a
EB1a030	Low flow Showerhead	Electric	HEA	1.00	0.91	n/a	0.91	0.91	0.31	0.81
EB1a031 GB1a010 EB1a032 EB1a033 EB1a034	Low flow Showerhead	Gas Kerosene Oil Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
EA2a030	Low flow Showerhead	Electric	Home Performance	0.99	1.00	n/a	1.00	1.00	0.31	0.81
EA2a031 GA2a010 EA2a032 EA2a033 EA2a034	Low flow Showerhead	Gas Kerosene Oil Propane	Home Performance	0.99	n/a	1.00	n/a	n/a	n/a	n/a

<u>In-Service Rates:</u>

In-service rates are 99% for Home Performance and are 100% for HEA based on evaluation results.[1, 4]

Realization Rates:

All PAs use a realization rate of 96% for Home Performance and a realization rate of 91% for HEA.[1 4]

Coincidence Factors:

A summer coincidence factor of 31% and a winter coincidence factor of 81% are utilized.[2]

Energy Load Shape:

See Appendix 1 "Water Heater – Electric".

Revision History:

Revision Number	Issue Date	Description
24	1/14/2022	Added missing BC measures IDs to the algorithms for primary energy impact tables.
25	1/14/2022	Updated typos in footnote numbering.
120	12/1/2022	Included additional information on software used for the vendor calculated savings. Add verbiage to align with table for Home Performance values.

Endnotes:

1 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. kWh were estimated using the input values and methodology described in 'Table C-7. Algorithms and Inputs for Efficient Showerheads'.
2 : Navigant Consulting,2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
3 : Guidehouse, inc (2020). Massachusetts Comprehensive TRM Review - MA19R17-B-TRM. Prepared for the electric and gas program administrators of Massachusetts part of the residential evaluation program area.
4 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.34. Water Heater

Measure Code	RES-HW-WH
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Hot Water

Measure Description:

Installation of a new high-efficiency natural gas tankless and storage water heaters.

Baseline Efficiency:

For indirect water heaters, the baseline efficiency case is the existing indirect water heater with EF of 0.6.[1]

For water heaters integrated with condensing boiler, the baseline efficiency case is an 85% AFUE rated boiler (79.3% AFUE actual) with a 0.6 EF water heater.[1] The ER baseline is an 80% AFUE rated boiler (77.4% AFUE actual) with either an indirect water heater or with a 0.55 EF water heater.

For tankless water heaters, the baseline efficiency case is a stand-alone tank water heater with a UEF of 0.63. For the early retirement portion, the baseline efficiency is an existing 0.58 UEF standalone water heater.

For standalone storage tank water heater, the baseline efficiency case is a stand-alone tank water heater with a UEF of 0.63. For the early retirement portion, the baseline efficiency is an existing 0.58 UEF standalone water heater.

High Efficiency:

The high efficiency case for indirect water heaters is an indirect water heater attached to an ENERGY STAR® rated forced hot water boiler.

For water heaters integrated with condensing boilers, the high efficiency case is an integrated water heater/boiler unit with a 90% AFUE condensing boiler and a 0.9 EF water heater or a 95% AFUE condensing boiler and a 0.95 EF water heater.

For tankless water heaters, the high efficiency case is a tankless water heater with UEF of 0.94.

For standalone storage tank water heater, the baseline efficiency case is a stand-alone water heater with EF $\geq$ 0.66.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[2] [3] Savings have been adjusted to reflect the mix of replace and failure and early retirement based on study results. There is an electric penalty associated with the gas on-demand tankless water heater to account for additional electrical consumption for power venting and electronic pilot ignition.

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
GA3b012	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82)	Gas	ES Products			4.0
GA3b013	Water Heater - Integrated with Condensing Boiler >= 90% AFUE	Gas	ES Products			8.4
GA3b014	Water Heater - Integrated with Condensing Boiler >= 95% AFUE	Gas	ES Products			12.8
GA3b015	Condensing Water Heater (EF 0.95)	Gas	ES Products	-43.0[8]	-0.010[8]	7.0
GA3b016	Stand Alone Storage Tank Water Heater (EF 0.67)	Gas	ES Products	-43.0[8]	-0.010[8]	3.0
GA3b018	Water Heater - Tankless, On-Demand UEF >=. 87	Gas	ES Products	-43.0[8]	-0.010[8]	7.3
EB1a096	Stand Alone Storage Water Heater	Electric	HEA			
EB1a097	Stand Alone Storage Water Heater	Gas	HEA	-43.0[8]	-0.01[8]	2.5
EB1a099	Stand Alone Storage Water Heater	Propane	HEA			
EB1a098	Indirect Water Heater	Oil	HEA			4.7[3]

EA2a082	Indirect Water Heater	Oil	Home Performance			4.7[3]
EA2a083	Indirect Water Heater	Propane	Home Performance			4.0[3]

Measure Life:

The table shows the measure life for each measure.[4] [5] [6] [7]

BC Measure ID	Measure Name	Fuel Type	Program	Measure Life
GA3b012	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82) (Retrofit)	Gas	ES Products	20
GA3b013	Water Heater - Integrated with Condensing Boiler >= 90% AFUE (Retrofit)	Gas	ES Products	19
GA3b014	Water Heater - Integrated with Condensing Boiler >= 95% AFUE (Retrofit)	Gas	ES Products	19
GA3b015	Condensing Water Heater (EF 0.95)	Gas	ES Products	15
GA3b016	Stand Alone Storage Tank Water Heater (EF 0.67)	Gas	ES Products	10
GA3b018	Water Heater - Tankless, On-Demand >=.87	Gas	ES Products	19
EB1a096	Stand Alone Storage Water Heater	Electric	HEA	13
EB1a097	Stand Alone Storage Water Heater	Gas	HEA	13
EB1a099	Stand Alone Storage Water Heater	Propane	HEA	13
EB1a098	Indirect Water Heater	Oil	HEA	13
EA2a082	Indirect Water Heater	Oil	Home Performance	13
EA2a083	Indirect Water Heater	Propane	Home Performance	13

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GA3b012	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82) (Retrofit)		ES Products	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GA3b013	Water Heater - Integrated with Condensing Boiler >= 90% AFUE (Retrofit)		ES Products	1.00	n/a	n/a	n/a	n/a	n/a	n/a
GA3b014	Water Heater - Integrated with Condensing Boiler >= 95% AFUE (Retrofit)		ES Products	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GA3b015	Condensing Water Heater (EF 0.95)		ES Products	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GA3b016	Stand Alone Storage Tank Water Heater (EF 0.67)		ES Products	1.00	1.00	1.00	n/a	n/a	0.21	0.40
GA3b018	Water Heater - Tankless, On-Demand >=.94 (New Construction)		ES Products	1.00	1.00	1.00	n/a	n/a	0.21	0.40

EB1a096	Stand Alone Storage Water Heater	Electric	HEA	1.00	.91	n/a	n/a	n/a	0.21	0.40
EB1a097	Stand Alone Storage Water Heater	Gas	HEA	1.00	n/a	.91	n/a	n/a	n/a	n/a
EB1a099	Stand Alone Storage Water Heater	Propane	HEA	1.00	n/a	.91	n/a	n/a	n/a	n/a
EB1a098	Indirect Water Heater	Oil	HEA	1.00	n/a	.91	n/a	n/a	n/a	n/a
EA2a082	Indirect Water Heater	Oil	Home Performance	1.00	n/a	.91	n/a	n/a	n/a	n/a
EA2a083	Indirect Water Heater	Propane	Home Performance	1.00	n/a	.91	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service-rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A summer coincidence factor of 21% and a winter coincidence factor of 40% are claimed for tankless and stand-alone storage water heaters.[8]

Energy Load Shape:

See Appendix 1 – "Water Heater - Natural Gas/Fuel Oil"

Revision History:

Revision Number	Issue Date	Description
26	1/14/2022	Fixed broken link in reference #3 for Navigant (2018). Home Energy Service Impact Evaluation. Prepared for program administrators in Massachusetts.

27	1/14/2022	Added entries for non-gas water heaters which had been omitted from the TRM. New entries include BC MEASURE ID's EB1a096, EB1a097, EB1a099, EB1a098, EA2a082, EA2a083

Endnotes:

1 : The 85% AFUE baseline represents value negotiated in MA for new boilers, which is applied to water heaters in this case.
2 : Massachusetts Program Administrators (2018). 2019-2021 Gas HVAC and Water Heating Calculations Workbook. Workbook can be downloaded here: https://etrm.anbetrack.com/#/workarea/trm/MADPU/RES-WH-ODTWH/2020%20Report%20DRAFT%20WORKING%20TRM/version/4?measureName=Hot%20Water%20-%20On%20Demand%2FTankless%20Water%20Heater
3 : Navigant (2018). Home Energy Service Impact Evaluation. Prepared for program administrators in Massachusetts. http://ma-eeac.org/wordpress/wp-content/uploads/RES34_HES-Impact-Evaluation-Report-with-ES_FINAL_29AUG2018.pdf
4 : GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachusetts. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-in-MA.pdf
5: Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler. https://www.energystar.gov/sites/default/files/asset/document/Savings_and_Cost_Estimate_Summary.pdf
6 : DOE (2008). Energy Star Residential Water Heaters: Final Criteria Analysis and The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.
7 : Guidehouse, inc (2020). Massachusetts Comprehensive TRM Review - MA19R17-B-TRM. Prepared for the electric and gas program administrators of Massachusetts part of the residential evaluation program area.
8 : Navigant Consulting (2018). Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.35. LED Bulb

Measure Code	RES-LTG-LEDB
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Lighting

Measure Description:

The installation of Light-Emitting Diode (LED) screw-in lamps and linear LEDs. LEDs offer comparable luminosity to incandescent and halogen lamps at significantly less wattage and significantly longer lamp lifetimes.

Baseline Efficiency:

Effective July 2023, the revived EISA backstop will make LEDs the lost opportunity baseline for all general service lamps (GSL). 1 Expanded GSL definition includes reflector lamp types such as PAR lamps. From January 1st 2023 to July 1st 2023, the baseline efficiency case lost opportunity is a combination of an incandescent lamp, halogen lamp, and a compact fluorescent lamp. The baseline efficiency case for retrofit LED lamps is a combination of an incandescent lamp and halogen lamp.

High Efficiency:

The high efficiency case is an ENERGY STAR ® rated LED lamp.

Algorithms for Calculating Primary Energy Impact:

Unit savings are based on the algorithm below. Demand savings are derived from the Navigant Demand Impact Model.

Vendor calculated unit savings are calculated using the following algorithms and assumptions:[2]

$\Delta kWh = ((Watts\_Ineff - Watts\_EE) \times HOU)/1000 \times 365$

$\Delta kW = \Delta kWh \times kW/kWh$

kW/kWh = Average kW reduction per kWh reduction: 0.00025 kW/kWh

Watts_Ineff = Rated watts of inefficient lamps (either removed, through retrofit, or assumed to have been installed in lieu of the program lamps, through lost opportunity)

Watts_EE = Rated watts of efficient lamps installed

365 = Days per year

HOU = Daily hours of use. The hours of use are largely based on recent NH evaluation studies for the ENERGY STAR Products Program and the Home Performance Program, as well as increased hours of operation for ENERGY STAR Products to account for cross-sector sales at retailers (i.e., businesses purchasing program incented lamps). The direct installation delivery strategies (Home Performance, HEA) are based on residential hours only but reflect higher hours of use since the programs direct contractors to only replace lamps that are used for at least three hours per day. The following summarizes the key assumptions for daily hours of use:[2]

- Lost opportunity LEDs installed in residential applications: 1.75 hours/day *

- Lost opportunity LEDs installed in commercial applications (7% of all lost opportunity lamps): 7 hours/day

- Retrofit Home Performance LEDs (all installed in residential applications): 3.0 hours/day

- Retrofit HEA LEDs: (all installed in residential applications): 3.0 hours/day

*The 2.1 hours per day for ES Products and HTR channel are calculated as the weighted combination of residential and commercial hours of use: (residential HOU*residential %)+(commercial HOU*commercial %) = (1.75*0.93)+(7.0*0.07). HOU for ES Homes reflects the residential HOU only. Hours of use for the Home Performance and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day.

Delta watts (Watts_Ineff – Watts_EE) are broken out by lamp style and delivery strategy, and reflect a mix of program lamp wattages (for the efficient wattage), removed lamps (for retrofit inefficient lamps), and a blended mix of incandescents, halogens, and CFLs that would have been purchased in absence of the program measure (for lost opportunity inefficient lamps).[4 5]

Note that the ENERGY STAR Homes values represent a weighted average (based on the distribution of LEDs in NH homes as identified as part of a recent saturation study) of general service lamps, reflectors, and other specialty values.[6] The linear lamp values are based off of a separate research project in MA that specifically examined the characteristics (e.g., incented technologies, rooms with linear lamps) of linear LEDs.[7]

Measures with an asterisk will be reduced to 0 effective July 1st 2023 due to the revived EISA back stop.

BC Measure ID	Measure Name	Program	Delta Watts	Daily HOU	ΔkWh	ΔkW
EA3a001	General Service Lamps*	ES Products	40	2.1	30.7	0.008
EA3a004	Reflector*	ES Products	43	2.1	33.0	0.008
EA3a003	Other Specialty	ES Products	35	2.1	26.8	0.007
EA3a002	Linear	ES Products	17.9	1.6	10.5	0.003

EA2a044 EA2a099	General Service Lamps*	Home Performance	32.2	3.0	35.3	0.009
EA2a047 EA2a102	Reflector*	Home Performance	46.2	3.0	50.6	0.013
EA2a046 EA2a101	Other Specialty	Home Performance	46.2	3.0	50.6	0.013
EA2a045 EA2a100	Linear	Home Performance	17.9	3.0	19.6	0.005
EB1a044	General Service Lamps*	HEA	Vendor Calculated			
EB1a047	Reflector*	HEA	Vendor Calculated			
EB1a046	Other Specialty	HEA	Vendor Calculated			
EB1a045	Linear	HEA	Vendor Calculated			
EA3a005	General Service Lamps (Hard to Reach) *	ES Products	40	2.1	30.7	0.008
EA3a008	Reflector (Hard to Reach) *	ES Products	43	2.1	33.0	0.008
EA3a007	Other Specialty (Hard to Reach)	ES Products	35	2.1	26.8	0.007
EA3a006	Linear (Hard to Reach)	ES Products	17.9	1.6	10.5	0.003
EA1a023	ES Homes Lighting	ES Homes	10.2	1.75	6.5	0.002

Measure Life:

The table below summarizes the measure lives for each of the measures listed above. Note, AMLs for general service lamps and reflectors have been reduced to 1, as the revived EISA back stop will be enacted July, 1st 2023. Note these measure lives have been adjusted to account for the differential in measure life between the inefficient lamps and LEDs (as well as the remaining useful life in the retrofit cases), and the potential for future lighting standards to lead the same sockets reached through the program to have been occupied by an LED in a period shorter than the technical life of the LED.[8]

BC Measure ID	Measure Name	Program	Adjusted Measure Life
EA3a001	General Service Lamps	ES Products/Drop Ship	1
EA3a004	Reflector	ES Products/Drop Ship	1
EA3a003	Other Specialty	ES Products/Drop Ship	3

EA3a002	Linear	ES Products	7
EA2a044 EA2a099 EB1a044	General Service Lamps	Home Performance/HEA	1
EA2a047 EA2a102 EB1a047	Reflector	Home Performance/HEA	1
EA2a046 EA2a101 EB1a046	Other Specialty	Home Performance/HEA	2
EA2a045 EA2a100 EB1a045	Linear	Home Performance/HEA	7
EA3a005	General Service Lamps (Hard to Reach)	ES Products	1
EA3a008	Reflector (Hard to Reach)	ES Products	1
EA3a007	Other Specialty (Hard to Reach)	ES Products	3
EA3a006	Linear (Hard to Reach)	ES Products	7
EA1a023	ES Homes Lighting	ES Homes	3

Other Resource Impacts:

Based on the 2018 NH Energy Star Products Program Evaluation report, fossil fuel interactive penalties for residential lighting programs are -2,272 Btu/kWh saved.[7]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3a001	General Service Lamps	ES Products	0.86	1.00	n/a	1.00	1.00	0.55	0.85
EA3a004	Reflector	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85
EA3a003	Other Specialty	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85
EA3a002	Linear	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85

EB1a044	General Service Lamps	HEA	1.00	0.91	n/a	0.91	0.91	0.55	0.85
EA2a044 EA2a099	General Service Lamps	Home Performance	0.99	1.00	n/a	1.00	1.00	0.55	0.85
EB1a047	Reflector	HEA	1.00	0.91	n/a	0.91	0.91	0.55	0.85
EA2a047 EA2a102	Reflector	Home Performance	0.99	1.00	n/a	1.00	1.00	0.55	0.85
EB1a046	Other Specialty	HEA	1.00	0.91	n/a	0.91	0.91	0.55	0.85
EA2a046 EA2a101	Other Specialty	Home Performance	0.99	0.96	n/a	0.96	0.96	0.55	0.85
EB1a045	Linear	HEA	1.00	0.91	n/a	0.91	0.91	0.55	0.85
EA2a045 EA2a100 EB1a045	Linear	Home Performance	0.99	0.96	n/a	0.96	0.96	0.55	0.85
EA3a005	General Service Lamps (Hard to Reach)	ES Products	0.86	1.00	n/a	1.00	1.00	0.55	0.85
EA3a008	Reflector (Hard to Reach)	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85
EA3a007	Other Specialty (Hard to Reach)	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85
EA3a006	Linear (Hard to Reach)	ES Products	0.89	1.00	n/a	1.00	1.00	0.55	0.85
EA1a023	ES Homes Lighting	ES Homes	1.00	1.00	n/a	1.00	1.00	0.55	0.85

<u>In-Service Rates:</u>

All HEA installations use an in-service rate of 100% because HEA realization rates account for uninstalled measures[10] . All Home Performance installations use an in-service rate of 99%.[11] In-service for all other installations are based on MA evaluations.[12]

Realization Rates:

Based on evaluation results, all HEA installations use a realization rate of 91%.[13] All Home Performance installations use a realization rate of 100% because gross savings assumptions are adjusted to reflect evaluated results.[14] All other installations have a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are based on prescriptive loadshapes from the updated Navigant Massachusetts

Demand Impact Model.[15]

Energy Load Shape:

See Appendix 1 – "Lighting"

Impact Factors for Calculating Net Savings:

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BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EA3a001	General Service Lamps	ES Products	77%	n/a	n/a	23%
EA3a004	Reflector	ES Products	77%	n/a	n/a	23%
EA3a003	Other Specialty	ES Products	77%	n/a	n/a	23%
EA3a002	Linear	ES Products	77%	n/a	n/a	23%
EA3a005	General Service Lamps (Hard to Reach)	ES Products	57%	n/a	n/a	23%
EA3a008	Reflector (Hard to Reach)	ES Products	57%	n/a	n/a	23%
EA3a007	Other Specialty (Hard to Reach)	ES Products	57%	n/a	n/a	23%
EA3a006	Linear (Hard to Reach)	ES Products	57%	n/a	n/a	23%

Revision History:

Revision Number	Issue Date	Description
58	1/14/2022	Removed drop ship measures which are not being offered.
85	12/1/2022	Updated Baseline to reflect EISA backstop. Reduced AMLs affected by EISA back stop to 1. Added missing links for studies in references.

Endnotes:

1 : Department of Energy (2022) Energy Conservation Program: Energy Conservation Standards for General Service Lamps. https://www.govinfo.gov/content/pkg/FR-2022-05-09/pdf/2022-09477.pdf#page=1

2 : Note that interactive effects require modeling HVAC end-use consumption based on home characteristics and equipment (e.g., cooling, heating fuel) saturation assumptions. The data and models were not available for New Hampshire, so are not included in the TRM.

3 : Hours of use (residential) for the ES Products and HTR channel are based off of "New Hampshire ENERGY STAR® Products Program", prepared by Cadmus for the New Hampshire ENERGY STAR Products New Hampshire Evaluation Measurement & Verification Working Group, October 17, 2018. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/20181017-Monitor-Evaluation-Report-Energy-Star-Products-Final-Report.pdf The 2.1 hours per day for ES Products and HTR channel are calculated as the weighted combination of residential and commercial hours of use: (residential HOU*residential %)+(commercial HOU*commercial %) = (1.75*0.93)+(7.0*0.07). HOU for ES Homes reflects the residential HOU only. Hours of use for the Home Performance and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day. The values reflect the daily weighted average LED hours of use. Cross-sector sales are based upon MA RLPNC Cross-Sector Sale HOU Update", Prepared by the NMR Group for the Massachusetts Program Administrators (PAs), August 2, 2018. The 2.1 hours per day for ES Products and HTR channel are calculated as the weighted combination of residential and commercial hours of use: (residential HOU*residential %)+(commercial HOU*commercial %) = (1.75*0.93)+(7.0*0.07). HOU for ES Homes reflects the residential HOU only. Hours of use for the Home Performance and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day.

4 : NMR, 2020. Delta Watt Update (MA19R09-E). Delta watts for ES Products and HTR are based on both historical lamps sales in Massachusetts and the most recently available market adoption model (for PY2021-https://ma-eeac.org/wp-content/uploads/MA19R09-E-DeltaWattReport-Memo_FINAL_2020.03.26.pdf). Note that Massachusetts data were used because the New Hampshire ENERGY STAR Product evaluation had not stratified the program data or forecasted baseline wattage by style at the time of this TRM. The delta watts for ES Homes is reduced by 75% to reflect the requirement that 75% of lamps be high-efficacy lamps for new construction (https://codes.iccsafe.org/content/IECC2018).

5 : Delta watts for Home Performance are based on NH study "Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL," Prepared by Opinion Dynamics Corporation, June 11, 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf

6 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf

7 : RLPNC 18-7: TLED Product Impact Factor Estimation, Memo from NMR Group, Inc. to the Massachusetts Program Administrators, August 3, 2018

8 : The direct installation measure life values come from RLPNC 18-5 Home Energy Assessment LED Net-to-Gross Consensus, Prepared by NMR Group, Inc. for the 2019—21 Planning Assumptions: Lighting Hours-of-Use and In-Service Rate, Prepared by NMR Group, Inc. for the Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) Consultants, July 23, 2018 (https://ma-eeac.org/wp-content/uploads/RLPNC_185_HEALEDNTG_REPORT_23July2018_Final.pdf). These values reflect early replacement baselines, and assume that the replaced bulb, when it burnt out, would have been

replaced by an LED at that time. Lighting measures with lost opportunity baselines (e.g., ES Products) add a year to measure life to reflect the different baseline as well as significantly lower hours of use.
9 : Table 22. PY2016 Residential Lighting Energy Savings by Utility. Shows evaluated annual net electric energy savings, and evaluated penalties for gas, oil, and propane. Using the values for Eversource, a total calculated heating energy penalty of 341,757,000,000 Btu was assessed on the 150,403,000 kWh of electrical energy savings. "New Hampshire ENERGY STAR® Products Program 2016 Evaluation Report", prepared by Cadmus for the New Hampshire ENERGY STAR Products New Hampshire Evaluation Measurement & Verification Working Group, October 17, 2018.
10 : Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
11 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
12 : In-service rates for ES Products and HTR channel are based on the MA study "Residential Lighting Hours-of Use Quick Hit Study MA20R21-E," Prepared by the NMR Group, Inc. for the Massachusetts Program Administrators, July 13, 2018. Note the ISR is adjusted downward for lamps that are assumed to never be installed but does account (through discounted values) for lamps that are not immediately installed but are likely to be installed in the future. The ISR for Drop Ship is estimated based on program experience with lighting kits and will be evaluated. https://ma-eeac.org/wp-content/uploads/MA20R21-E-LTGHOU-Report-Final-2020.03.31.pdf
13 : Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
14 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
15 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
16 : "R1615 Light Emitting Diode (LED) Net-to- Gross Evaluation," Prepared by the NMR Group, Inc. for the Connecticut EEB, August 7, 2017. The 2020 Connecticut net-to-gross values are applied to New Hampshire for 2021 to account for the relatively slower pace of market transformation, due in part to fewer program bulbs per home in New Hampshire (2.5 bulbs per home in 2019) compared to Connecticut (4 bulbs per home in 2019). https://www.energizect.com/sites/default/files/R1615_CT%20LED%20Net-To-Gross%20Evaluation%20Report_Final_8.5.17.pdf

1.36. Lighting - Fixture

Measure Code	RES-LF-LGT
Markets	Residential
Program Types	Retrofit/Lost opportunity
Categories	Lighting

Measure Description:

The installation of Light-Emitting Diode (LED) fixtures, which offer comparable luminosity to incandescent and halogen fixtures at significantly less wattage and significantly longer lifetimes.

Baseline Efficiency:

The baseline efficiency case for a lost opportunity LED fixture is a combination of an incandescent fixture, halogen fixture, and a compact fluorescent fixture. The baseline efficiency case for a retrofit LED fixture is a combination of an incandescent fixture and halogen fixture.

High Efficiency:

The high efficiency case is an ENERGY STAR ® rated LED fixture.

Algorithms for Calculating Primary Energy Impact:

Unit savings are based on the algorithm below. Demand savings are derived from the Navigant Demand Impact Model.

Vendor calculated unit savings are calculated using the following algorithms and assumptions:

ΔkWh = ((Watts_Ineff- Watts_EE) × HOU)))/1000 × Qty_Bulbs × 365

ΔkW = ΔkWh × kW/kWh

kW/kWh = Average kW reduction per kWh reduction: 0.00025 kW/kWh

Watts_Ineff = Rated watts of inefficient bulbs (either removed, through retrofit, or assumed to have been installed, through lost opportunity)

Watts_EE = Rated watts of efficient bulbs installed

Qty_Bulbs = Number of bulbs per fixture

365 = Days per year

HOU = Daily hours of use. The hours of use are largely based on recent NH evaluation studies for the ENERGY STAR Products Program and the Home Performance Program, as well as increased hours of operation for ENERGY STAR Products to account for cross-sector sales at retailers (i.e., businesses purchasing program incented fixtures). The direct installation delivery strategies (Home Performance) are based on residential hours only but reflect higher hours of use since the programs direct contractors to only replace fixtures that are used for at least three hours per day. The following summarizes the key assumptions for daily hours by program type and application before adjustments for the ES products Program :

• Lost opportunity LEDs installed in residential applications: 1.75 hours/day

• Lost opportunity LEDs installed in commercial applications (7% of all lost opportunity fixtures):7 hours/day

• Retrofit Home Performance LEDs all installed in residential applications: 3.0 hours/day

• Retrofit HEA LEDs: all installed in residential applications: 3.0 hours/day

Delta watts (WattsINEFF – WattsEE) are broken out by delivery strategy, and reflect a mix of program fixture wattages (for the efficient wattage), removed fixtures (for retrofit inefficient fixtures), and a blended mix of incandescents, halogens, and CFLs that would have been purchased in absence of the program measure.[1]

BC Measure ID	Measure Name	Program	Delta Watts per Fixture	Daily HOU[2]	Number of Bulbs	ΔkWh	ΔkW
EA3a009	LED Fixture	ES Products	34.7	2.1	1	26.35	0.03
EA2a048 EA2a103	LED Fixture	Home Performance	Vendor Calculated				
EB1a048	LED Fixture	HEA	Vendor Calculated				
EA3a010	LED Fixture (Hard to Reach)	ES Products	34.7	2.1	1	26.35	0.03
EA1a024	LED Fixture	ES Homes	37.51	1.75	1	24	.04

Measure Life:

The table below summarizes the measure lives for each of the measures listed above. Note these measure lives have been adjusted to account for the differential in measure life between the inefficient fixtures and LED fixtures (as well as the remaining useful life in the retrofit cases), and the potential for future lighting standards to lead the same sockets reached through the program to have been occupied by an LED in a period shorter than the technical life of the LED.[3] Note- Lighting measures with lost opportunity baselines (e.g., ES Products) add a year to measure life to reflect the different baseline as well as significantly lower hours of use.

BC Measure ID	Measure Name	Program	Adjusted Measure Life
EA3a009	LED Fixture	ES Products	3
EA2a048 EA2a103 EB1a048	LED Fixture	Home Performance/HEA	2
EA3a010	LED Fixture (Hard to Reach)	ES Products	3
EA1a024	LED Fixture	ES Homes	3

Other Resource Impacts:

Based on the 2018 NH Energy Star Products Program Evaluation report, fossil fuel interactive penalties for residential lighting programs are -2,272 Btu/kWh saved.[4]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3a009	LED Fixture	ES Products	1.00	1.00	n/a	1.00	1.00	0.55	0.85
EA2a048 EA2a103	LED Fixture	Home Performance	0.99	0.96	n/a	0.96	0.96	0.55	0.85
EB1a048	LED Fixture	HEA	1.00	0.91	n/a	0.91	0.91	0.55	0.85
EA3a010	LED Fixture (Hard to Reach)	ES Products	1.00	1.00	n/a	1.00	1.00	0.55	0.85
EA1a024	LED Fixture	ES Homes	1.00	1.00	n/a	1.00	1.00	0.55	0.85

In-Service Rates:

All HEA installations use an in-service rate of 100% because HEA realization rates account for uninstalled measures. All Home Performance installations use in-service rate of 99% based on evaluation results.[5] [6] All other installations have a 100% in-service rate unless an evaluation finds otherwise.[7]

Realization Rates:

Based on evaluation results, all HEA installations use a realization rate of 91% and all Home Performance installations use a realization rate of 100% because gross savings assumptions are adjusted to reflect evaluated results.[5, 6.] All other installations have a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are based on prescriptive loadshapes from the updated Navigant Massachusetts

Demand Impact Model.[8]

Energy Load Shape:

See Appendix 1 – "Lighting".[8.]

Impact Factors for Calculating Net Savings:

[9]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EA3a009	LED Fixture	ES Products	77%	n/a	n/a	23%
EA3a010	LED Fixture (Hard to Reach)	ES Products	57%	n/a	n/a	43%

Revision History:

Revision Number	Issue Date	Description
73	3/1/2022	NTG updated for 2022 values.
131	21/1/2022	Added back in measure life table, updated delta watts to reflect latest study values for 2021, updated savings accordingly.

Endnotes:

1 : The delta watts are based off of the "MA PAs (2018). 2019-2021 Lighting Worksheet" (https://etrm.anbetrack.com/etrm/api/v1/etrm/documents/5bd06d1d6c50367b3deba017/view?authToken=fe238b4571e888c7558f844a02040d1941948e021564ac20156f12ece790e6a86c8a6c488b1d838694b8d9). Note the delta watts for ES Homes is reduced by 75% to reflect the requirement that 75% of lamps be high-efficacy lamps for new construction (https://www.energycodes.gov/sites/default/files/becu/2015_IECC_residential_requirements.pdf).
2 : *Hours of use (residential) for the ES Products and HTR channel are based off of "New Hampshire ENERGY STAR® Products Program", prepared by Cadmus for the New Hampshire ENERGY STAR Products New Hampshire Evaluation Measurement & Verification Working Group, October 17, 2018.(: Cadmus (2018) New Hampshire Energy Star Products Program, Evaluation Report. https://www.puc.nh.gov/electric/Monitoring%20and%20Evaluation%20Reports/20181017-Monitor-Evaluation-Report-Energy-Star-Products-Final-Report.pdf) The values reflect the daily weighted

average LED hours of use. Cross-sector sales are based upon MA RLPNC Cross-Sector Sale HOU Update", Prepared by the NMR Group for the Massachusetts Program Administrators (PAs), August 2, 2018. The 2.1 hours per day for ES Products and HTR are calculated as the weighted combination of residential and commercial hours of use: (residential HOU*residential %)+(commercial HOU*commercial %) = (1.75*0.93)+(7.0*0.07). HOU for ES Homes reflects the residential HOU only. Hours of use for the Home Performance and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day.
3 : The direct installation measure life values come from RLPNC 18-5 Home Energy Assessment LED Net-to-Gross Consensus, Prepared by NMR Group, Inc. for the 2019—21 Planning Assumptions: Lighting Hours-of-Use and In-Service Rate, Prepared by NMR Group, Inc. for the Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) Consultants, July 23, 2018 (http://ma-eeac.org/wp-content/uploads/RLPNC_185_HEALEDNTG_REPORT_23July2018_Final.pdf). These values reflect early replacement baselines, and assume that the replaced bulb, when it burnt out, would have been replaced by an LED at that time. Lighting measures with lost opportunity baselines (e.g., ES Products) add a year to measure life to reflect the different baseline as well as significantly lower hours of use.
4 : Table 22. PY2016 Residential Lighting Energy Savings by Utility. Shows evaluated annual net electric energy savings, and evaluated penalties for gas, oil, and propane. Using the values for Eversource, a total calculated heating energy penalty of 341,757,000,000 Btu was assessed on the 150,403,000 kWh of electrical energy savings. "New Hampshire ENERGY STAR® Products Program 2016 Evaluation Report", prepared by Cadmus for the New Hampshire ENERGY STAR Products New Hampshire Evaluation Measurement & Verification Working Group, October 17, 2018.
5 : Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
6 : Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
7 : : In-service rates for ES Products and HTR channel, as well as ES Homes, are based on MA assumptions of 100% ISR for fixtures. In-service rates for Home Performance and HEA are based on the NH study "Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL," Prepared by Opinion Dynamics Corporation, June 11, 2020. https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NHSaves-HPwES-Evaluation-Report-Final-20200611.pdf
8 : Navigant, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
9 : "R1615 Light Emitting Diode (LED) Net-to- Gross Evaluation," Prepared by the NMR Group, Inc. for the Connecticut EEB, August 7, 2017. The 2020 Connecticut net-to-gross values are applied to New Hampshire for 2021 to account for the relatively slower pace of market transformation, due in part to fewer program bulbs per home in New Hampshire (2.5 bulbs per home in 2019) compared to Connecticut (4 bulbs per home in 2019).

1.37. ECM Circulator Pump

Measure Code	RES-MND-ECP
Markets	Residential
Program Types	Lost Opportunity
Categories	Motors and Drives

Measure Description:

Installation of high efficiency residential boiler circulator pumps, equipped with variable speed electronically commutated motors (ECMs).

Baseline Efficiency:

The baseline efficiency case is the installation of a standard circulator pump.

High Efficiency:

The high efficiency case is the installation of an ECM circulator pump.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results[1] .

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EA3b013	ECM Motor for FWH Circulating Pump	ES Products	68.0	0.024

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EA3b013	ECM Motor for FWH Circulating Pump	ES Products	1.00	1.00	n/a	1.00	1.00	0.00	1.00

In-Service Rates:

All installations have a 100% in-service-rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Programs use a summer coincidence factor of 0% and a winter coincidence factor of 100%, because the deemed value of 0.024 kW cited above represents coincident winter peak demand reduction .[1]

Energy Load Shape:

See Appendix 1 – "Boiler Distribution"[2.]

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

For ECM motors delivered through midstream channels, the following factors apply.

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EA3b013	ECM Motor for FWH Circulating Pump	ES Products	0.40	0.09	0.00	0.69

Endnotes:

1 : West Hill Energy and Computing, 2018. CT HVAC and Water Heater Process and Impact Evaluation and CT Heat Pump Water Heater Impact Evaluation.
2 : Assumed to be consistent with C&I Electric Motors & Drives – Energy & Resources Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-1. ERS_2005_Measure_Life_Study

1.38. Pool Pump

Measure Code	RES-MND-PP
Markets	Residential
Program Types	Lost Opportunity
Categories	Motors and Drives

Measure Description:

The installation of a variable-speed drive pool pump, .5 HP or larger. Operating a pool pump for a longer period at a lower wattage can move the same amount of water, using significantly less energy.

Baseline Efficiency:

The baseline efficiency case is pump that meets the July 2021 federal standard 10 CFR part 431 in table 1.3.1.[1]

Equipment Class			
Dedicated-Purpose Pool Pump Variety	Hydraulic HP Applicability*	Motor Phase	Minimum allowable WEF ** Score
Standard-Size Self-Priming Pool Filter Pumps	<2.5 hhp and>=.711	Single	WEF= -2.30*ln(hhp)+6.59
Small-Size Self-Priming Pool Filter Pumps	Hhp< .711hp	Single	WEF = 5.55 for hhp ≤ 0.13 hp, -1.30 * ln (hhp) + 2.90 for hhp > 0.13 hp
Non-SelfPriming Pool Filter Pumps	hhp < 2.5 hp	Any	WEF = 4.60 for hhp ≤ 0.13 hp, -0.85 * ln (hhp) + 2.87 for hhp > 0.13 hp
Pressure Cleaner Booster Pumps	any	Any	WEF = 0.42

*All instances of hhp refer to rated hydraulic horsepower determined in accordance with the DOE test procedure at 10 CFR 431.464 and applicable sampling plans. ** WEF is measured by kgal/kWh.

High Efficiency:

The high efficiency case is an Energy Star rated pump.[2]

Pump Sub-Type	Size Class	Version 2.0 Energy Efficiency Leve, Effective January, 2019
Self-Priming (Inground) Pool Pumps	Small	WEF ≥ -1.30 x ln (hhp) + 4.95 for hhp > 0.13 WEF ≥ 7.60 for hhp ≤ 0.13
	(hhp<0.711)	
Self-Priming (Inground) Pool Pumps	Standard Size	WEF ≥ -2.30 x ln (hhp) + 6.59
	(hhp ≥ 0.711)	
Non-Self-Priming (Aboveground) Pool Pumps	Extra Small (hhp ≤ 0.13)	WEF ≥ 4.92
Non-Self-Priming (Aboveground) Pool Pumps	Standard Size (hhp > 0.13)	WEF ≥ -1.00 x ln (hhp) + 3.85
Pressure Cleaner Booster Pumps	All	WEF ≥ 0.45
Pool Pump Replacement Motors	TBD	TBD

Algorithms for Calculating Primary Energy Impact:

Savings are calculated using the 2021 Guidehouse Pool Pump Savings Estimate calculator, originally created for the MA PA's.[3] The calculator is based on the based on the DOE Technical Support Document for Dedicated-Purpose Pool Pumps [4]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EA3b024	Pool Pump (Variable Speed)	ES Products	157.62	0.17

Measure Life:

The measure life is 6years.[4]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA3b024	Pool Pump (Variable Speed)	ES Products	1.00	1.00	n/a	1.00	1.00	0.55	0.00

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

Programs use a summer coincidence factor of 55% and a winter coincidence factor of

0% which are estimated using demand allocation methodology described in the Demand Impact Model.[5]

Energy Load Shape:

See Appendix 1 – "Pool Pump".[3]

Revision History:

Revision Number	Issue Date	Description
178	1/1/2024	Updated baseline to align with new federal standard and savings.
179	1/1/2024	Updated measure life to reflect most recent study

Endnotes:

1 : https://www.regulations.gov/document/EERE-2015-BT-STD-0008-0105
2 : Energy Star (2019) Pool Pumps Key Product Criteria https://www.energystar.gov/products/other/pool_pumps/key_product_criteria
3 : 2021_Guidehouse_Pool Pump Savings Estimate July 2021
4: DOE Direct Final Rule Technical Support Document Dedicated-Purpose Pool Pumps table 7.4.1 https://www.regulations.gov/document/EERE-2015-BT-STD-0008-0105
5: Guidehouse (2021). Comprehensive TRM Review. 2021_Guidehouse_TRM_Final_Report
6 : Navigant, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.39. Whole Home - New Construction

Measure Code	RES-WH-NC
Markets	Residential
Program Types	Lost Opportunity
Categories	Whole Home

Measure Description:

The Program Administrators currently use vendor calculated energy savings using a RESNET accredited Rating Software Tool (REM/Rate) where a user inputs a detailed set of technical data about a project, comparing as-built projected energy consumption to that of a Baseline Home. This process is used to calculate electric and fossil fuel energy savings due to heating, cooling, and water heating for all homes.[1]

Baseline Efficiency:

The Baseline Home is based on a User Defined Reference Home (UDRH), which is to be updated for 2023 to incorporate provisions from the 2018 IECC code. The last update of the UDRH (2019) reflects the IECC 2015 code, with amendments as adopted by the state of NH.[2] [3] UDRH heating system efficiencies and air infiltration rates remain more stringent than code to reflect the results of the 2017 NH Energy Star Homes evaluation.[4]

High Efficiency:

The high-efficiency case is represented by the specific energy characteristics of each "as-built" home completed through the program.

Algorithms for Calculating Primary Energy Impact:

Unit savings are custom calculated for each home for heating, cooling, and water heating end uses. Demand savings are derived from the Navigant Demand Impact Model. As noted below, because the values are custom generated on a site-by-site basis, they are not shown in the table below.

BC Measure ID	Measure Name	Program
EA1a001 EA1a012 EB1a107 EB1a116 GA1a001 GA1a002	~~Cooling, Electric~~ Cooling, Electric, SF Cooling, Electric, MF	ES Homes HEA
EA1a002 EA1a013	Heating, Electric, SF Heating, Electric, MF	ES Homes HEA

EB1a108 EB1a117		
EA1a003 EA1a014 GA1a002 GA1a005	~~Heating, Gas~~ Heating, Gas, SF Heating, Gas, MF	ES Homes
EA1a004 EA1a015 EB1a109 EB1a118	Heating, Oil, SF Heating, Oil, MF	ES Homes HEA
EA1a005 EA1a016 EB1a110 EB1a119	Heating, Propane, SF Heating, Propane, MF	ES Homes HEA
EA1a006 EA1a017 EB1a111 EB1a120	Heating, Wood Pellets, SF Heating, Wood Pellets, MF	ES Homes HEA
EA1a007 EA1a018 EB1a112 EB1a121	Hot Water, Electric, SF Hot Water, Electric, MF	ES Homes HEA
EA1a008 EA1a019 GA1a003 GA1a006	~~Hot Water, Gas~~ Hot Water, Gas, SF Hot Water, Gas, MF	ES Homes
EA1a009 EA1a020 EB1a113 EB1a122	Hot Water, Oil, SF Hot Water, Oil, MF	ES Homes HEA
EA1a010 EA1a021 EB1a114 EB1a123	Hot Water, Propane, SF Hot Water, Propane, MF	ES Homes HEA
EA1a011 EA1a022 EB1a115 EB1a124	Hot Water, Wood Pellets, SF Hot Water, Wood Pellets, MF	ES Homes HEA

Measure Life:

The measure life is shown below and varies by end use.[5]

BC Measure ID	Measure Name	Program	EUL
EA1a002 EA1a013 EA1a003 EA1a014 EA1a004 EA1a015 EA1a005 EA1a016 EA1a006 EA1a017 EB1a108 EB1a117 EB1a109 EB1a118 EB1a110 EB1a119 EB1a111 EB1a120 GA1a002 GA1a005	Heating	ES Homes HEA	25
EA1a001 EA1a012 EB1a107 EB1a116 GA1a001 GA1a002	Cooling	ES Homes HEA	25
EA1a007 EA1a018 EA1a008 EA1a019 EA1a009 EA1a020 EA1a010 EA1a021 EA1a011 EA1a022 EB1a112 EB1a121 EB1a113 EB1a122 EB1a114 EB1a123 EB1a115 EB1a124 GA1a003 GA1a006	Water Heating	ES Homes HEA	15

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EA1a001 EA1a012 EB1a107 EB1a116	Cooling, Electric	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	0.35	0.00
EA1a002 EA1a013 EB1a108 EB1a117	Heating, Electric	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	0.00	0.43
EA1a003 EA1a014	Heating, Gas	ES Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a004 EA1a015 EB1a109 EB1a118	Heating, Oil	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a005 EA1a016 EB1a110 EB1a119	Heating, Propane	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a006 EA1a017 EB1a111 EB1a120	Heating, Wood Pellets	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a007 EA1a018 EB1a112 EB1a121	Hot Water, Electric	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	0.31	0.81
EA1a008 EA1a019	Hot Water, Gas	ES Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a009 EA1a020 EB1a113 EB1a122	Hot Water, Oil	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EA1a010 EA1a021 EB1a114	Hot Water, Propane	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00

EB1a123									
EA1a011 EA1a022 EB1a115 EB1a124	Hot Water, Wood Pellets	ES Homes HEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00

In-Service Rates:

All installations have 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All energy realization rates are 100% because energy and demand savings are custom calculated based on project specific details.

Coincidence Factors:

Coincidence factors for electric end uses are based on prescriptive load shapes from the updated Navigant Demand Impact Model for Massachusetts.[6]

Coincidence factors for non-electric end uses are set to 100% as no electrical energy impacts are expected.

Energy Load Shape:

See Appendix 1 for:

Non-Electric Measures

Clothes Washer

24-hour operation

Clothes Dryer - Electric

Clothes Dryer - Natural Gas

Hardwired Electric Heat

Lighting

Primary TV and Peripherals

Primary Desktop Computer

Primary Refrigerator

Secondary Refrigerator

Freezer

Dehumidifier

Pool Pump

Dishwasher

Water Heater - Electric

Water Heater - Heat Pump

Water Heater - Natural Gas/Fuel Oil

Central Air Conditioner/Heat Pump (Cooling)

Room or Window Air Conditioner

Mini-Split Air Conditioner/Heat Pump (Cooling)

Mini-Split Heat Pump (Heating)

Furnace Fan

Boiler Distribution

Weighted HVAC - All Homes

Weighted HVAC - Multi-family

Weighted HVAC - Multi-family Low Income

Weighted HVAC - Single Family

Weighted HVAC - Single Family Low Income

Central Heat Pump

DMSHP

Electric Resistance with AC

Revision History:

Revision Number	Issue Date	Description

40	1/14/2022	Fixed broken link in references
86	12/1/2022	Updated evaluation and code references to latest versions and added reference to Energy Star v3.1 baseline doc.

Endnotes:

1 : Note that there are also prescriptive rebates for appliances, including clothes washers, clothes dryers, and refrigerators, as well as lighting, which are covered in other sections of the TRM
2 : See "ESHOME UDRH update 02-23-2018, Revised 5-17-2019.docx"; https://www.energystar.gov/ia/partners/downloads/ES_Combined_Path_v3.1.pdf
3 : Note the UDRH represents both single family and multifamily homes, and all measures (cooling heating, and hot water) are present in both single family and multifamily homes.
4 : Energy and Resource Solutions, December 7, 2018. New Hampshire ENERGY STAR Homes Program Impact Evaluation. Prepared for the NH Program Administrators. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/NH_ESHomes_Report_Final_v4-2017.pdf
5 : MA Technical Reference Manual 2022-24 Plan Version, Page 252, "Chapter 1.64: Whole Home New Construction" section, https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/14154670.
6 : Navigant Consulting, 2018. RES 1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2. Commercial and Industrial Measures

2.1. C&I Active Demand Response

Measure Code	COM-ADR-ADR
Markets	Commercial
Program Types	Custom
Categories	Active Demand Response

Measure Description:

Active Demand Reduction includes C&I Load Curtailment Targeted Dispatch and Storage Daily Dispatch Performance.

The Load Curtailment offering is technology agnostic and provides an incentive for verifiable shedding of load in response to a signal or communication from the Program Administrators coinciding with system peak conditions. Large C&I customers that are subject to demand charges and/or direct capacity charges (determined by ICAP tags) with the ability to control lighting, HVAC, and/or process loads, can use this demand reduction performance offering to generate revenue by altering their operations a few times per year. The offering focuses on reducing demand during summer peak events typically targeting fewer than twenty hours per summer.

The C&I Storage Performance offering provides performance incentives for C&I storage performance. Since storage does not impact customer comfort or operations, storage resources are expected to be available for daily dispatch to maximize their value.

Baseline Efficiency:

Baseline conditions will be determined based on technology.

For Load Curtailment, baseline conditions are based on an adjustment settlement baseline with symmetric, additive adjustment. The symmetrically adjusted settlement baseline is developed based on a pool of the most recent 10 non-holiday weekdays. The baseline shape consists of average load per interval across the eligible days. The baseline is adjusted based on the difference between baseline and facility load in the second hour prior to the event (the baseline adjustment period), and the adjustment can be either to increase or decrease the estimated load reduction (i.e., symmetric adjustment). This adjustment accounts for weather-related and other differences of load magnitude.[1]

For Storage, demand reduction is calculated based on battery load. A baseline value is not directly calculated for storage, instead, the counterfactual is the actual facility load without the battery, which is derived based on the facility load with the battery and the battery load.[2]

High Efficiency:

Active Demand Reduction does not directly increase efficiency. Load curtailment does reduce power consumption by curtailing use but does not inherently reduce energy consumption.

Storage increases energy consumption due to round trip efficiency losses. Battery round trip efficiency losses are calculated on a per-project basis. For reference, evaluation results for daily dispatch storage reflect an impact of 240 kWh per year per kW of nameplate battery discharge capacity.[2.]

Algorithms for Calculating Primary Energy Impact:

The Active Demand Reduction measure generates site-specific vendor-reported demand savings, which are validated by evaluation. Savings estimates for these projects are calculated using engineering analysis with project-specific details.

Measure Life:

As all C&I active demand response measures are based on Program Administrators calling demand reduction events each year, the deemed measure life is one year.

BC Measure ID	Measure Name	Program	Measure Life
EC5a001	Load Curtailment Targeted Dispatch P4P Summer	C&I Active Demand Response	1
EC5a002	Storage Daily Dispatch P4P (savings) Summer	C&I Active Demand Response	1
EC5a003	Storage Daily Dispatch P4P (consumption) Summer	C&I Active Demand Response	1

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC5a001	Load Curtailment Targeted Dispatch P4P Summer	C&I Active Demand Response	1.00	0.981	1.00	0.981	1.00	1.00	0.00
EC5a002	Storage Daily Dispatch P4P (savings) Summer	C&I Active Demand Response	1.00	1.04	1.00	1.04	1.00	1.00	0.00
EC5a003	Storage Daily Dispatch P4P (consumption) Summer	C&I Active Demand Response	1.00	1.04	1.00	1.04	1.00	1.00	0.00

In-Service Rates:

In-service rates for commercial and industrial active demand response are assumed to be 100% by default, as measured performance in the ADR program is required to claim savings.

Realization Rates:

Electrical energy realization rates for this measure are assumed to be equal to summer peak demand realization rates.

Summer peak realization rates for interruptible load are based on a program evaluation of the 2019 summer demand reduction period for New Hampshire.[1.] These realization rates are based on the overall program savings, rather than individual measure savings, and represent the retrospective realization rate (i.e. the evaluated symmetric savings estimate divided by the reported asymmetric savings estimate).

For daily and targeted storage dispatch programs, summer peak realization rates are based on an evaluation of Eversource battery storage demonstration projects[2.]

Coincidence Factors:

Coincidence factors for this measure are assumed to be 100%, as the scaling factor accounts for the coincidence of program events with the system peak. The programs are not claiming winter peak impacts because the ISO-NE system is summer peaking.

Scaling Factors:

A scaling factor is used to account for the fact that the benefits of an active demand response resource depend on how often it performs. The greater the frequency of demand response events, the more that the active demand resource reduces the installed capacity requirement, and therefore the greater its value. For planning the utilities use a scaling factor of 10% for load curtailment measures and 100% for daily dispatch measures, reflecting the AESC 2018 review of sensitivity analyses run by PJM load forecasters.[3] For reporting utilities will use scaling factor values based on the most recent evaluation timing of events that are called in 2021.

Energy Load Shape:

As commercial active demand response events are called on the day preceding the event, the most appropriate load shape to use is a symmetric load based on the 10-baseline day load shape at the same facility.[1.]

Endnotes:

1 : ERS (2020). Cross-State C&I Active Demand Reduction Initiative Summer 2019 Evaluation Report. Prepared for Eversource, National Grid, and Unitil (MA, CT, and NH). https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Cross-State-CI-DR-S19-Evaluation-Report_04-15-2020.pdf
2 : ERS (2020). Daily Dispatch Battery Project Evaluation Report. Prepared for Eversource. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488776996f264267df7b6/view?authToken=8a34f85987739923

25038987ea62e83319d208f835e892092c491823f78722e7a92604e473dc75021eb90f821f219b8cbc0ddafa
ae207ed1924f97faecb70d5eaf3e5372d04fb6

3 : Avoided Energy Supply Components in New England: 2018 Report, page 105. https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-Oct-ReRelease.pdf

2.2. Advanced Power Strip

Measure Code	COM-APP-APS
Markets	Commercial
Program Types	Lost Opportunity
Categories	Appliances

Measure Description:

Advanced power strips can automatically eliminate standby power loads of electronic peripheral devices that are not needed (computer printer, scanner, etc.) either automatically or when an electronic control device (typically a television or personal computer) is in standby or off mode.

Baseline Efficiency:

The baseline efficiency case is the customers' electronic peripheral devices as they are currently operating. Baseline usage estimates for

High Efficiency:

The high efficiency case is the installation of an Advanced Power Strip purchased through the C&I online marketplace. Limit, 10 per year per account.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on refenced study results.[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EC1c055 EC2c055	OMP Smart Strip, Tier I	LBES SBES	105.00	0.010
EC1c056 EC2c056	OMP Smart Strip, Tier II	ES LBES SBES	207.00	0.024

Measure Life:

The measure life is 5 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c055 EC2c055	OMP Smart Strip, Tier I	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.58	0.86
EC1c056 EC2c056	OMP Smart Strip, Tier II	LBES Mid SBES Mid	1.00	1.00	n/a	1.00		0.58	0.86

In-Service Rates:

In-service rates are assumed to be 100% until evaluated.

Realization Rates:

Realization rates are assumed to be 100% until evaluated.

Coincidence Factors:

Programs use a summer coincidence factor of 58% and a winter coincidence factor of 86%[3] .

Energy Load Shape:

See Appendix 1 – "Primary TV and Peripherals"[2].

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c055 EC2c055	OMP Smart Strip, Tier I	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%
EC1c056 EC2c056	OMP Smart Strip, Tier II	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%

Revision History:

Revision Number	Date	Description
103	12/1/2022	New Measures Added

Endnotes:

1 : NMR Group Inc (2019) RLPNC 17-3: Advanced Power Strip Metering Study https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488726996f2b1b57df7a3/view?authToken=3da42fae99dc586f4b471345dbea348c0ac998555ebf2a55d95ce1a98360bfa95531073edab1860626068ca5d53d6c9c23447fbfa467295248e785a1649ff5ecb5c8a2459de6f2

2 : This value is borrowed from the Massachusetts Common Assumptions.

3 : Guidehouse (2021) Massachusetts Residential Baseline Study Phase 4 https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2.3. Dehumidifier

Measure Code	COM-APP-DEH
Markets	Commercial
Program Types	Lost Opportunity
Categories	Appliances

Measure Description:

Dehumidifiers exceeding minimum qualifying efficiency standards established as ENERGY STAR.

Baseline Efficiency:

The lost opportunity baseline efficiency case is a dehumidifier that meets the federal standard effective June 13, 2019. Specific baseline Energy Factors (EFs) by product capacity found in the Code of Federal Regulations, 10 CFR 430.32(v)(2). The retrofit baseline efficiency case is the existing dehumidifier.

High Efficiency:

The high efficiency case is a dehumidifier that meets the ENERGY STAR standard as of October 31, 2019[1]. For a new dehumidifier with a capacity less than 25 pints/day the minimum EF is 1.57 litres/kWh. For a new dehumidifier with a capacity between 25.01 and 50 pints/day the minimum EF is 1.8 litres/kWh. For a new dehumidifier with a capacity greater than or equal to 50 pints/day the minimum EF is 3.3 litres/kWh.

Capacity (pints)	Energy Factor (2019 Federal Standard)	Energy Factor (ENERGY STAR)
≤ 25	1.30	1.57
25.01-50	1.60	1.80
≥ 50	2.80	3.30

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated as below. Demand savings are derived from the Navigant Demand Impact Model[1].

$$\Delta kWh = Load \times [(1 \div Eff_{BASE}) - (1 \div Eff_{ES})] \times Hours$$

Where:

Load = Typical dehumidification load, 1520 Litres/year[1.]

Eff_{BASE} = Average efficiency of model meeting the federal standard, in Litres/kWh

Eff_{ES} = Efficiency of ENERGY STAR® model, in Litres/kWh

Hours = Dehumidifier annual operating hours, site-specific if available, or deemed 2,851 hour/year[2]

Table: Measure Energy Impact[3]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EC1c063	OMP Dehumidifier	LBES Mid	82.3	0.02
EC2c063	OMP Dehumidifier	SBES Mid	82.3	0.02

Measure Life:

The measure life is 12 years[3.]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c063	Dehumidifier	LBES Mid	1	1	n/a	1	1	0.82	0.17
EC2c063	Dehumidifier	SBES Mid	1	1	n/a	1	1	0.82	0.17

<u>In-Service Rates:</u>

Installations have 100% in service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Realization rates are 100% for unless an evaluation finds otherwise

Coincidence Factors:

All programs use a summer coincidence factor of 82% and a winter coincidence factor of 17%[1.]

Energy Load Shape:

See Appendix 1 – "Dehumidifier"[1.]

Revision History:

Revision Number	Revision Date	Description
102	12/1/2022	Added new measure: C&I OMP Dehumidifier

Endnotes:

1 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. https://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
2 : Environmental Protection Agency (2019). Dehumidifier Key Efficiency Criteria. https://www.energystar.gov/products/appliances/dehumidifiers/key_efficiency_criteria
3 : Environmental Protection Agency (2014). Savings Calculator for Energy Star Qualified Appliances. ENERGY_STAR_2015_Appliance_Calculator

2.4. Room Air Purifier

Measure Code	COM-APP-RAP
Markets	Commercial
Program Types	Lost Opportunity
Categories	Appliances

Measure Description:

Room air purifiers exceeding minimum qualifying efficiency standards established as ENERGY STAR®.

Baseline Efficiency:

There are no appliance standards for room air purifiers. Consistent with the MA TRM, the baseline efficiency case is a room air purifier with 2.0 CADR/ Watt. Partial on power is set at the Energy Star threshold of 2 Watts.

High Efficiency:

The high efficiency case is a room air purifier with a 3 .0 CADR/ Watt, consistent with the MA TRM and partial on power of 2 Watts or less purchased through the C&I Online Market Place. Limit, 10 per year per account.

Algorithms for Calculating Primary Energy Impact:

Gross annual kWh savings

$DkWh = kWh_{base} – kWh_{EE}$

$$kWh_{Base} = hr \times \left(\frac{Smoke\ CADR_{,base}}{Smoke\ CADR/Watt_{,base} \times 1000}\right) + (8760 - hr) \times \frac{Watt_{partial\ on,base}}{1000}$$

$$kWh_{EE} = hr \times \left(\frac{Smoke\ CADR_{,EE}}{Smoke\ CADR/Watt_{,EE} \times 1000}\right) n + (8760 - hr) \times \frac{Watt_{partial\ on,EE}}{1000}$$

Gross annual kW savings:
$DkW = DkWh/hr \times CF$

where:
kWh_{Base} = Annual Electrical Usage for baseline unit (kWh)
kWh_{EE} = Annual Electrical Usage for efficient unit (kWh)
hr = Annual active operating hours. See Table below.
$Smoke\ CADR_{base}$ = Smoke CADR for baseline units (cfm)
$Smoke\ CADR/Watt_{base}$ = Smoke CADR delivery rate per watt for baseline units (cfm/W) = 2
$Watt_{partial\ on,\ base}$ = Partial On Power for baseline units (watts) = 2

1000 = Conversion factor from watts to kilowatts
Smoke $CADR_{EE}$ = Smoke CADR for baseline units (cfm)
Smoke $CADR/Watt_{EE}$ = Smoke CADR delivery rate per watt for baseline units (cfm/W) = 3
$Watt_{partial\ on,\ EE}$ = Partial On Power for baseline units (watts) = 2

The energy and peak demand savings for a unit with a CADR = 500 cfm across 3 building types is shown below:

Building Type	Hours of Use	CADR (cfm)	CADR/ W_{base}	CADR/ W_{EE}	kWh savings	CF	kW savings
Education	2,967	500	2	3	247	0	0.000
Retail	4,939	500	2	3	412	1	0.083
Small Office	3,748	500	2	3	312	1	0.083

Measure Life:

The measure life is 3 years.[3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c054 EC2c054	OMP Room Air Purifier	LBES Mid SBES Mid	0.97	1.00	n/a	1.00	1.00	1.00	1.00

In-Service Rates:

In-service rate is 100% until evaluated.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are 100% for both summer and winter peaks, since the air purifiers are expected to operate continuously during peak hours.

Energy Load Shape:

See Appendix 1 – "24 hour operation".[3]

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	**FR**	**SO_P**	**SO_{NP}**	**NTG**
EC1c054 EC2c054	OMP Room Air Purifier	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%

Revision History:

Revision Number	Revision Date	Description
104	12/1/2022	New Measure Added

Endnotes:

1 : The Residential 9 year measure life can't be expected due to the driver for customer interest for this measure is COVID which is expected to be temporary. Additionally, plug load in C&I where equipment is transient is a concern.
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.

2.5. Clothes Washer, High Speed

Measure Code	COM- APP- CWHS
Markets	Commercial
Program Types	New Construction, Retrofit
Categories	Appliances

Measure Description:

This measure applies to the installation of clothes washers with extraction speeds of 200G or greater, which is significantly higher than traditional hard-mount washers. Standard washer extractors in laundromats operate at speeds of 70-80G1535. The high-speed extraction process in the wash cycle removes more water from each compared to standard washers, reducing operating time and gas consumption of clothes dryers. Heat exposure and mechanical action are also reduced, resulting in less linen wear.

Baseline Efficiency:

The baseline equipment is assumed to be a clothes washer with an extraction speed of 100G or less, installed in a commercial laundromat.

High Efficiency:

The efficient equipment is assumed to be a clothes washer with an extraction speed of 200G or greater, installed in a commercial laundromat.

Algorithms for Calculating Primary Energy Impact:

Fossil Fuel Savings:

$$\Delta Therms = (Ncycles \times Days \times Capacity \times RMC \times h_e / \eta_{dryer} / 100{,}000) \times DryerUse \times LF$$

Where:

Ncycles = Average number of washer cycles per day
= Use values below, depending on application

Application	Ncycles
Coin op	4.2[1]
MF	3.4[2]
Hotel/motel hospital	10.4[3]

Days = Days per year of commercial laundromat operation, if unknown assume 360 days, assumes closure on holidays.
Capacity= Clothes washer rated capacity (lb/cycle). Use actual based on the weight of dry clothing.

RMC = Retained Moisture Content (%) reduction from replacing a low extraction speed washer, assume 15%. [4]
h_e = Heat required by a dryer to evaporate 1 lb of water = Assume 1,200 Btu/lb [5]
ηdryer = Efficiency of the clothes dryer = Actual, or if unknown, assume 60%[6]
100,000 = Converts Btus to therms
DryerUse = % of washer loads dried in the field = Assume 91%[7]
LF = Load Factor (%) to account for the pounds per washer load, as a percentage of rated capacity. Assume 66%[8]

Measure Life:

The measure life is 7 years.[9]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b032 GC1c022 GC2b032 GC2c022 GC3b032	Clothes Washer, High Speed	LBES New SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	N/A	N/A

In-Service Rates:

In-service rate is 100% until evaluated.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

N/A

Energy Load Shape:

N/A

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c022 GC2c022	Clothes Washer, High Speed	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%

Revision History:

Revision Number	Revision Date	Description
180	1/1/2024	New Measure Added

Endnotes:

1 : 2021 2020-2021 State of the Self-Service Laundry Industry (Part 2), Bruce Beggs, April 1, 2021. https://americancoinop.com/articles/2020-2021-state-self-service-laundry-industry-part-2
2 : "Assessment of Water Savings for Commercial Washers: Report on the Monitoring and Assessment of Water Savings from the Coin-Operated Multi-Load Clothes Washers Voucher Initiative Program." San Diego County Water Authority October 2016. https://kipdf.com/assessment-of-water-savings-for-commercial-washers_5ad8603f7f8b9af21d8b4594.html

3: "Laundry Planning Guide." EDRO, January 2015.

4: "Laundry Planning Guide." EDRO, January 2015. Using Moisture Retention Chart on page 11 and assuming a 50/50 cloth blend load of cotton and polyester, the retained moisture drops from approximately 65% to 50% when a 100 g washer is replaced with a 200 g washer. Chart from "Laundry Planning Guide." EDRO, January 2015. The Department of Energy test procedures for commercial clothes washers specifies, "…the use of energy test cloth consisting of a pure finished bleach cloth, made with a momie or granite weave, which is a blended fabric of 50- percent cotton and 50-percent polyester." – Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers; Final Rule, Notice of Proposed Rulemaking, DOE, March 2014 (10 CFR Part 431)

5: "Laundry Planning Guide." EDRO, January 2015.

6: ACEEE (2010), "Are We Missing Energy Savings in Clothes Dryers?" Paul Bendt (Ecos), 2010, https://www.aceee.org/files/proceedings/2010/data/papers/2206.pdf

7: "Dryer Field Study." Northwest Energy Efficiency Alliance, November 20, 2014., https://ecotope-publications-database.ecotope.com/2014_005_1_DryerStudy.pdf

8: Assessment of Water Savings for Commercial Washers: Report on the Monitoring and Assessment of Water Savings from the Coin-Operated Multi-Load Clothes Washers Voucher Initiative Program." San Diego County Water Authority October 2016. https://kipdf.com/assessment-of-water-savings-for-commercial-washers_5ad8603f7f8b9af21d8b4594.html

9: Assessment of Water Savings for Commercial Washers: Report on the Monitoring and Assessment of Water Savings from the Coin-Operated Multi-Load Clothes Washers Voucher Initiative Program." San Diego County Water Authority October 2016. https://kipdf.com/assessment-of-water-savings-for-commercial-washers_5ad8603f7f8b9af21d8b4594.html

2.6. Air Sealing and Insulation

Measure Code	COM-BS-ASI
Markets	Commercial
Program Types	Retrofit
Categories	Building Shell

Measure Description:

Air Sealing: Air sealing will decrease the infiltration of outside air through cracks and leaks in the building.

Insulation: The installation of high efficiency insulation in an existing structure.

Air sealing and insulation are offered through the Municipal Energy Solutions program, and apply to municipal buildings. Air sealing measures apply to small commercial buildings without continuous ventilation air during occupied hours.

Baseline Efficiency:

Air Sealing: Baseline flow rate will come from blower door testing where available. IF pre-implementation blower door results are unavailable, use default of 0.4 CFM_{75}/SF[1]

Insulation: The baseline efficiency case is characterized by the total R-value of the existing attic, basement, or sidewall (Rexist). This is calculated as the R-value of the existing insulation, estimated by the program contractor, plus R-Assembly, calculated as the R-value of the ceiling, floor, or wall (for all projects: RCEILING = 3.36; RFLOOR = 6.16; RWALL = 6.65).

High Efficiency:

Air Sealing: The baseline efficiency case is the existing building after the air sealing measure is implemented. The high efficiency case is characterized by the new air changes per hour, which is measured after the air sealing measure is implemented. The high efficiency flow rate will come from the post- installation blower door air test. If test results are unavailable, use 0.25CFM_{75}/SF[2]

Insulation: The high efficiency case is characterized by the total R-value of the attic after the installation of additional attic, basement, or sidewall insulation. This is calculated as the sum of the existing R-value (Rexisit) plus the R-value of the added insulation.

Algorithms for Calculating Primary Energy Impact:

Air Sealing:

Unit savings are calculated using the following algorithms and assumptions:

Annual Electric Savings:

$$\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$$

$$\Delta kWh_{cooling} = \frac{\left[\left(\left(\frac{CFM75}{SF}\right)_{baseline} - \left(\frac{CFM75}{SF}\right)_{ee}\right) \div \left(F_{n,cooling} \times F_h\right)\right] \times SF \times LM \times 1.08 \times CDD \times 24}{EFF_{ElecCool} \times 1000}$$

$$\Delta kWh_{heating} = \frac{\left[\left(\left(\frac{CFM75}{SF}\right)_{baseline} - \left(\frac{CFM75}{SF}\right)_{ee}\right) \div \left(F_{n,heating} \times F_h\right)\right] \times SF \times 1.08 \times HDD \times 24 \times F_{ElecHeat}}{HSPF \times 1000}$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \frac{\left[\left(\left(\frac{CFM75}{SF}\right)_{baseline} - \left(\frac{CFM75}{SF}\right)_{ee}\right) \div \left(F_{n,cooling} \times F_h\right)\right] \times SF \times LM \times 1.08}{EER \times 1000} \times CF$$

Annual Fossil Fuel Energy Savings:

$$\Delta kWh_{heating} = \frac{\left[\left(\left(\frac{CFM75}{SF}\right)_{baseline} - \left(\frac{CFM75}{SF}\right)_{ee}\right) \div \left(F_{n,heating} \times F_h\right)\right] \times SF \times 1.08 \times HDD \times 24 \times F_{FuelHeat}}{Eff_{FuelHeat} \times 1{,}000{,}000}$$

Where:

Variable	Definition	Value
ΔkWh	Annual electric energy savings	
ΔkW	Peak coincident demand electric savings	
ΔMMBtu	Annual fossil fuel energy savings	
$\Delta kWh_{cooling}$	Annual electric cooling energy savings	
$\Delta kWh_{heating}$	Annual electric heating energy savings	
baseline	Characteristic of baseline condition	From application, results from blower door test. If pre-implementation blower door test

		results are unavailable, use 0.40 CFM75/SF as default
ee	Characteristic of energy efficient condition	From application, results from blower door test. If post -implementation blower door test results are unavailable, use 0.25 CFM75/SF as default
(CFM75/SF)	Infiltration rate (cubic foot per minute per building square foot) at a negative pressure differential of 75 Pa or 0.3 inches of water[3]	See baseline and ee values to use above.
$Fn_{,cooling}$	Infiltration-Leakage Ratio, used to convert pressurized blower door testing results to natural infiltration rates, climate zone factor during cooling season	Look up in Infiltration-Leakage Ratio, Climate Zone table below based on location and building shielding class, as defined below.
$Fn_{,heating}$	Infiltration-Leakage Ratio, used to convert pressurized blower door testing results to natural infiltration rates, climate zone factor during heating season	Look up in Infiltration-Leakage Ratio, Climate Zone table below based on location and building shielding class, as defined below.
F_h	Infiltration-Leakage Ratio, used to convert pressurized blower door testing results to natural infiltration rates, building height factor	$= Nstories^{-0.3}$. Based on the number of conditioned stories in the building. [4] The selected value should reflect the number of stories located inside the conditioned envelope of the building. Unconditioned basements and attics should not be included. Upper levels without full height perimeter walls shall be considered as half-stories (0.5).
LM	Latent Multiplier, used to convert the sensible cooling savings calculated to a value representing sensible and latent cooling loads	Look up in the Latent Multiplier table below, based on location.
SF	Square footage of the above- and below-grade building envelope784 (ft2)	From auditor
CDD	Cooling Degree Day	From application. If unknown, use 607.[5]
HDD	Heating Degree Day	From auditor. if unknow, use 5,800. [6]
EffElecCool	Seasonal average energy efficiency of electric cooling equipment, BTU/watthour, using either SEER (65,000 BTU/h)	SEER or IEER based on namplate rating metric of existing equipment
HSPF	Seasonal average energy efficiency of site's electric heating equipment. Heating Seasonal Performance Factor, BTU/watt-hour, total heating output (supply heat) in	HSPF based on nameplate rating of existing equipment. If equipment rated in COP, convert to HSPF using the equivalency HPSF = COP x 3.412

	BTU (including resistance heating) during the heating season / total electric energy heat pump consumed (in watt-hour); if equipment efficiency is reported in COP, convert to HSPF using the equivalency HSPF = COP x 3.412	
EER	Energy efficiency ratio under peak conditions (BTU/watt-hour)	From auditor. If unknown, baseline EER is established as follows[7] : $EER = (1.12 \times \text{EffElecCool}) - (0.02 \times \text{EffElecCool}^2)$
EffFuelHeat	Efficiency of fossil fuel heating equipment (AFUE, Et, or Ec)	
FElecHeat	Electric heating factor; used to account for the presence or absence of an electric heating system	Use a value of 1.0 if the building is electrically heated. Otherwise, use 0.0.
FFuelHeat	Fossil fuel heating factor; used to account for the presence or absence of a fossil fuel heating system	Use a value of 1.0 if the building is fossil fuel heated. Otherwise use 0.0.
CF	coincidence factor,	See impact factor section.
1.08	Specific heat of air x density of inlet air @ 70ºF x 60 min/hr, in BTU/h-ºFCFM[8]	
24	Hours in a day	
1,000	Conversion factor, one kW equals 1,000 Watts	
1,000,000	Conversion factor, one MMBtu equals 1,000,000 BTU	

Infiltration-Leakage Ratio, Climate Zone

The Infiltration-Leakage Ratio, Climate Zone tables below are based on the NYSERDA TRM, using the temperature zones for Albany (climate zone 5) and Binghamton (Climate Zone 6). [8] Look up Fn,cooling and Fn,heating in the tables below based on climate zone and shielding class, as defined below, based on application.

Shielding Class[10]

(1) No shielding on any side

(2) A few nearby obstructions

(3) A collection of obstructions within 25 feet

4) Substantial number of obstructions shield most of the perimeter – typical suburban setting

(5) Building surrounded by large structures – typical urban setting

Shielding Class	$F_{n,cooling}$	
	Climate Zone 5	Climate Zone 6
1	12	11
2	14	13
3	16	15
4	20	19
5	34	32

Shielding Class	$F_{n,heating}$	
	Climate Zone 5	Climate Zone 6
1	12	10
2	13	11
3	15	13
4	19	17
5	28	26

Latent Multiplier:

The latent multiplier tables below are based on the NYSERDA TRM, using the temperature zones for Albany (climate zone 5) and Binghamton (Climate Zone 6). [11] The Latent Multiplier converts the sensible cooling load savings captured in the savings equation to a savings capturing both latent and sensible load savings. The multiplier accommodates for the energy savings impacts associated with decreased humidity influx in a building with improved air sealing. During the cooling season, humidity poses an additional load on the cooling system. The Latent Multiplier is the ratio of total heat load (latent and sensible) to sensible heat load. Set indoor conditions are taken as 75ºF and 50% rh.

Location	Latent Load	Sensible Load	Latent Multiplier (LM)
Climate Zone 5	2.3	0.4	6.8
Climate Zone 6	2.2	0.1	23.0

Insulation:

Unit savings are calculated using the following algorithms and assumptions:

$MMBtuannual = ((1/R_{exist} - 1/R_{new}) * HDD * 24 * Area)/1000000 * \eta\ heat$

$kWh_{annual} = MMBtu_{annual} * 293.1$

$kW = kWh_{annual} * kW/kWh_{heating}$

Where,

R_{exist} = Existing effective R-value (R-ExistingInsulation + R-Assembly),ft2-°F/Btuh

R_{new} = New total effective R-value (R-ProposedMeasure + R-ExistingInsulation+ R-Assembly), ft2-°F/Btuh

Area = Square footage of insulated area

η heat = Efficiency of the heating system (AFUE or COP) 293.1 = Conversion constant (1MMBtu = 293.1 kWh)

24 = Conversion for hours per day

HDD = Heating Degree Days; dependent on location

1,000,000 = Conversion from Btu to MMBtu kW/kWh heating = Average annual kW reduction per kWh reduction[2].

Measure	kW/kWh Factor
Insulation (Electric)	0.00073
Insulation (Gas, Oil, Other FF)	0.00076
Insulation, Central AC in Electrically Heated Unit	0.00059

Measure Life:

The measure life is shown in the table below.[12]

BC Measure ID	Measure Name	Program	Measure Life

EC3a015 EC3a016 EC3a017 EC3a018 EC3d017 EC3d018 EC3d019 EC3d020	Air Sealing	Municipal Retrofit Municipal Direct Install	15
EC3a051 EC3a052 EC3a053 EC3a054 EC3d051 EC3d052 EC3d053 EC3d054	Insulation	Municipal Retrofit Municipal Direct Install	25
GC1a017 GC2a017	Air Sealing	Large C&I Retrofit Small C&I Retrofit	15
GC1a018 GC2a018	Insulation	Large C&I Retrofit Small C&I Retrofit	25

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

2.

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC3a015 EC3d017	Air Sealing	Electric	Muni Retro Muni DI	1.00	1.00	n/a	n/a	n/a	0.00	0.43
EC3a016 EC3d018	Air Sealing	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a017 EC3d019	Air Sealing	Oil	Muni Retro	1.00	n/a	1.00	n/a	n/a	n/a	n/a

			Muni DI							
EC3a018 EC3d020	Air Sealing	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a051 EC3d051	Insulation	Electric	Muni Retro Muni DI	1.00	1.00	n/a	n/a	n/a	0.34	0.17
EC3a052 EC3d052	Insulation	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a053 EC3d053	Insulation	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a054 EC3d054	Insulation	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1a017 GC2a017	Air Sealing	Gas	Large C&I Retrofit Small C&I Retrofit	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1a018 GC2a018	Insulation	Gas	Large C&I Retrofit Small C&I Retrofit	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Summer and winter coincidence factors for insulation are estimated using demand allocation methodology described in the Demand Impact Model.

A winter coincidence factor of 43% is utilized for air sealing.[2.]

Energy Load Shape:

For electric air sealing and insulation, see Appendix 1 C&I Load Shapes "Hardwired Electric Heat"

For non-electric air sealing, see Appendix 1 C&I Load Shapes “Non-Electric Measures”

For non- electric insulation, see Appendix 1 C&I Load Shapes “Central Air Conditioner/ Heat Pump (Cooling)

Revision History:

Revision Number	Date	Description
156	12/1/2022	Updated algorithm and baselines for air sealing as previously unable to trace baseline and high efficiency to sources.

Endnotes:

1 : IECC 2018 C402.5 Air leakage – thermal envelope (Mandatory) https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC402.5
2 : IECC 2018, C406.9 Reduced Air Infiltration. https://codes.iccsafe.org/s/iecc2018/chapter-4-ce-commercial-energy-efficiency/IECC2018-CE-Ch04-SecC406.9
3 : IECC 2020 C402.5 Air leakage – thermal envelope (Mandatory)
4 : LBL, Exegesis of Proposed ASHRAE Standard 119: Air Leakage Performance for Detached Single-Family Residential Buildings, M. Sherman, July 1986, p. 12
5 : EIA (2021) Cooling Degree Days by Census Division in 2021. https://www.eia.gov/energyexplained/units-and-calculators/degree-days.php
6 : EIA (2021) Heating Degree Days by Census Division in 2021. https://www.eia.gov/energyexplained/units-and-calculators/degree-days.php
7 : DOE, Building America House Simulation Protocols, October 2010
8 : The sensible heat constant at standard conditions of 1.08 is applied in accordance with standard HVAC industry practice per NYSERDA TRM. https://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/72c23decff52920a85257f1100671bdd/$FILE/NYS%20TRM%20V9.pdf
11 : NYSERDA TRM (2022) Commercial and Industrial Measures, Air Leakage Sealing Pg 496. https://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/72c23decff52920a85257f1100671bdd/$FILE/NYS%20TRM%20V9.pdf
10 : ASHRAE Handbook – Fundamentals, 2017. Chapter 16 Ventilation and Infiltration, Section 10 Simplified Models of Residential Ventilation and Infiltration, Table 5 Local Shelter Classes
11 : NYSERDA TRM (2022) Commercial and Industrial Measures, Air Leakage Sealing Pg 496. https://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/72c23decff52920a85257f1100671bdd/$FILE/NYS%20TRM%20V9.pdf
12 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf

2.7. Adding Compressor Capacity and/or Storage

Measure Code	COM-CA-CS
Markets	Commercial
Program Types	Retrofit
Categories	Compressed Air

Measure Description:

Adding storage capacity to compressed air systems with previously insufficient storage results in less system pressure fluctuations and allows lower average system pressures, leading to air compressor energy savings when operated at lower system pressures. It also reduces cycling losses in compressor systems that use a compressor with load-unload controls for part-load modulation.

Baseline Efficiency:

The baseline is the site-specific air compressor energy consumption operating at the higher average system pressure with insufficient compressed air storage.

High Efficiency:

The high efficiency case is the site-specific air compressor energy consumption operating at the lower average system pressure after the added compressed air storage, and with reduced cycling losses for load/unload compressors.

Algorithms for Calculating Primary Energy Impact:

The energy savings are based on air compressor energy efficiency improvements resulting from two components: the lower average pressure after air storage capacity is added, and reduced cycling losses. The measure may realize one or both savings components, depending on baseline conditions.

The algorithm for calculating electric demand savings from the system pressure reduction is:

$$\Delta kW_{PR} = kW_{BASE} \times (psi_{BASE} - psi_{EE}) \times 0.4\%$$

Where:

ΔkW_{PR} = Average kW savings from the system pressure reduction

kW_{BASE} = Baseline air compressor system average input kW

psi_{BASE} = Baseline average system pressure, in psi

psi_{EE} = Energy efficient average system pressure with added storage, in psi

0.4%/psi = Compressor kW reduction factor[1]

The algorithm for calculating annual electric energy savings from the system pressure reduction is:

$$\Delta kWh_{PR} = \Delta kW_{PR} \times \frac{hr}{yr}$$

Where:

ΔkWh_{PR} = Gross annual kWh savings from system pressure reduction

ΔkW_{PR} = Average kW savings from the system pressure reduction

$\frac{hr}{yr}$ = Annual compressed air system pressurization hours

The algorithm for calculating savings from the reduction in cycling losses is:

$$\Delta kW_{CL} = kW_{BASE,MOD} \times (\%kW_{BASE} - \%kW_{EE})$$

Where:

ΔkW_{CL} = Average kW savings from the reduction in cycling losses for load/unload compressors

$kW_{BASE,MOD}$ = Baseline air compressor input kW for the load-unload compressor that is the modulating or topping compressor

$\%kW_{BASE}$ = Percentage kW input in the base case (refer to %kW table, interpolate as needed)

$\%kW_{EE}$ = Percentage kW input in the energy efficient case after added storage (refer to % kW table, as needed)

Average Percent Capacity	Tank Plus Distribution System Storage per Compressor Capacity (Use the modulating compressor capacity only)	% kW[2]
25%	1 gal/cfm	70%
	3 gal/cfm	55%
	5 gal/cfm	50%

	10 gal/cfm	48%
50%	1 gal/cfm	88%
	3 gal/cfm	76%
	5 gal/cfm	71%
	10 gal/cfm	68%
75%	1 gal/cfm	96%
	3 gal/cfm	92%
	5 gal/cfm	89%
	10 gal/cfm	86%

The algorithm for calculating annual electric energy savings from the cycling losses is

$$\Delta kWh_{CL} = \Delta kW_{CL} \times \frac{hr}{yr}$$

Where:

ΔkWh_{CL} = Gross annual kWh savings from the reduction in cycling losses for load/unload compressors

ΔkW_{CL} = Average kW savings from the reduction in cycling losses for load/unload compressors

$\frac{hr}{yr}$ = Annual operating hours of the load/unload topping compressor

Measure Life:

The measure life is 17 years for non-mechanical infrastructure[3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EC1b020	Compressed air – compressor storage	LBES	1.00	.99	n/a	1.00	1.00	1.17	0.98
EC2b020	Compressed air – compressor storage	SBES	1.00	1.00	n/a	1.00	1.00	1.17	0.98
EC3b032	Compressed air – compressor storage	Muni	1.00	1.00		1.00	1.00	1.17	0.98

In-Service Rates:

All installations have 100% a in-service-rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs. [4]

Coincidence Factors:

A summer coincidence factor of 117% and a winter coincidence factor of 98% is utilized.[4.]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Compressed Air- VFD Compressor".

Load Shape Description	**Total Energy**			
	Summer		**Winter**	
	On Peak	**Off Peak**	**On Peak**	**Off Peak**
C&I Compressed Air - VFD Compressor	26.50%	23.70%	25.90%	23.90%

Endnotes:

1 : Estimate based on ERS data of CAGI Compressor Data Sheets of 40 operating points of 10 compressors from 4 manufacturers, downloaded 5/21/20.
2 : Department of Energy Compressed Air Challenge. Improving Compressed Air System Performance A Sourcebook for Industry, Third Edition, DOE/EE-1340, (approx. 2015) p. 40.
3 : Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf Measure life value represents the median MA Measure Life for 15-75 HP Efficient Compressors in the Compressed Air Category shown in Table 3-9 of the study.
4 : DNV GL (2015). Impact Evaluation of Prescriptive Chiller and Compressed Air Installations.

Prepared for The Massachusetts Joint Utilities. DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf

2.8. Air Compressor

Measure Code	COM-CA-AC
Markets	Commercial
Program Types	Lost Opportunity
Categories	Compressed Air

Measure Description:

Covers the installation of oil flooded, rotary screw compressors with Variable Speed Drive or Variable Displacement capacity control with properly sized air receiver. Efficient air compressors use various control schemes to improve compression efficiencies at partial loads.

Baseline Efficiency:

The baseline efficiency case is a typical load/unload compressor.

High Efficiency:

The high efficiency case is an oil-flooded, rotary screw compressor with Variable Speed Drive or Variable Displacement capacity control with a properly sized air receiver. Air receivers are designed to provide a supply buffer to meet short-term demand spikes which can exceed the compressor capacity. Installing a larger receiver tank to meet occasional peak demands can allow for the use of a smaller compressor.

Algorithms for Calculating Primary Energy Impact:

Δ kWh = (HP COMPRESSOR) x (Save) x (Hours)

Δ kW = (HP COMPRESSOR) x (Save)

Where:

HP COMPRESSOR = Nominal rated horsepower of high efficiency air compressor

Save = Air compressor kW reduction per HP: 0.189[1]

Hours = Annual operating hours of the air compressor

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b016	Air Compressor	LBES New	1.00	.99	n/a	1.00	1.00	1.17	0.98
EC2b016 EC3b016	Air Compressor	SBES New Muni New	1.00	1.00	n/a	1.00	1.00	1.17	0.98

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[3]

Coincidence Factors:

CFs from the prospective results of the 2015 study of prescriptive compressed air.[1.]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Compressed Air – VFD Compressor"

Endnotes:

1 : DNV GL, October 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for the MA PAs and EEAC. Result for VSD 25-75 HP used since "All" result includes savings from load/unload compressors, which are now baseline. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488686996f24a5b7df77b/view?authToken=9cef6fc41bf9049f9b84f7c42ff58f149ae469bbf646ea693348ebc8066f687d12134372e861872bdb9566c819f0339c59d775081b2ff93575d4696c201bdc45b956b0a5ddc16d
2 : ERS, November 2005. Measure Life Study. Prepared for MA Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf

2.9. Compressed Air Leak Detection

Measure Code	COM-CA-AN
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Compressed Air

Measure Description:

This measure covers the detection of compressed air losses through ultrasonic leak detection, and the repair of compressed air leaks. Air leaks are common in compressed air systems, often wasting 20%-30% of the compressor's output. Air leak loss rate depend on the supply pressure in an uncontrolled system, as well as leak size quantity and time. This measure is applicable for general plant compressed air systems in manufacturing environments (70 to 125 psig).

Baseline Efficiency:

The baseline efficiency case is the air compressor operating with leaks.

High Efficiency:

The high efficiency case is the air compressor with leaks repaired.

Algorithms for Calculating Primary Energy Impact:

Retrofit Gross Energy Savings, Electric

$$\Delta kWh = NL \times CFM_{leak} \times EFF_{comp} \times MEF \times H$$

Retrofit Gross Peak Demand Savings, Electric

$$SkW = \frac{\Delta kWh}{H} CF_s$$
$$WkW = \frac{\Delta kWh}{H} CF_w$$

Where:

ΔKWH = Annual electric energy savings
kW = Demand Savings
NL = Number of detected leaks
CFM_{Leak} = Flow rate loss per leak in cubic feet per minute (CFM) in kw/CFM see table for CFM per Leak Size for Compressed Air Leaks below.
EFF_{Comp} = Efficiency of air compressor in kW/ % load, see table "kW/CFM Efficiencies for Several Air Compressor Types (EFFComp), use 0.19 kW/CFM", if unknown, use .19kW/CFM [1]

MEF = Marginal efficiency factor per control type for air compressor, see table "Marginal Efficiency Factors per Control Type for Air Compressor Types (MEF)"
H = Annual Hours the compressed air system is pressurized

Table: CFM per Leak Size for Compressed Air Leaks:[2]
Most gaps are irregular and sometimes ragged, which decreased the flow rate relative to the equivalent area. For well rounded orfices, values should be multiplied by 0.97 and by 0.61 for sharp ones.

Leakage rates (CFM) for different supply pressures and approximately equivalent orifice sizes						
Preasure (psig)	Orifice Diameter (inches)					
	1/64	1/32	1/16	1/8	¼	3/8
70	0.29	1.16	4.66	18.62	74.40	167.8
80	0.32	1.26	5.24	20.76	83.10	187.2
90	0.36	1.46	5.72	23.1	92.00	206.6
100	0.40	1.55	6.31	25.22	100.9	227.00
125	0.48	1.94	7.66	30.65	122.2	275.50

kW/CFM Efficiencies for Several Air Compressor Types (EFFComp)

Air Compressor Type	SAVE (kW/CFM)
Single-acting Reciprocating Air Compressor	0.230
Double-acting Reciprocating Air Compressor	0.155
Lubricant-injected Rotary Screw Compressor	0.185
Lubricant-free Rotary Screw Compressor	0.200
Centrifugal Compressor	0.180
Average	0.19

Marginal Efficiency Factors per Control Type for Air Compressor Types (MEF)[3]

Control Type	Percent kW/Percent Load
Inlet Valve Modulated	0.31
Variable Displacement	0.69
Variable Speed Drive	0.85

Measure Life:

The measure life is 5 years.[4]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b059	Compressed air leak detection	LBES New	1.00	0.99	n/a	1.00	1.00	0.80	0.54
EC2b059 EC3b088	Compressed air leak detection	SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.80	0.54

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs. [3]

Coincidence Factors:

CFs from the prospective results of the 2015 study of prescriptive compressed air.[2]

Energy Load Shape:

See Appendix 1 C&I Load Shapes “C&I Compressed Air – VFD Compressor".

Revision History:

Revision Number	Issue Date	Description
181	1/1/2024	New Measure

Endnotes:

1 : Compressed Air Challenge "Fundamentals of Compressed Air Systems" Pgs. 28-32.
2 : U.S. Department of Energy. Energy Tips – Compressed Air. August 2004. Available online: https://www.energy.gov/sites/prod/files/2014/05/f16/compressed_air3.pdf. Originally from Fundamentals of Compressed Air Systems Training offered by the Compressed Air Challenge®
3 : Compressed Air Challenge "Fundamentals of Compressed Air Systems" Pgs. 90-91.
4 : Energy & Resource Solutions. ERS Measure Life Study.: Prepared for the Massachusetts Joint Utilities, Oct. 10, 2005. P 4-9

2.10. Air Nozzle

Measure Code	COM-CA-AN
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Compressed Air

Measure Description:

Covers the installation of engineered air nozzles which provide effective air nozzle action while reducing compressed air system air flow.

Baseline Efficiency:

The baseline efficiency case is a standard nozzle on a compressed air system.

High Efficiency:

The high efficiency case is an engineered nozzle on the same compressed air system.

Algorithms for Calculating Primary Energy Impact:

Savings are calculated in a spreadsheet tool per the following:

$$\Delta kW = (FLOW_{BASE} - FLOW_{EE}) \times \frac{kW}{cfm}$$

$$\Delta kWh = \Delta kW \times hr$$

Where:

$FLOW_{BASE}$ = base case nozzle flow in cfm, at site specific pressure if available, or else at 80 psig[1]

$FLOW_{EE}$ = energy efficient nozzle flow in cfm, at site specific pressure if available, or else at 80 ~~psig[2]~~ psig[1]

$\frac{kW}{cfm}$ = site specific compressor efficiency, ~~default value of 0.29~~ if unavailable, use values from the following table[4]

Air Compressor Type	kW/CFM	
	Normal Range	Default Midpoint
Single-Acting, Air-Cooled Reciprocating	0.22-0.24	0.230
Double-Acting Water-Cooled Reciprocating	0.15-0.16	0.155
Lubricant-Injected Rotary Screw Compressor	0.18-0.19 (single stage) 0.16-0.17 (two stage)	0.185 (single stage) 0.165 (two stage)
Lubricant-Free Rotary Screw Compressor	0.18-0.22	0.20

Centrifugal Air Compressor	0.16-0.20	0.18

hr = annual operating hours times % nozzle use factor (site specific if available, else default to 0.05 use factor)

Measure Life:

The measure life is 13 years.

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b017	Air Nozzle	LBES New	1.00	.99	n/a	1.00	1.00	0.80	0.54
EC2b017 EC3b017	Air Nozzle	SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.80	0.54

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.3

Coincidence Factors:

CFs from the prospective results of the 2015 study of prescriptive compressed air.[2]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Compressed Air – VFD Compressor".

Revision History:

Revision Number	Issue Date	Description
42	1/14/2022	Fixed broken link in references

100	12/1/2022	Updated default pressure from 100psi to 80psi. Added operating hour description and use factor based on MA TRM assumption
181	7/1/2023	Updated high efficiency

Endnotes:

~~1 : NH Baseline Practices Lit Review Presentation_2022~~
~~2~~ 1 : NH Baseline Practices Lit Review Presentation_2022
~~3~~ 2 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
~~4~~ 3 : DNV GL, October 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for Massachusetts Program Administrators and Massachusetts Energy Efficiency Advisory Council. http://ma-eeac.org/wp-content/uploads/MA30-Prescriptive-Chiller-and-CAIR-Report_FINAL_151026.pdf
4 : Improving Compressed Air System Performance, a sourcebook for industry:
https://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/compressed_air_sourcebook.pdf

2.11. Low Pressure Drop Filter

Measure Code	COM-CA-LPDF
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Compressed Air

Measure Description:

Filters remove solids and aerosols from compressed air systems. Low pressure drop filters have longer lives and lower pressure drops than traditional coalescing filters, resulting in low air compressor energy use.

Baseline Efficiency:

The baseline efficiency case is a standard coalescing filter with initial drop of between 1 and 2 pounds per sq inch (psi) with an end of life drop of 10 psi.

High Efficiency:

The high efficiency case is a low pressure drop filter with initial drop not exceeding 1 psi over life and 3 psi at element change. Filters must be deep-bed, “mist eliminator” style and installed on a single operating compressor rated 15 - 75 HP.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kW = kW_{BASE} \times (psi_{BASE} - psi_{EE}) \times 0.4\%$$

$$\Delta kWh = \Delta kW \times \frac{hr}{yr}$$

Where:

ΔkW = Average kW savings

ΔkWh = Gross annual kWh savings

kW_{BASE} = Air compressor system average input kW, site specific

psi_{BASE} = Baseline standard filter pressure drop, in psi. Use the mid point of 1.5 psi were existing conditions are unavailable.

psi_{EE} = Energy efficient filter pressure drop, in psi

0.4%/psi = Compressor kW reduction factor[1]

$\frac{hr}{yr}$ = Annual compressed air system pressurization hours. Where system actual is unavailable, use the table below to determine annual hours.

Shift	Hours	Notes
Single shift (8/5)	1,976	7 AM – 3 PM, weekdays, minus some holidays and scheduled down time
2-shift (16/5)	3,952	7AM – 11 PM, weekdays, minus some holidays and scheduled down time
3-shift (24/5)	5,928	24 hours per day, weekdays, minus some holidays and scheduled down time
4-shift (24/7)	8,320	24 hours per day, 7 days a week minus some holidays and scheduled down time

Measure Life:

The measure life is 5 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a032	Low Pressure Drop Filter	LBES Retro	1.00	.99	n/a	1.00	1.00	0.80	0.54
EC1b043	Low Pressure Drop Filter	LBES New	1.00	.99	n/a	1.00	1.00	0.80	0.54
EC1d032	Low Pressure Drop Filter	LBES DI	1.00	.99	n/a	1.00	1.00	0.80	0.54
EC2a032	Low Pressure Drop Filter	SBES Retro	1.00	1.00	n/a	1.00	1.00	0.80	0.54
EC2b043	Low Pressure Drop Filter	SBES New	1.00	1.00	n/a	1.00	1.00	0.80	0.54
EC2d032	Low Pressure Drop Filter	SBES DI	1.00	1.00	n/a	1.00	1.00	0.80	0.54
EC3a055	Low Pressure Drop Filter	Muni Retro	1.00	1.00	n/a	1.00	1.00	0.80	0.54
EC3b065	Low Pressure Drop Filter	Muni New	1.00	1.00	n/a	1.00	1.00	0.80	0.54

EC3d055	Low Pressure Drop Filter	Muni DI	1.00	1.00	n/a	1.00	1.00	0.80	0.54

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Realization rates are based on impact evaluation of PY 2004 compressed air installations[3] .

Realization rates are based on impact evaluation of NSTAR 2006 compressed air installations[4] . The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.

Coincidence Factors:

Summer and winter coincidence factors are CFs based on impact evaluation of PY 2004 compressed air installations.

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Compressed Air – VFD Compressor".

Revision History:

Revision	Date	Description
144	12/1/2022	Added clarified baseline set point where existing system data is unavailable. Added in default hours table.

Endnotes:

1 : Estimate based on ERS data of CAGI Compressor Data Sheets of 40 operating points of 10 compressors from 4 manufacturers, downloaded 5/21/20.
2 : ERS, November 2005. Measure Life Study. Prepared for MA Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : DMI, 2006. Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Results analyzed in RLW Analytics, 2006. Sample Design and Impact Evaluation Analysis for Prescriptive Compressed Air Measures in Energy Initiative and Design 2000 Programs.
4 : LW Analytics, 2008. Business & Construction Solutions (BS/BC) Programs Measurement & Verification - 2006 Final Report.

2.12. Refrigerated Air Dryer

Measure Code	COM-CA-RAD
Markets	Commercial
Program Types	Lost Opportunity
Categories	Compressed Air

Measure Description:

The installation of cycling or variable frequency drive (VFD)-equipped refrigerated compressed air dryers. Refrigerated air dryers remove the moisture from a compressed air system to enhance overall system performance. An efficient refrigerated dryer cycles on and off or uses a variable speed drive as required by the demand for compressed air instead of running continuously. Only properly sized refrigerated air dryers used in a single-compressor system are eligible.

Baseline Efficiency:

The baseline efficiency case is a non-cycling refrigerated air dryer.

High Efficiency:

The high efficiency case is a cycling refrigerated dryer or a refrigerated dryer equipped with a VFD.

Algorithms for Calculating Primary Energy Impact:

Δ kWh = (CFM DRYER) x (Save) x (HRS)

Δ kW = (CFM DRYER) x (Save)

Where:

CFM DRYER = Full flow rated capacity of the refrigerated air dryer in cubic feet per minute (CFM) obtained from equipment's Compressed Air Gas Institute Datasheet.

Save = Refrigerated air dryer kW reduction per dryer full flow rated CFM: 0.00554[1]

HRS = Annual operating hours of the refrigerated air dryer. Site specific, if unavailable use default operating hours below.

Default Operating Hours

Shift	Hours	Notes

Single shift (8/5)	1,976	7 AM – 3 PM, weekdays, minus some holidays and scheduled down time
2-shift (16/5)	3,952	7AM – 11 PM, weekdays, minus some holidays and scheduled down time
3-shift (24/5)	5,928	24 hours per day, weekdays, minus some holidays and scheduled down time
4-shift (24/7)	8,320	24 hours per day, 7 days a week minus some holidays and scheduled down time

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b047	Refrigerated Air Dryer	LBES New	1.00	1.56	n/a	1.00	1.00	1.17	0.98
EC2b047	Refrigerated Air Dryer	SBES New	1.00	1.56	n/a	1.00	1.00	1.17	0.98
EC3b078	Refrigerated Air Dryer	Muni New	1.00	1.56	n/a	1.00	1.00	1.17	0.98

In-Service Rates:

All installations have a 100% in-service rates unless an evaluation finds otherwise.

Realization Rates:

Realization rates are from the prospective results of the 2015 study of prescriptive compressed air[1].

Coincidence Factors:

Summer and winter coincidence factors are from the prospective results of the 2015 study of prescriptive compressed air.[1]

Energy Load Shape:

See Appendix 1, C&I Load Shapes Table "C&I Compressed Air – Air Dryer"

Revision History:

Revision Number	Date	Revision
146	12/1/2022	Added default operating hours based on CT PSD

Endnotes:

1 : DNV GL, October 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for MA Joint Utilities and MA EEAC. http://ma-eeac.org/wordpress/wp-content/uploads/MA30-Prescriptive-Chiller-and-CAIR-Report_FINAL_151026.pdf
2 : ERS, November 2005. Measure Life Study. Prepared for MA Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf

2.13. Zero Loss Condensate Drain

Measure Code	COM-CA-ZLCD
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Compressed Air

Measure Description:

Drains remove water from a compressed air system. Zero loss condensate drains remove water from a compressed air system without venting any air, resulting in less air demand and consequently less air compressor energy use.

Baseline Efficiency:

The baseline efficiency case a standard condensate drain on a compressor system.

High Efficiency:

The high efficiency case is installation of a zero loss condensate drain on a single operating compressor rated ≤ 75 HP.

Algorithms for Calculating Primary Energy Impact:

ΔkWh = (CFMpipe) x (CFMsave) x (Save) x (Hours)

ΔkW = (CFMpipe) x (CFMsave) x (Save)

Where:

ΔkWh = Energy Savings

ΔkW = Demand savings

CFMpipe = CFM capacity of piping that is served by the condensate drain, site specific

CFMsaved = Average CFM saved per CFM of piping capacity: 0.049[1]

Save = Average savings per CFM, site specific if available, default value of 0.21 kW/CFM[1].

Hours = Annual operating hours of the zero loss condensate drain. Site-specific, if unknown use hours below.

Default Operating Hours

Shift	Hours	Notes
Single shift (8/5)	1,976	7 AM – 3 PM, weekdays, minus some holidays and scheduled down time
2-shift (16/5)	3,952	7AM – 11 PM, weekdays, minus some holidays and scheduled down time
3-shift (24/5)	5,928	24 hours per day, weekdays, minus some holidays and scheduled down time
4-shift (24/7)	8,320	24 hours per day, 7 days a week minus some holidays and scheduled down time

Measure Life:

The measure life is 5 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a046	Zero Loss Condensate Drains	LBES Retro	1.00	.99	1.00	1.00	1.00	0.80	0.54
EC1b051	Zero Loss Condensate Drains	LBES New	1.00	.99	1.00	1.00	1.00	0.80	0.54
EC1d046	Zero Loss Condensate Drains	LBES DI	1.00	.99	1.00	1.00	1.00	0.80	0.54
EC2a046	Zero Loss Condensate Drains	SBES Retro	1.00	1.00	1.00	1.00	1.00	0.80	0.54
EC2b051	Zero Loss Condensate Drains	SBES New	1.00	1.00	1.00	1.00	1.00	0.80	0.54
EC2d046	Zero Loss Condensate Drains	SBES DI	1.00	1.00	1.00	1.00	1.00	0.80	0.54
EC3a090	Zero Loss Condensate Drains	Muni Retro	1.00	1.00	1.00	1.00	1.00	0.80	0.54
EC3b082	Zero Loss Condensate Drains	Muni New	1.00	1.00	1.00	1.00	1.00	0.80	0.54

EC3d090	Zero Loss Condensate Drains	Muni DI	1.00	1.00	1.00	1.00	1.00	0.80	0.54

In-Service Rates:

All installations have a 100% in-service rate since unless an evaluation finds otherwise.

Realization Rates:

All program use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs[3] .

Coincidence Factors:

Summer and winter coincidence factors are based on Massachusetts TRM values. Latest 2015 evaluation study did not yield a statistically significant sample size for updating CF values.

Energy Load Shape:

See Appendix 1, C&I Load Shapes Table "C&I Compressed Air – VFD Compressor"

Revision History:

Revision Number	Date	Revision
145	12/1/2022	Added default operating hours based on CT PSD

Endnotes:

1 : Prescriptive_CAIR_ZLD_LPDF_Tool.xlsx referenced by the Massachusetts TRM.
2 : Energy & Resource Solutions, November 2005. Measure Life Study. Prepared for Massachusetts Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : DNV GL (2015). Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for The Massachusetts Joint Utilities. DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf

2.14. Custom Measures

Measure Code	COM-CUS-LCI
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Custom

Measure Description:

The Custom project track is offered for electric and natural gas energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects which do not qualify for incentives under any of the prescriptive rebate offering.

Baseline Efficiency:

Retrofit projects will use the existing system or performance as the baseline as the first baseline and code or industry standard practice (ISP) as the second baseline. Lost opportunity projects will generally refer to code for measures where code applies, until such time as the EM&V working group selects appropriate ISP values from relevant research. Other factors being equal, New Hampshire jurisdiction-specific results will be favored over results from other jurisdictions, however when relevant results exist from both New Hampshire and from other states, it may be necessary to balance the desirable attributes of state-specificity and data reliability. When considering whether to apply results from a study originating in another jurisdiction to New Hampshire programs, the EM&V working group (with support from independent evaluation firms as needed), will make the determination based on 1) the similarity of evaluated program/measures to those offered in NH; 2) the similarity of relevant markets and customer base, 3) the recency of the study relative to the recency of any applicable NH results, and 4) the quality of the study's methodology and sample size. If a relevant ISP has been established, lost opportunity projects should refer to that ISP if applicable. If code does not apply and an ISP is not available, engineering judgment should be used to determine a project baseline. Baseline selection by engineering judgment should be justified by interviews with equipment vendors or subject matter experts; or by examining similar equipment installation by customer in other facilities.

High Efficiency:

The high efficiency scenario is specific to the custom project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on projected or measured changes in equipment efficiencies and operating characteristics and are determined on a case-by-case basis.

Algorithms for Calculating Primary Energy Impact:

Gross energy and demand savings estimates for custom projects are calculated using engineering analysis with project-specific details. Custom analyses typically include a weather dependent load bin analysis, whole building energy model simulation, end-use metering or other engineering analysis and include estimates of savings, costs, and an evaluation of the projects' cost-effectiveness.

Measure Life:

For both lost-opportunity and retrofit custom applications, the measure life is determined on a case-by-case basis.[1] Measure life for similar prescriptive measures may be used as default values. Remaining useful life (RUL) for existing equipment should be justified based on maintenance and repair history, As a default, RUL equal to one third of the equipment life may be used.

Other Resource Impacts:

Other resource impacts should be determined on a case by case basis for custom projects.

Impact Factors for Calculating Adjusted Gross Savings:

2

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b001	Custom Large Compressed Air New	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1a001	Custom Large Compressed Air Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1d001	Custom Large Compressed Air Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1b002	Custom Large Hot Water New	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1a002	Custom Large Hot Water Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1d002	Custom Large Hot Water Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1b003	Custom Large HVAC New	LBES	1.000	0.900	0.87	1.000	1.000	1.00	0.385
EC1a003	Custom Large HVAC Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC1d003	Custom Large HVAC Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC1b004	Custom Large Lighting New – Interior	LBES	1.000	0.990	n/a	1.000	1.000	0.80	0.61
EC1b054	Custom Large Lighting New – Exterior	LBES	1.000	0.990	n/a	1.000	1.000	0.00	1.00
EC1b055	Custom Large Lighting New – Controls	LBES	1.000	0.990	n/a	1.000	1.000	0.15	0.13

EC1a004	Custom Large Lighting Retro – Interior	LBES	1.000	0.990	n/a	1.000	1.000	0.80	0.61
EC1a047	Custom Large Lighting Retro – Exterior	LBES	1.000	0.990	n/a	1.000	1.000	0.00	1.00
EC1a048	Custom Large Lighting Retro – Controls	LBES	1.000	0.990	n/a	1.000	1.000	0.15	0.13
EC1d004	Custom Large Lighting Direct Install – Interior	LBES	1.000	0.990	n/a	1.000	1.000	0.80	0.61
EC1d005	Custom Large Lighting Direct Install – Exterior	LBES	1.000	0.990	n/a	1.000	1.000	0.00	1.00
EC1d006	Custom Large Lighting Direct Install – Controls	LBES	1.000	0.990	n/a	1.000	1.000	0.15	0.13
EC1b005	Custom Large Motors New	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1a005	Custom Large Motors Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.92	0.90
EC1d007	Custom Large Motors Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.92	0.90
EC1b008	Custom Large Other New	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1a008	Custom Large Other Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1a010	Custom Large Other Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC1b006	Custom Large Process New	LBES	1.000	0.900	0.87	1.000	1.000	0.95	0.45
EC1a006	Custom Large Process Retro	LBES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC1d008	Custom Large Process Direct Install	LBES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC1b007	Custom Large Refrigeration New	LBES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC1a007	Custom Large Refrigeration Retro	LBES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC1d009	Custom Large Refrigeration Direct Install	LBES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC1b056	Custom Large Comprehensive Design	LBES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC3b001	Custom Muni Compressed Air New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00

EC3a001	Custom Muni Compressed Air Retro	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3d001	Custom Muni Compressed Air Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3b002	Custom Muni Hot Water New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3a002	Custom Muni Hot Water Retro	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3d002	Custom Muni Hot Water Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3b003	Custom Muni HVAC New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3a003	Custom Muni HVAC Retro	MES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC3d003	Custom Muni HVAC Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC3b004	Custom Muni Lighting New – Interior	MES	1.000	1.066	n/a	1.000	1.000	0.00	0.00
EC3b085	Custom Muni Lighting New – Exterior	MES	1.000	1.027	n/a	1.000	1.000	0.00	0.00
EC3b086	Custom Muni Lighting New – Controls	MES	1.000	1.00	n/a	1.000	1.000	0.00	0.00
EC3a004	Custom Muni Lighting Retro – Interior	MES	1.000	1.066	n/a	1.000	1.000	0.80	0.61
EC3a091	Custom Muni Lighting Retro – Exterior	MES	1.000	1.027	n/a	1.000	1.000	0.00	1.00
EC3a092	Custom Muni Lighting Retro – Controls	MES	1.000	1.00	n/a	1.000	1.000	0.15	0.13
EC3d004	Custom Muni Lighting Direct Install – Interior	MES	1.000	1.066	n/a	1.000	1.000	0.80	0.61
EC3d005	Custom Muni Lighting Direct Install – Exterior	MES	1.000	1.027	n/a	1.000	1.000	0.00	1.00
EC3d006	Custom Muni Lighting Direct Install – Controls	MES	1.000	1.00	n/a	1.000	1.000	0.15	0.13
EC3b005	Custom Muni Motors New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3a005	Custom Muni Motors Retro	MES	1.000	0.900	0.87	1.000	1.000	0.92	0.90
EC3d007	Custom Muni Motors Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.92	0.90

EC3b008	Custom Muni Other New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3a008	Custom Muni Other Retro	MES	1.000	0.900	0.87	1.000	1.000	0.476	0.428
EC3d010	Custom Muni Other Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.476	0.428
EC3b006	Custom Muni Process New	MES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC3a006	Custom Muni Process Retro	MES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC3d008	Custom Muni Process Direct Install	MES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC3b007	Custom Muni Refrigeration New	MES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC3a007	Custom Muni Refrigeration Retro	MES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC3d009	Custom Muni Refrigeration Direct Install	MES	1.000	0.900	n/a	1.000	1.000	0.00	0.00
EC2b001	Custom Small Compressed Air New	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2a001	Custom Small Compressed Air Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2d001	Custom Small Compressed Air Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2b002	Custom Small Hot Water New	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2a002	Custom Small Hot Water Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2d002	Custom Small Hot Water Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.00	0.00
EC2b003	Custom Small HVAC New	SBES	1.000	0.900	0.87	1.000	1.000	1.00	0.385
EC2a003	Custom Small HVAC Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC2d003	Custom Small HVAC Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.70	0.85
EC2b004	Custom Small Lighting New - Interior	SBES	1.000	1.066	n/a	1.000	1.000	0.80	0.61
EC2b054	Custom Small Lighting New - Exterior	SBES	1.000	1.027	n/a	1.000	1.000	0.00	1.00

EC2b055	Custom Small Lighting New - Controls	SBES	1.000	1.00	n/a	1.000	1.000	0.15	0.13
EC2a004	Custom Small Lighting Retro - Interior	SBES	1.000	1.066	n/a	1.000	1.000	0.70	0.85
EC2a047	Custom Small Lighting Retro- Exterior	SBES	1.000	1.027	n/a	1.000	1.000	0.80	0.61
EC2a048	Custom Small Lighting Retro - Controls	SBES	1.000	1.00	n/a	1.000	1.000	0.15	0.13
EC2d004	Custom Small Lighting Direct Install - Interior	SBES	1.000	1.066	n/a	1.000	1.000	0.70	0.85
EC2d005	Custom Small Lighting Direct Install - Exterior	SBES	1.000	1.027	n/a	1.000	1.000	0.80	0.61
EC2d006	Custom Small Lighting Direct Install - Controls	SBES	1.000	1.00	n/a	1.000	1.000	0.15	0.13
EC2b005	Custom Small Motors New	SBES	1.000	0.900	0.87	1.000	1.000	0.95	0.80
EC2a005	Custom Small Motors Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.92	0.90
EC2d007	Custom Small Motors Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.92	0.90
EC2b008	Custom Small Other New	SBES	1.000	0.900	0.87	1.000	1.000	0.476	0.428
EC2a008	Custom Small Other Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.45	0.52
EC2d010	Custom Small Other Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.45	0.52
EC2b006	Custom Small Process New	SBES	1.000	0.900	0.87	1.000	1.000	0.95	0.45
EC2a006	Custom Small Process Retro	SBES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC2d008	Custom Small Process Direct Install	SBES	1.000	0.900	0.87	1.000	1.000	0.95	0.90
EC2b007	Custom Small Refrigeration New	SBES	1.000	0.900	n/a	1.000	1.000	0.80	0.80
EC2a007	Custom Small Refrigeration Retro	SBES	1.000	0.900	n/a	1.000	1.000	0.90	0.99
EC2d009	Custom Small Refrigeration Direct Install	SBES	1.000	0.900	n/a	1.000	1.000	0.90	0.99
EC2b056	Custom Small Comprehensive Design	SBES	1.000	0.900	n/a	1.000	1.000	0.90	0.99

GC1a001	Custom Large Hot Water Retro	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1a002	Custom Large HVAC Retro	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1a003	Custom Large Other Retro	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1a004	Custom Large Process Retro	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1b001	Custom Large Hot Water New	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1b002	Custom Large HVAC New	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1b003	Custom Large Other New	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC1b004	Custom Large Process New	LBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2a001	Custom Small Hot Water Retro	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2a002	Custom Small HVAC Retro	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2a003	Custom Small Other Retro	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2a004	Custom Small Process Retro	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2b001	Custom Small Hot Water New	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2b002	Custom Small HVAC New	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2b003	Custom Small Other New	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a
GC2b004	Custom Small Process New	SBES	1.000	n/a	0.87	n/a	n/a	n/a	n/a

Energy Load Shape:

See Appendix 1, C&I Load Shapes Table

- “C&I Interior Lighting – Prescriptive”
- “C&I Exterior Lighting”
- “C&I Lighting Controls”
- “C&I Refrigeration”

Impact Factors for Calculating Net Savings:

[3] Free-ridership and spillover for custom lighting are based on study results from CT the nearby jurisdiction with programs and markets most similar to those in NH.[4]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC2b004	Custom Small Lighting New - Interior	SBES	11%	5%	0%	94%
EC2b054	Custom Small Lighting New - Exterior	SBES	11%	5%	0%	94%
EC2b055	Custom Small Lighting New - Controls	SBES	11%	5%	0%	94%
EC2a004	Custom Small Lighting Retro - Interior	SBES	11%	5%	0%	94%
EC2a047	Custom Small Lighting Retro- Exterior	SBES	11%	5%	0%	94%
EC2a048	Custom Small Lighting Retro - Controls	SBES	11%	5%	0%	94%
EC2d004	Custom Small Lighting Direct Install - Interior	SBES	11%	5%	0%	94%
EC2d005	Custom Small Lighting Direct Install - Exterior	SBES	11%	5%	0%	94%
EC2d006	Custom Small Lighting Direct Install - Controls	SBES	11%	5%	0%	94%
EC3b004	Custom Muni Lighting New – Interior	MES	11%	5%	0%	94%
EC3b085	Custom Muni Lighting New – Exterior	MES	11%	5%	0%	94%
EC3b086	Custom Muni Lighting New – Controls	MES	11%	5%	0%	94%
EC3a004	Custom Muni Lighting Retro – Interior	MES	11%	5%	0%	94%
EC3a091	Custom Muni Lighting Retro – Exterior	MES	11%	5%	0%	94%
EC3a092	Custom Muni Lighting Retro – Controls	MES	11%	5%	0%	94%
EC3d004	Custom Muni Lighting Direct Install – Interior	MES	11%	5%	0%	94%
EC3d005	Custom Muni Lighting Direct Install – Exterior	MES	11%	5%	0%	94%
EC3d006	Custom Muni Lighting Direct Install – Controls	MES	11%	5%	0%	94%
EC1b004	Custom Large Lighting New – Interior	LBES	11%	5%	0%	94%
EC1b054	Custom Large Lighting New – Exterior	LBES	11%	5%	0%	94%
EC1b055	Custom Large Lighting New – Controls	LBES	11%	5%	0%	94%
EC1a004	Custom Large Lighting Retro – Interior	LBES	11%	5%	0%	94%
EC1a047	Custom Large Lighting Retro – Exterior	LBES	11%	5%	0%	94%
EC1a048	Custom Large Lighting Retro – Controls	LBES	11%	5%	0%	94%

EC1d004	Custom Large Lighting Direct Install – Interior	LBES	11%	5%	0%	94%
EC1d005	Custom Large Lighting Direct Install – Exterior	LBES	11%	5%	0%	94%
EC1d006	Custom Large Lighting Direct Install – Controls	LBES	11%	5%	0%	94%

Revision History:

Revision Number	Date	Description
135	12/1/2022	Added verbiage to clarify process for baseline and measure life calculation.

Endnotes:

1 : Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-2. ERS_2005_Measure_Life_Study
2 : Realization rates for custom non lighting measures are based on a weighted average of realization rates from jurisdictions within New England, with a 50% weight for New Hampshire. To be updated once the Large C&I Custom Impact Evaluation is complete in 2021/2022. Realization rates for custom lighting measures are based on DNV GL, September 2015. New Hampshire Utilities Large Commercial and Industrial (C&I) Retrofit And New Equipment & Construction Program Impact Evaluation. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
3 : Baseline Categories and preliminary Out Year Factors are described at a high level in DNV GL, ERS (2018). Portfolio Model Companion Sheet. Additional background on the baseline categorization given in DNV GL, ERS (2018). Portfolio Model Methods and Assumptions – Electric and Natural Gas Memo. 2018_DNVGL_ERS_Portfolio_Model_Companion_Sheet
4 : EMI, September 25, 2019 . C1644 EO Net-to-Gross Study, Final Report. https://www.energizect.com/sites/default/files/C1644%20-%20EO%20NTG%20Final%20Report_9.25.19.pdf Downstream NTG values are based on Energy Opportunities NTG Study Results for Lighting shown in Table ES-1-1 on p. ES-3.

2.15. Conveyor Broiler

Measure Code	COM-FS-CB
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an energy efficient underfired broiler to replace a conventional automatic constant input rate conveyor broiler. This measure has both electric and gas savings.

Baseline Efficiency:

Baseline broiler must be an automatic conveyor broiler capable of maintaining a temperature above 600 F with a tested idle rate greater than:
• 40 kBtu/h for a belt narrower than 22"
• 60 kBtu/h for a belt between 22 and 28"
• 70 kBtu/h for a belt wider than 28"

High Efficiency:

An efficient conveyor broiler must be installed with a catalyst and have an input rate of less than 80 kBtu/h OR a dual-stage or modulating gas valve with a capacity of throttling the input rate below 80 kBtu/h. Must be installed under a Type II Hood.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on the SoCalGas Commercial Conveyor Broilers workpaper WPSCGNRCC171226A.[1]

BC MEASURE ID	Measure Name	Program	ΔkWH[1]	ΔkW[1]	Δtherms[1]
EC1c047 EC2c047	Conveyor Broiler <22”	LBES Mid SBES Mid	7,144	1.48	1,145
EC1c047 EC2c047	Conveyor Broiler 22-28”	LBES Mid SBES Mid	6,403	.88	1,933
EC1c047 EC2c047	Conveyor Broiler >22”	LBES Mid SBES Mid	23,849	3.29	3,161

Measure Life:

The measure life for a conveyor broiler is 12 years. [2]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c047 EC2c047	Conveyor Broiler <22"	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	.90	.90
EC1c047 EC2c047	Conveyor Broiler 22-28"	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	.90	.90
EC1c047 EC2c047	Conveyor Broiler >22"	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	.90	.90

<u>In-Service Rates:</u>
All installations have a 100% in-service rate unless an evaluation finds otherwise

<u>Realization Rates:</u>
All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>
Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[3]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "LS_111 C&I Food Service"

Impact Factors for Calculating Net Savings[4]:

BC Measure ID	Measure Name	Program	FR	SO_p	SO_{NP}	NTG
EC1c047 EC2c047	Conveyor Broiler <22"	LBES Mid SBES Mid	0.225	0.085	0.00	0.86
EC1c047 EC2c047	Conveyor Broiler 22-28"	LBES Mid SBES Mid	0.225	0.085	0.00	0.86
EC1c047 EC2c047	Conveyor Broiler >22"	LBES Mid SBES Mid	0.225	0.085	0.00	0.86

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

Revision History:

Revision Number	Date	Revision
60	3/1/2022	Conveyor Broiler Measures Added to TRM

Endnotes:

1 : SoCalGas, 2019. “WPSCGNRCC171226A – Commercial Conveyor Broilers” Revision 01.
2 : California Public Utilities Commission (CPUC), Energy Division. 2014. “DEER2014-EUL-table-update_2014-02-05.xlsx” https://www.caetrm.com/media/reference-documents/DEER2014-EUL-table-update_2014-02-05_PUq4NzL.xlsx
3 : SoCalGas, 2019. “WPSCGNRCC171226A – Commercial Conveyor Broilers” Revision 01.

4 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors’ Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.16. Deck Oven

Measure Code	CI-FS-DO
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of a Food Service Technology Center (FSTC) pre-approved electric deck oven, with greater than 60% efficiency and less than 1.3 kw idle rate. A commercial electric deck oven is an appliance that cooks food product within a heated chamber. The food product can be placed directly on the floor of the chamber during cooking and energy is delivered to the food product by convective, conductive, or radiant heat transfer. The chamber can be heated by electric forced convection, radiation, or quartz tubes. Top and bottom heat of the oven can be independently controlled.

Baseline Efficiency:

The baseline is defined as a commercial electric deck oven with equal to or greater than 40% cooking efficiency, an idle energy rate less than or equal to 1.9 kW and a measure pre heat energy of less than or equal to 6.5 kWh.[1]

High Efficiency:

An efficient deck oven is defined as having greater than or equal to 60% efficiency, less than or equal to 1.3 Kw idle energy rate, and a preheat energy us of less than or equal to 3 kWh and included on the Food Service Technology Center (FSTC) pre-approved list found at : https://caenergywise.com/rebates/

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkWh[1,2]	ΔkW[1,2]
EC1c050 EC2c050	Electric Deck Oven	LBES Mid SBES Mid	7,519	1.545

KW savings numbers are calculated based on PSD AKW savings equation:

$$\Delta \boldsymbol{KW} = \frac{\Delta \boldsymbol{KWH}}{\mathbf{8,760}\ \boldsymbol{hrs/yr}}$$

Measure Life:

The measure life for an electric deck oven is 12 years. [3]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c050 EC2c050	Electric Deck Oven	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	0.90	0.90

In-Service Rates:
All installations have a 100% in-service rate unless an evaluation finds otherwise
Realization Rates:
All programs use a 100% realization rate unless an evaluation finds otherwise.
Coincidence Factors:
Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[1]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "LS_111 C&I Food Service"

Impact Factors for Calculating Net Savings[2]:

BC Measure ID	Measure Name	Program	FR	SO_p	SO_{NP}	NTG
EC1c050 EC2c050	Electric Deck Oven	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
61	3/1/2021	New Measure Added

Endnotes:

1 : SoCalGas, 2019. "WPSCGNRCC171226A – Commercial Conveyor Broilers" Revision 01.
2 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52

2.17. Dishwasher

Measure Code	COM-FSE-DWS
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Dishwasher High Temperature: Installation of a qualified ENERGY STAR® high temperature commercial dishwasher in a building with gas domestic hot water. High temperature dishwashers use a booster heater to raise the rinse water temperature to 180 F – hot enough to sterilize dishes and assist in drying. Electric savings are achieved through savings to the electric booster.

Dishwasher Low Temperature: Installation of a qualified ENERGY STAR® low temperature commercial dishwasher in a facility with electric hot water heating. Low temperature dishwashers use the hot water supplied by the kitchen's existing water heater and use a chemical sanitizing agent in the final rinse cycle and sometimes a drying agent.

Baseline Efficiency:

Dishwasher High Temp: The baseline efficiency case is a commercial dishwasher with idle energy rates and water consumption as follows[1]

Dishwasher Type	Idle Energy Rate (kW)	Water Consumption (gal/rack)
High Temp Under Counter Dishwasher	0.76	1.09
High Temp Door Type Dishwasher	0.87	1.29
High Temp Single Tank Conveyer Dishwasher	1.93	0.87
High Temp Multi Tank Conveyer Dishwasher	2.59	0.97
High Temp Pots & Pans Dishwasher	1.20	0.70

Dishwasher Low Temp: The baseline efficiency case is a commercial dishwasher with idle energy rates and water consumption as follows[2] .

Dishwasher Type	Idle Energy Rate (kW)	Water Consumption (gal/rack)
Low Temp Under Counter Dishwasher	0.50	1.73
Low Temp Door Type Dishwasher	0.60	2.10

Low Temp Single Tank Conveyor Dishwasher	1.60	1.31
Low Temp Multi Tank Conveyor Dishwasher	2.00	1.04

High Efficiency:

Dishwasher High Temp: The high efficiency case is a commercial dishwasher with idle energy rates and water consumption following ENERGY STAR® Efficiency Requirements[3] as follows:

Dishwasher Type	Idle Energy Rate (kW)	***Washing Energy***	Water Consumption (gal/rack)
High Temp Under Counter Dishwasher	≤ 0.30kW	≤ 0.35 kWh/rack	0.86
High Temp Door Type Dishwasher	≤ 0.55kW	≤ 0.35 kWh/rack	0.89
High Temp Single Tank Conveyer Dishwasher	≤ 1.20kW	≤ 0.36 kWh/rack	0.70
High Temp Multi Tank Conveyer Dishwasher	≤1.85kW	≤ 0.36 kWh/rack	0.54
High Temp Pots & Pans Dishwasher	≤0.90kW	≤ 0.55 + 0.05 x SFrack k	0.58

Dishwasher Low Temp: The high efficiency case is a commercial dishwasher with idle energy rates and water consumption following ENERGY STAR® Efficiency Requirements[4] · as follows:

Dishwasher Type	Idle Energy Rate (kW)	***Washing Energy***	Water Consumption (gal/rack)
Low Temp Under Counter Dishwasher	≤ 0.25 kW	≤ 0.15 kWh/rack	1.19
Low Temp Door Type Dishwasher	≤ 0.30 kW	≤ 0.15 kWh/rack	1.18
Low Temp Single Tank Conveyor Dishwasher	≤ 0.85 kW	≤ 0.16 kWh/rack	0.79
Low Temp Multi Tank Conveyor Dishwasher	≤ 1.00 kW	≤ 0.22 kWh/rack	0.54

Algorithms for Calculating Primary Energy Impact:

Dishwasher High Temp: Unit kwh savings are deemed based on the Energy Star Commercial Kitchen Equipment Savings Calculator[5] :

For kW savings

kW = kWh / hours

Where:

kWh = gross annual kWh savings from the measure. See table below.

kW = gross average kW savings from the measure. See table below.

MMBtu = gross average natural gas MMBtu savings from the measure. See table below.

Hours = Average annual equipment operating hours is 18 hours/ day, 6,570 hours/year per the Energy Star calculator

BC Measure ID	Measure	Program	ΔkW	ΔkWh
EC1b026 EC2b026 EC3b040 EC1c024 EC2c024	High Temp Under Counter Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	0.48	3,171
EC1b022 EC2b022 EC3b036 EC1c020 EC2c020	High Temp Door Type Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	1.81	11,863
EC1b025 EC2b025 EC3b039 EC1c023 EC2c023	High Temp Single Tank Conveyer Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	1.40	9,212
EC1b023 EC2b023 EC3b037 EC1c021 EC2c021	High Temp Multi Tank Conveyer Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	4.17	27,408
EC1b024 EC2b024 EC3b038 EC1c022 EC2c022	High Temp Pots & Pans Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	0.50	3,311

EC1b030 EC2b030 EC3b044 EC1c028 EC2c028	Low Temp Under Counter Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	0.39	2,540
EC1b027 EC2b027 EC3b041 EC1c025 EC2c025	Low Temp Door Type Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	2.46	16,153
EC1b029 EC2b029 EC3b043 EC1c027 EC2c027	Low Temp Single Tank Conveyor Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	2.07	13,626
EC1b028 EC2b028 EC3b042 EC1c026 EC2c026	Low Temp Multi Tank Conveyor Dishwasher	LBES New SBES New Muni New LBES Mid SBES Mid	2.86	18,811

Measure Life:

The measure life for a new high temperature dishwasher is given by type below[6]

BC Measure ID	Measure Name	Program	Measure Life
EC1b026 EC2b026 EC3b040	High Temp Under Counter Dishwasher	LBES New SBES New Muni New	10
EC1b022 EC2b022 EC3b036	High Temp Door Type Dishwasher	LBES New SBES New Muni New	15
EC1b025 EC2b025 EC3b039	High Temp Single Tank Conveyer Dishwasher	LBES New SBES New Muni New	20
EC1b023 EC2b023 EC3b037	High Temp Multi Tank Conveyer Dishwasher	LBES New SBES New Muni New	20
EC1b024 EC2b024 EC3b038	High Temp Pots & Pans Dishwasher	LBES New SBES New Muni New	10

EC1b030 EC2b030 EC3b044	Low Temp Under Counter Dishwasher	LBES New SBES New Muni New	10
EC1b027 EC2b027 EC3b041	Low Temp Door Type Dishwasher	LBES New SBES New Muni New	15
EC1b029 EC2b029 EC3b043	Low Temp Single Tank Conveyor Dishwasher	LBES New SBES New Muni New	20
EC1b028 EC2b028 EC3b042	Low Temp Multi Tank Conveyor Dishwasher	LBES New SBES New Muni New	20

Other Resource Impacts:

Dishwasher high temp: There are water savings associated with this measure.[7]

Dishwasher Type	Annual water savings (gal/unit)
High Temp Under Counter Dishwasher	6,296
High Temp Door Type Dishwasher	40,880
High Temp Single Tank Conveyer Dishwasher	24,820
High Temp Multi Tank Conveyer Dishwasher	94,170
High Temp Pots & Pans Dishwasher	12,264

Dishwasher low temp: There are water savings associated with this measure.[8]

Dishwasher Type	Annual water savings (gal/unit)
Low Temp Under Counter Dishwasher	14,783
Low Temp Door Type Dishwasher	94,024
Low Temp Single Tank Conveyor Dishwasher	75,920
Low Temp Multi Tank Conveyor Dishwasher	109,500

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b026 EC2b026 EC3b040 EC1c024 EC2c024	High Temp Under Counter Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b022 EC2b022 EC3b036 EC1c020 EC2c020	High Temp Door Type Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b025 EC2b025 EC3b039 EC1c023 EC2c023	High Temp Single Tank Conveyer Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b023 EC2b023 EC3b037 EC1c021 EC2c021	High Temp Multi Tank Conveyer Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b024 EC2b024 EC3b038 EC1c022 EC2c022	High Temp Pots & Pans Dishwasher	SBES New LBES Mid SBES Mid Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b030 EC2b030 EC3b044 EC1c028 EC2c028	Low Temp Under Counter Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b027 EC2b027 EC3b041 EC1c025 EC2c025	Low Temp Door Type Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b029 EC2b029 EC3b043 EC1c027 EC2c027	Low Temp Single Tank Conveyor Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90

EC1b028 EC2b028 EC3b042 EC1c026 EC2c026	Low Temp Multi Tank Conveyor Dishwasher	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b026 EC2b026 EC3b040	High Temp Under Counter Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b022 EC2b022 EC3b036	High Temp Door Type Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b025 EC2b025 EC3b039	High Temp Single Tank Conveyer Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b023 EC2b023 EC3b037	High Temp Multi Tank Conveyer Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b024 EC2b024 EC3b038	High Temp Pots & Pans Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b030 EC2b030 EC3b044	Low Temp Under Counter Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b027 EC2b027 EC3b041	Low Temp Door Type Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b029 EC2b029 EC3b043	Low Temp Single Tank Conveyor Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b028 EC2b028 EC3b042	Low Temp Multi Tank Conveyor Dishwasher	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90

In-Service Rates:

In-service rates are assumed to be 100% until an evaluation finds otherwise.

Realization Rates:

Realization rates are assumed to be 100% until an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[9]

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1, C&I Load Shapes Table- “C&I Food Services”

Impact Factors for Calculating Net Savings:

10

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c024 EC2c024	High Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c020 EC2c020	High Temp Door Type Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c023 EC2c023	High Temp Single Tank Conveyer Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c021 EC2c021	High Temp Multi Tank Conveyer Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c022 EC2c022	High Temp Pots & Pans Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c028 EC2c028	Low Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c025 EC2c025	Low Temp Door Type Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c027 EC2c027	Low Temp Single Tank Conveyor Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c026 EC2c026	Low Temp Multi Tank Conveyor Dishwasher	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Endnotes:

1 : ENERGY STAR Commercial Kitchen Equipment Calculator. Updated March 2021. Note: High temperature units are assumed to have natural gas hot water and electric temperature boosters. Low temperature units are assumed to have electric hot water.
https://www.energystar.gov/partner_resources/energy_star_training_center/commercial_food_service
2 : ENERGY STAR Commercial Kitchen Equipment Calculator. Updated March 2021. Note: High

temperature units are assumed to have natural gas hot water and electric temperature boosters. Low temperature units are assumed to have electric hot water.
https://www.energystar.gov/partner_resources/energy_star_training_center/commercial_food_service
3 : ENERGY STAR Commercial Dishwashers Key Product Criteria, version 3.0. Effective July 27,2021.
https://www.energystar.gov/sites/default/files/Commercial%20Dishwashers%20Final%20Version%203.0%20Specification.pdf
4 : 3 : ENERGY STAR Commercial Dishwashers Key Product Criteria, version 3.0. Effective July 27,2021.
https://www.energystar.gov/sites/default/files/Commercial%20Dishwashers%20Final%20Version%203.0%20Specification.pdf
5 : CFS_calculator_07-15-2021 (1)_ Dishwasher
6 : CFS_calculator_07-15-2021 (1)_ Dishwasher
7 : CFS_calculator_07-15-2021 (1)_ Dishwasher
8 : CFS_calculator_07-15-2021 (1)_ Dishwasher
9 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
10 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.18. Freezer

Measure Code	COM-FS-FRZR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Installation of a qualified ENERGY STAR qualified reach-in freezer that replaces a standard efficiency unit of the same configuration and capacity. The freezer may have a solid door or transparent door. Measure savings are defined by configuration and internal volume as specified in the ENERGY STAR commercial requirements presented below.

Baseline Efficiency:

The baseline case includes standard-efficiency, reach-in, solid and transparent door freezers and are defined by the U.S. Department of Energy (DOE) federal requirements.

High Efficiency:

The high efficiency case is an ENERGY STAR qualified reach-in freezer having the same configuration and capacity as the baseline equipment .

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated and based on the ENERGY STAR Commercial Kitchen Equipment Calculator.

$$\Delta kWh = kWh_{BL} - kWh_{EE}$$
$$kWh_{BL} = (kWh_D)_{BL} \times D$$
$$kWh_{EE} = (kWh_D)_{EE} \times D$$

Where,

ΔkWh = Annual electric energy savings (kWh)
kWh_{BL} = Annual electric energy consumption of baseline equipment (kWh). Calculate from table below.
kWh_{EE} = Annual electric energy consumption of efficient equipment (kWh). Calculate from table below.
kWh_D = Daily electric energy consumption (kWh)
D = Number of days of operation of the unit. Use site specific data if possible (365 days is default).
V = Internal volume of equipment (ft3)

Equipment Daily Consumption[1 2]

Door Type	Size Thresholds	Baseline Freezer Daily Energy Consumption $(kWh_D)_{BL}$	Efficient Freezer Daily Energy Consumption $(kWh_D)_{EE}$
Solid Door	0 < V < 15	(0.22 x V) + 1.38	(0.021 x V) + 0.90
	15 < V < 30		(0.012 x V) + 2.248
	30 < V < 50		(0.285 x V) - 2.703
	50 < V		(0.142 x V) + 4.445
Transparent Door	All	(0.29 x V) + 2.95	(0.232 x V) + 2.36

Measure Life:

[3]

BC Measure ID	Measure Name	Measure Life
EC1c030 EC2c030	Freezer, Transparent Door	12
EC1c029 EC2c029	Freezer, Solid Door	12

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c030 EC2c030	Freezer, Transparent Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00
EC1c029 EC2c029	Freezer, Solid Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

All programs use a 100% coincidence factor unless an evaluation finds otherwise.

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Food Service".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[4]

BC Measure ID	Measure Name	Program	FR	SOP	SONP	NTG
EC1c030 EC2c030	Freezer, Transparent Door	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c029 EC2c029	Freezer, Solid Door	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:

1 : Efficient equipment daily energy consumption is in line with ENERGY STAR. 2016. "ENERGY STAR® Program Requirements Product Specification for Commercial Refrigerators and Freezers - Eligibility Criteria Version 4.0." Effective on March 27, 2017.
2 : Baseline equipment daily energy consumption is defined by the U.S. Department of Energy (DOE) federal requirements. Code of Federal Regulations at 10 CFR 431.66.
3 : California Public Utilities Commission (CPUC), Energy Division. 2014. "DEER2014-EUL-table-update_2014-02-05.xlsx."
4 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.19. Fryer

Measure Code	COM-FS-FRYR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Electric Fryer: Installation of a qualified ENERGY STAR standard or large vat commercial fryer. ENERGY STAR commercial fryers save energy during cooking and idle times due to improved cooking efficiency and idle energy rates.

Gas Fryer: The installation of a natural-gas fired fryer that is either ENERGY STAR rated or has a heavy-load cooking efficiency of at least 50%. Qualified fryers use advanced burner and heat exchanger designs to use fuel more efficiently, as well as increased insulation to reduce standby heat loss

Baseline Efficiency:

Electric Fryer: The baseline efficiency case for both, standard sized fryers and large capacity fryers is an electric deep-fat fryer of the same size with a cooking energy efficiency, shortening capacity, and idle energy rate as defined by any relevant U.S. federal requirements.

Gas Fryer: The baseline efficiency case is a gas deep-fat fryer of the same size with a cooking energy efficiency, shortening capacity, and idle energy rate as defined by any relevant U.S. federal requirements.

High Efficiency:

Electric Fryer: The high efficiency case for both, standard sized fryer and large capacity fryers is an electric deep-fat fryer with a cooking energy efficiency, shortening capacity, and idle energy rate in line with ENERGY STAR Commercial Fryer Program Requirements Version 3.0 effective October 1st, 2016.

Gas Fryer: The high efficiency case is a deep-fat gas fryer with a cooking energy efficiency, shortening capacity, and idle energy rate in line with ENERGY STAR ENERGY STAR Commercial Fryer Program Requirements Version 3.0 effective October 1st, 2016.

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = \Delta kWh$
$\Delta kW = \Delta kWh / Hours$

Where:

ΔkWh = gross annual kWh savings from the measure per table below
ΔkW = gross average kW savings from the measure per table below
Hours = Annual hours of operation

ΔMMBtu = ΔMMBtu

Where:

ΔMMBtu = gross annual MMBtu gas savings from the measure per table below

Energy Savings for Commercial Fryer:[1]

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh[2]	ΔMMBtu[3]
EC1b033 EC2b033 EC3b050 EC1c032 EC2c032	Electric Fryer, Standard Vat	LBES New SBES New Muni LBES Mid SBES Mid	0.56	3,272	n/a
EC1b032 EC2b032 EC3b049 EC1c031 EC2c031	Electric Fryer, Large Vat	LBES New SBES New Muni LBES Mid SBES Mid	0.61	2,696	n/a
GC1b024 GC2b024 GC1c004 GC2c004	Gas Fryer	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	51.2

Measure Life:

The measure life for a new commercial fryer is 12 years[4]

Other Resource Impacts:

There are no other resource impacts for these measures.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b033	Electric Fryer, Standard Vat	LBES New	1.00	.99	n/a	1.00	1.00	0.90	0.90
EC1b032	Electric Fryer, Large Vat	LBES New	1.00	.99	n/a	1.00	1.00	0.90	0.90

GC1b024	Gas Fryer	LBES New	1.00	n/a	1.00	1.00	1.00	n/a	n/a
EC1b033 EC2b033 EC3b050 EC1c032 EC2c032	Electric Fryer, Standard Vat	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b032 EC2b032 EC3b049 EC1c031 EC2c031	Electric Fryer, Large Vat	SBES New Muni LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
GC1b024 GC2b024 GC1c004 GC2c004	Gas Fryer	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	1.00	1.00	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[2]

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 C&I Load Shapes, "C&I Food Services"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[6]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c032 EC2c032	Electric Fryer, Standard Vat	LBES Mid SBES Mid	0.225	0.085	0	0.86

EC1c031 EC2c031	Electric Fryer, Large Vat	LBES Mid SBES Mid	0.225	0.085	0	0.86
GC1c004 GC2c004	Gas Fryer	LBES Mid SBES Mid	0.237	0.07	0	0.83

Revision History:

Revision	Date	Description
152	12/1/2022	Updated electric and gas savings to align with 2021 Energy Star Commercial Food Service Calculator.

Endnotes:

1 : CFS_calculator_07-15-2021 (4)_Fryer 2022
2 : California Energy Wise Commercial Kitchen Energy Savings Calculators, Available online at: https://caenergywise.com/calculators/
3 : California Energy Wise Commercial Kitchen Energy Savings Calculators, Available online at: https://caenergywise.com/calculators/, last accessed Jul. 30, 2019.
4 : SupportTable_EUL.csv, from DEER Database for Energy-Efficient Resources; Version 2016, READI v.2.4.3 (Current Ex Ante data) found at http://www.deeresources.com/
5 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
6 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.20. Pasta Cooker

Measure Code	COM-FS-PC
Markets	Commercial
Program Types	New Construction, Downstream
Categories	Food Service Equipment

Measure Description:

This measure applies to natural gas fired dedicated pasta cookers with removable strainers as determined by the manufacturer and installed in a commercial kitchen.

Baseline Efficiency:

The baseline equipment is an existing natural gas fired stove where pasta is cooked in a pan.

High Efficiency:

The installed dedicated natural gas fueled high efficiency pasta cooker with removable strainer equivalent to 50% effeciency steam kettle.

Algorithms for Calculating Primary Energy Impact:

Savings are shown as annual therms savings per pasta cooker. [1]

BC Measure ID	Measure Name	Program	Δtherms per pasta cooker
GC1b033 GC1c023 GC2b033 GC2c023 GC3b033	Efficient Pasta Cooker	LBES New/retro SBES New/retro Muni New/retro LBES Mid SBES Mid	1,402

Measure Life:

The measure life for an energy efficient pasta cooker is 12 years. [2]

Other Resource Impacts:

There are no other resource impacts for these measures.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b033 GC1c023 GC2b033 GC2c023 GC3b033	Efficient Pasta Cooker	LBES Mid LBES New SBES Mid SBES New Muni New	1.00	n/a	1.00	1.00	1.00	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 C&I Load Shapes, "C&I Food Services"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[6]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c023 GC2c023	Efficient Pasta Cooker	LBES Mid SBES Mid	0.225	0.085	0	0.86

Revision History:

Revision	Date	Description
	7/1/2023	New Measure Added

Endnotes:

1 : 'Arkansas Deemed TRM Table for GasFoodService.xls' from v4. Volume 2 Arkansas Technical Reference Manual. http://www.apscservices.info/pdf/10/10-100-R_118_3.pdf
2 : 'Arkansas Deemed TRM Table for GasFoodService.xls' from v4. Volume 2 Arkansas Technical Reference Manual. http://www.apscservices.info/pdf/10/10-100-R_118_3.pdf

2.21. Griddle

Measure Code	COM-FS-GRDL
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Electric Griddle: Installation of a qualified ENERGY STAR electric griddle.

Gas Griddle: Installation of a qualified ENERGY STAR gas griddle.

ENERGY STAR griddles save energy cooking and idle times due to improved cooking efficiency and idle energy rates.

Baseline Efficiency:

Electric Griddle: The baseline efficiency case is a typically sized, (6 sq. ft.) electric, commercial griddle with a cooking energy efficiency, production capacity, and idle energy rate as defined by any applicable U.S. federal requirements.

Gas Griddle: The baseline efficiency case is a typically sized, (6 sq. ft.) gas, commercial griddle with a cooking energy efficiency, production capacity, and idle energy rate as defined by any applicable U.S. federal requirements.

High Efficiency:

Electric Griddle: The high efficiency case is a typically sized (6 sq. ft.), electric, commercial griddle with a cooking energy efficiency, production capacity, and idle energy rate meeting the minimum ENERGY STAR program requirements version 1.2. [1]

Gas Griddle: The high efficiency case is a typically sized (6 sq. ft.), gas, commercial griddle with a cooking energy efficiency, production capacity, and idle energy rate meeting the minimum ENERGY STAR program requirements version 1.2.[2]

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed using the 2021 Energy Star Commercial Food Service Calculators.[3]

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu

EC1b034 EC2b034 EC3b055 EC1c033 EC2c033	Commercial Electric Griddle, double sided	LBES New SBES New Muni LBES Mid SBES Mid	0.73	3,179	n/a
GC1b025 GC2b025 GC1c005 GC2c005	Commercial Gas Griddle, double sided	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	22.1

For electric Griddle:

$\Delta kWh = \Delta kWh$
$\Delta kW = \Delta kWh / Hours$

Where:

ΔkWh = gross annual kWh savings from the measure per table above
ΔkW = gross average kW savings from the measure per table above
Hours = annual operating hours

For Gas Griddle:

$\Delta MMBtu = MMBtu$

Where:

$\Delta MMBtu$ = gross annual MMBtu gas savings from the measure per table above.

Measure Life:

The measure life for a new commercial griddle is 12 years[4]

Other Resource Impacts:

There are no other resource impacts for these measures.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}

EC1b034	Electric Griddle	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
GC1b025	Gas Griddle	LBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC2b034 EC3b055 EC1c033 EC2c033	Electric Griddle	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
GC1b025 GC2b025 GC1c005 GC2c005	Gas Griddle	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[5]

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 C&I Load Shapes, “C&I Food Services”.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[6]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c033 EC2c033	Electric Griddle	LBES Mid SBES Mid	0.225	0.085	0	0.86
GC1c005 GC2c005	Gas Griddle	LBES Mid SBES Mid	0.237	0.07	0	0.83

Endnotes:

1 : Energy Star Program Requirements for Commercial Griddles version 1.2. https://www.energystar.gov/sites/default/files/Commercial%20Griddles%20Version%201.2%20%28Rev%20December%20-%202020%29.pdf
2 : Energy Star Program Requirements for Commercial Griddles version 1.2. https://www.energystar.gov/sites/default/files/Commercial%20Griddles%20Version%201.2%20%28Rev%20December%20-%202020%29.pdf
3 : CFS_calculator_07-15-2021 (4)_griddle
4 : SupportTable_EUL.csv, from DEER Database for Energy-Efficient Resources; Version 2016, READI v.2.4.3 (Current Ex Ante data) found at http://www.deeresources.com/
5 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
6 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.22. Hand-Wrap Machine

Measure Code	COM-FS-HWM
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment
Subcategories	Food Service Equipment

Measure Description:

Installation of an on-demand hand-wrap machine with Mechanical or optical control system. Food items, such as meat and cheese, are often placed on trays and wrapped in plastic film before being displayed for purchase. The plastic wrap protects the food from airborne organisms and dust, allows customers to view the product, and provides a surface for pasting information labels. A hand-wrap machine consists of a heating bar and a heating platform, rated at approximately 0.05 kW and 0.55 kW, respectively. The heating bar cuts the wrapping film as it comes in contact with itself. The heating platform heats up the wrapping film. When the wrapping film is heated, the film sticks to the package and seals the product.

High Efficiency:

An efficient hand-wrap machine is defined as an on-demand model with a mechanical or optical control system.[1]

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkWh[2]	ΔkW[3]
EC1c051 EC2c051	Hand-wrap Machine	LBES Mid SBES Mid	1,565	0.181

Assumptions:

Annual Energy					
Hand-Wrap Case	SUPERMARKET CHAIN 1 (kWh/yr)	SUPERMARKET CHAIN 2 (kWh/yr)	SUPERMARKET CHAIN 3 (kWh/yr)	SUPERMARKET CHAIN 4 (kWh/yr)	Annual Energy Consumption (kWh/yr)
Baseline	2,310.55	1,809.70	1,776.20	1,983.14	1,969.90
Efficient Case	411.64	395.1	452.3	361.21	405.06
Annual Savings	1898.91	1414.6	1323.9	1621.93	1564.84

Demand					
Hand-Wrap Case	UPERMARKET CHAIN 1 (kW)	SUPERMARKET CHAIN 2 (kW)	SUPERMARKET CHAIN 3 (kW)	SUPERMARKET CHAIN 4 (kW)	Demand Savings (kW)
Baseline	0.267	0.227	0.201	0.229	0.231
Efficient Case	0.054	0.043	0.059	0.043	0.05
Annual Savings	0.21	0.18	0.14	0.19	0.181

Measure Life:

The measure life for a hand-wrap machine is 10 years. [3]

Other Resource Impacts:

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_e	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c051 EC2c051	Hand-wrap Machine	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	0.90	0.90

In-Service Rates:
All installations have a 100% in-service rate unless an evaluation finds otherwise
Realization Rates:
All programs use a 100% realization rate unless an evaluation finds otherwise.
Coincidence Factors:
Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[4]

Energy Load Shape:

See Appendix 1 C&I Load Shapes “LS_111 C&I Food Service”

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)

BC Measure ID	Measure Name	Program	FR[5]	SO_P[5]	SO_{NP}[5]	NTG[5]
EC1c051	Hand-wrap Machine	LBES Mid	0.225	0.085	0.0	0.86

EC2c051		SBES Mid				

Revision History

Revision Number	Date	Revision
62	3/1/2022	New Measure Added

Endnotes

1: Southern California Edison (SCE), Emerging Products. 2015. Commercial Hand Wrap Machines for Food Service Applications Field Test. ET13SCE1190. https://www.caetrm.com/media/reference-documents/SCE_2014_ET13SCE1190_Report.pdf
2: Southern California Edison (SCE). 2016. “SCE17CC014.0 Com Hand Wrap Machines Costs 2016.xlsx.” https://www.caetrm.com/media/reference-documents/SCE17CC014.0_Com_Hand_Wrap_Machines_Costs_2016.xlsx
3: University of California, Office of the President, Purchasing Services. 2018. "Useful Life Index, G8605: Cutters, Slicers, Saws, Choppers, Graters, Grinders, Universal Mach, Food Prep." Download https://www.caetrm.com/media/reference-documents/UC_EUL_for_Hand_Wrap_Food_Prep_2018.pdf
4: SoCalGas, 2019. “WPSCGNRCC171226A – Commercial Conveyor Broilers” Revision 01.
5: NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors’ Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.23. High Efficiency Condensing Unit

Measure Code	COM-FS-HECU
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an efficient condensing unit defined as having three requisite attributes: an efficient scroll compressor, floating head pressure controls, and modulating compressor fan speed capabilities.. The collective effect of these three features results in the refrigeration load requirements being met while using less power as compared to a baseline unit.

Baseline Efficiency:

A baseline condensing unit is one with a standard compressor efficiency rating (as defined and established by Efficiency Vermont's Refrigeration Analysis Tool), no floating head pressure controls, and single speed compressor fan motors.[1]

Algorithms for Calculating Primary Energy Impact:

Deemed savings will be claimed based on a unit's temperature application, power phase requirements and compressor horsepower rating. The prescriptive, deemed savings in the table below are based on linear interpolation and extrapolation of currently available data from the 2018 Vermont TRM.[1]

BC Measure ID	Program	HECU Type	Single Phase Low Temp		Single Phase Medium Temp		Three Phase Low Temp		Three Phase Medium Temp	
		HP	ΔkW	ΔkWh	ΔkW	ΔkWh	ΔkW	ΔkWh	ΔkW	ΔkWh
EC1c052 EC2c052	LBES Mid SBES Mid Muni	1	0.283	1,112	0.426	2,239	0.210	992	0.341	1,854
		1.5	0.333	1,612	0.400	2,237	0.269	1,413	0.354	2,014
		2	0.384	2,285	0.467	2,2609	0.329	2,003	0.413	2,349
		2.5	0.422	2,579	0.547	3,056	0.382	2,356	0.483	2,751
		3	0.471	2,878	0.641	3,730	0.426	2,629	0.563	3,282
		3.5	0.570	3,483	0.781	4,399	0.516	3,182	0.694	3,907
		4	0.583	3,528	0.864	4,865	0.557	3,450	0.769	4,321

BC Measure ID	Program	HECU Type	Single Phase Low Temp		Single Phase Medium Temp		Three Phase Low Temp		Three Phase Medium Temp	
		4.5	0.618	3,802	0.879	4,952	0.611	3,718	0.783	4,398
		5	0.683	4,240	0.829	4,904	0.673	4,416	0.805	4,678
		6	0.783	5,083	0.829	4,904	0.788	4,979	0.805	4,678

Measure Life:

The measure life for a HECU is 13 years. [1]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c052 EC2c052	High Efficiency Condensing Unit	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	.90	.90

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[2]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "LS_111 C&I Food Service"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR[3]	SO_p[2]	SO_{NP}[2]	NTG[2]
EC1c052 EC2c052	High Efficiency Condensing Unit	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
63	3/1/2022	New Measure Added

Endnotes:

1 : SoCalGas, 2019. "WPSCGNRCC171226A – Commercial Conveyor Broilers" Revision 01.
2 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52

2.24. Holding Cabinet

Measure Code	COM-FS-HC
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Installation of a qualified ENERGY STAR hot food holding cabinet (HFHC). ENERGY STAR hot food holding cabinets are 70 percent more energy efficient than standard models. Models that meet this requirement incorporate better insulation, reducing heat loss, and may also offer additional energy saving devices such as magnetic door gaskets, auto-door closures, or Dutch doors. The insulation of the cabinet also offers better temperature uniformity within the cabinet from top to bottom. Offering full size, 3/4 size, and 1/2 size HFHC.

Baseline Efficiency:

The baseline efficiency idle energy rate for a HFHC is a unit meeting any applicable federal energy efficiency standards.

High Efficiency:

The high efficiency idle energy rate for HFHC is based on the product interior volume in cubic feet (V) as shown below[1]

Size Category	Product Interior Volume, V (ft^3)	Product Idle Energy Consumption Rate (W)
Half size	**$0 < V < 13$**	**≤ 21.5 V**
3/4 size	**$13 \leq V < 28$**	**≤ 2.0 V + 254.0**
Full size	**$28 \leq V$**	**≤ 3.8 V + 203.5**

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed:

kWh = kWh
kW = kWh / Hours

Where:

kWh = gross annual kWh savings from the measure: See table below.
kW = gross average kW savings from the measure: See table below.
Hours = annual operating hours

Energy Savings for Commercial Hot Food Holding Cabinets

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh
EC1b037 EC2b037 EC3b058 EC1c035 EC2c035	Full Size	LBES New SBES New Muni New LBES Mid SBES Mid	0.50	2,737
EC1b036 EC2b036 EC3b057 EC1c034 EC2c034	3/4 Size	LBES New SBES New Muni New LBES Mid SBES Mid	0.20	1,095
EC1b038 EC2b038 EC3b059 EC1c036 EC2c036	1/2 Size	LBES New SBES New Muni New LBES Mid SBES Mid	0.20	1,095

Measure Life:

The measure life for a new commercial HFHC is 12 years.[2]

Other Resource Impacts:

There are no other resource impacts for these measures.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b037	Hot Food Holding Cabinet Full Size	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b036	Hot Food Holding Cabinet 3/4 Size	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b038	Hot Food Holding Cabinet Half Size	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2b037 EC3b058 EC1c035 EC2c035	Hot Food Holding Cabinet Full Size	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC2b036 EC3b057 EC1c034 EC2c034	Hot Food Holding Cabinet 3/4 Size	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC2b038 EC3b059 EC1c036 EC2c036	Hot Food Holding Cabinet Half Size	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90

In-Service Rates:

All installations have a 100% in-service rate since programs include verification of equipment installations.

Realization Rates:

100% Realization Rates are assumed because savings are based on researched assumptions by ENERGY STAR. . The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[3]

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 C&I Load Shapes, "C&I Food Services".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only):[4]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c035 EC2c035	Hot Food Holding Cabinet Full Size	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c034 EC2c034	Hot Food Holding Cabinet 3/4 Size	LBES Mid SBES Mid	0.225	0.085	0	0.86

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c036 EC2c036	Hot Food Holding Cabinet Half Size	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:

1 : ENERGY STAR Program Requirements Product Specification for Commercial Hot Food Holding Cabinets, Version 2.0. Effective October 1, 2011. https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/hfhc/Final_V2.0_HFHC_Program_Requirements.pdf?b187-e770
2 : FSTC Life Cycle Savings Calculators https://fishnick.com/saveenergy/tools/calculators/
3 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
4 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.25. Ice Machine

Measure Code	COM-FS-IM
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Installation of a qualified ENERGY STAR commercial ice machine. Commercial ice machines meeting the ENERGY STAR specifications are on average 15 percent more energy efficient and 10 percent more water-efficient than standard models. ENERGY STAR qualified equipment includes ice-making head (IMH), self-contained (SCU), and remote condensing units (RCU).

Baseline Efficiency:

The baseline efficiency case is a non-ENERGY STAR commercial ice machine, which must be compliant with the applicable federal standard[1]

High Efficiency:

The high efficiency case is a commercial ice machine meeting the ENERGY STAR V3.0 Efficiency Requirements for commercial ice machines.

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated on a per-unit basis, based on the equipment type and daily ice harvest rate.

$$\Delta kWh = units\ x\ (kWh_{baseline} - kWh_{ee})\ x\ 365\ x\ Cycle\ x\ \left(\frac{IHR}{100}\right)$$

$$\Delta kW = \frac{\Delta kWh}{8{,}760\ x\ Cycle}\ x\ CF$$

Where:
ΔkWh = Annual electric energy savings
ΔkW = Peak coincident demand electric savings
units = Number of measures installed under the program
baseline = Baseline condition or measure
ee = Energy efficient condition or measure
kWh = Daily electric energy consumption per 100 pounds of ice
Cycle = Compressor duty cycle [2] = .75
IHR = Ice Harvest Rate (lbs/day) of the energy efficient ice maker.
CF = Coincidence factor
365 = Days in one year
100 = Factor to convert IHR to units of 100 lbs/day

8,760 = Hours in one year

The baseline condition is a non-ENERGY STAR commercial ice machine, which must be compliant with the applicable federal standard updated January 28, 2018.[1] The baseline daily energy usage per 100 pounds of ice is established in accordance with the current federal energy standards as specified in the Code of Federal Energy Regulations, updated January 28, 2018 .

Baseline Efficiency Inputs for Automatic Ice Machines[1]:

Cooling	Equipment Type	IHR	Maximum energy use kWh/100 lb ice[1]
Continuous Type			
Air	Ice-Making Head	<310	9.19-0.00629IHR
	Ice-Making Head	≥310 and <820	8.23-0.0032IHR
	Ice-Making Head	≥820 and <4,000	5.61
Air	Remote Condensing (no remote compressor)	<800	9.7-0.0058IHR
	Remote Condensing (no remote compressor)	≥800 and <4,000	5.06
	Remote Condensing & Remote Compressor	<800	9.9-0.0058IHR
Air	Self-Contained	<200	14.22-0.03 IHR
	Self-Contained	≥200 and <700	9.47-0.00624 IHR
	Self-Contained	≥700 and <4,000	5.1
Batch Type			
Air	Ice-Making Head	< 300	10-0.01233 IHR
	Ice-Making Head	≥ 300 and < 800	7.05-0.0025 IHR
	Ice-Making Head	≥ 800 and < 1,500	5.55-0.00063 IHR
	Ice-Making Head	≥ 1500 and < 4,000	4.61
Air	Remote Condensing (no remote compressor)	< 988	7.97-0.00342 IHR
	Remote Condensing (no remote compressor)	≥ 988 and < 4,000	4.59
	Remote Condensing & Remote Compressor	< 930	7.97-0.00342 IHR

Cooling	Equipment Type	IHR	Maximum energy use kWh/100 lb ice[1]
	Remote Condensing & Remote Compressor	≥ 930 and < 4,000	4.79
Air	Self-Contained	< 110	14.79-0.0469 IHR
	Self-Contained	≥ 110 and < 200	12.42-0.02533 IHR
	Self-Contained	≥ 200 and < 4,000	7.35

The high efficiency condition is commercial ice machine meeting the ENERGY STAR V3.0 Efficiency Requirements for commercial ice machines. Efficient daily energy use per 100 pounds of ice is established based on efficient equipment Ice Harvest Rate in accordance with ENERGY STAR® maximum qualifying specifications.

Energy Efficient Inputs for Automatic Commercial Ice Machines [3]

BC Measure ID	Program	Equipment Type	IHR	Maximum energy use kWh/100 lb ice[1]
	Continuous Type			
EC1b039 EC2b039 EC3b060 EC1c037 EC2c037	LBES New SBES New MUNI New LBES Mid SBES Mid	Air cooled Ice-Making Head	IHR < 310	7.90 – 0.005409 IHR
		Air cooled Ice-Making Head	310 ≤ IHR < 820	7.08 – 0.002752 IHR
		Air cooled Ice-Making Head	820 ≤ IHR ≤ 4000	4.82
EC1b042 EC2b042 EC3b063 EC1c040 EC2c040	LBES New SBES New MUNI New LBES Mid SBES Mid	Air Cooled Remote Condensing Unit	IHR < 800	7.76 – 0.00464 IHR
		Air Cooled Remote Condensing Unit	800 ≤ IHR ≤ 4000	4.05
EC1b040 EC2b040 EC3b061 EC1c038 EC2c038	LBES New SBES New MUNI New LBES Mid SBES Mid	Air Cooled Self-Contained	IHR<200	12.37 – 0.0261 IHR
		Air Cooled Self-Contained	200 ≤ IHR ≤ 700	8.24 – 0.005429 IHR
		Air Cooled Self-Contained	700 ≤ IHR ≤ 4000	4.44
	Batch Type			
	LBES New SBES New MUNI New LBES Mid SBES Mid	Air cooled Ice-Making Head	IHR <300	9.20 - 0.01134 IHR
		Air cooled Ice-Making Head	300 ≤ IHR < 800	6.49 - 0.0023 IHR
		Air cooled Ice-Making Head	800 ≤ IHR < 1,500	5.11 - 0.00058 IHR

BC Measure ID	Program	Equipment Type	IHR	Maximum energy use kWh/100 lb ice[1]
		Air cooled Ice-Making Head	1,500 ≤ IHR ≤ 4000	4.24
EC1b041 EC2b041 EC3b062 EC1c039 EC2c039	LBES New SBES New MUNI New LBES Mid SBES Mid	Air Cooled Remote Condensing Unit	IHR < 988	7.17 – 0.00308 IHR
		Air Cooled Remote Condensing Unit	988 ≤ IHR ≤ 4000	4.13
	LBES New SBES New MUNI New LBES Mid SBES Mid	Air Cooled Self-Contained	IHR <110	12.57 - 0.0399 IHR
		Air Cooled Self-Contained	110 ≤ IHR ≤ 200	10.56 - 0.0215 IHR
		Air Cooled Self-Contained	200 ≤ IHR ≤ 4000	6.25

Example Calculations: :

	Ice Machine Type	**IHR**	**Baseline**	**EE**	**Days in a year**	**Duty Cycle**	**IHR/100**	**Delta KWH**
Batch type	Ice making head	250.00	6.92	6.37	365.00	0.75	2.50	**378.12**
Batch type	Ice making head	500.00	5.82	5.34	365.00	0.75	5.00	**657.00**
Batch type	Ice making head	1200.00	4.79	4.41	365.00	0.75	12.00	**1248.30**
Batch type	Ice making head	3000.00	4.61	4.24	365.00	0.75	30.00	**3038.63**
Batch type	remote condensing	500.00	6.26	5.63	365.00	0.75	5.00	**862.31**
Batch type	remote condensing	2000.00	4.59	4.13	365.00	0.75	20.00	**2518.50**
Batch type	Self contained	60.00	14.51	10.23	365.00	0.75	0.60	**702.76**
Batch type	Self contained	180.00	7.86	6.69	365.00	0.75	1.80	**576.81**
Batch type	Self contained	1000.00	7.35	6.25	365.00	0.75	10.00	**3011.25**

Measure Life:

The measure life for a new ice making machine is 8 years.[2.]

Other Resource Impacts:

Water savings associated with this measure are calculated using on the Energy Star Commercial Food Service Calculator, updated in March 2021[4]

Ice Machine		Water (thousand gallons)
Batch	Ice Making Head	33
	Remote Condensing Unit	57
	Self Contained Unit	9
Continuous	Ice Making Head	22
	Remote Condensing Unit	38
	Self Contained Unit	8

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b039	Ice Machine - Ice Making Head	LBES New	1.00	0.99	n/a	1.00	1.00	0.9	0.9
EC1b040	Ice Machine - Remote Cond./Split Unit - Batch	LBES New	1.00	0.99	n/a	1.00	1.00	0.9	0.9
EC1b041	Ice Machine - Remote Cond./Split Unit - Continuous	LBES New	1.00	0.99	n/a	1.00	1.00	0.9	0.9
EC1b042	Ice Machine - Self Contained	LBES New	1.00	0.99	n/a	1.00	1.00	0.9	0.9
EC2b039 EC3b060 EC1c037 EC2c037	Ice Machine - Ice Making Head	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2b040 EC3b061 EC1c038 EC2c038	Ice Machine - Remote Cond./Split Unit - Batch	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2b041 EC3b062 EC1c039 EC2c039	Ice Machine - Remote Cond./Split Unit - Continuous	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.9	0.9

EC2b042 EC3b063 EC1c040 EC2c040	Ice Machine - Self Contained	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.9	0.9

In-Service Rates:
All installations have 100% in service rate since programs include verification of equipment installations.
Realization Rates:
100% realization rates are assumed because savings are based on researched assumptions. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs. [5]
Coincidence Factors:
Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 "C&I Load Shapes, "C&I Food Services".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[5] :

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c037 EC2c037	Ice Machine - Ice Making Head	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c038 EC2c038	Ice Machine - Remote Cond./Split Unit - Batch	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c039 EC2c039	Ice Machine - Remote Cond./Split Unit - Continuous	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c040 EC2c040	Ice Machine - Self Contained	LBES Mid SBES Mid	0.225	0.085	0	0.86

Revision History:

Revision Number	Date	Revision
43	1/14/2022	Corrected algorithms to provide annualized savings, updated baselines
44	1/14/2022	Added other resource impacts.

183	1/1/2024	Updated usage of H for Harvest Rate to IHR for clarity and consistency

Endnotes:

1 : 10 CFR 431.136. Effective January 28, 2018, https://www.ecfr.gov/cgi-bin/text-idx?node=se10.3.431_1136&rgn=div8
2 : FOOD SERVICE COMMERCIAL ICE MACHINE. SWFS006-01. (CA) December 2018. http://www.deeresources.net/workpapers
3 : ENERGY STAR Program Requirements For Automatic Commercial Ice Makers. V3.0. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_ice_makers/key_product_criteria
3 : ENERGY STAR Program Requirements For Automatic Commercial Ice Makers. V3.0.
4 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
5 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.26. Oven

Measure Code	COM-FS-OVN
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Combination Oven, Electric Convection Oven, Electric	Installation of a qualified ENERGY STAR commercial convection oven or commercial combination oven. ENERGY STAR commercial ovens save energy during preheat, cooking and idle times due to improved cooking efficiency, and preheat and idle energy rates. Combination ovens can be used either as convection ovens or as steamers.

Combination Oven, Gas Convection Oven, Gas Conveyor Oven, Gas Rack Oven, Gas	Installation of High Efficiency Gas Ovens

Baseline Efficiency:

The baseline efficiency case is a convection, combination, conveyor, or rack oven that meets applicable minimum federal efficiency standards and uses the same fuel as the proposed high efficiency equipment.

High Efficiency:

The high efficiency case is a commercial oven that meets the ENERGY STAR program requirements version 3 effective January 12th, 2023 for its type and fuel, as shown below.[1] Note that combination ovens are rated based on their capacity in number of pans (P), and that no ENERGY STAR program requirements for conveyor ovens have yet been approved.

Oven Fuel	Measure Name	Efficiency Requirement	Idle rate
Electric	Convection Oven, Half Size	≥ 71%	≤ 1.00 kW
Electric	Convection Oven, Full Size ≥5 Pans	≥ 76%	≤ 1.40 kW
Electric	Convection Oven, Full Size ≤5 Pans	≥ 76%	≤ 1.00 kW

Oven Fuel	Measure Name	Efficiency Requirement	Idle rate
Electric	Combination Oven, 5-40 pan capacity	≥ 55% steam mode ≥ 78% convection mode	≤ 0.133P+0.6400 kW steam mode ≤ 0.083 P+0.35 kW convection mode
Gas	Convection Oven, full size	≥ 49%	≤ 9,500 Btu/hr
Gas	Combination Oven, 5-40 Pan capacity	≥ 41% steam mode ≥ 57% convection mode	≤ 200P + 6,511 Btu/hr steam mode ≤ 140P +3,800 Btu/hr convection mode
Gas	Conveyer Oven		
Gas	Rack Oven, single	≥ 48%	≤ 25,000 Btu/hr

Ovens must be rated based on ASTM F1496 (Convection Oven), ASTM F2861 (Combination Oven), and ASTM 2093 (Conveyor Oven and Rack Oven).

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed using the Energy Star CFS Calculator and its default entries. [2]

ΔkWh = kWh
ΔkW = kWh / hours
ΔMMBtu = MMBtu

Where:

ΔkWh = gross annual kWh savings from the measure. See table below.
ΔkW = gross average kW savings from the measure. See table below.
ΔMMBtu = gross average natural gas savings from the measure. See table below.
Hours = Annual hours of operation = 4,380 hr/yr at 12 hr/day

Energy Savings for Commercial Ovens

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
EC1b021 EC2b021 EC3b035	Electric Full Size Convection Oven	LBES New SBES New Muni New LBES Mid	0.46	2,001	n/a

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
		SBES Mid			
EC1b019 EC2b019 EC3b031	Electric Combination Oven	LBES New SBES New Muni New LBES Mid SBES Mid	1.45	6,368	n/a
GC1b022 GC2b022 GC1c002 GC2c002	Gas Convection Oven, full size	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	12.7
GC1b021 GC2b021 GC1c001 GC2c001	Gas Combination Oven	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	33.6
GC1b023 GC2b023 GC1c003 GC2c003	Gas Conveyer Oven	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	88.4
GC1b026 GC2b026 GC1c007 GC2c007	Gas Rack Oven	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	122.9

Measure Life:

The measure life for a new commercial oven is 12 years.[3]

Other Resource Impacts:

There are no other resource impacts for these measures.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b021	Electric Convection Oven	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1b019	Electric Combination Oven	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b022	Gas Convection Oven	LBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b021	Gas Combination Oven	LBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b023	Gas Conveyer Oven	LBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b026	Gas Rack Oven	LBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC1b021 EC2b021 EC3b035 EC1c019 EC2c019	Electric Convection Oven	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC1b019 EC2b019 EC3b031 EC1c018 EC2c018	Electric Combination Oven	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
GC1b022 GC2b022 GC1c002 GC2c002	Gas Convection Oven	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b021 GC2b021 GC1c001 GC2c001	Gas Combination Oven	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b023 GC2b023 GC1c003 GC2c003	Gas Conveyer Oven	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b026 GC2b026 GC1c007 GC2c007	Gas Rack Oven	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have 100% in service rate since programs include verification of equipment installations

Realization Rates:

Installations have a 100% realization rate because programs use researched values for savings estimates. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[3]

Coincidence Factors:

Coincidence Factors for electric ovens are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1"C&I Load Shapes, "C&I Food Services".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[5]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c019 EC2c019	Electric Convection Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c018 EC2c018	Electric Combination Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
GC1c002 GC2c002	Gas Convection Oven	LBES Mid SBES Mid	0.237	0.07	0	0.83
GC1c001 GC2c001	Gas Combination Oven	LBES Mid SBES Mid	0.237	0.07	0	0.83

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c003 GC2c003	Gas Conveyer Oven	LBES Mid SBES Mid	0.237	0.07	0	0.83
GC1c007 GC2c007	Gas Rack Oven	LBES Mid SBES Mid	0.237	0.07	0	0.83

Revision History:

Revision Number	Date	Description
153	12/2/2022	Updated high efficiency case to align with new version 3.0 Energy Star program requirements effective 1/12/2023. Updated savings to align with updated new efficiency standards and updated 2021 efficiency calculator.

Endnotes:

1 : ENERGY STAR Program Requirements for Commercial Ovens. Version 3.0 effective January 12th 2023
https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%203.0%20Commercial%20Ovens%20Final%20Specification_0.pdf
2 : CFS_calculator_07-15-2021 (4)_Oven
3 : FSTC Life Cycle Savings Calculators https://fishnick.com/saveenergy/tools/calculators/
4 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
5 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.27. Refrigerated Chef Base

Measure Code	COM-FS-RCB
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an efficient refrigerated chef base. Refrigerated chef bases are found in almost all commercial kitchens. A refrigerated chef base is used to keep ingredients or prepared meals close to the cooking station, making food preparation more efficient. The capacity or size of a chef base is represented by its exterior length (feet), ranging from approximately three feet to about ten feet. The refrigerated compartment can be equipped with drawers or doors according to customer specifications.

Baseline Efficiency:

The baseline condition is defined as a refrigerated chef base which uses more energy than the high efficiency case specified for the equivalent exterior length, in the table below:

Baseline Efficiencies[1] :

Exterior Length (inches)	Daily Energy Use Intensity (kWh/day/ ft^3)
35-54	0.6000
55-73	0.5400
74-89	0.4751
90-120	0.4694

High Efficiency:

The high efficiency case is defined as a refrigerated chef base that uses energy less than or equal to the maximum daily energy consumption specified in the table below:

High Efficiencies[1]:

Exterior Length (inches)	Daily Energy Use Intensity (kWh/day/ft^3)
35-54	0.1785
55-73	0.1600
74-89	0.1408
90-120	0.1391

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkWh/ year[2]	ΔkW[3]
EC1c053	Refrigerated Chef Base 35-54 inches	LBES Mid SBES Mid	1,052	.1152
EC1c053	Refrigerated Chef Base 55-73 inches	LBES Mid SBES Mid	1,637	.177
EC1c053	Refrigerated Chef Base 74-89 inches	LBES Mid SBES Mid	1,985	.2142
EC1c053	Refrigerated Chef Base 90-120 inches	LBES Mid SBES Mid	2,673	.2885

Savings Algorithms[4]:

ΔkWh= base kwhdayft3 -measure kwhdayft3 ×constRefVol× constopDaysyr

$$\Delta kWh = \left(\frac{base\ kwh/day}{ft^3} - \frac{measure\ kwh/day}{ft^3}\right) \times constRef_{Vol} \times const_{opDaysyr}$$

ΔkW= Base kWft3 -measure kWft3 ×c onstRefVol

$$\Delta kW = \left(\frac{Base\ kW}{ft^3} - \frac{measure\ kW}{ft^3}\right) \times c\ onstRef_{Vol}$$

Where:
Base kwh/day/ft^3 = Baseline efficiency daily energy use intensity
Measure kwh/day/ ft^3 = High efficiency daily energy use intensity
$ConstRef_{vol}$= refrigerated volume (ft^3**)**
$Const_{opsDaysyr}$= 365 annual days of operation

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c053	Refrigerated Chef Base 35-54 inches	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	.90	.90
EC1c053	Refrigerated Chef Base 55-73 inches	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	.90	.90
EC1c053	Refrigerated Chef Base 74-89 inches	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	.90	.90
EC1c053	Refrigerated Chef Base 90-120 inches	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	.90	.90

In-Service Rates:
All installations have 100% in service rate since programs include verification of equipment installations.
Realization Rates:
100% realization rates are assumed because savings are based on researched assumptions. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs. [4]
Coincidence Factors:
Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 C&I Load Shapes "LS_109 C&I Refrigeration"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):[4]

BC Measure ID	Measure Name	Program	FR	SO_p	SO_{NP}	NTG
EC1c053	Refrigerated Chef Base 35-54 inches	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c053	Refrigerated Chef Base 55-73 inches	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c053	Refrigerated Chef Base 74-89 inches	LBES Mid SBES Mid	0.225	0.085	0.0	0.86
EC1c053	Refrigerated Chef Base 90-120 inches	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
59	3/1/2022	New Measure Added

Endnotes:

1 : Southern California Edison (SCE), Emerging Products. 2016. Chef Bases for Foodservice Applications. ET15SCE1010 Report. August. https://www.caetrm.com/media/reference-documents/ET15SCE1010_Chef_Bases_Report_final2.pdf
2 : Southern California Edison (SCE). 2019. "SWFS016-01 – Savings and Cost Analysis.xlsx." https://www.caetrm.com/media/reference-documents/SWFS016-01_Savings_and_Cost_Analysis.xlsx
3 : Southern California Edison (SCE). 2019. "SWFS016-01 – Savings and Cost Analysis.xlsx." https://www.caetrm.com/media/reference-documents/SWFS016-01_Savings_and_Cost_Analysis.xlsx
4: NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

5: NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.28. Refrigerator

Measure Code	COM-FS-RFGR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Installation of a qualified ENERGY STAR qualified reach-in refrigerator that replaces a standard efficiency unit of the same configuration and capacity. The refrigerator may have a solid door or transparent door. Measure savings are defined by configuration and internal volume as specified in the Energy Star commercial requirements presented below.

Baseline Efficiency:

The baseline case includes standard-efficiency, reach-in solid and transparent door refrigerators and are defined by the U.S. Department of Energy (DOE) federal requirements.

High Efficiency:

The high efficiency case is an ENERGY STAR qualified reach-in refrigerator having the same configuration and capacity as the baseline equipment.

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated and based on the Energy Star Commercial Kitchen Equipment Calculator.

$$\Delta kWh = kWh_{BL} - kWh_{EE}$$

$$kWh_{BL} = (kWh_D)_{BL} \times D$$

$$kWh_{EE} = (kWh_D)_{EE} \times D$$

Where,

ΔkWh= Annual electric energy savings (kWh)
kWhBL = Annual electric energy consumption of baseline equipment (kWh). Calculate from table below.
kWhEE = Annual electric energy consumption of efficient equipment (kWh). Calculate from table below.
kWhD = Daily electric energy consumption (kWh)
D = Number of days of operation of the unit. Use site specific data if possible (365 days is default).
V = Internal volume of equipment (ft3)

Equipment Daily Consumption[1 2]

Door Type	Size Thresholds	Baseline Refrigerator Daily Energy Consumption $(kWh_D)_{BL}$	Efficient Refrigerator Daily Energy Consumption $(kWh_D)_{EE}$
Solid Door	0 < V < 15	(0.05 x V) + 1.36	(0.022 x V) + 0.97
	15 < V < 30		(0.066 x V) + 0.31
	30 < V < 50		(0.04 x V) + 1.09
	50 < V		(0.024 x V) + 1.89
Transparent Door	0 < V < 15	(0.1 x V) + 0.86	(0.095 x V) + 0.445
	15 < V < 30		(0.05 x V) + 1.12
	30 < V < 50		(0.076 x V) + 0.34
	50 < V		(0.105 x V) - 1.111

Measure Life:

[3]

BC Measure ID	Measure Name	Program	Measure Life
EC1c041 EC2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	12
EC1c042 EC2c042	Refrigerator, Solid Door	LBES Mid SBES Mid	12

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c041 EC2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00
EC1c042 EC2c042	Refrigerator, Solid Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

All programs use a 100% coincidence factor unless an evaluation finds otherwise.

Energy Load Shape:

See Appendix 1

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[4]

BC Measure ID	Measure Name	Program	FR	SOP	SONP	NTG
EC1c041 EC2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	0.225	0.085	0	0.86
EC1c042 EC2c042	Refrigerator, Solid Door	LBES Mid SBES Mid	0.225	0.085	0	0.86

Future application of measure-specific NEI values will be considered by the NH Benefit/Cost (B/C) Working Group, per Commission Order No. 26,323 , December 31, 2019

Endnotes:

1 : Efficient equipment daily energy consumption is in line with ENERGY STAR. 2016. "ENERGY STAR® Program Requirements Product Specification for Commercial Refrigerators and Freezers - Eligibility Criteria Version 4.0." Effective on March 27, 2017
2 : Baseline equipment daily energy consumption is defined by the U.S. Department of Energy (DOE) federal requirements. Code of Federal Regulations at 10 CFR 431.66
3 : California Public Utilities Commission (CPUC), Energy Division. 2014. “DEER2014-EUL-table-update_2014-02-05.xlsx.”
4 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors’ Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.29. Steam Cooker

Measure Code	COM-FS-SC
Markets	Commercial
Program Types	Lost Opportunity
Categories	Food Service Equipment

Measure Description:

Electric Steam Cooker: Installation of a qualified ENERGY STAR commercial steam cooker. ENERGY STAR steam cookers save energy during cooling and idle times due to improved cooking efficiency and idle energy rates.

Gas Steam Cooker: The installation of an ENERGY STAR rated natural-gas fired steamer, either connectionless or steam-generator design. Qualified steamers reduce heat loss due to better insulation, improved heat exchange, and more efficient steam delivery systems.

Baseline Efficiency:

Electric Steam Cooker: The Baseline Efficiency case is an electric steam cooker with a cooking efficiency, pan production capacity, preheat energy, and idle energy rate as defined by any relevant U.S. federal requirements.

Gas Steam Cooker: The baseline efficiency case is a gas steam cooker with a cooking efficiency, pan production capacity, preheat energy, and idle energy rate as defined by any relevant U.S. federal requirements.

High Efficiency:

Electric Steam Cooker: The High Efficiency case is an electric steam cooker with a cooking energy efficiency, pan production capacity, preheat energy, and an idle energy rate meeting the minimum ENERGY STAR Program Requirements for Commercial Steam Cookers.

Energy Efficiency Requirements for Electric Steam Cookers[1]		
Pan Capacity	Heavy Load Cooking Energy Efficiency	Idle Rate (watts
3-pan	50%	400
4-pan	50%	530
5-pan	50%	670
6-pan and larger	50%	800

Gas Steam Cooker: The high efficiency case is a gas steam cooker with a cooking energy efficiency, pan production capacity, preheat energy, and an idle energy rate meeting the minimum ENERGY STAR Program Requirements for Commercial Steam Cookers.

Energy Efficiency Requirements for Gas Steam Cookers[1]		
Pan Capacity	Heavy Load Cooking Energy Efficiency	Idle Rate (btu/h)
3-pan	38%	6,250
4-pan	38%	8,350
5-pan	38%	10,400
6-pan and larger	38%	12,500

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔMMBtu
EC1b048 EC2b048 EC3b079 EC1c043 EC2c043	Electric Steam Cooker	LBES New SBES New Muni New LBES Mid SBES Mid	6,550	2.28	n/a
GC1b027 GC2b027 GC1c008 GC2c008	Gas Steam Cooker	LBES New SBES New LBES Mid SBES Mid	n/a	n/a	71.3

Quantity = Number of pans (3 pans per unit for electric; 6 pans per unit for gas based on ENERGY STAR 1.2 default values)

Hours = Average annual equipment operating hours (9 hours per day x 311 days = 2,873 hours based on ENERGY STAR 1.2 default values)

Measure Life:

The measure life for a new steamer is 12 years.[2]

Other Resource Impacts:

Electric Steam Cooker: Deemed annual water savings.

Gas Steam Cooker: Deemed annual water savings.[3]

Measure Name	Annual water savings (gal/unit)
Electric Steam Cooker	69,975
Gas Steam Cooker	103,563

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b048	Electric Steam Cooker	LBES New	1.00	0.99	n/a	1.00	1.00	0.90	0.90
GC1b027	Gas Steam Cooker	LBES New	1.00	n/a	1.00	1.00	1.00	n/a	n/a
EC2b048 EC3b079 EC1c043 EC2c043	Electric Steam Cooker	SBES New Muni New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
GC2b027 GC1c008 GC2c008	Gas Steam Cooker	SBES New LBES Mid SBES Mid	1.00	n/a	1.00	1.00	1.00	n/a	n/a

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[4]

<u>Coincidence Factors:</u>

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1 See Appendix 1“C&I Load Shapes, “C&I Food Services”

Revision History:

Revision Number	Issue Date	Description
142	12/1/2022	Updated deemed savings for kWh, kW, MMBtu and water according to the Savings Calculator for ENERGY STAR Commercial Food Service (CFS) Products release in 2021.
184	1/1/2024	Updated end notes for high efficiency section and added table from Energy Star Requirements documentation

Endnotes:

1 : ENERGY STAR® Program Requirements for Commercial Steam Cookers https://www.energystar.gov/sites/default/files/specs//private/Commercial_Steam_Cookers_Program_Requirements%20v1_2.pdf?_gl=1*1qr8g7u*_ga*ODU2ODMxOTE1LjE2ODU2MzQwODM.*_ga_S0KJTVVLQ6*MTY4NTYzNDA4Mi4xLjEuMTY4NTYzNDIwOS4wLjAuMA..

2: SupportTable_EUL.csv, from DEER Database for Energy-Efficient Resources; Version 2016, READI v.2.4.3 (Current Ex Ante data) found at http://www.deeresources.com/
3 : ENERGY STAR Commercial Kitchen Equipment Calculator. Updated July 2021. https://www.energystar.gov/sites/default/files/asset/document/CFS_calculator_07-15-2021.xlsx
4 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf

2.30. Laboratory Grade Cold Storage ~~Ultra Low-Temp Freezer~~

Measure Code	COM-FS-ULTF
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an ENERGY STAR qualified laboratory grade refrigerator, freezer or ultra low temperature (ULT) freezer to replace a standard efficiency units.

Baseline Efficiency:

The baseline technology is a standard efficiency laboratory grade refrigerator, freezer or ultra low temperature (ULT) freezer.

High Efficiency:

The high efficiency case is ENERGY STAR qualified laboratory grade refrigerator, freezer or ultra low temperature (ULT) freezer.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on vendor data from ULT freezers offered in MA and the 2017 DMI ULT Base Case Investigation.[3]

Measure Description	Gross Annual kWh per Unit	Gross kW per Unit
Laboratory Grade High Performance Freezers, 6≤V<22 cu. ft.	1,608	0.18
Laboratory Grade High Performance Freezers, ≥22 cu. ft.	2,596	0.30
Laboratory Grade High Performance Refrigerators, 6≤V<25 cu. ft.	1,403	0.16
Laboratory Grade High Performance Refrigerators, ≥44 cu. ft.	2,552	0.29
Laboratory Grade High Performance Refrigerators, 25≤V<44 cu. ft.	1,913	0.22
Ultra Low-Temp Freezer	5,737	0.65

Measure Life:

The measure life for a Laboratory Grade Refrigerator, Freezer or ULT Freezer is 15 years.[1]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c048 EC2c048	Midstream Laboratory Grade Cold Storage	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	0.90	0.90

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[3]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "LS_109 C&I Refrigeration"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR[4]	SO_p[5]	SO_{NP}[4]	NTG[4]
EC1c048 EC2c048	Midstream Laboratory Grade Cold Storage	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
64	3/1/2022	New Measure Added
185	1/1/2024	Changed name of measure from Ultra Low Temp Freezer to Cold Storage Suggest changing the name of this chapter to "Cold Storage" as there are a number of lab grade freezers and refrigerators that are available under the offering.
196		Added deemed kW savings from CT PSD.

Endnotes:

1 : Eversource Energy ULT Freezer Base Case Investigation, prepared by DMI, October 7, 2017
2 : EnergyStar (2016) "Laboratory Grade Refrigerators & Freezers Specification" https://www.energystar.gov/products/other/laboratory_grade_refrigerators_and_freezers
3 : SoCalGas, 2019. "WPSCGNRCC171226A – Commercial Conveyor Broilers" Revision 01.
4 : Conservative estimate based on manufacturer's EUL of 20 years. NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52

2.31. Underfired Broilers

Measure Code	COM-FS-UFB
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an efficient underfired broiler with an input rate ≤ 22 kBtu/hr/len-ft while maintaining a surface temperature of 600 °F. An underfired broiler is composed of a heavy-duty cooking grate suspended above a radiant heat source. Below the grate is a set of atmospheric burners spaced every four to twelve inches along the width of the broiler, covered by a protective radiant material.

Baseline Efficiency:

The baseline is defined as underfired broiler with an input rate greater than 22 Kbtu/hr/ln-ft at 600 degrees F, and an idle and cooking energy rate of 25,000.00. [1]

High Efficiency:

The high efficiency case is defined as an underfired broiler with an input rate of less than 22 kbtu/hr at 600 degrees F and an idle and cooking energy of less than or equal to 20,000 as specified per the ASTM F1695 standard, and of similar size to the replacement unit.[2]

Algorithms for Calculating Primary Energy Impact:

Deemed Savings[3] :

BC MEASURE ID	Measure Name	Δtherms
GC1c021 GC2c021	Underfired broiler	217.8

Δ Therms = (base_idlebtuh_ft – Measure_idlebtuh_ft) x opHr_day*Op_Day

Where:
base_idlebtuh_ft = idle energy rate, baseline (btu/hr)
measure_idlebtuh = idle energy rate, efficient (btu/hr)
opHr_day = operating hours per day
op_Day = operating days per year

Inputs and Assumptions[4] :

Description	Standard Model	Efficient Model
Preheat Time (min)	30	30

Description	Standard Model	Efficient Model
Broiler Idle Energy Rate (Btuh)	25,000	20,000
Broiler Production Capacity (lb/h)	25	20
Operating Hours/Day	12	12
Operating Days/Year	363	363

Measure Life:

The measure life for an underfired broiler is 15 years.[1]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1c021 GC2c021	Underfired Broiler	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	.90	.90

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.[5]

Energy Load Shape:

There are no other resource impacts for this measure.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR[6]	SO_p[7]	SO_{NP}[6]	NTG[6]
GC1c021 GC2c021	Underfired Broiler	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
65	3/1/2022	New Measure Added

Endnotes:

1 : Fisher-Nickel, Inc. 2014. Emerging Technologies (ET) Lidded Thermostatic Infrared Broiler Field Study. Emerging Technologies project ET13PGE1311. Prepared for Pacific Gas and Electric Company (PG&E). December 15. https://www.caetrm.com/media/referencedocuments/et13pge1311liddedbroilerfinal_201412161.pdf
2 : American Society for Testing and Materials (ASTM). 2015. ASTM F1695-03, Standard Test Method for the Performance of Underfired Broilers. West Conshohocken (PA): ASTM International.
3 : Southern California Gas Company (SCG). 2018. “SWFS019-02 Energy and Cost Calculations.xlsx.” https://www.caetrm.com/media/reference-documents/SWFS019-02_Energy_and_Cost_Calculations.xlsx
4 : Livchack, D. (Fisher-Nickel, Inc.). 2017. Energy Efficient Underfired Broilers. ET Project Number ET16PGE1941. Prepared for Pacific Gas and Electric Company (PG&E). March 24. https://www.caetrm.com/media/referencedocuments/et16pge1941_energy_efficient_broilers_20170329.pdf
5 : SoCalGas, 2019. “WPSCGNRCC171226A – Commercial Conveyor Broilers” Revision 01
6 : NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors’ Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52

2.32. Induction Cook Top

Measure Code	COM-FS-ICT
Markets	Commercial
Program Types	New, Retrofit
Categories	Food Service Equipment

Measure Description:

Installation of an induction cooktop replacing an existing electric or natural gas cook top.

Baseline Efficiency:

The baseline efficiency case for the induction cooktop is a traditional electric resistance.

High Efficiency:

The high efficiency case is a cooktop with an induction heating element.

Algorithms for Calculating Primary Energy Impact:

Unit kwh savings are deemed per burner assuming use in a cook to order restaurant.[1] Demand savings are derived from the demand impact model, developed as part of the MA residential baseline study.

BC Measure ID	Measure Name	ΔkWh	ΔkW	Δtherms
EC1b058 EC1a050 EC1d047 EC1c064 EC2a050 EC2b058 EC2c064 EC2d047 EC3a093 EC3b088 EC3d091	Induction Cooktop Displacing Electric Resistance	2,488	0.43	n/a

Measure Life:

The measure life for an induction cooktop is 12 years.[2]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b058 EC1a050 EC1d047	Induction Cooktop Displacing Electric Resistance	LBES Retro LBES New LBES DI	1.00	0.99	n/a	1.00	1.00	0.90	0.90
EC1c064 EC2a050 EC2b058 EC2c064 EC2d047 EC3a093 EC3b088 EC3d091	Induction Cooktop Displacing Electric Resistance	LBES Mid SBES Retro SBES New SBES Mid SBES DI Muni Retro Muni New Muni DI	1.00	1.00	n/a	1.00	1.00	0.90	0.90
	Induction Cooktop Displacing Natural Gas	LBES new SBES new	1.00	1.00	n/a	1.00	1.00	0.90	0.90
	Induction Cooktop Displacing Natural Gas	LBES retro SBES retro	1.00	n/a	1.00	1.00	1.00	0.90	0.90

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise

Realization Rates:

Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence Factors are 0.9 for both summer and winter seasons to account for the fact that some restaurants close one day per week and some may not serve both lunch and dinner on weekdays.

Energy Load Shape:

See Appendix 1"C&I Load Shapes, "C&I Food Services".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR[6]	SO_p[7]	SO_{NP}[6]	NTG[6]
EC1c064 EC2c064	Induction Cooktop	LBES Mid SBES Mid	0.225	0.085	0.0	0.86

Revision History:

Revision Number	Date	Revision
186	7/1/2023	New Measure Added

Endnotes:

1 : Food Service Technology Center, Vollrath HIDC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013, Table 8

2 : Frontier Energy (2019). Residential Cooktop Performance and Energy Comparison Study. 2019_Frontier_Energy_Residential_Cooktop_Performance_and_Energy_Comparison_Study

2.33. Boiler Reset Controls

Measure Code	COM-HVAC-BRC
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Boiler Reset Controls: Boiler Reset Controls are devices that automatically control boiler water temperature based on outdoor or return water temperature using a software program.

Baseline Efficiency:

The baseline efficiency case is a boiler without reset controls.

High Efficiency:

The High efficiency case is a boiler without reset controls.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results. [1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu/unit
EC3a019 EC3d021 GC1a010 GC2a010	Boiler Reset Controls	Gas	Muni Retro Muni DI LBES Retro SBES Retro	35.5
EC3a020 EC3d022	Boiler Reset Control	Oil	Muni Retro Muni DI	35.5
EC3a021 EC3d023	Boiler Reset Control	Propane	Muni Retro Muni DI	35.5

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC3a019 EC3d021 GC1a010 GC2a010	Boiler Reset Controls	Gas	Muni Retro Muni DI LBES Retro SBES Retro	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a020 EC3d022	Boiler Reset Control	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a021 EC3d023	Boiler Reset Control	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise

Coincidence Factors:

Not applicable for this measure since no electric savings are claimed

Energy Load Shape:

See Appendix 1 C&I Load Shapes "Non- Electric Measures"

Revision History:

Revision Number	Date	Description
129	12/1/2022	Removed reference to electric measures.

Endnotes:

1 : GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachusetts, as cited in the Massachusetts TRM. Study assumes 710.46 MMBTU base use with 5% savings factor. GDS_2009_Natural_Gas_Energy_Efficiency_Potential_in_MA.

2 : ACEEE, 2006. Emerging Technologies Report: Advanced Boiler Controls.https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488606996f25d7f7df759/view?authToken=2ec31c0c3366eefbec8e238482b281636b0584a3d60865531cfd0e2397768bae977a9e60ee77c3b5c1aee11a038f90b5cc03f151c54423cddbcf40254d6e3407c389f4490c5224

2.34. Boilers

Measure Code	COM-HVAC-BLR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The installation of a high efficiency natural gas fired condensing hot water boiler. High-efficiency condensing boilers can take advantage of improved design, sealed combustion, and condensing flue gases in a second heat exchanger to achieve improved efficiency.

Baseline Efficiency:

Baseline efficiency is an 85% efficient boiler.

High Efficiency:

High efficiency is per table of efficiency thresholds below.

BC Measure ID	Measure Name	Program	Measure Efficiency
GC1b010	< 300 MBH (0.95 AFUE)	LBES New	95% AFUE
GC2b010		SBES New	95% AFUE
GC1b009	< 300 MBH (0.90 AFUE)	LBES New	90% AFUE
GC2b009		SBES New	90% AFUE
GC1b008	300-499 MBH (0.90 TE)	LBES New	90% Et
GC2b008		SBES New	90% Et
GC1b007	500-999 MBH (0.90 TE)	LBES New	90% Et
GC2b007		SBES New	90% Et
GC1b006	1000-1700 MBH (0.90 TE)	LBES New	90% Et
GC2b006		SBES New	90% Et
GC1b005	1701 - 2500 MBH (0.90 TE)	LBES New	90% Et

BC Measure ID	Measure Name	Program	Measure Efficiency
GC2b005		SBES New	90% Et

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[1]

BC Measure ID	Measure Name	Program	ΔMMBtu
GC1b010 GC2b010	<= 300 MBH (0.95 AFUE)	LBES New SBES New	17.7
GC1b009 GC2b009	<= 300 MBH (0.90 AFUE)	LBES New SBES New	14.7
GC1b008 GC2b008	301-499 MBH (0.90 TE)	LBES New SBES New	28.0
GC1b007 GC2b007	500-999 MBH (0.90 TE)	LBES New SBES New	51.4
GC1b006 GC2b006	1000-1700 MBH (0.90 TE)	LBES New SBES New	94.5
GC1b005 GC2b005	1701+ MBH (0.90 CE)	LBES New SBES New	165.3

Equipment Type		Size	Efficiency[2]	Units
Boiler	Hot Water - Small	< 300,000 Btu/hr	85%	AFUE
Boiler	Hot Water - Medium	300,000 to 2,500,000 Btu/hr	85%	TE
Boiler	Hot Water - Large	> 2,500,000 Btu/hr	85%	CE

Measure Life:

The measure life is 25 years[3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b010 GC2b010	<= 300 MBH (0.95 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b009 GC2b009	<= 300 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b008 GC2b008	301-499 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b007 GC2b007	500-999 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b006 GC2b006	1000-1700 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b005 GC2b005	1701+ MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Not applicable for this measure since no electric savings are claimed.

Energy Load Shape:

See Appendix 1 “C&I Heating & Cooling”.

Endnotes:

1 : DNVGL,NMR Group, 2017, Gas Boiler Market Characterization. https://ma-eeac.org/wp-content/uploads/Gas-Boiler-Market-Characterization-Study-Phase-II-Final-Report.pdf
2 : DNVGL,NMR Group, 2017, Gas Boiler Market Characterization. https://ma-eeac.org/wp-content/uploads/Gas-Boiler-Market-Characterization-Study-Phase-II-Final-Report.pdf
3 : ASHRAE Applications Handbook, 2003; Page 36.3.

2.35. Circulator Pump

Measure Code	COM-HVAC-CP
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Single-phase circulator pumps used in C&I buildings used for hydronic heating and system hot water.

Baseline Efficiency:

The baseline system is a pump without an EC motor. The baseline system may have no control, a timer, aquastat, or be on demand. The baseline system is assumed to run a weighted average of these four control types.

High Efficiency:

The high efficiency case is a circulator pump with an ECM.

Algorithms for Calculating Primary Energy Impact:

Savings depend on application and pump size as described in table below.[1]

Size	Type	kW	kWh
<= 1 HP	Hydronic Heating	ΔkW = 0.245 * HP rated + 0.02	ΔkWh = 1,325 * HP rated+ 111
<= 1 HP	Service Hot Water	ΔkW = 0.245 * HP rated+ 0.02	ΔkWh = 2,780 * HP rated+ 233
> 1 HP	Hydronic Heating	ΔkW = 0.265	ΔkWh = 1,436
> 1 HP	Service Hot Water	ΔkW = 0.265	ΔkWh = 3,013

Measure Life:

The measure life is 20 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure

Impact Factors for Calculating Adjusted Gross Savings:

3,

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b018	Circulator Pump	LBES New	1.000	0.999	n/a	1.000	1.000	0.820	0.050
EC2b018	Circulator Pump	SBES New	1.000	1.000	n/a	1.000	1.000	0.820	0.050
EC3b030	Circulator Pump	Muni New	1.000	1.000	n/a	1.000	1.000	0.820	0.050
EC1c001	Midstream Circulator Pump	LBES Midstream	1.000	1.000	n/a	1.000	1.000	0.820	0.050
EC2c001	Midstream Circulator Pump	SBES Midstream	1.000	1.000	n/a	1.000	1.000	0.820	0.050

In-Service Rates:
All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

Realization Rates:
Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:
A summer coincidence factor of 82.0% and a winter coincidence factor of 5.0% are utilized. [3]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Heating & Cooling"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

4

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c001 EC2c001	Midstream Circulator Pump	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

Endnotes:

1 : The Cadmus Group, 2017. Circulator Pump Technical Memo. Prepared for National Grid and Eversource engineers.
2 : Energy & Resource Solutions, November 2005. Measure Life Study. Prepared for The Massachusetts Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-

JointUtilities_ERS.pdf
3 : Navigant Consulting (2018). RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
4 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.36. Condensing Unit Heaters

Measure Code	COM-HVAC-CUH
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of a condensing gas-fired unit heater for space heating with capacity up to 300 MBH and minimum combustion efficiency of 90%.

Baseline Efficiency:

The baseline efficiency case is a standard efficiency gas fired unit heater with minimum combustion efficiency of 80%, interrupted or intermittent ignition device (IID), and either power venting or an automatic flue damper. 1 As a note, the baseline efficiency referenced applies to 2016. Baseline requirements for 2017 and on have not been finalized.

High Efficiency:

The high efficiency case is a condensing gas unit heater with 90% AFUE or greater.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[2]

BC Measure ID	Measure Name	Program	ΔMMBtu
GC1b013 GC2b013	Condensing Unit Heater (<= 300 MBH) – Gas	LBES New SBES New	40.9
EC3b033	Condensing Unit Heater (<= 300 MBH) – Oil	MES New	40.9
EC3b034	Condensing Unit Heater (<= 300 MBH) – Propane	MES New	40.9

Measure Life:

The measure life is 18 years. [3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b013 GC2b013	Condensing Unit Heater – Gas	LBES New SBES New	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3b033	Condensing Unit Heater – Oil	MES New	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3b034	Condensing Unit Heater – Propane	MES New	1.000	n/a	1.000	n/a	n/a	n/a	n/a

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

Not applicable for this measure since no electric savings are claimed.

Energy Load Shape:

See Appendix 1 “C&I Heating & Cooling”.

Revision History:

Revision Number	Date	Description
49	1/14/2022	Corrected baseline to reference most current code.

Endnotes:

1 : 2012 International Energy Conservation Code
2 : NYSERDA Deemed Savings Database (Rev 11); Measure Name: A.UNIT-HEATER-COND.
3 : Ecotrope, Inc., August 2003. Natural Gas Efficiency and Conservation Measure Resource Assessment for the Residential and Commercial Sectors. Prepared for the Energy Trust of Oregon. https://library.cee1.org/system/files/library/1366/544.pdf

2.37. Demand Control Ventilation

Measure Code	COM-HVAC-DCV
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The measure controls the quantity of outside air to an air handling system based on detected space CO_2 levels. The installed systems monitor the CO_2 in the spaces or return air and reduce the outside air use when possible to save energy while meeting indoor air quality standards. Measure is applicable to situations where not required by the 2018 IECC Energy and Conservation Code section 403.7 Ventilation and Exhaust Systems. [1]

Baseline Efficiency:

The baseline for midstream measures is the demand control ventilation required based on climate one, OA% and total CFM supply air.

The baseline efficiency case for all other measures is site specific and reflective of any existing ventilation control strategies currently employed.

High Efficiency:

The high efficiency case is the installation of an outside air intake control based on CO_2 sensors

Algorithms for Calculating Primary Energy Impact:

Energy savings are calculated based on site specific input for all projects. Savings are based on hours of operation, return air dry bulb temperature, return air enthalpy, system total air flow, percent outside air, estimated average outside air reduction, and cooling and heating efficiences. Savings are estiamted using a temperature BIN spreadsheet that uses the reduction of outside air to calculate the energy saved by not having to condition that air. The savings are calculated for each temperature BIN with the exception of BINs that would include economizer cooling. Summer seasonal peak demand savings are calculated based on the top two temperature BINS used in the spreadsheet.

Measure Life:

The measure life is 10 years.[4]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a018 EC1d020	Demand Control Ventilation	LBES Retro LBES DI	1.00	0.999	n/a	1.000	1.000	0.820	0.050
EC2a018 EC2d020	Demand Control Ventilation	SBES Retro SBES DI	1.00	1.00	n/a	1.000	1.000	0.820	0.050
EC3a024 EC3d026	Demand Control Ventilation	Muni Retro Muni DI	1.00	1.00	n/a	1.000	1.000	0.820	0.050
EC1c002 EC2c002	Midstream Demand Control Ventilation	LBES Midstream SBES Midstream	1.00	1.00	n/a	1.000	1.000	0.820	0.050

<u>In-Service Rates:</u>
All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>[5]
Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>
CFs are based on Massachusetts TRM standard assumptions.

Energy Load Shape:

Appendix 1 – "C&I Heating and Cooling"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

[6]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c002 EC2c002	Midstream Demand Control Ventilation	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

Revision History:

Revision Number	Date	Description

45	1/14/2022	Updated midstream and retrofit baselines.
46	1/14/2022	Fixed broken link.
139	12/1/2022	Added federal code to measure description.
195	1/1/2024	Updated savings algorithm to use a temperature BIN spreadsheet that uses the reduction of outside air to calculate the energy saved by not having to condition that air with NH specific TMY3 data.

Endnotes:

1 : 2018 International Energy Conservation Code, Ventilation and Exhaust Systems (Mandatory) https://codes.iccsafe.org/content/IECC2018P5/chapter-4-ce-commercial-energy-efficiency#IECC2018P5_CE_Ch04_SecC403.7
2 : Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid.
3 : Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid.
4 : Energy & Resource Solutions, November 2005. Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-1. Measure life is assumed to be the same as Enthalpy Economizer. https://www.ers-inc.com/wpcontent/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
5 : New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Impact Evaluation report. Table 3
6 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.38. Dual Enthalpy Economizer Controls

Measure Code	COM-HVAC-DEEC
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The measure is to installa dual enthalpy economizer on an existing unit with fixed outdoor air. The system will continuously monitor the enthalpy of both the outside air and return air. The system will control the system dampers adjust the outside quantity based on the two readings.

Baseline Efficiency:

The baseline efficiency case for this measure assumes the relevant HVAC equipment is operating without an economizer.

High Efficiency:

The high efficiency case is the installation of an outside air economizer utilizing two enthalpy sensors, one for outdoor air and one for return air.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kWh}$$

Where:

kBtu/h = Capacity of the cooling equipment in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h)

$SAVE_{kWh}$ = Average annual kWh reduction per ton of cooling capacity: 289 kWh/ton [1] .

Measure Life:

The measure life is 10 years [2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a020 EC1d022	Dual Enthalpy Economizer Controls	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.342	0.000
EC2a020 EC2d022	Dual Enthalpy Economizer Controls	SBES Retro SBES DI	1.000	1.000	n/a	1.000	1.000	0.342	0.000
EC3a026 EC3d028	Dual Enthalpy Economizer Controls	MES Retro MES DI	1.000	1.000	n/a	1.000	1.000	0.342	0.000
EC1c004 EC2c004	Midstream Dual Enthalpy Economizer Controls	LBES Midstream SBES Midstream	1.000	1.000	n/a	1.000	1.000	0.342	0.000

In-Service Rates:
All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

Realization Rates:
Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:
Coincidence factors are based on 2011 NEEP C&I Unitary AC Loadshape Project [3]

Energy Load Shape:

See Appendix 1 – "C&I Heating and Cooling".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

4

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c004 EC2c004	Midstream Dual Enthalpy Economizer Controls	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

Revision History:

Revision	Date	Description
140	12/1/2022	Updated baseline to be a unit without an economizer. Removed KW savings as economizers are generally closed under peak summer conditions.

Endnotes:

1 : Patel, Dinesh, 2001. Energy Analysis: Dual Enthalpy Control. Prepared for Eversource (NSTAR).
2 : Energy & Resource Solutions, November (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.https://www.ers-inc.com/wpcontent/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : Coincidence Factors are from 2011 NEEP HVAC Loadshape Study Table 0-5 (ISO_NE on Peak for NE-North)
https://neep.org/sites/default/files/resources/NEEP_HVAC_Load_Shape_Report_Final_August2_0.pdf
4 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators.
http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.39. Duct Insulation

Measure Code	COM-HVAC-DI
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

For existing ductwork in non-conditioned spaces, insulate ductwork. This could include replacing uninsulated flexible duct with rigid insulated ductwork and installing 1" to 2" of duct-wrap insulation.

Baseline Efficiency:

The baseline efficiency case is existing, uninsulated ductwork in unconditioned spaces (e.g. attic or basement).

High Efficiency:

The high efficiency condition is ductwork insulated to R-6 or better in unconditioned spaces.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results:

Δ MMBtu = MMBtu/unit x Units

Where:

Unit = Number of square feet of ductwork insulated

MMBtu/unit = Average annual MMBtu savings per unit: 0.035[1]

Measure Life:

The measure life is 20 years.[1]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC3a027 EC3d029	Duct Insulation	Electric	Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.350	0.000
EC3a028 EC3d030	Duct Insulation	Gas	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a029 EC3d031	Duct Insulation	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a030 EC3d032	Duct Insulation	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A summer coincidence factor of 35% is utilized.[2]

Energy Load Shape:

For electric measures, see Appendix 1 C&I Load Shapes "Weighted HVAC – Multi-Family"

For non-electric measures, see Appendix 1 C&I Load Shapes "Non-Electric Measures".

Endnotes:

1 : National Grid Staff Estimate, 2010. MA SBS-DI Duct Sealing and Insulation Scenario and Deemed Savings. https://api-plus.anbetrack.com/etrmgateway/etrm/api/v1/etrm/documents/5ee4885c6996f2b5047df743/view?authToken=fa8e547661bf80dea
8750ffa5a1d3608215165882ceaf6ebc0b7193a1ab071622426a78ec0a491b80535c621447604a03ab75d3119793c326860fd96007eec8b851ba43c196fab
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wpcontent/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2.40. Duct Sealing

Measure Code	COM-HVAC-DS
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

For existing ductwork in non-conditioned spaces, seal ductwork. This could include sealing leaky fixed ductwork with mastic or aerosol.

Baseline Efficiency:

The baseline efficiency case is existing, non-sealed (leaky) in unconditioned spaces (e.g. attic or basement). Baseline leakage determine by pre sealing leakage measurements

High Efficiency:

The high efficiency condition is air sealed ductwork in unconditioned spaces. Leakage reduction determined by post sealing leakage measurements

Algorithms for Calculating Primary Energy Impact:

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

Methodology 1: Test in / test out duct leakage measurements.

$$\Delta MMBtu = \frac{CFM_{25\ base} - CFM_{25\ ee}}{17 \times Cap_{heat}} \times Cap_{heat} \times EFLH_{heat} \times TRF_{heat} \times \frac{1}{DE_{base} \times \overline{\eta_{heat}}\ x\ 1000}$$

Methodology 2: Evaluation of distribution efficiency, only use if test in/ test out data is unavailable.

$$\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$$

$$\Delta kWh_{cooling} = \frac{DE_{cool,ee} - DE_{cool,base}}{DE_{cool,ee}} \times (1 - TRF_{cool}) \times EFLH_{cool} \times \frac{Cap_{cool}}{\overline{EER}}$$

$$\Delta kWh_{heating} = \frac{DE_{heat,ee} - DE_{heat,base}}{DE_{heat,ee}} \times (1 - \mathrm{TRF_{heat}}) \times EFLH_{heat} \times \frac{Cap_{heat}}{3.412 \times \overline{\mathrm{COP}}}$$

$$\Delta MMBtu = \frac{DE_{heat,ee} - DE_{heat,base}}{DE_{heat,ee}} \times EFLH_{heat} \times Cap_{heat} \times \frac{1}{\overline{\eta_{heat}} \times 1000}$$

Methodology 2: Test in / test out duct leakage measurements.

$$\Delta kWh_{cooling} = \frac{CFM_{25\,base} - CFM_{25\,ee}}{400 \times Cap_{cool}} \times Cap_{cool} \times EFLH_{cool} \times (1 - TRF_{cool}) \times \frac{12}{DE_{base} \times \overline{EER}}$$

$$\Delta kWh_{heating} = \frac{CFM_{25\,base} - CFM_{25\,ee}}{17 \times Cap_{heat}} \times Cap_{heat} \times EFLH_{heat} \times (1 - TRF_{heat}) \times \frac{1}{DE_{base} \times 3.412 \times \overline{COP}}$$

Summer Peak Coincident Demand Savings

$$\Delta kW_{Peak} = \frac{\Delta kWh_{cooling}}{EFLH_{cool}} \times CF$$

ΔkWh = Annual electric energy savings
$\Delta kWh_{cooling}$ = Annual electric energy savings, cooling
$\Delta kWh_{heating}$ = Annual electric energy savings, heating
ΔTherms = Annual fuel savings
ΔMMBtu = Annual fossil fuel energy savings
Cap_{cool} = Output cooling capacity in tons
Cap_{heat} = Output heating capacity in kBTU/h
TRF_{cool} = Cooling thermal regain factor based on duct location
TRF_{heat} = Heating thermal regain factor based on duct location
$\overline{EER}$ = Seasonal average energy efficiency ratio in BTU/watt-hour. Use SEER for systems with cooling capacity < 65 kBtu/hr; IEER for systems >= 65 kBtu/hr cooling capacity
EER = Energy efficiency ratio under peak conditions in BTU/watt-hour.
$\overline{COP}$ = heating season average coefficient of performance. Use HSPF/3.412 for heat pumps with cooling capacity < 65 kBtu/hr; COP at 47F for heat pumps >= 65 kBtu/hr; 1.0 for electric resistance heat.
HSPF = Heating seasonal performance factor, total heating output (supply heat) in BTU (including electric strip heat) during the heating season divided by the total electric energy heat pump consumed in watt-hours
$\overline{\eta_{heat}}$ = heating season average efficiency. Use AFUE for heating systems < xx kBtu/hr; Et or Ec for heating systems > xx kBtu/hr
$EFLH_{cooling}$ = Cooling equivalent full-load hours. See appendix 2
$EFLH_{heating}$ = Heating equivalent full-load hours. See appendix 2.
baseline = Characteristic of baseline condition
ee = Characteristic of energy efficient condition
DE_{cool} = Distribution system efficiency in cooling mode (See Table for cooling distribution efficiency)
DE_{heat} = Distribution system efficiency in heating mode (See Table fpr heating distribution efficiency)
$CFM_{25\,base}$ = Standard duct leakage test result at 25 Pascal pressure differential of the duct system prior to sealing

$CFM_{25\,ee}$ = Standard duct leakage test result at 25 Pascal pressure differential of the duct system after sealing

CF = Coincidence factor
3.412 = Conversion factor, one watt-hour equals 3.412 BTU
12 = (kBTU/h)/ton of air conditioning capacity
1,000 = Conversion factor, one MMBtu equals 1,000 kBTU

Heating Distribution Efficiency [1]

Duct total leakage (%)	Duct system R-value (supply and	Assembly	Fast food	Full Service	Small Retail	Other
8%	Uninsulated	0.909	0.809	0.816	0.657	0.798
15%	Uninsulated	0.879	0.784	0.789	0.624	0.769
20%	Uninsulated	0.858	0.766	0.77	0.602	0.749
25%	Uninsulated	0.835	0.75	0.753	0.582	0.73
30%	Uninsulated	0.816	0.734	0.736	0.563	0.712
8%	R-6	0.951	0.901	0.904	0.792	0.887
15%	R-6	0.917	0.862	0.866	0.742	0.847
20%	R-6	0.895	0.836	0.84	0.71	0.82
25%	R-6	0.871	0.813	0.816	0.68	0.795
30%	R-6	0.849	0.791	0.794	0.652	0.772

Cooling Distribution Efficiency [1]

Duct total leakage (%)	Duct system R-value (supply and	Assembly	Fast food	Full Service	Small Retail	Other
8%	Uninsulated	0.87	0.853	0.827	0.825	0.844
15%	Uninsulated	0.859	0.843	0.825	0.818	0.836
20%	Uninsulated	0.85	0.836	0.821	0.812	0.83
25%	Uninsulated	0.84	0.827	0.818	0.805	0.823
30%	Uninsulated	0.829	0.818	0.813	0.798	0.815
8%	R-6	0.948	0.95	0.959	0.932	0.947
15%	R-6	0.932	0.933	0.955	0.921	0.935
20%	R-6	0.92	0.921	0.95	0.912	0.926
25%	R-6	0.906	0.908	0.943	0.903	0.915
30%	R-6	0.892	0.895	0.934	0.892	0.903

Thermal Regain Factors [2]

Duct Location	$TRF_{cooling}$	$TRF_{heating}$
Attic	0.10	0.10
Garage	0.10	0.10
Crawl space, unvented, uninsulated	0.60	0.60
Crawl Space, Unvented, Insulated Building Floor and Crawl Space walls	0.60	0.30
Crawl Space, Unvented, Insulated Floor Only	0.30	0.30
Crawl Space, Vented, Uninsulated	0.60	0.55
Crawl Space, Insulated Building Floor and Crawl Space Walls	0.63	0.60
Crawl Space, Vented, Insulated Floor Only	0.30	0.30
Basement, Uninsulated	0.50	0.50
Basement, Insulated Walls	0.60	0.60
Under-slab	0.20	0.20

Measure L

ife:

The measure life is 20 years. [2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a021 EC1d023	Duct Sealing	Electric	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.350	0.000
EC2a021 EC2d023	Duct Sealing	Electric	SBES Retro SBES DI	1.000	1.000	n/a	1.000	1.000	0.350	0.000
EC3a031 EC3d033	Duct Sealing	Electric	Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.350	0.000
EC3a032 EC3d034	Duct Sealing	Gas	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a033 EC3d035	Duct Sealing	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a034 EC3d036	Duct Sealing	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a

In-Service Rates:
All installations have a 100.0% in-service rate unless an evaluation finds otherwise

Realization Rates:
Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:
A summer coincidence factor if 35.0% is utilized [2,]

Energy Load Shape:

For electric measures, see Appendix 1 C&I Load Shapes "Weighted HVAC – Multi-Family"

For non-electric measures, see Appendix 1 C&I Load Shapes "Non-Electric Measures".

Revision Number	Date	Description
196	1/1/2024	Updated the test in- test out methodology to be the primary approach to use, only using the distribution efficiency methodology when test in- test out dat a is unavailable. Also added in the heating and cooling distribution efficiencies and thermal regain factors.

Endnotes:

1 : New York TRM v.10 Appendix H. Values shown for Albany NY.
2 : New York TRM v. 10 Commercial Duct Sealing and Insulation, p. 689.
3 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. Weighted CF by end use (Table 3). http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2.41. Energy Management System

Measure Code	COM-HVAC-EMS
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The measure is the installation of a new building energy management system (EMS) or the expansion of an existing energy management system for control of non-lighting electric and gas end-uses in an existing building on existing equipment.

Baseline Efficiency:

The baseline for this measure is site specific, calculated per vendor tools but with the consideration of the existing conditions.

High Efficiency:

The high efficiency case is the installation of a new EMS or the expansion of an existing EMS to control additional non-lighting electric or gas equipment. The EMS must be installed in an existing building on existing equipment.

Algorithms for Calculating Primary Energy Impact:

Gross energy and demand savings for energy management systems (EMS) are custom calculated using the EMS savings calculation tools from program administrators in Massachusetts. These tools are used to calculate energy and demand savings based on project-specific details including hours of operation, HVAC system equipment and efficiency and points controlled.

BC Measure ID	Measure Name	Fuel Type	Program	MMBtu/kWh
GC1a012 GC2a012	Energy Management System	Gas	LBES Retro – Gas SBES Retro – Gas	Calculated
EC1a025 EC1d027 EC2a025 EC2d027 EC3a038 EC3d040	Energy Management System	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	Calculated

Measure Life:

The measure life is 10 years.[1]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RRE	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a025 EC1d027	Energy Management System	LBES Retro LBES DI	1.000	0.999	1.000	1.000	1.000	0.950	1.000
EC2a025 EC2d027	Energy Management System	SBES Retro SBES DI	1.000	1.000	1.000	1.000	1.000	0.950	1.000
EC3a038 EC3d040	Energy Management System	Muni Retro Muni DI	1.000	1.000	1.000	1.000	1.000	0.950	1.000
GC1a012 GC2a012	Energy Management System	LBES Retro – Gas SBES Retro – Gas	1.000	n/a	1.000	1.000	1.000	0.000	0.000

<u>In-Service Rates:</u>
All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>
Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>
A summer coincidence factor of 95.0% and a winter coincidence factor of 100.0% is utilized.[2]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Heating and Cooling"

Revision History:

Revision Number	Date	Description
47	1/14/2022	Corrected baseline from "assumes the relevant HVAC equipment has no centralized control" to "site specific"

Endnotes:

1 : The Fleming Group, 1994. Persistence of Commercial/Industrial Non-Lighting Measures, Volume 3, Energy Management Control Systems. Prepared for New England Power Service Company.
2 : New Hampshire common assumptions.

2.42. Furnaces

Measure Code	COM-HVAC-FUR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The installation of a high efficiency natural gas warm air furnace. High efficiency furnaces are better at converting fuel into direct heat and better insulated to reduce heat loss. Federal appliance regulations require high efficiency fan motors on new residential furnaces which are also used in small commercial buildings. This measure calculates natural gas savings only.

Baseline Efficiency:

The baseline efficiency in an 85% AFUE (< 225,000 Btu/hr) or 85% Et furnace (>= 225,000 Btu/hr).[1]

High Efficiency:

The high efficiency scenario assumes either a gas-fired furnace equal or higher than 95% AFUE or 97% AFUE (< 225,000 Btu/hr); or 95% E_t or 97% E_t (>= 225,000 Btu/hr)

Algorithms for Calculating Primary Energy Impact:

Unit Savings are deemed based on study results. [1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔMMBtu
GC1b014 GC2b014	Furnace, 95%	LBES New SBES New	0	0	5.7
GC1b015 GC2b015	Furnace, 97%	LBES New SBES New	0	0	6.7

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Fossil Fuel Energy Savings

$$\Delta \text{MMBtu} = \text{units} \times \frac{\text{kBTU}/h_{in}}{unit} \times \left(\frac{Eff_{ee}}{Eff_{baseline}} - 1\right) \times \frac{EFLH_{heating}}{1{,}000}$$

where:
ΔkWh = Annual electric energy savings
ΔkW = Peak coincident demand electric savings
ΔMMBtu = Annual fossil fuel energy savings units = Number of measures installed under the program
kBTU/h_{in} = Fuel Input Rating per unit, name plate input rating of the efficient unit, from application.
Eff_{ee} = Efficiency of energy efficient condition
$Eff_{baseline}$ = Efficiency of baseline condition, from application or see baseline above of .85
$EFLH_{heating}$ = Heating equivalent full-load hours, refer to Appendix 2
1,000 = Conversion factor, one MMBtu equals 1,000 kBTU

Measure Life:

The measure life is 18 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

3

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b014 GC2b014	Furnace, 95%	LBES New SBES New	1.00	1.00	1.00	n/a	n/a	0.00	0.16
GC1b015 GC2b015	Furnace, 97%	LBES New SBES New	1.00	1.00	1.00	n/a	n/a	0.00	0.16

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates</u>:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A winter coincidence factor of 16% is utilized. Values pertain to other resource impacts for the EC motors.

Energy Load Shape:

See Appendix 1 “C&I Heating & Cooling”.

Endnotes:

1 : DNV (2021), Application of MA19C08-B-NRNCMKT Results
https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/14155471

DNV-GL, 2015. Recalculation of Prescriptive Program Gas Furnace Savings Using New Baseline. Prepared for National Grid, Massachusetts.
2 : ASHRAE Applications Handbook, 2003; Page 36.
3 : Massachusetts TRM 2019 Plan-Year Report Version, 2020. Measure 3.42: HVAC Combo Furnace, Gas, Commercial Page 510

2.43. Heat Pump Systems

Measure Code	COM-HVAC-HPS
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure includes the installation of single package,ducted split system and ductless mini-split, ground source and water source heat pumps to serve the space heating and space cooling loads in a C&I facility. “Water source” refers to systems that use ground or lake water rather than a boiler as a loop heat source. The savings for this measure are realized through the increased nameplate efficiency between the baseline and installed equipment.

Baseline Efficiency:

For lost opportunity, the baseline is a code compliant heat pump unit of the same type as the high efficiency unit. Details regarding heat pump baseline efficiencies based on capacity and type are provided in a tabular format along with the savings algorithms.

For early retirement (retrofit), it is assumed that the new unit replaces the pre-existing heat pump unit, which is not at the end of its useful life. In this case, the baseline is the pre-existing, inefficient heat pump unit.

High Efficiency:

The high efficiency (or energy efficient) case is the site-specific heat pump unit. The energy efficient heat pump unit is assumed to be of the same type as the baseline unit.

Algorithms for Calculating Primary Energy Impact:

The savings for this measure are attributable to the increase in nameplate efficiency between the baseline and installed units.

The algorithm for calculating electric demand savings is:

$$\Delta kW = \max(\Delta kW_{cool} \text{ or } \Delta kW_{heat})$$

$$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

If unit is a standard air source or minisplit heat pump

$$\Delta kW_{heat} = 0$$

If unit is a cold climate air source or minisplit heat pump

$$\Delta kW_{heat} = Cap_{heat}(5) \times \left(1 - \frac{1}{COP_{EE}(5)}\right) \times \frac{1}{3.412}$$

$Cap_{heat}(5) = Cap_{cool} \times 0.87$ if unit is a cold climate air source heat pump

$Cap_{heat}(5) = Capcool \times 0.94$ if unit is a cold climate ductless mini split heat pump

If unit is a ground source or water source heat pump

$$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{COP_{Base}} - \frac{1}{COP_{EE}}\right) \times \frac{1}{3.412}$$

$Cap_{heat} = Cap_{cool} \times (COP_{EE} \times 3.412)/EER_{EE}$ if unit is a ground source or water source heat pump

The algorithm for calculating annual electric energy savings is:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

For air source and ductless mini split heat pumps < 65 kBtu/hr cooling capacity:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

For air source heat pumps >= 65 kBtu/hr cooling capacity:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{IEER_{Base}} - \frac{1}{IEER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{COP_{Base}} - \frac{1}{COP_{EE}}\right) \times \frac{EFLH_{heat}}{3.412}$$

For water source and ground source heat pumps

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{COP_{Base}} - \frac{1}{COP_{EE}}\right) \times \frac{EFLH_{heat}}{3.412}$$

Where:

ΔkW= Gross annual demand savings for heat pump unit

ΔkW_{cool}= Gross annual cooling demand savings for heat pump unit

ΔkW_{heat}= Gross annual heating demand savings for heat pump unit. For non cold-climate heat pumps OR for facilities that employ supplemental heating sources (such as fossil fuel or electric resistance heat), $\Delta kW_{heat} = 0$

Cap_{cool}= Cooling capacity (in kBtu/h) of the energy efficient heat pump unit, from equipment specifications

Cap_{heat}= Heating capacity (in kBtu/h) of the energy efficient pump unit, from equipment specifications. Use given equations to convert from cooling capacity value if standard equipment literature does not provide this value

EER_{BASE}= Energy Efficiency Ratio of the baseline heat pump equipment

EER_{EE}= Energy Efficiency Ratio of the energy efficient heat pump unit, from equipment specifications

COP_{BASE}= Heating Coefficient of Performance of baseline heat pump equipment

COP_{EE}= Heating Coefficient of Performance of energy efficient heat pump unit, from equipment specifications

ΔkWh_{cool}= Gross annual cooling savings for heat pump unit

ΔkWh_{heat}= Gross annual heating savings for heat pump unit

$SEER_{BASE}$= Seasonal Energy Efficiency Ratio of baseline heat pump equipment

$SEER_{EE}$= Seasonal Energy Efficiency Ratio of energy efficient heat pump unit, from equipment specifications

$IEER_{BASE}$= Integrated Energy Efficiency Ratio of the baseline heat pump equipment

$IEER_{EE}$= Integrated Energy Efficiency Ratio of the energy efficient heat pump unit, from equipment specifications

$HSPF_{BASE}$= Heating Seasonal Performance Factor of baseline heat pump equipment

$HSPF_{EE}$= Heating Seasonal Performance Factor of energy efficient heat pump unit, from equipment specifications

$EFLH_{cool}$= Equivalent Full Load Hours for cooling. See Appendix 2 for inputs.

$EFLH_{heat}$= Equivalent Full Load Hours for heating. See Appendix 2 for inputs.

0.9= Conversion factor[1] to convert cooling capacity to heating capacity for heat pump units not on NEEP's cold climate air source heat pump (ccASHP) product list. The conversion factor for ccASHPs is 1.0.

Tables based on Federal Standards 10CFR Part 431.97 and IECC 2018.[2]

Heat Pump Type	Cooling Capacity Range	Parameter	Value (Lost Opportunity)	Value (Retrofit)	Units
Air source heat pump (single phase)	≤65,000 Btu/h	EER_{BASE}	11.8	Pre-existing equipment EER	Btu/W-h
		$SEER_{BASE}$	15.0	Pre-existing equipment SEER	Btu/W-h
		$HSPF_{BASE}$	8.8	Pre-existing equipment HSPF	Btu/W-h
Air source heat pump (3 phase)	≤65,000 Btu/h	EER_{BASE}	11.8	Pre-existing equipment EER	Btu/W-h
		$SEER_{BASE}$	14.0	Pre-existing equipment SEER	Btu/W-h
		$HSPF_{BASE}$	8.2	Pre-existing equipment HSPF	Btu/W-h
Air source heat pump	≥ 65,000 and < 135,000	EER_{BASE}	11.0 (electric heat or none) 10.8 (all other heat)	Pre-existing equipment EER	Btu/W-h

Heat Pump Type	Cooling Capacity Range	Parameter	Value (Lost Opportunity)	Value (Retrofit)	Units
		$IEER_{BASE}$	14.1 (electric heat or none) 13.9 (all other heat)	Pre-existing equipment IEER	Btu/W-h
		COP_{BASE}	3.3	Pre-existing equipment COP	Btu/Btu
Air source heat pump	≥ 135,000 and < 240,000	EER_{BASE}	10.6 (electric heat or none) 10.4 (all other heat)	Pre-existing equipment EER	Btu/W-h
		$IEER_{BASE}$	13.5 (electric heat or none) 13.3 (all other heat)	Pre-existing equipment IEER	Btu/W-h
		COP_{BASE}	3.2	Pre-existing equipment COP	Btu/Btu
Air source heat pump	≥240,000 Btu/h < 760,000 Btu/h	EER_{BASE}	9.5 (electric heat or none) 9.3 (all other heat)	Pre-existing equipment EER	Btu/W-h
		$IEER_{BASE}$	12.5 (electric heat or none) 12.3 (all other heat)	Pre-existing equipment SEER	Btu/W-h
		COP_{BASE}	3.2	Pre-existing equipment HSPF	Btu/Btu
Ductless Mini Split	≤65,000 Btu/h Single Phase	EER_{BASE}	11.8	Pre-existing equipment EER	Btu/W-h
		$SEER_{BASE}$	15	Pre-existing equipment SEER	Btu/W-h
		$HSPF_{BASE}$	8.8	Pre-existing equipment HSPF	Btu/W-h

Heat Pump Type	Cooling Capacity Range	Parameter	Value (Lost Opportunity)	Value (Retrofit)	Units
Ductless Mini Split	≤65,000 Btu/h 3 Phase	EER_{BASE}	11.8	Pre-existing equipment EER	Btu/W-h
		$SEER_{BASE}$	14	Pre-existing equipment SEER	Btu/W-h
		$HSPF_{BASE}$	8.2	Pre-existing equipment HSPF	Btu/W-h
Water Source	<17,000 Btu/h	EER_{BASE}	12.2 at 86F entering water	Pre-existing equipment EER	Btu/W-h
		COP_{BASE}	4.3 at 68F entering water	Pre-existing equipment COP	Btu/Btu
Water Source	≥17,000 Btu/h < 65,000 Btu/h	EER_{BASE}	13.0 at 86F entering water	Pre-existing equipment EER	Btu/W-h
		COP_{BASE}	4.3 at 68F entering water	Pre-existing equipment COP	Btu/Btu
Water Source	≥65,000 Btu/h < 135,000 Btu/h	EER_{BASE}	13.0 at 86F entering water	Pre-existing equipment EER	Btu/W-h
		COP_{BASE}	4.3 at 68F entering water	Pre-existing equipment COP	Btu/Btu
Ground Source (Open Loop)	< 135,000 Btu/h	EER_{BASE}	18.00 at 59F entering water	Pre-existing equipment EER	Btu/W-h
		COP_{BASE}	3.7 at 50F entering water	Pre-existing equipment COP	Btu/Btu
Ground Source (Closed Loop)	< 135,000 Btu/h	EER_{BASE}	14.1 at 77F entering water	Pre-existing equipment EER	Btu/W-h
		COP_{BASE}	3.2 at 32F entering fluid	Pre-existing equipment COP	Btu/Btu

Heat Pump Type	Cooling Capacity Range	Parameter	Value (Lost Opportunity)	Value (Retrofit)	Units
All		$HSPF_{BASE}$	3.142 For when baseline/pre-existing system is electric resistance heat		Btu/W-h
All		COP_{BASE}	1.0 For when baseline/pre-existing system is electric resistance heat		Btu/Btu

Federal Standards require heat pump cooling seasonal efficiency rated as SEER2 for systems < 65,000 Btu/hr cooling capacity beginning January 2023.

For air source heat pumps SEER2 is converted to SEER using the table below :

SEER2	SEER
13.4	14
14.3	15
15.2	16
16	17
17	18
18	19
19	20
20	21
21	22
22	23

For minisplit heat pumps:

SEER2 = SEER

Federal Standards require heat pump heating seasonal efficiency rated as HSPF2 for systems < 65.000 Btu/hr cooling capacity beginning January 2023.

For air source heat pumps, HSPF2 is converted to HSPF using the table below:

HSPF2	HSPF
6.7	8
7.1	8.5
7.5	8.8
7.8	9.2
8	9.5
8.4	10
8.5	10.2
8.9	10.8
9.1	11
9.3	11.3
9.7	11.9
10	12.4
10.4	12.9

For minisplit heat pumps:

HSPF2 = HSPF x 0.95

Measure Life:

The measure life is listed below by measure. Due to limitations with the avoided cost calculations in the Benefit/Cost Models, where measure lives are greater than 25 years, the models use a 25-year measure life

BC Measure ID	**Measure Name**	**Program**	Measure Life
	Air Source Heat Pump	LBES Retrofit	12
	Air Source Heat Pump	LBES DI	12
	Air Source Heat Pump	SBES Retrofit	12
	Air Source Heat Pump	SBES DI	12
	Air Source Heat Pump	Muni Retrofit	12

BC Measure ID	Measure Name	Program	Measure Life
	Air Source Heat Pump	Muni DI	12
EC1a022	Ductless Mini Split Heat Pump	LBES Retrofit	12[3]
EC1d024	Ductless Mini Split Heat Pump	LBES DI	12
EC2a022	Ductless Mini Split Heat Pump	SBES Retrofit	12
EC2d024	Ductless Mini Split Heat Pump	SBES DI	12
EC3a035	Ductless Mini Split Heat Pump	Muni Retrofit	12
EC3d037	Ductless Mini Split Heat Pump	Muni DI	12
EC1b050	Water Source Heat Pump	LBES New	12
EC2b050	Water Source Heat Pump	SBES New	12
EC3b081	Water Source Heat Pump	Muni New	12
EC1b035	Ground Source Heat Pump	LBES New	25
EC2b035	Ground Source Heat Pump	SBES New	25
EC3b056	Ground Source Heat Pump	Muni New	25
EC1c003	Midstream DMSHP Systems	LBES Midstream	12
EC2c003	Midstream DMSHP Systems	SBES Midstream	12
EC1c006	Midstream Heat Pump Systems	LBES Midstream	12
EC2c006	Midstream Heat Pump Systems	SBES Midstream	12
EC1c009	Midstream Water Source Heat Pump Systems	LBES Midstream	12
EC2c009	Midstream Water Source Heat Pump Systems	SBES Midstream	12

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a022	Ductless Mini Split Heat Pump	LBES Retrofit	1.000	0.999	1.000	1.000	1.000	0.342	0.000

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1d024	Ductless Mini Split Heat Pump	LBES DI	1.000	0.999	1.000	1.000	1.000	0.342	0.000
EC2a022	Ductless Mini Split Heat Pump	SBES Retrofit	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC2d024	Ductless Mini Split Heat Pump	SBES DI	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC3a035	Ductless Mini Split Heat Pump	Muni Retrofit	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC3d037	Ductless Mini Split Heat Pump	Muni DI	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC1b050	Water Source Heat Pump	LBES New	1.000	0.999	1.000	1.000	1.000	0.342	0.342
EC2b050	Water Source Heat Pump	SBES New	1.000	1.000	1.000	1.000	1.000	0.342	0.342
EC3b081	Water Source Heat Pump	Muni New	1.000	1.000	1.000	1.000	1.000	0.342	0.342
EC1b035	Ground Source Heat Pump	LBES New	1.000	0.999	1.000	1.000	1.000	0.342	0.342
EC2b035	Ground Source Heat Pump	SBES New	1.000	1.000	1.000	1.000	1.000	0.342	0.342
EC3b056	Ground Source Heat Pump	Muni New	1.000	1.000	1.000	1.000	1.000	0.342	0.342
EC1c003	Midstream DMSHP Systems	LBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC2c003	Midstream DMSHP Systems	SBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC1c006	Midstream Heat Pump Systems	LBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC2c006	Midstream Heat Pump Systems	SBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.000
EC1c009	Midstream Water Source Heat Pump Systems	LBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.342

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2c009	Midstream Water Source Heat Pump Systems	SBES Midstream	1.000	1.000	1.000	1.000	1.000	0.342	0.342

In-Service Rates:

All installations have 100% in-service-rates since programs include verification of equipment installations.

Realization Rates: [7]

All programs use 100% realization rate except for LBES (Retrofit, Direct Install, and NEC), which use a value of 99.90%.

Coincidence Factors: [5]

For ductless mini split heat pumps, summer coincidence factor is 37% and a winter coincidence factor is 0%.

For cold-climate ductless mini split heat pumps, is 34.2% and a winter coincidence factor is 34.2%.

For water source heat pumps and ground source heat pumps, summer & winter coincidence factor is 34.2%.

Energy Load Shape:

For ductless minisplit heat pumps, see Appendix 1 – "DMSHP"

For water source and ground source heat pumps, see Appendix 1 – "Central Heat Pump"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

6

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c003 EC2c003	Midstream DMSHP Systems	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c006 EC2c006	Midstream Heat Pump Systems	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860
EC1c009 EC2c009	Midstream Water Source Heat Pump Systems	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

Revision History:

Revision Number	Date	Revision
55	1/14/2022	Updated SEER to EER conversion factor
72	3/1/2022	Added EFLH values

Endnotes:

1 : Conversion factor is based on internal ERS analysis of Mass Save and NEEP ccASHP product data.
2 : https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-431/subpart-F/subject-group-ECFR2640f6ad978e4e6/section-431.97
3 : DNV GL (2018). Expected Useful Life (EUL) Estimation for Air-Conditioning Equipment from Current Age Distribution Memo. https://ma-eeac.org/wp-content/uploads/Final-memo-on-P73-Track-D-EUL-estimation-results-to-date-v2.pdf
4 : New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Impact Evaluation report. Table 3
5 : Coincidence Factors are from 2011 NEEP HVAC Loadshape Study Table 0-5 (ISO_NE on Peak for NE-North)
6 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.44. Heat and Hot Water Combo Systems

Measure Code	COM-HVAC-HWCS
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Combo Condensing Furnace / Water Heater: Installation of a combination furnace.
Combo Condensing Boiler / Water Heater: This measure promotes the installation of a combined highefficiency boiler and water heating unit. Combined boiler and water heating systems are more efficient than separate systems because they eliminate the standby heat losses of an additional tank.

Baseline Efficiency:

Combo Condensing Furnace / Water Heater: It is assumed that the baseline is an 85% AFUE furnace 1 and a separate high draw gas fired storage water heater with an efficiency rating of 0.63 UEF.

Combo Condensing Boiler / Water Heater: The baseline efficiency case is a standard efficiency gas-fired storage tank hot water heater with a separate 85% AFUE boiler for space heating purposes.

High Efficiency:

Combo Condensing Furnace / Water Heater: A new combination 97% AFUE furnace and 0.90 tankless water heater.

Combo Condensing Boiler / Water Heater: The high efficiency case is either a condensing, integrated water heater/boiler with an AFUE of >=90% or AFUE>=95%

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results[2]

BC Measure ID	Measure Name	ΔMMBtu
GC1b012 GC2b012	Combo Condensing Furnace/Water Heater, Gas	15.1
GC1b011 GC2b011	Combo Condensing Boiler/Water Heater, Gas	30.5

Measure Life:

Combo Condensing Furnace / Water Heater: The measure life is 18 years.[3]

Combo Condensing Boiler/Water Heater: 20 years.[4]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b012 GC2b012	Combo Condensing Furnace/Water Heater, Gas	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1b011 GC2b011	Combo Condensing Boiler/Water Heater, Gas	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Not applicable for this measure since no electric savings are claimed

Energy Load Shape:

See Appendix 1, C&I Load Shapes Table- “Heating and Cooling.

Revision History:

Revision Number	Date	Description
48	1/14/2022	Update baseline. Baseline boiler should be 85% consistent with

		treatment elsewhere in the TRM. 30.5 MMBtu/unit savings are OK, consistent with MA assumptions:

Endnotes:

1 : Massachusetts TRM 2019 Plan-Year Report Version, 2020. Measure 3.30: HVAC Combo Furnace/Water Heater, Commercial Page 477
2 : The Cadmus Group, March 2015. High Efficiency Heating Equipment Impact Evaluation. Prepared for The Electric and Gas Program Administrators of Massachusetts, Part of the Residential Evaluation Program Area https://neep.org/sites/default/files/resources/High-Efficiency-Heating-Equipment-ImpactEvaluation-Final-Report.pdf
3 : Environmental Protection Agency, 2009. Lifecycle Cost Estimate for Energy Star Furnace.
4 : Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks, GDS Associates, April 2009. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-inMA.pdf

2.45. High Efficiency Chiller

Measure Code	COM-HVAC-HEC
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure promotes the installation of efficient water-cooled and air-cooled water chilling packages for comfort cooling applications. Eligible chillers include air-cooled, water cooled rotary screw and scroll, and water-cooled centrifugal chillers for single chiller systems or for the lead chiller only in multi-chiller systems.

Baseline Efficiency:

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by New Hampshire State Building Code. Energy efficiency must be met via compliance with the International Energy Conservation Code (IECC) 2018.

The table below details the specific efficiency requirements by equipment type and capacity..

Chiller - Minimum Efficiency Requirements [1] :

For water cooled ≤300 tons positive displacement is the baseline. For > 300 tons Centrifugal is the baseline. 2 Path A is intended for applications where significant operating time is expected at full load. Path B is intended for applications where significant operating time is expected at part-load.

Size Category (Tons)	Units	Path A	Path A	Path B	Path B
		Full Load	IPLV	Full Load	IPLV
Air-cooled chillers					
< 150	EER	10.100	13.700	9.700	15.800
≥ 150	EER	10.100	14.000	9.700	16.100
Water cooled, electrically operated, positive displacement (rotary screw and scroll)					
< 75	kW/ton	0.750	0.600	0.780	0.500
≥ 75 and < 150	kW/ton	0.720	0.560	0.750	0.490
≥ 150 and < 300	kW/ton	0.660	0.540	0.680	0.440

Size Category (Tons)	Units	Path A	Path A	Path B	Path B
		Full Load	IPLV	Full Load	IPLV
≥ 300 and <600	kW/ton	0.610	0.520	0.625	0.410
≥ 600	kW/ton	0.560	0.500	0.585	0.380
Water cooled, electrically operated, centrifugal					
< 150	kW/ton	0.610	0.550	0.695	0.440
≥ 150 and < 300	kW/ton	0.610	0.550	0.635	0.400
≥ 300 and < 400	kW/ton	0.560	0.520	0.595	0.390
≥ 400 and < 600	kW/ton	0.560	0.500	0.585	0.380
≥ 600	kW/ton	0.560	0.500	0.585	0.380

High Efficiency:

The high efficiency scenario assumes water chilling packages that exceed the efficiency levels required by New Hampshire State Building Code and meet the minimum efficiency requirements as stated in the New Construction HVAC energy efficiency rebate forms.

Algorithms for Calculating Primary Energy Impact:

Gross energy and demand savings for chiller installations may be custom calculated using the PA's Chillers savings calculation tool. These tools are used to calculated energy and demand savings based on site-specific chiller plant details including specific chiller plan equipment, operational staging, operating load profile and load profile.

Alternatively, the energy and demand savings may be calculated using the algorithms and inputs below. Please note that consistent efficiency types (FL or IPLV) must be used between the baseline and high efficiency cases. It is recommended that IPLV be used over FL efficiency types when possible.

All Chillers: [2]
$kWh = Tons * (kW/ton_{base} - kW/ton_{EE}) * Hours$
$kW = Tons * (kW/ton_{base} - kW/ton_{EE}) * CF$

Where:

Tons = Rated capacity of the cooling equipment
Hours = Use hours from appendix 2 where building type information is available. If unavailble, set squivalent full load hours for chiller operation 1,361[3]
RR_{adjkwh}= Adjusted kWh realization rate from evaluation (119.6%)
kW/ton_{BASE} = Energy efficiency IPLV rating of the baseline equipment. *
kW/ton_{EE} = Energy efficiency IPLV rating of the efficient equipment. *
CF= Coincidence Factor from evaluation (.49 summer on peak, .06 winter on peak, .42 summer seasonal peak, .04 winter seasonal peak)

* For Aircooled units, use the following equation to convert EER to kw/ton:

kW/ton = 12 / EER

Measure Life:

The measure life is 23 years.[4]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b053	Chillers – IPLV used	LBES New	1.000	0.999	n/a	1.000	1.000	0.490	0.060
EC2b053	Chillers – IPLV used	SBES New	1.000	1.000	n/a	1.000	1.000	0.490	0.060
EC3b084	Chillers – IPLV used	Muni New	1.000	1.000	n/a	1.000	1.000	0.490	0.060
EC1b052	Chillers – FL used	LBES New	1.000	0.999	n/a	1.000	1.000	0.860	0.100
EC2b052	Chillers – FL used	SBES New	1.000	1.000	n/a	1.000	1.000	0.860	0.100
EC3b083	Chillers – FL used	Muni New	1.000	1.000	n/a	1.000	1.000	0.860	0.100

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are based on prospective statewide results from 2015 prescriptive chiller study.[5]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Electric Chiller (Combined)".

Revision History:

Revision Number	Issue Date	Description
51	1/14/2022	Added EFLH based on 2015 DNV GL study. EFLH value was previously missing.
52	1/14/2022	Fixed error under baseline efficiency, high efficiency, and references section. Document originally labelled the referenced code as "Massachusetts" building code, rather than "New Hampshire". The referenced code, IECC 2015 Energy Conservation, and the values listed were correct but were incorrectly labelled with "Massachusetts". Additionally, the reference to the code was updated as it was not included originally.
99	12/1/2022	Updated methodology to align with latest study, Kema, 2015. Impact of Prescriptive Chiller and Compressed Air Installations. Note, since NH RR is applied under impact factors section, the RR adjustment was removed from the algorithm. Also updated equation to use EFLH from appendix 2, where building type is available. Added conversion factor for kw/ton to EER

Endnotes:

1 : Energy Solutions, 2018. Northeast Chillers Market Research.
2 : KEMA inc, 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488686996f24a5b7df77b/view?authToken=b6501145f0e30abd7ca606f9b9e786b4ca1d1c1b64f4305fcc879bb360065f0978f0d3b139677be691407f1ee45095d58a488538bc5577782deb127cafd8e7eb197da16b1912a7
3 : KEMA inc, 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488686996f24a5b7df77b/view?authToken=b6501145f0e30abd7ca606f9b9e786b4ca1d1c1b64f4305fcc879bb360065f0978f0d3b139677be691407f1ee45095d58a488538bc5577782deb127cafd8e7eb197da16b1912a7
4 : Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_1Jun2007.pdf
5 : DNV GL, October 2015. Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for the MA PAs and EEAC. http://ma-eeac.org/wordpress/wp-content/uploads/MA30-Prescriptive-Chiller-and-CAIR-Report_FINAL_151026.pdf

2.46. Hotel Occupany Sensor

Measure Code	COM-HVAC-HOS
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The measure is to the installation of hotel occupancy sensors (HOS) to control packaged terminal AC units (PTACs) with electric heat, heat pump units and/or fan coil units in hotels that operate all 12 months of the year.

Baseline Efficiency:

The baseline efficiency case assumes the equipment has no occupancy-based controls.

High Efficiency:

The high efficiency case is the installation of controls that include (a) occupancy sensors, (b) window/door switches for rooms that have operable window or patio doors, and (c) set back to 65°F in the heating mode and set forward to 78°F in the cooling mode when occupancy detector is in the unoccupied mode. Sensors controlled by a front desk system are not eligible.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on evaluation results[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
EC1a031 EC1d031 EC2a031 EC2d031 EC3a050 EC3d050	Hotel Occupancy Sensor	LBES Retro LBES DI SBES Retro SBES DI Muni Retrofit Muni DI	438	0.090

Measure Life:

The measure life is 10 years[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a031 EC1d031	Hotel Occupancy Sensor	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.820	0.050
EC2a031 EC2d031	Hotel Occupancy Sensor	SBES Retro SBES DI	1.000	1.000	n/a	1.000	1.000	0.820	0.050
EC3a050 EC3d050	Hotel Occupancy Sensor	Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.820	0.050

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates</u>:

Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors</u>:

Coincidence factors are 82% for summer peak and 5% for winter peak.[3]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Heating and Cooling".

Endnotes:

1 : MassSave, 2010. Energy Analysis: Hotel Guest Occupancy Sensors. Prepared for National Grid and Eversource (NSTAR).
2 : Energy and Resource Solutions, November 2005. Measure Life Study. Prepared for MA Joint Utilities. HOS measure life assumed to be the same as that for occupancy-based lighting controls. https://www.ers-

inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : New Hampshire Common Assumptions.

2.47. Infrared Heater

Measure Code	COM-HVAC-IH
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

The installation of a gas-fired low intensity infrared heating system in place of unit heater, furnace, or other standard efficiency equipment. Infrared heating uses radiant heat as opposed to warm air to heat buildings. In commercial environments with high air exchange rates, heat loss is minimal because the space's heat comes from surfaces rather than air.

Baseline Efficiency:

The baseline efficiency case is a standard efficiency gas-fired unit heater with combustion efficiency of 80%.[1]

High Efficiency:

The high efficiency case is a gas-fired low-intensity infrared heating unit.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on the Impact Evaluation of 2011 Prescriptive Gas Measures for the Mass Save Program Administrators. [2]

BC Measure ID	Measure Name	Fuel Type	**Program**	ΔMMBtu
GC1b016 GC2b016	Infrared Heater	Gas	LBES New SBES New	12.0
EC3b064	Infrared Heater	Propane	MES New	12.0

Measure Life:

The measure life is 17 years. [3]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1b016 GC2b016	Infrared Heater	LBES New SBES New	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3b064	Infrared Heater	MES New	1.000	n/a	1.000	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Not applicable for this measure since no electric savings are claimed.

Energy Load Shape:

See Appendix 1 “C&I Heating & Cooling”.

Revision History:

Revision Number	Date	Description
50	1/14/2022	Corrected baseline to reference most current code.
71	3/1/2022	Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
142	12/1/2022	Removed algorithm for calculation. Current program design is prescriptive.

Endnotes:

1 : 2015 International Energy Conservation Code
2 : KEMA, June 2013. Impact Evaluation of 2011 Prescriptive Gas Measures; Page 1-5. http://maeeac.org/wordpress/wp-content/uploads/Impact-Evaluation-of-2011-Prescription-Gas-Measures6.27.13.pdf
3 : Nexant, 2006. DSM Market Characterization Report. Prepared for Questar Gas.

2.48. Pipe Wrap

Measure Code	COM-HVAC-PW
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Pipe Wrap – Heating: Install insulation on steam pipes located in non-conditioned spaces.
Pipe Wrap – Hot Water: Install insulation on hot water located in non-conditioned spaces.

Baseline Efficiency:

Pipe Wrap – Heating: The baseline efficiency case is un-insulated steam piping in unconditioned space

Pipe Wrap – Hot Water: The baseline efficiency case is un-insulated hot water piping in unconditioned space.

High Efficiency:

Pipe Wrap – Heating: The high efficiency condition is steam piping in unconditioned space with insulation installed.

Pipe Wrap – Hot Water: The high efficiency condition is hot water piping in unconditioned space with insulation installed.

Algorithms for Calculating Primary Energy Impact:

Gas unit savings are deemed based on an average of unit savings for 1.5 inch pipes and 3 inch pipes .[1] kW savings for hot water pipes with electric are calculated using the demand impact model.

Savings for steam pipes with electric heating is calculated as:

$$\Delta kWh = \frac{\left(\left(\frac{UA}{L}\right)_{baseline} - \left(\frac{UA}{L}\right)_{ee}\right)}{E_t \times 3{,}412} \times L \times \Delta T_{amb} \times hrs$$

Where,

$\left(\frac{UA}{L}\right)_{baseline}$= Overall baseline heat transfer coefficient per unit length. 0.97 for 1.5", 1.19 for 2", and 1.70 for 3" copper pipes. For steel pipes, 1.23 for 1.5", 1.51 for 2", and 2.16 for 3".

$\left(\frac{UA}{L}\right)_{ee}$= Overall energy efficient heat transfer coefficient per unit length: 0.12 for all pipe sizes assuming fiber glass insulation of thickness equal to pipe diameter. Use 0.46 for rigid foam/cellular glass insulation of thickness equal to pipe diameter.

L = Length of the pipe insulated.

ΔT_{amb} = 85 °F.1

hrs = Annual operating hours.

E_t = Thermal efficiency of electric heater. Default value of 0.98.

$$\Delta kW = \frac{\Delta kWh}{8760}$$

Measure ID	**Measure Name**	**Fuel Type**	**Program**	ΔkWh	ΔkW	ΔMMBtu/ linear foot
GC1a013 GC2a013	Pipe Wrap – Heating	Gas	LBES Retro – Gas SBES Retro – Gas	n/a	n/a	.29
GC1a008 GC2a008	Pipe Wrap – Hot Water	Gas	LBES Retro – Gas SBES Retro – Gas	n/a	n/a	.29
EC3a068 EC3d068	Pipe Wrap – Heating	Gas	Muni Retro Muni DI	n/a	n/a	Calculated
EC3a072 EC3d072	Pipe Wrap – Hot Water	Gas	Muni Retro Muni DI	n/a	n/a	Calculated
EC3a069 EC3d069	Pipe Wrap – Heating	Oil	Muni Retro Muni DI	n/a	n/a	Calculated
EC3a073 EC3d073	Pipe Wrap – Hot Water	Oil	Muni Retro Muni DI	n/a	n/a	Calculated

Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu/ linear foot
EC3a070 EC3d070	Pipe Wrap – Heating	Propane	Muni Retro Muni DI	n/a	n/a	Calculated
EC3a074 EC3d074	Pipe Wrap – Hot Water	Propane	Muni Retro Muni DI	n/a	n/a	Calculated
EC1a038 EC1d038 EC2a038 EC2d038 EC3a067 EC3d067	Pipe Wrap – Heating	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	Calculated	Calculated	n/a
EC1a039 EC1d039 EC2a039 EC2d039 EC3a071 EC3d071	Pipe Wrap – Hot Water	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	Calculated	Calculated	n/a
EC1c061 EC2c061	OMP Pipe Wrap, 7 feet	Electric	LBES Mid SBES Mid	192.5	0.01	
GC1c017 GC2c017	OMP Pipe Wrap, 10 feet	Gas	LBES Mid SBES Mid	n/a	n/a	2.9

Measure Life:

The measure life is 15 years.[3]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

2

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1a013 GC2a013 EC3a068 EC3d068	Pipe Wrap – Heating	Gas	LBES Retro – Gas SBES Retro – Gas	1.000	n/a	1.000	n/a	n/a	n/a	n/a

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
			Muni Retro Muni DI							
GC1a008 GC2a008 EC3a072 EC3d072	Pipe Wrap – Hot Water	Gas	LBES Retro – Gas SBES Retro – Gas Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a069 EC3d069	Pipe Wrap – Heating	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a073 EC3d073	Pipe Wrap – Hot Water	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a070 EC3d070	Pipe Wrap – Heating	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a074 EC3d074	Pipe Wrap – Hot Water	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC1a038 EC1d038	Pipe Wrap – Heating	Electric	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.000	0.433
EC2a038 EC2d038 EC3a067 EC3d067	Pipe Wrap – Heating	Electric	SBES Retro SBES DI Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.000	0.433
EC1a039 EC1d039	Pipe Wrap – Hot Water	Electric	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.312	0.808
EC2a039 EC2d039 EC3a071 EC3d071	Pipe Wrap – Hot Water	Electric	SBES Retro SBES DI Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.312	0.808
EC1c061 EC2c061	OMP Pipe Wrap, 7 feet	Electric	LBES Mid SBES Mid	1.000	1.000	n/a	1.000	1.000	0.312	0.808
GC1c017 GC2c017	OMP Pipe Wrap, 10 feet	Gas	LBES Mid SBES Mid	1.000	n/a	1.000	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Large Business Energy Solution uses a 99.9% electric realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A summer coincidence factor of 31.2% and a winter coincidence factor of 80.8% is utilized for insulation of hot water pipes with electric heating. For heating pipes with electric heating, a winter coincidence factor of 43.3% is utilized.[3]

Energy Load Shape:

For electric heating measures, see Appendix 1 C&I Load Shapes “Hardwired Electric Heat”.
For electric hot water measures, see Appendix 1 C&I Load Shapes “Water Heater – Electric”.
For non-electric measures, see Appendix 1 C&I Load Shapes “Non-electric Measures”

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c061 EC2c061	OMP Pipe Wrap, 7 feet	LBES Mid SBES Mid	0.237	0.07	0	0.86
GC1c017 GC2c017	OMP Pipe Wrap, 10 feet	LBES Mid SBES Mid	0.237	0.07	0	0.86

Revision History:

Revision Number	Revision Date	Description
108	12/1/2022	Added new OMP Measures.

Endnotes:

1 : National Grid Staff Calculation, 2010. Pipe insulation for SBS DI measures 2010 Excel Workbook.https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee4885c6996f2d3357df744/view?authToken=7fee5ba9537c0f5f564abd5d10975916a6a377ca27b3db4ab2d14a8fccd27767411a93ba3aeb7bf5b51d488f6bd8d9adc9a2471d1508cd1c7bbaadcb846385e4b40dd3442ba7aa
2 : Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks, GDS Associates, April 2009. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-inMA.pdf

3 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wpcontent/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2.49. Programmable Thermostat

Measure Code	COM-HVAC-PGM
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Installation of a programmable thermostat, which gives the ability to adjust heating or air-conditioning operating times according to a pre-set schedule.

Baseline Efficiency:

The baseline efficiency case is an HVAC system without a programmable thermostat.

High Efficiency:

The high efficiency case is an HVAC system that has a programmable thermostat installed, purchased through the C&I Online Market Place

Algorithms for Calculating Primary Energy Impact:

Savings are based on the MA Residential Wi-Fi and Programmable Thermostat Impact Evaluation. [1]

BC Measure ID	Measure Name	Energy Type	Program	ΔkWh	ΔkW	ΔMMbtu
GC1c019 GC2c019	OMP Programmable Thermostat, Gas	Gas	LBES Mid SBES Mid	n/a	n/a	2.07

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

No other resource impacts are included.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1c019 GC2c019	OMP Programmable Thermostat, Gas	NG - Res Heating	HEA	1.00	n/a	1.00	n/a	n/a	n/a	n/a

Programmable thermostats that control both cooling and heating equipment should claim both the 27 kWh of electric energy savings associated with the cooling equipment at the impact factors listed above and any heating savings.

<u>In-Service Rates:</u>

All installations have a 100% in-service rate until and evaluation finds otherwise.

<u>Realization Rates:</u>

All installations have a 100% realization rate until an evaluation finds otherwise.

<u>Coincidence Factors:</u>

n/a

Energy Load Shape:

See Appendix 1 “Weighted HVAC- All Homes” and "Central Air Conditioner/Heat Pump (Cooling)"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c020 GC2c020	OMP Wi-Fi Thermostat	LBES Mid SBES Mid	0.237	0.07	0	0.86

Revision History:

Revision Number	Issue Date	Description
109	12/1/2022	New Measure Added

Endnotes:

1 : Guidehouse Inc (2021) Residential Wi-Fi and Programmable Thermostat Impacts https://ma-eeac.org/wp-content/uploads/MARES24-Final-Report-2021-09-29.pdf
2 : Environmental Protection Agency, 2010. Life Cycle Cost Estimate for ENERGY STAR

Programmable Thermostat.

2.50. Steam Traps

Measure Code	COM-HVAC-ST
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

Repair or replace malfunctioning steam traps.

Baseline Efficiency:

The baseline efficiency case is a failed steam trap.

High Efficiency:

The high efficiency case is a repaired or replaced steam trap.

Algorithms for Calculating Primary Energy Impact:

Deemed annual unit savings are as detailed in the table below: [1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔMMBtu
GC1a014 GC2a014 EC3a084 EC3d084	Steam Trap	Gas	LBES Retro – Gas SBES Retro – Gas Muni Retro Muni DI	n/a	Low pressure (≤= 10 psig): 8.4 High pressure (>10 psig): 35.6
EC3a085 EC3d085	Steam Trap	Oil	Muni Retro Muni DI	n/a	Low pressure (≤= 10 psig): 8.4 High pressure (>10 psig): 35.6
EC3a086 EC3d086	Steam Trap	Propane	Muni Retro Muni DI	n/a	Low pressure (≤= 10 psig): 8.4 High pressure (>10 psig): 35.6

Measure Life:

The measure life is 6 years.[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1a014 GC2a014 EC3a084 EC3d084	Steam Trap	Gas	LBES Retro – Gas SBES Retro – Gas Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a085 EC3d085	Steam Trap	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a086 EC3d086	Steam Trap	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a

<u>In-Service Rates:</u>
All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>
Large Business Energy Solution uses a 99.9% electric realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>
Not applicable for this measure since no electric savings are claimed.

Energy Load Shape:

See Appendix 1 – "Boiler Distribution".

Endnotes:

1 : Energy and Resource Solutions, April 2018. Two-Tier Steam Trap Savings Study. Prepared for National Grid and Eversource of Massachusetts. http://maeeac.org/wordpress/wp-content/uploads/MA-CIEC-Two-Tier-Steam-Traps-MemoFINAL.pdf
2 : DNV GL, June 2015. Massachusetts 2013 Prescriptive Gas Impact Evaluation – Steam Trap Evaluation Phase I. Prepared for Massachusetts Gas Program Administrators and Massachusetts Energy Efficiency Advisory Council. http://maeeac.org/wordpress/wp-content/uploads/MA-2013-Prescriptive-Gas-Impact-EvaluationSteam-Trap-Evaluation-Phase-1.pdf

2.51. Thermostat - Wi-Fi Communicating

Measure Code	COM-HVAC-WIFI
Markets	Commercial
Program Types	Retrofit
Categories	Heating Ventilation and Air Conditioning

Measure Description:

A Wi-Fi enabled communicating thermostat which allows remote set point adjustment and control via remote application. System requires an outdoor air temperature algorithm in the control logic to operate heating and cooling system.

Baseline Efficiency:

The baseline efficiency case is an HVAC system with either a manual or a programmable thermostat.

High Efficiency:

The high efficiency case is an HVAC system that has a Wi-Fi thermostat installed.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on residential study results, adjusted for commercial buildings.[1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
EC1a026 EC1d028 EC2a026 EC2d028 EC3a039 EC3d041	Wi-Fi Thermostat	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	160.90	0.256	n/a
EC3a040 EC3d042 GC1a016 GC2a016	Wi-Fi Thermostat	Gas	Muni Retro Muni DI LBES Retro – Gas SBES Retro – Gas	n/a	n/a	3.11
EC3a041 EC3d043	Wi-Fi Thermostat	Oil	Muni Retro Muni DI	n/a	n/a	3.11
EC3a042 EC3d044	Wi-Fi Thermostat	Propane	Muni Retro Muni DI	n/a	n/a	3.11

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
GC1c020 GC2c020	OMP Wi-Fi Thermostat	Gas	LBES Mid SBES Mid	n/a	n/a	3.11

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a026 EC1d028	Wi-Fi Thermostat	Electric	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.346	0.000
EC2a026 EC2d028 EC3a039 EC3d041	Wi-Fi Thermostat	Electric	SBES Retro SBES DI Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.346	0.000
EC3a040 EC3d042 GC1a016 GC2a016	Wi-Fi Thermostat	Gas	Muni Retro Muni DI LBES Retro – Gas SBES Retro – Gas	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a041 EC3d043	Wi-Fi Thermostat	Oil	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
EC3a042 EC3d044	Wi-Fi Thermostat	Propane	Muni Retro Muni DI	1.000	n/a	1.000	n/a	n/a	n/a	n/a
GC1c020 GC2c020	OMP Wi-Fi Thermostat	Gas	LBES Mid SBES MID	1.000	n/a	1.000	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Large Business Energy Solution uses a 99.9% electric realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Summer and winter Coincidence Factors are estimated using demand allocation methodology described the Demand Impact Model.[3]

Energy Load Shape:

See Appendix 1 "Weighted HVAC- All Homes"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c020 GC2c020	OMP Wi-Fi Thermostat	LBES Mid SBES Mid	0.237	0.07	0	0.86

Revision History:

Revision Number	Revision Date	Description
110	12/2/2022	Added new C&I OMP Measures

Endnotes:

1 : Navigant Consulting, September 2018. Wi-Fi Thermostat Impact Evaluation--Secondary Research Study Memo. https://ma-eeac.org/wp-content/uploads/Wi-Fi-Thermostat-Impact-Evaluation-Secondary-Literature-Study_FINAL.pdf The residential savings values for Wi-Fi communicating thermostats recommended in the 2018 Secondary Research Study memo are applied to the commercial measures in this chapter as it has not been possible to document savings from commercial Wi-Fi communicating measures. The residential values are not scaled up as the savings from the commercial measures are expected to be very low.
2 : Assumed to have the same lifetime as a regular programmable thermostat. Environmental Protection Agency, 2010. Life Cycle Cost Estimate for ENERGY STAR Programmable Thermostat.
3 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wpcontent/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

2.52. Unitary Air Conditioner

Measure Code	COM-HVAC-UAC
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure promotes the installation of high efficiency unitary air conditioning equipment in lost opportunity applications. Air conditioning (AC) systems are a major consumer of electricity and systems that exceed baseline efficiencies can save considerable amounts of energy. This measure applies to air, water, and evaporatively-cooled unitary AC systems, both single-package and split systems.

Baseline Efficiency:

The baseline efficiency case for new installations assumes compliance with the efficiency requirements as mandated by New Hampshire State Building Code.

High Efficiency:

The high efficiency case assumes the HVAC equipment meets or exceeds the Consortium for Energy Efficiency's (CEE) specification. This specification results in cost-effective energy savings by specifying higher efficiency HVAC equipment while ensuring that several manufacturers produce compliant equipment. The CEE specification is reviewed and updated annually to reflect changes to the ASHRAE and IECC energy code baseline as well as improvements in the HVAC equipment technology. Equipment efficiency is the rated efficiency of the installed equipment for each project.

Algorithms for Calculating Primary Energy Impact:

For units with cooling capacities less than 65 kBtu/h:

$\Delta kWh = (kBtu/h)\ (1/\ SEER_{BASE} - 1/\ SEER_{EE})\ (EFLH_{Cool})$

$\Delta kW = kBtu/h)(1EER_{BASE}\text{-}1/EER_{EE})$

For units with cooling capacities equal to or greater than 65 kBtu/h and IEER or available:

$\Delta kWh = (kBtu/h)\ (1/\ IEER_{BASE} - 1/\ IEER_{EE})\ (EFLH_{Cool})$

$\Delta kW = (kBtu/h)\ (1/\ IEER_{BASE} - 1/\ IEER_{EE})$

Where:

ΔkWh = Gross annual kWh savings from the measure

ΔkW = Gross connected kW savings from the measure

kBtu/h = Capacity of the cooling equipment in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h).

$SEER_{BASE}$ = Seasonal Energy Efficiency Ratio of the baseline equipment

$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of the energy efficient equipment

$EFLH_{Cool}$ = Cooling equivalent full load hours. If building type is available, use EFLH value from appendix 2. If not, use EFLH value of 755. [1]

$IEER_{BASE}$ = Integrated Energy Efficiency Ratio of the baseline equipment*

$IEER_{EE}$ = Integrated Energy Efficiency Ratio of the energy efficient equipment

$Hours_{Cool}$ = Annual Cooling Hours

*If converting from SEER, please use the following equation: $EER = -0.02 \times SEER^2 + 1.12 \times SEER$. 1

The baseline efficiency case for new installations assumes compliance with the efficiency requirements as mandated by Federal Standards (10 CFR 431.97) or IECC 2018[2]

Measure Life:

The measure life is 12 years. [1]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b049	Unitary Air Conditioner	LBES New	1.000	0.999	n/a	1.000	1.000	0.342	0.000
EC2b049	Unitary Air Conditioner	SBES New	1.000	1.000	n/a	1.000	1.000	0.342	0.000
EC3b080	Unitary Air Conditioner	Muni New	1.000	1.000	n/a	1.000	1.000	0.342	0.000
EC1c007	Midstream Unitary Air Conditioners	LBES Midstream	1.000	1.000	n/a	1.000	1.000	0.342	0.000

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2c007	Midstream Unitary Air Conditioners	SBES Midstream	1.000	1.000	n/a	1.000	1.000	0.342	0.000

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Large Business Energy Solution uses a 99.9% realization rate. All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A summer coincidence factor of 33% is utilized.[2]

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Electric Cooling Unitary Equipment".

Impact Factors for Calculating Net Savings:

(Upstream/Midstream Only):[4]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c007 EC2c007	Midstream Unitary Air Conditioners	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.86

Revision History:

Revision Number	Date	Revision
54	1/14/2022	Updated baseline table for clarity and to reference most recent code.
69	3/1/2022	Added EFLH reference to Appendix 2
151	12/1/2022	Updated baseline values to align with 2023 Federal Standards update. Added default value for EFLH where building type is not available.

Endnotes:

1 : KEMA((2011). C&I Unitary AC Loadshape Project - Final Report. KEMA_2011_CI Unitary HVAC Load Shape Project
2 : IECC (2018) https://codes.iccsafe.org/content/iecc2018
3 : KEMA, August 2011. C&I Unitary HVAC Loadshape Project. https://neep.org/sites/default/files/resources/NEEP_HVAC_Load_Shape_Report_Final_August2_0.pdf
4 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.53. VRF Systems

Measure Code	COM-HVAC-VRFS2
Markets	Commercial
Program Types	Lost Opportunity
Categories	Heating Ventilation and Air Conditioning

Measure Description:

This measure includes in the installation of high-efficiency variable flow refrigerant (VRF) heat pumps.

Baseline Efficiency:

The baseline is a code compliant VRF heat pump unit. Details regarding heat pump baseline efficiencies based on capacity and type are provided in a tabular format along with the savings algorithms.

High Efficiency:

The high efficiency case is the site-specific VRF heat pump unit.

Algorithms for Calculating Primary Energy Impact:

The savings for this measure are attributable to the increase in nameplate efficiency between the baseline and installed units.

The algorithm for calculating electric demand savings is:

$$\Delta kW = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

Where:

$\Delta kW =$ Gross annual demand savings for VRF unit
$Cap_{cool} =$ Cooling capacity (in kBtu/h) of the energy efficient VRF unit, from equipment specifications
$EER_{BASE} =$ Energy Efficiency Ratio of the baseline VRF equipment

$EER_{EE} =$ Energy Efficiency Ratio of the energy efficient VRF unit, from equipment specifications

The algorithm for calculating annual electric energy savings is:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

For equipment < 65,000 Btu/hr cooling:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

For equipment >= 65,000 Btu/hr cooling:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times EFLH_{cool}$$

For equipment < 65,000 Btu/hr cooling

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

For equipment >= 65,000 Btu/hr cooling

$$\Delta kWh_{heat} = \frac{Cap_{heat}}{3.412} \times \left(\frac{1}{COP_{BASE}} - \frac{1}{COP_{EE}}\right) \times EFLH_{heat}$$

Where:

ΔkWh_{cool} = Gross annual cooling savings for VRF unit

ΔkWh_{heat} = Gross annual heating savings for VRF unit
Cap_{cool} = Cooling capacity (in kBtu/h) of the energy efficient VRF unit, from equipment specifications
Cap_{heat} = Heating capacity (in kBtu/h) of the energy efficient VRF unit, from equipment specifications.

$SEER_{BASE}$= Seasonal Energy Efficiency Ratio of baseline VRF unit

$SEER_{EE}$= Seasonal Energy Efficiency Ratio of energy efficient VRF unit, from equipment specifications

EER_{BASE} Energy Efficiency Ratio of baseline VRF equipment EEREE Energy Efficiency Ratio of energy efficient VRF unit

$HSPF_{BASE=}$ Heating Seasonal Performance Factor of baseline VRF unit

$HSPF_{EE}$= Heating Seasonal Performance Factor of energy efficient VRF unit, from equipment specifications

COP_{BASE} = Coefficient of performance in heating mode of baseline VRF equipment
COP_{EE} = Coefficient of performance in heating mode of energy efficient VRF unit

$EFLH_{cool}$=Where building type is available, refer to appendix 2. Where it is unavailable, use 755 hrs/ year for cooling.
$EFLH_{heat}$ = Where building type is available, refer to appendix 2. Where it is unavailable, use 1,329 hrs/ year for heating. [1]

Cooling Mode Baseline Efficiencies per Federal Standards 10 CRF 431.97 and IECC 2018

VRF System Type	Size Category	Subcategory or rating condition	Min efficiency Cooling Mode Value[4]
Air Cooled	<65,000 Btu/h	All	13.0 SEER
	^{3}65,000 Btu/h and <135,000 Btu/h	Electric resistance or none	11.2 EER
	^{3}65,000 Btu/h and <135,000 Btu/h	All other heating	11.0 EER
	^{3}135,000 Btu/h and <240,000 Btu/h	Electric resistance or none	11.0 EER
	^{3}135,000 Btu/h and <240,000 Btu/h	All other heating	10.8 EER
	^{3}240,000 Btu/h < 760,000 Btu/h	Electric resistance or none	10.0 EER
	^{3}240,000 Btu/h < 760,000 Btu/h	All other heating	9.8 EER

VRF Heat Pump Cooling Mode Baseline Efficiencies per 10 CRF 431.97 and IECC 2018

VRF System Type	Size Category	Subcategory or rating condition	Min efficiency Cooling Mode Value[4]
Air Cooled	<65,000 Btu/h	All	13.0 SEER
	^{3}65,000 Btu/h and <135,000 Btu/h	Electric resistance or none	11.0 EER
	^{3}65,000 Btu/h and <135,000 Btu/h	All other heating	10.8 EER
	^{3}135,000 Btu/h and <240,000 Btu/h	Electric resistance or none	10.6 EER

VRF System Type	Size Category	Subcategory or rating condition	Min efficiency Cooling Mode Value[4]
	≥135,000 Btu/h and <240,000 Btu/h	All other heating	10.4 EER
	≥240,000 Btu/h < 760,000 Btu/h	Electric resistance or none	9.5 EER
	≥240,000 Btu/h < 760,000 Btu/h	All other heating	9.3 EER
Water Cooled			
	<17,000 Btu/hr	Without heat recovery	12.0 EER
	<17,000 Btu/hr	With Heat recovery	11.8 EER
	>=17,000 and <65,000 Btu/h	All	12.0 EER
	≥65,000 Btu/h and <135,000 Btu/h	All	12.0 EER
	≥135,000 Btu/h and <760,000 Btu/h	Without Heat recovery	10. EER
	≥135,000 Btu/h and <760,000 Btu/h	With heat recovery	9.8 EER

VRF Heat Pump Heating Mode Baseline Efficiencies

VRF System Type	Size Category	Subcategory or rating condition	Min efficiency Cooling Mode Value[5]
Air Cooled	<65,000 Btu/h (cooling capacity)	All	8.2HSPF
	≥65,000 Btu/h and <135,000 Btu/h (cooing capacity)	All	3.3 COP_H
	≥135,000 Btu/h < 760,000 Btu/h (cooling capacity)	All	3.2 COP_H
Water Cooled	<17,000 Btu/h (cooling capacity)	All	4.2 COP_H

VRF System Type	Size Category	Subcategory or rating condition	Min efficiency Cooling Mode Value[5]
	^{3} 17,000 Btu/h <65,000 Btu/h (cooling capacity)	All	4.2 COP_H
	^{3} 65,000 Btu/h <135,000 Btu/h (cooling capacity)	All	4.2 COP_H
	^{3}135,000 Btu/h and <760,000 Btu/h (cooling capacity)	All	3.9 COP_H

Measure Life:

The measure life is 12 years.[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c008 EC2c008	Midstream VRF	LBES Midstream SBES Midstream	1.000	1.000	n/a	1.000	1.000	0.342	0.000

In-Service Rates:

All installations have a 100.0% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All installations have a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

The summer coincidence factor is 34.2% and the winter coincidence factor is 0%[3]

Energy Load Shape:

See Appendix 1 – “Central Heat Pump”.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

(Upstream/Midstream Only)[4]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
EC1c008 EC2c008	Midstream VRF	LBES Midstream SBES Midstream	0.225	0.085	0.000	0.860

Revision History:

Revision Number	Date	Description
150	12/1/2022	Updated baseline tables to include capacity and subcategory. Update EFLH to refer to appendix 2 where possible and included default values for where building type is not available. Updated algorithms to reference correct performance metrics.

Endnotes:

1 : KEMA((2011). C&I Unitary AC Loadshape Project - Final Report. KEMA_2011_CI Unitary HVAC Load Shape Project
2 : Energy & Resource Solutions, November. Measure Life Study. Prepared for The Massachusetts Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
3 : Coincidence Factors are from 2011 NEEP HVAC Loadshape Study Table 0-5 (ISO_NE on Peak for NE-North)
4 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf

2.54. Faucet Aerators

Measure Code	COM-HW-FA
Markets	Commercial
Program Types	Lost Opportunity
Categories	Hot Water

Measure Description:

Installation of a faucet aerator with a flow rate of 1.5 GPM or less on an existing faucet with high flow in a commercial setting.

Baseline Efficiency:

The baseline efficiency case is an existing faucet aerator with Federal Standard flow rate of 2.2 GPM[1]

High Efficiency:

The high efficiency case is a low flow faucet aerator with EPA WaterSense[2] specified maximum flow rate of 1.5 GPM.

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated using the Federal Energy Management Program ("FEMP") Energy Cost Calculator[3] . kW savings are calculated using the demand impact model.[4]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
EC1a028 EC1b031 EC1d030 EC2a028 EC2b031 EC2d030 EC3a044 EC3b045 EC3d046	Faucet Aerator	Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	309	0.01	n/a
EC1c060 EC2c060	OMP Faucet Aerator	Electric	LBES Mid SBES Mid	309	0.01	n/a

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
EC3a045 EC3b046 EC3d047 GC1a005 GC1b017 GC2a005 GC2b017	Faucet Aerator	Gas	LBES Retro LBES New LBES DI LBES Retro LBES New SBES DI SBES New	n/a	n/a	1.7
GC1c016 GC1c016	OMP Faucet Aerator	Gas	LBES Mid SBES Mid	n/a	n/a	1.7
EC3a046 EC3b047 EC3d048	Faucet Aerator	Oil	Muni Retro Muni New Muni DI	n/a	n/a	1.7
EC3a047 EC3b048 EC3d049	Faucet Aerator	Propane	Muni Retro Muni New Muni Gas	n/a	n/a	1.7

Measure Life:

The measure life for a faucet aerator is 10 years.[5]

Other Resource Impacts:

There are deemed water savings of 5,460 gallons/unit.[3.]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a028	Faucet Aerator	Electric	LBES Retro LBES New LBES DI	1.00	0.99	1.00	1.00	1.00	0.31	0.81
EC3a045	Faucet Aerator	Gas	LBES Retro LBES New LBES DI	1.00	n/a	0.99	n/a	n/a	n/a	n/a
EC3a046	Faucet Aerator	Oil	LBES Retro LBES New LBES DI	1.00	n/a	0.99	n/a	n/a	n/a	n/a

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC3a047	Faucet Aerator	Propane	LBES Retro LBES New LBES DI	1.00	n/a	0.99	n/a	n/a	n/a	n/a
EC1b031 EC1d030 EC2a028 EC2b031 EC2d030 EC3a044 EC3b045 EC3d046	Faucet Aerator	Electric	SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	1.00	1.00	1.00	1.00	1.00	0.31	0.81
EC1c060 EC2c060	Faucet Aerator	Electric	LBES Mid SBES Mid	1.00	1.00	1.00	1.00	1.00	0.31	0.81
EC3b046 EC3d047 GC1a005 GC1b017 GC2a005 GC2b017	Faucet Aerator	Gas	LBES Retro LBES New SBES Retro SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c016 GC1c016	Faucet Aerator	Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3b047 EC3d048	Faucet Aerator	Oil	Muni Retro Muni New Muni Gas	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3b048 EC3d049	Faucet Aerator	Propane	Muni Retro Muni New Muni Gas	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs.[6]

Coincidence Factors:

Summer and winter coincidence factors of 31% and 81% have been utilized per the MA demand impact model[4].

Energy Load Shape:

For electric measures, see Appendix 1 C&I Load Shapes " Water Heater – Electric".

For non-electric measures, see Appendix 1 C&I Load Shapes "Non- Electric Measures"

For non-electric measures, see Appendix 1 C&I Load Shapes "Non- Electric Measures"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Fuel Type	Program	**FR**	**SO_P**	**SO_{NP}**	**NTG**
EC1c060 EC2c060	OMP Faucet Aerator	Electric	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%
GC1c016 GC1c016	OMP Faucet Aerator	Gas	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%

Revision History:

Revision Number	Revision Date	Description
106	12/1/22	Added OMP Measures

Endnotes:

1 : In 1998, the Department of Energy adopted a maximum flow rate standard of 2.2 gpm at 60 psi for all faucets: 63 Federal Register 13307; March 18, 1998. https://www.epa.gov/sites/production/files/2017-02/documents/ws-specification-home-final-suppstatement-v1.0.pdf
2 : WaterSense: Bathroom Faucets. https://www.epa.gov/watersense/bathroom-faucets
3 : Federal Energy Management Program ("FEMP") Energy Cost Calculator for Faucets and Showerheads. Available at: https://www.energy.gov/eere/femp/energy-cost-calculator-faucets-andshowerheads-0. On average, faucets are assumed to run 30 minutes per day, 260 days per year. Actual usage values should be used, when known, in lieu of default savings values
4 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
5 : Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks, GDS Associates, April 2009. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-in-MA.pdf
6 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.

https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf

2.55. Pre-Rinse Spray Valve

Measure Code	COM-HW-PRSV
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Hot Water

Measure Description:

Pre-Rinse Spray Valve: Retrofitting existing standard spray nozzles in locations where service water is supplied by hot water heater with new low flow pre-rinse spray nozzles with an average flow rate of 1.6 GPM.

Baseline Efficiency:

Pre-Rinse Spray Valve, Gas: The baseline efficiency case is an existing efficiency spray valve.

High Efficiency:

Pre-rinse Spray Valve, Gas: The high efficiency case is a low flow pre-rinse spray valve with an average flow rate of 1.6 GPM. [1]

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results. [2 3]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔMMBtu
EC1a040 EC1b046 EC1d040 EC2a040 EC2b046 EC2d040 EC3a075 EC3b074 EC3d075	Pre-Rinse Spray Valve	Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	126 kWh for grocery and 957 kWh for non-grocery facility type	0.031 for grocery .233 for non-grocery
EC3a076 EC3b075 EC3d076 GC1a009 GC1b020 GC2a009 GC2b020	Pre-Rinse Spray Valve	Gas	Muni Retro Muni New Muni DI LBES Retro LBES New SBES Retro SBES New		11.4

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔMMBtu
GC1c006 GC2c006			LBES Mid SBES Mid		
EC3a077 EC3b076 EC3d077	Pre-Rinse Spray Valve,	Oil	LBES Retro SBES Retro Muni Retro		11.4
EC3a078 EC3b077 EC3d078	Pre-Rinse Spray Valve	Propane	LBES Retro SBES Retro Muni Retro		11.4
GC1c018 GC2c018	OMP Pre-Rinse Spray Valve	Gas	LBES Mid SBES Mid		11.4
EC1c062 EC2c062	OMP Pre-Rinse Spray Valve	Electric	LBES Mid SBES Mid	126 kWh for grocery and 957 kWh for non-grocery facility type	0.031 for grocery .233 for non-grocery

Measure Life:

The measure life is 8 years.[2]

Other Resource Impacts:

There are water savings of 6,410 gallons per unit.[2]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}		CF_{SP}	CF_{WP}
EC1a040 EC1b046 EC1d040	Pre-Rinse Spray Valve	Electric	LBES Retro LBES New LBES DI	1.00	0.99	1.00	1.00	1.00		0.52	1.00

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_{E}	RR_{NE}	RR_{SP}	RR_{WP}		CF_{SP}	CF_{WP}
GC1a009 GC1b020	Pre-Rinse Spray Valve	Gas	LBES Retro LBES New	1.00	n/a	0.99	n/a	n/a		n/a	n/a
EC2a040 EC2b046 EC2d040 EC3a075 EC3b074 EC3d075	Pre-Rinse Spray Valve	Electric	SBES Retro SBES New SBES DI Retro Muni New Muni DI	1.00	1.00	1.00	1.00	1.00		0.52	1.00
EC3a076 EC3b075 EC3d076 GC2a009 GC2b020 GC2c006	Pre-Rinse Spray Valve	Gas	Muni Retro Muni New Muni DI SBES Retro SBES New LBES Mid SBES Mid	1.00	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a077 EC3b076 EC3d077	Pre-Rinse Spray Valve,	Oil	Muni New Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a		n/a	n/a
EC3a078 EC3b077 EC3d078	Pre-Rinse Spray Valve	Propane	Muni New Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a		n/a	n/a
GC1c018 GC2c018	OMP Pre-Rinse Spray Valve	Gas	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC1c062 EC2c062	OMP Pre-Rinse	Electric	LBES Mid	1.00	1.00	1.00	1.00	1.00		0.52	1.00

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}		CF_{SP}	CF_{WP}
	Spray Valve		SBES Mid								

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise. The LBES program uses a realization rate of 99.9% from a 2015 impact evaluation on commercial and industrial programs. [5]

Coincidence Factors:

A summer coincidence factor of 52% and a winter coincidence factor of 100% is utilized.[5]

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

[6]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c006 GC2c006	Pre Rinse Spray Valve	LBES Mid SBES Mid	0.237	0.07	0	0.83
EC1c062 EC2c062 GC1c018 GC2c018	OMP, Pre-Rinse Spray valve	LBES Mid SBES Mid	0.237	0.07	0	0.86

Revision History:

Revision Number	Revision Date	Description
107	12/1/2022	Added new entries for C&I online marketplace measures :E21C1c062, E21C2c062,GC1c018, G21C2 c018

Endnotes:

1 : Adopted the Massachusetts program administrator internal analysis.
2 : Impact Evaluation of Massachusetts Prescriptive Gas Pre-Rinse Spray Valves, DNV GL, November 2014. http://ma-eeac.org/wordpress/wp-content/uploads/Prescriptive-Gas-Pre-Rinse-Spray-Valve-

Measure-Impact-Evaluation.pdf
3 : Connecticut Program Savings Document 2020. Measure 3.2.1: Water-Saving Measures.
4 : DNV GL, September 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. Prepared for NH Electric and Gas Utilities.
https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
5 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
6 : NMR Group, Inc. (2018). Massachusetts Sponsors' Commercial and Industrial Free-ridership and Spillover Study. 2018_NMR_CI FR-SO Report

2.56. Showerhead

Measure Code	COM-HW-SH
Markets	Commercial
Program Types	Retrofit
Categories	Hot Water

Measure Description:

Thermostatic Shut-Off Valve: Installation of a stand-alone thermostatic shut-off valve on standard flow showerhead.

Low-Flow Showerhead, Electric, Gas, Oil, Propane: Installation of a low-flow showerhead with a flow rate of 1.5 GPM or less.

Baseline Efficiency:

Measure Name	Baseline Equipment
Thermostatic Shut-Off Valve, stand alone	Existing standard-flow shower head (2.5 GPM) with no thermostatic shut off valve.
Low-Flow Shower Head with Integrated thermostatically actuated valve	Existing standard-flow showerhead (2.5 GPM) with no thermostatic shut-off valve.
Low-Flow Shower Head	The baseline efficiency case is a 2.5 GPM showerhead.

High Efficiency:

Measure	High Efficiency Case
Thermostatic Shut-Off Valve, Stand Alone	The high efficiency case is a standard flow showerhead (2.5 GPM) with the addition of a stand-alone thermostatic shut-off valve. (The "Lady Bug")
Low-Flow Showerhead with Integrated Thermostatic Valve	The high efficiency case is a low-flow showerhead (1.5 GPM) with an integrated thermostatically actuated valve.
Low-Flow Showerhead	The high efficiency case is a low-flow showerhead (1.5 GPM).

Algorithms for Calculating Primary Energy Impact:

Low-Flow Showerhead with Thermostatic Valve: Unit savings are deemed based on the National Grid Shower Start Savings Spreadsheet .[1]

kW savings are calculated using the demand impact model.[2]

Low-Flow Showerhead, Unit savings are deemed.[3]

Low-Flow Showerhead with integrated thermostatic valve, Unit savings are deemed [4]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
GC1a006 GC1b018 GC2a006 GC2b018	Thermostatic Shut-Off Valve	Gas	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	n/a	n/a	0.33
GC1c013 GC2c013	OMP Thermostatic Shut-Off Valve	Gas	LBES Mid SBES Mid	n/a	n/a	0.34
EC1a033 EC1b044 EC1d033 EC2a033 EC2b044 EC2d033 EC3a056 EC3b066 EC3d056	Thermostatic Shut-Off Valve	Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	69	0.02	N/a
EC1c059 EC2c059	OMP Thermostatic Shut-Off Valve	Electric	LBES Mid SBES Mid	69	0.02	n/a
EC3a058 EC3b068 EC3d058	Thermostatic Shut-Off Valve	Oil	Muni Retro Muni New Muni DI	n/a	n/a	0.33
EC3a059 EC3b069 EC3d059	Thermostatic Shut-Off Valve	Propane	Muni Retro Muni New Muni DI	n/a	n/a	0.33
EC1a034 EC1b045 EC1d034	Low-Flow Showerhead	Electric	LBES Retro LBES New LBES DI	507	0.09	n/a

EC2a034 EC2b045 EC2d034 EC3a060 EC3b070 EC3d060			SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI			
EC1c057 EC2c057	OMP Low-Flow Showerhead	Electric	LBES Mid SBES Mid	507	0.09	n/a
GC1a007 GC1b019 GC2a007 GC2b019	Low-Flow Showerhead	Gas	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni	n/a	n/a	2.65
GC1c014 GC2c014	OMP Low-Flow Showerhead	Gas	LBES Mid SBES Mid	n/a	n/a	2.65
EC3a062 EC3b072 EC3d062	Low-Flow Showerhead	Oil	Muni Retro Muni New Muni DI	n/a	n/a	2.65
EC3a063 EC3b073 EC3d063	Low-Flow Showerhead	Propane	Muni Retro Muni New Muni DI	n/a	n/a	2.65
GC1c015 GC2c015	OMP Low-Flow Shower Head with Integrated Thermostatic Valve	Gas	LBES Mid SBES Mid	N/a	N/a	1.41
EC1c058 EC2c058	OMP Low-Flow Shower Head with Integrated Thermostatic Valve	Electric	LBES Mid SBES Mid	183	0.04	n/a

Measure Life:

The measure life for all Showerheads is 10 years.[5]

The measure life for a stand alone thermostatic shut-off valve is 15 years. [6]

Other Resource Impacts:

Low-Flow Showerhead With Thermostatic Valve: Annual water savings of 558 gallons per unit.[1]

Low-Flow Showerhead, Electric, Gas, Oil, Propane: Annual water savings of 7,300 gallons per unit.[3]

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
GC1a006 GC1b018 GC2a006 GC2b018	Thermostatic Shut-Off Valve	Gas	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c013 GC2c013	OMP Thermostatic Shut-Off Valve	Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC1a033 EC1b044 EC1d033 EC2a033 EC2b044 EC2d033 EC3a056 EC3b066 EC3d056	Thermostatic Shut-Off Valve	Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	1.00	1.00	n/a	1.00	1.00	0.31	0.81
EC1c059 EC2c059	OMP Thermostatic Shut-Off Valve	Electric	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.31	0.81
EC3a058 EC3b068 EC3d058	Thermostatic Shut-Off Valve	Oil	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a059 EC3b069 EC3d059	Thermostatic Shut-Off Valve	Propane	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC1a034 EC1b045 EC1d034 EC2a034 EC2b045 EC2d034 EC3a060 EC3b070 EC3d060	Low-Flow Showerhead	Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	1.00	1.00	n/a	1.00	1.00	0.31	0.81

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c057 EC2c057	OMP Low-Flow Showerhead	Electric	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.31	0.81
GC1a007 GC1b019 GC2a007 GC2b019	Low-Flow Showerhead	Gas	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c014 GC2c014	OMP Low-Flow Showerhead	Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a062 EC3b072 EC3d062	Low-Flow Showerhead	Oil	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC3a063 EC3b073 EC3d063	Low-Flow Showerhead	Propane	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c015 GC2c015	OMP Low-Flow Shower Head with Integrated Thermostatic Valve	Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
EC1c058 EC2c058	OMP Low-Flow Shower Head with Integrated Thermostatic Valve	Electric	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.31	0.81

<u>In-Service Rates:</u>
All programs have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>
All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:
Summer and winter coincidence factors of 31% and 81% have been utilized per the MA demand impact model[2].

Energy Load Shape:

For electric measures, see Appendix 1 C&I Load Shapes " Water Heater – Electric".

For non-electric measures, see Appendix 1 C&I Load Shapes "Non- Electric Measures"

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
GC1c015 GC2c015 EC1c058 EC2c058	OMP Low-Flow Shower Head with Integrated Thermostatic Valve	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%
GC1c013 GC2c013 EC1c059 EC2c059	OMP Thermostatic Valve	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%
GC1c014 GC2c014 EC1c057 EC2c057	OMP Low-Flow Shower Head	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86%

Revision History:

Revision Number	Revision Date	Description
105	12/1/2022	Added new LBES Mid and SBES Mid measures for Thermostatic valve, low-flow shower head with integrated thermostatic valve, and low-flow shower head.
111	12/1/2022	Updated measure life for standalone thermostatic valve

Endnotes:

1 : National_Grid_2014_ShowerStart_Savings_Final_2015-2-9 (1)
2 : Navigant Consulting, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wpcontent/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

3 : Federal Energy Management Program ("FEMP") Energy Cost Calculator for Faucets and Showerheads. Available at: https://www.energy.gov/eere/femp/energy-cost-calculator-faucetsandshowerheads-0. On average, showerheads are assumed to run 20 minutes per day, 365 days per year. Actual usage values should be used, when known, in lieu of default savings values.
4 : Guidehouse (2020) Comprehensive TRM Review https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/60463491d38ce8bca0795e4b/view?authToken=93e861ad3053d0716f3757b0a5d06f096582c89051d4841798b9efda91a45e2ed41741970a88d6b70e556d22887b967a186d65c834bd4150666dd417f76a0e240d88a664318fe8
5 : Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks, GDS Associates, April 2009. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-inMA.pdf
6 : Guidehouse Inc (2021) Comprehensive TRM Review https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/60463491d38ce8bca0795e4b/view?authToken=93e861ad3053d0716f3757b0a5d06f096582c89051d4841798b9efda91a45e2ed41741970a88d6b70e556d22887b967a186d65c834bd4150666dd417f76a0e240d88a664318fe8

2.57. Water Heaters

Measure Code	COM-HW-WH
Markets	Commercial
Program Types	Lost Opportunity
Categories	Hot Water

Measure Description:

Installation of a heat pump hot water heater, indirect water heater, on demand tankless water heater, volume water heater or condensing water heater through the midstream channel.

Baseline Efficiency:

All Water Heaters: The baseline efficiency case assumes compliance with the efficiency requirements as mandated by New Hampshire Building Code. As described in the NH Building Code, energy efficiency must be met via compliance with the relevant International Energy Conservation Code (IECC).

BC Measure ID	Measure Name	Baseline
EC1c044 EC2c044	Midstream <55 Gallon Heat Pump Water Heater	0.95 UEF Electric resistance water heater.[1]
EC1c046 EC2c046	Midstream Heat Pump Water Heater, 80 gallons	1.98 UEF Heat Pump water heater[2]
EC1c045 EC2c045	Midstream Heat Pump Water Heater, 50 gallons	1.94 UEF Heat Pump water heater[3]
GC1c009 GC2c009	Midstream Indirect Water Heater	Hot water boiler operating at 78% recovery efficiency. Additionally, a baseline storage water heater was assumed for purpose of estimating standby losses. [4]
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater	A code-compliant gas-fired storage water heater with EF = 0.61.[5]
GC1c011 GC2c011	Midstream Volume Water Heater	A code specified 80% TE volume water heater.
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	A code specified 80% TE water heater.

High Efficiency:

- Midstream Heat Pump Water Heater

- Midstream Indirect Water Heater: The high efficiency scenario is an indirect water heater with a Combined Appliance Efficiency (CAE) of 85% or greater.
- Midstream On Demand Tankless Water Heater, Gas: The high efficiency equipment is either a gas-fired instantaneous hot water heater with an Energy Factor of at least 0.90.
- Midstream Volume Water Heater, Gas: The high efficiency case is a volume water heater with a 94% TE
- Midstream Condensing Water Heater, Gas: The high efficiency case is a high efficiency stand alone commercial water heater with a thermal efficiency of 94% or greater and a capacity greater than 75,000 btu/h.

BC Measure ID	Measure Name	High Efficiency Case
EC1c044 EC2c044	Midstream <55 Gallon Heat Pump Water Heater	UEF 3.2 or greater.
EC1c046 EC2c046	Midstream Heat Pump Water Heater, 80 gallons	UEF 3.2 or greater.
EC1c045 EC2c045	Midstream Heat Pump Water Heater, 50 gallons	UEF 3.6 or greater
GC1c009 GC2c009	Midstream Indirect Water Heater	The high efficiency scenario is an indirect water heater with a Combined Appliance Efficiency (CAE) of 85% or greater.
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater	The high efficiency equipment is either a gas-fired instantaneous hot water heater with an Energy Factor of at least 0.90.
GC1c011 GC2c011	Midstream Volume Water Heater	The high efficiency case is a volume water heater with a 94% TE.
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	The high efficiency case is a high efficiency standalone commercial water heater with a thermal efficiency of 94% or greater and a capacity greater than 75,000 btu/h.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on vendor calculations.

BC Measure ID	Measure Name	Program	ΔkWh	ΔMMBtu	ΔMMBtu / Mbtuh
EC1c044 EC2c044	Midstream Heat Pump Water Heater, 120 gallons	LBES Mid SBES Mid	2,082		
EC1c046 EC2c046	Midstream Heat Pump Water Heater, 55-80 gallons	LBES Mid SBES Mid	1,171		
EC1c045 EC2c045	Midstream Heat Pump Water Heater, <55 gallons	LBES Mid SBES Mid	4,556		

BC Measure ID	Measure Name	Program	ΔkWh	ΔMMBtu	ΔMMBtu / Mbtuh
GC1c009 GC2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid		19.0[6]	
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater	LBES Mid SBES Mid		8.9[2]	
GC1c011 GC2c011	Midstream Volume Water Heater	LBES Mid SBES Mid			0.6077[2]
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	LBES Mid SBES Mid			0.1441[2]

Measure Life:

BC Measure ID	Measure Name	Program	Measure Life
EC1c044 EC2c044 EC1c045 EC2c045 EC1c046 EC2c046	Midstream Heat Pump Water Heater, 120 gallons Midstream Heat Pump Water Heater, 80 gallons Midstream Heat Pump Water Heater, 50 gallons	LBES Mid SBES Mid	13[7]
GC1c009 GC2c009	Midstream Indirect Water Heater:	LBES Mid SBES Mid	15[8]
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater, Gas:	LBES Mid SBES Mid	20[5]
GC1c011 GC2c011	Midstream Volume Water Heater, Gas:	LBES Mid SBES Mid	15[4]
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	LBES Mid SBES Mid	15[4]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c044 EC2c044	Midstream Heat Pump Water Heater, 120 gallons	LBES Mid SBES Mid	1.00	1.00	n/a	n/a	n/a	0.413	0.747
EC1c046 EC2c046	Midstream Heat Pump Water Heater, 80 gallons	LBES Mid SBES Mid	1.00	1.00	n/a	n/a	n/a	0.413	0.747
EC1c045 EC2c045	Midstream Heat Pump Water Heater, 50 gallons	LBES Mid SBES Mid	1.00	1.00	n/a	n/a	n/a	0.413	0.747
GC1c009 GC2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater, Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c011 GC2c011	Midstream Volume Water Heater, Gas	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

A summer coincidence factor of 43.1% and a winter coincidence factor of 74.7% are utilized.

Energy Load Shape:

For heat pump water heaters, see Appendix 1 – “ Water Heater - Heat Pump”.

For all remaining water heaters, see Appendix 1 – “ Water Heater – Natural Gas/Fuel Oil”.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

6,11

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1c044 EC2c044 EC1c045 EC2c045 EC1c046 EC2c046	Midstream Heat Pump Water Heater, 120 gallons Midstream Heat Pump Water Heater, 80 gallons Midstream Heat Pump Water Heater, 50 gallons	LBES Mid SBES Mid	22.5%	8.5%	0.0%	86.0%
GC1c009 GC2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid	70.0%	0.0%	0.0%	30.0%
GC1c010 GC2c010	Midstream on Demand Tankless Water Heater	LBES Mid SBES Mid	40.0%	0.0%	0.0%	60.0%
GC1c011 GC2c011	Midstream Volume Water Heater	LBES Mid SBES Mid	40.0%	0.0%	0.0%	60.0%
GC1c012 GC2c012	Midstream Condensing Gas Water Heater	LBES Mid SBES Mid	70.0%	0.0%	0.0%	30.0%

Revision History:

Revision Number	Revision Date	Description
90	12/1/2022	Added values for midstream heat pump water heaters and updated references to NH building code.

Endnotes:

1 : 2018 IECC Code Table C404.2 'Minimum Performance of Water-Heating Equipment" https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC404
2 : 2018 IECC Code Table C404.2 'Minimum Performance of Water-Heating Equipment" https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC404

3 : 2018 IECC Code Table C404.2 'Minimum Performance of Water-Heating Equipment" https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC404
4 : Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010; Energy Conservation standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters: Final Rule, Federal Register, 75 FR 20112, April 16, 2010
5 : Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010; Energy Conservation standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters: Final Rule, Federal Register, 75 FR 20112, April 16, 2010
6 : Savings for indirect water heaters are based on: KEMA, June 27, 2013. Impact Evaluation of 2011 Prescriptive Gas Measures Final Report.
7 : Navigant Consulting (2018). Water Heating, Boiler, and Furnace Cost Study (RES 19) Add-On Task Residential Water Heater Analysis Memo. 2018 Navigant Water Heater Analysis Memo
8 : GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks;
9 : Hewitt, D. Pratt, J. & Smith, G., December 2005. Tankless Gas Water Heaters: Oregon Market Status. Prepared for the Energy Trust of Oregon. https://www.energytrust.org/wp-content/uploads/2016/11/051206_TanklessGasWaterHeaters0.pdf
10 : NMR, DNV GL, and Tetra Tech, August 2018. Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study. Prepared for Massachusetts Program Administrators. http://ma-eeac.org/wordpress/wp-content/uploads/TXC_49_CI-FR-SO-Report_14Aug2018.pdf
11 : DNV GL, NMR, Tetra Tech (2018) Massachusetts Commercial and Industrial Upstream HVAC/Heat Pump and Hot Water NTG and Market Effects Indicator Study. https://ma-eeac.org/wp-content/uploads/TXC_35_Report_5Sep2018_FINAL.pdf

2.58. Lighting - Controls

Measure Code	COM-LTG-LC
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Lighting

Measure Description:

This measure includes the installation of lighting controls in both lost-opportunity and retrofit applications. Occupancy sensors and daylight dimming controls are both included. Traffic-sensing occupancy sensors that control refrigerated case LEDs are also included as a separate section.

Baseline Efficiency:

The baseline efficiency case for retrofit applications is no controls.

The baseline efficiency case for new construction is code-compliant controls as mandated by the New Hampshire Building Code, which currently reflects IECC 2015 and ASHRAE Standard 90.1-2013.

The baseline efficiency case for refrigerated case LEDs is no controls.

High Efficiency:

The high efficiency case for retrofit applications is lighting fixtures connected to controls that reduce the pre-retrofit hours of operation.

The high efficiency case for new construction applications is lighting fixture controls that reduce the hours of operation further beyond code-compliant controls.

The high efficiency case for refrigerated case LEDs is traffic-sensing controls that are mounted on cases to dim case lighting from a high level to a low-power mode (assumed to be 25% of full power consumption) in less than 2 minutes when on traffic is sensed in the aisle.

Algorithms for Calculating Primary Energy Impact:

For retrofit applications:

$\Delta kWh = Controlled\_kW \times Hours\_base \times (\%\_sav)$

$\Delta kW = (Controlled\_kW)$

Where:

Controlled_kW = controlled fixture wattage

Hours_base = Total annual hours that the connected Watts operated in the pre-retrofit case (retrofit installations) or would have operated with code-compliance controls (new construction installations). use below table for hours only when site specific assumptions do not exist. [9]

Building Type	Hours of Use
24x7 lighting	8,760
Automotive	4,056
Education	2,967
Grocery	5,468
Health Care	5,564
Hotel/Motel	3,064
Industrial	5,793
Large Office	4,098
Other	6,211*
Parking Lot/ Streetlights	6,887
Religious Building/ Convention Center	913
Restaurant	5,018
Retail	4,939
Small Office	3,748
Warehouse	5,667
Parking Garage	8,760

%_sav = percentage of kWh that is saved by utilizing this control measure, as shown in the study-informed deemed savings table below.[10]

Control Type	**% Savings Factor**
Lighting Controls – Daylighting Dimming	0.28

Control Type	% Savings Factor
Lighting Controls – Occupancy Sensor	0.24
Lighting Controls - Integral Dual Sensor	0.30
Lighting Controls - Integral Dual Sensors with Adaptive, Network-Capable Controls	0.35
Lighting Controls - Exterior Photocell	0.50

For lost opportunity applications:

$\Delta kWh = Controlled\_kW \times (Hours\_base - Hours\_ee)$

$\Delta kW = (Controlled\_kW)$

Where:

Controlled_kW = controlled fixture wattage

Hours_base = total annual hours that the connected Watts would have operated with code-compliant controls

Hours_ee = total annual hours that the connected kW operate with controls implemented, as determined on a per-application basis.

For refrigerated case LED controls:

$\Delta kWh = \Delta kWh\_lights + \Delta kWh\_refg$

$\Delta kWh\_lights = \Delta kW\_lights \times Hours$

$\Delta kW\_lights = kW\_hi - (0.85 \times kW\_hi + 0.15 \times kW\_lo)$

$\Delta kWh\_refg = \Delta kWh\_lights \times 0.28 \times Eff\_RS$

Where:

ΔkWh_lights = the lighting equipment contribution to savings

ΔkWh_refg = refrigeration interactive effects

kW_hi = the high-level lighting power per case, with deemed values shown in the table below

kW_lo = the low-level lighting power per case, with deemed values shown in the table below

Hours = the number of operating hours at the site, from application or deemed value shown in table below

0.85 = deemed fraction of time at high power[11]

0.15 = deemed fraction of time at low power[2]

0.28 = unit conversion between kW and tons of refrigeration

Eff_RS = efficiency of typical refrigeration system, with deemed values based on the CT X1931-5 PSD Commercial Refrigeration Efficiency Study shown in the table below

Input	System type	Deemed Value	Unit	Source
kW_hi	5’ case side mounted	13	W	4
	5’ case center mounted	26	W	
	6’ case side mounted	16	W	
	6’ case center mounted	32	W	
kW_lo	5’ case side mounted	8.5	W	4
	5’ case center mounted	17	W	
	6’ case side mounted	11	W	
	6’ case center mounted	21	W	
Hours, if not available from site	All	4,910	Hr/yr	4
Eff_RS	Small business	1.87 for freezer system 1.05 for refrigerator system	kW/ton	Converted from ACOP 1.88 for freezer and 3.35 for refrigerator system.

Input	System type	Deemed Value	Unit	Source
	Large business	1.87 for freezer system 1.05 for refrigerator syste	kW/ton	

Measure Life:

The table below provides measure life for control measures[2,3] .

BC Measure ID	Measure Name	Program	Measure Life
EC1a009 EC1d011 EC2a009 EC2d011 EC3a009 EC3d011	Daylight Dimming	LBES Retrofit, LBES DI, SBES Retrofit, SBES DI, MES Retrofit, MES DI	9
EC1b009 EC2b009 EC3b009	Daylight Dimming	LBES New, SBES New, MES New	10
EC1a014 EC1d016 EC2a014 EC2d016 EC3a014 EC3d016	Lighting Occupancy Sensors	LBES Retrofit, LBES DI, SBES Retrofit, SBES DI, MES Retrofit, MES DI	9
EC1b014 EC2b014 EC3b014	Lighting Occupancy Sensors	LBES New, SBES New, MES New	10

Other Resource Impacts:

Heating penalties for large C&I occupancy sensors are from a 12-month MA data logging study.[4] Penalties for small business and municipal programs are from the 2018 MA small business lighting impact evaluation.[5]

BC Measure ID	Measure Name	Program	MMBtu/kWh
EC1a009	Daylight Dimming	LBES	-0.002728
EC1b009			
EC1d011			
EC2a009	Daylight Dimming	SBES, MES	-0.004080
EC2b009			
EC2d011			
EC3a009			
EC3b009			
EC3d011			
EC1a014	Lighting Occupancy Sensors	LBES	-0.002728
EC1b014			
EC1d016			
EC2a014	Lighting Occupancy Sensors	SBES, MES	-0.004080
EC2b014			
EC2d016			
EC3a014			
EC3b014			
EC3d016			

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a009	Daylight Dimming	LBES							

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b009			1.000	0.999	1.000	1.000	1.000	0.138	0.134
EC1d011									
EC1a014	Lighting Occupancy Sensors	LBES	1.000	0.999	1.000	1.000	1.000	0.138	0.134
EC1b014									
EC1d016									
EC2a009	Daylight Dimming	SBES, MES	1.000	1.000	1.000	1.000	1.000	0.170	0.130
EC2b009									
EC2d011									
EC3a009									
EC3b009									
EC3d011									
EC2a014	Lighting Occupancy Sensors	SBES, MES	1.000	1.000	1.000	1.000	1.000	0.180	0.130
EC2b014									
EC2d016									
EC3a014									
EC3b014									
EC3d016									

In-Service Rates:

All installations have a 100% in-service-rate unless an evaluation finds otherwise.

Realization Rates:

Realization rates are 100% until evaluated. NH evaluations that have sampled a non-statistically significant number of lighting controls projects produced realization rates slightly greater than 100%, including for Large Business custom electric sites and Small Business and Municipal lighting projects, some of which included controls[6] [7] For refrigerated case lighting controls, realization rates are defaulted to 100% as the cited research for savings calculations is a study, and not an evaluation[8].

Coincidence Factors:

Summer and winter coincidence factors for small business and municipal programs are based on a MA study of lighting occupancy sensors in small businesses[9] . For large businesses, coincidence factors are based on a MA impact evaluation of the large C&I prescriptive lighting program.[10]

Energy Load Shape:

Energy load shapes are based on site-level metering of project sites in MA.[11]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	34.30%	30.30%	18.10%	17.40%
Exterior Lighting	19.20%	20.10%	29.00%	31.60%

Impact Factors for Calculating Net Savings:

10

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1a009	Daylight Dimming	LBES, SBES, MES	11%	5%	0%	94%
EC1b009						
EC1d011						
EC2a009						
EC2b009						
EC2d011						
EC3a009						
EC3b009						
EC3d011						
EC1a014	Lighting Occupancy Sensors	LBES, SBES, MES	11%	5%	0%	94%
EC1b014						
EC1d016						
EC2a014						

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC2b014						
EC2d016						
EC3a014						
EC3b014						
EC3d016						

Revision History:

Revision Number	Issue Date	Description
59	1/14/2022	Measure life for retrofit lighting occupancy sensors was updated to 9 years from 10, according to the cited ERS study. Original value was incorrect.
154	12/1/2022	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Added HOU table for where site specific hours are unavailable.

Endnotes:

1 : DNV GL, June 30, 2020. C1635 Impact Evaluation of PY 2016 & 2017 Energy Opportunities Program, Draft Report. Table 5-17. Interior Fixture Hours of Use Results by Building Type. Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports
2 : DNV KEMA, October 27, 2014. Retrofit Lighting Controls Measures Summary of Findings. Final Report. (MA). https://ma-eeac.org/wp-content/uploads/Lighting-Retrofit-Control-Measures-Final-Report.pdf (NOTE: Report applies to daylight dimming and occupancy sensors. Dual sensor control savings factors are engineering calculated. Exterior controls factor only apply to On/Off photocells for lighting systems that operate on 24 hours per day, 7 days per week. Exterior controls with bi-level occupancy, dimming functions, or any other advanced/networked controls would receive a
3 : Southern California Edison, January 2016. Refrigerated Case Door Aisle Traffic Sensor. Work paper SCE13CS003, revision 2.. http://www.deeresources.net/workpapers
4 : ERS, November 17, 2005. Measure Life Study. Prepared for MA Joint Utilities. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf
5 : DNV KEMA, June 21, 2013. Impact Evaluation of 2010 Prescriptive Lighting Installations. (MA) https://ma-eeac.org/wp-content/uploads/Impact-Evaluation-of-2010-Prescriptive-Lighting-Installations-Final-Report-6-21-13.pdf
6 : DNV GL, ERS, June 7, 2018. Impact Evaluation of PY2016 Small Business Initiative: Phase I https://ma-eeac.org/wp-content/uploads/P69-Impact-Eval-of-MA-Small-Business-Initiative-Phase-I-

Lighting_Report_FINAL.pdf
7 : DNV GL, June 21, 2018. Impact Evaluation of 2016 New Hampshire Commercial & Industrial Small Business and Municipal Lighting. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/small-business-and-municipal-lighting-impact-evaluation.pdf. See sample projects including controls, which produced an overall realization rate of 106.6%.
8 : DNV GL, September 25, 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf See 100.8% realization rate for custom electric measures in table 16.
9 : Cadmus Group, October 23, 2012. Small Business Direct Install Program: Pre/Post Lighting Occupancy Sensor Study. (MA) Available as appendix C-1 in https://ma-eeac.org/wp-content/uploads/Massachusetts-Small-Business-Direct-Install_2010-2012-Impact-Evaluations-1.29.13.pdf
10 : DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings.
11 : EMI, September 25, 2019 . C1644 EO Net-to-Gross Study, Final Report. https://www.energizect.com/sites/default/files/C1644%20-%20EO%20NTG%20Final%20Report_9.25.19.pdf Downstream NTG values are based on Energy Opportunities NTG Study Results for Lighting shown in Table ES-1-1 on p. ES-3.

2.59. Lighting - New Construction and Major Renovation

Measure Code	COM-LTG-NCMR
Markets	Commercial
Program Types	Lost Opportunity
Categories	Lighting

Measure Description:

Advanced lighting design refers to the implementation of various lighting design principles aimed at creating a quality and appropriate lighting experience while reducing unnecessary light usage. This is often done by a professional in a new construction or major renovation situation. Advanced lighting design uses techniques like maximizing task lighting and efficient fixtures to create a system of optimal energy efficiency and functionality.

Baseline Efficiency:

The Baseline Efficiency assumes compliance with lighting power density requirements as mandated by New Hampshire State Building Code, which currently reflects IECC 2018 with direct reference for compliance to ASHRAE Standard 90.1-2013. These standards specify the maximum lighting power densities (LPDs) by building type (building area method) and interior space type (space-by-space method). LPDs apply to all new construction and major renovation projects.

High Efficiency:

The high efficiency scenario assumes lighting systems that achieve lighting power densities below those required by New Hampshire State Building Code. Actual site lighting power densities should be determined on a case-by-case basis. Please refer to the current year application form for minimum percentage better than code efficiency requirements.

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = \sum_{i=1}^{n} ((LPD\_base\_i - Controlled \times LPD\_proposed\_i) \times Area\_i \times Hours\_i \times 1/1000)$

$\Delta kWFixture \sum_{i=1}^{n} ((LPD\_base\_i - LPD\_proposed\_i) \times 1/1000 \times Area\_i \times 1/1000)$

$\Delta kWControlled = \sum_{i=1}^{n} (LPD\_proposed\_i \times Area\_i \times 1/1000)$

Where:

n = Total number of spaces, or 1 for Building Area Method

LPD_base_i = Baseline lighting power density for building or space type i (Watts/ft^2)

Area_i = Area of building or space i (ft^2)

Hours_i = Annual hours of operation of the lighting equipment for space type i, see table below.

LPD_proposed_i = Proposed lighting power density for building or space type i (Watts/ft^2). See IECC 2018 C405.3.2Interior lighting power allowance, and C405.4 Exterior lighting power requirements linked in end notes. 1 [2]

Controlled = Min % of controlled lighting above required amounts

1000 = Conversion factor: 1000 watts per 1 kW

Note on HVAC system interaction: Additional Electric savings from cooling system interaction are included in the calculation of adjusted gross savings for Lighting Systems projects. The HVAC interaction adjustment factor is determined from lighting project evaluations and is included in the energy realization rates and demand coincidence factors and realization rates.

Note on Performance Lighting tiers: Performance Lighting has 3 tiers, for New Buildings & Major Renovations the min percentage of controlled lighting above required amounts at 0% for tier 1, 20% for tier 2, and 30% for tier 3. All other Performance Lighting programs have min percentage of controlled lighting above required amounts of 15% for tier 1, 35% for tier 2, and 45% for tier 3.

Hours of Use: [3]

Building Type	Hours of Use
24x7 lighting	8,760
Automotive	4,056
Education	2,967
Grocery	5,468
Health Care	5,564
Hotel/Motel	3,064
Industrial	5,793
Large Office	4,098
Other	6,211*
Parking Lot/ Streetlights	6,887

Building Type	Hours of Use
Religious Building/ Convention Center	913
Restaurant	5,018
Retail	4,939
Small Office	3,748
Warehouse	5,667
Parking Garage	8,760

Measure Life:

Measure lives are deemed based on study results from MA.[4]

BC Measure ID	Measure Name	Program	Measure Life
EC1b013 EC2b013 EC3b013	Performance Lighting (Interior)	LBES, SBES, MES	15
EC1b011 EC2b011 EC3b011	Performance Lighting (Exterior)	LBES, SBES, MES	15
EC1b012 EC2b012 EC3b012	Performance Lighting w/ controls (Interior)	LBES, SBES, MES	15
EC1b010 EC2b010 EC3b010	Performance Lighting w/ controls (Exterior)	LBES, SBES, MES	15

Other Resource Impacts:

Heating penalties are from alighting program evaluation performed on lighting systems in Massachusetts.[5]

BC Measure ID	Measure Name	Program	MMBtu/kWh
EC1b012 EC2b012 EC3b012 EC1b013 EC2b013 EC3b013	Performance lighting (interior) w/ and w/out controls	LBES, SBES, MES	-0.000162279

BC Measure ID	Measure Name	Program	MMBtu/kWh
EC1b010 EC2b010 EC3b010 EC1b011 EC2b011 EC3b011	Performance lighting (exterior) w/ and w/out controls	LBES, SBES, MES	n/a

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1b012 EC1b013	Performance lighting (interior)	LBES	1.000	0.999	1.000	1.000	1.000	0.504	0.389
EC2b012 EC3b012 EC2b013 EC3b013	Performance lighting (interior)	SBES, MES	1.000	1.066	1.000	1.135	1.000	0.504	0.389
EC1b010 EC1b011	Performance lighting (exterior)	LBES	1.000	0.999	1.000	1.000	1.000	0.000	1.000
EC2b010 EC3b010 EC2b011 EC3b011	Performance lighting (exterior)	SBES, MES	1.000	1.027	1.000	1.000	1.000	0.000	1.000

In-Service Rates:

All installations have a 100.0% in service rate unless an evaluation finds otherwise.

Realization Rates:

Large Business Energy Solutions uses a 99.9% realization rate. Energy and demand realization rates for Small Business Energy Solutions and Municipal Energy Solutions are based on a NH study of municipal and small business customers.[6] Realization rates for summer peak demand savings in interior systems reflect a 113.5% HVAC interactive multiplier.

Coincidence Factors:

All coincidence factors are based on a NH study of municipal and small business customers.[7]

Energy Load Shape:

Energy load shapes are based the MA P72 C&I loadshape study.[8]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	34.30%	30.30%	18.10%	17.40%
Exterior Lighting	19.20%	20.10%	29.00%	31.60%

Impact Factors for Calculating Net Savings:

[9]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
EC1b013 EC2b013 EC3b013	Performance Lighting (Interior)	LBES, SBES, MES	11%	5%	0%	94%
EC1b011 EC2b011 EC3b011	Performance Lighting (Exterior)	LBES, SBES, MES	11%	5%	0%	94%
EC1b012 EC2b012 EC3b012	Performance Lighting w/ controls (Interior)	LBES, SBES, MES	11%	5%	0%	94%
EC1b010 EC2b010 EC3b010	Performance Lighting w/ controls (Exterior)	LBES, SBES, MES	11%	5%	0%	94%

Endnotes:

1 : IECC (2018) C405.3. Interior lighting power requirements https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC405.3
2 : IECC (2018) C405.3. Exterior lighting power requirements https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency#IECC2018_CE_Ch04_SecC405.4
3 : DNV GL, June 30, 2020. C1635 Impact Evaluation of PY 2016 & 2017 Energy Opportunities Program, Draft Report. Table 5-17. Interior Fixture Hours of Use Results by Building Type. Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports
4 : DNV GL, ERS, July 22, 2019. Lighting Outyear Factor and Equivalent Measure Life. https://ma-eeac.org/wp-content/uploads/Lighting-Outyear-Factor-and-Equivalent-Measure-Life-Update_Final.pdf
5 : DNV GL, ERS, NMR, November 22, 2017. Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative https://ma-eeac.org/wp-content/uploads/Upstream-Lighting-Initiative-Impact-Evaluation-PY2015.pdf
6 : DNV GL, June 21, 2018. Impact Evaluation of 2016 New Hampshire Commercial & Industrial Small

Business and Municipal Lighting
https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/small-business-and-municipal-lighting-impact-evaluation.pdf
7 : DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings
8 : DNV GL June 30, 2020. C1635 Impact Evaluation of PY 2016 & 2017 Energy Opportunities Program, Table 5-20. (CT). Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports
9 : EMI, September 25, 2019 . C1644 EO Net-to-Gross Study, Final Report. https://www.energizect.com/sites/default/files/C1644%20-%20EO%20NTG%20Final%20Report_9.25.19.pdf Downstream NTG values are based on Energy Opportunities NTG Study Results for Lighting shown in Table ES-1-1 on p. ES-3.

2.60. Lighting - Retrofit

Measure Code	COM-LTG-LR
Markets	Commercial
Program Types	Retrofit
Categories	Lighting

Measure Description:

This measure includes efficient lighting products including, but not limited to, efficient Light-Emitting Diode (LED) lamps and fixtures, promoted through direct install retrofit programs, and installed in commercial and industrial buildings (C&I).

Midstream measures include efficient lighting products including, but not limited to, efficient Light-Emitting Diode (LED) lamps and fixtures, promoted through point-of-sale (also referred to as midstream) distributors.

Baseline Efficiency:

For C&I lighting retrofit installations, the baseline efficiency case is project-specific and is determined using actual fixture counts and wattages from the existing space.

All midstream measures assume a blend of retrofit and lost opportunity baseline,[1] determined using assumed wattages for each of the replaced lamps or fixtures

High Efficiency:

For C&I lighting retrofit installations, the high efficiency case is project-specific and is determined using actual fixture counts and wattages for the project.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = \left(\sum_{i=1}^{n} ((Count_{i} * Watts_{i} / 1000)_{BASE}) - \sum_{j=1}^{n} (Count_{j} * Watts_{j} / 1000)_{EE}\right) \times (Hours)$$

$$\Delta kW = \sum_{i=1}^{n} ((Count_{i} * Watts_{i} / 1000)_{BASE}) - \sum_{j=1}^{n} (Count_{j} * Watts_{j} / 1000)_{EE})$$

Where:
n = Total number of fixture types in baseline or pre-retrofit case
m = Total number of installed fixture types
$Count_{i}$ = Quantity of existing fixtures of type i.
$Watts_{i}$ = Existing fixture or baseline wattage for fixture type i
$Count_{j}$ = Quantity of efficient fixtures of type j.
$Watts_{j}$ = Efficient fixture wattage for fixture type j.

1000 = Conversion factor: 1000 watts per kW.
Hours = Lighting annual hours of operation.

For retrofit installations, the annual hours of operation is project-specific and determined using actual building operation data in which the lighting equipment was installed. If site specific hours of operation are unavailable or if vendor estimates of building operating hours are unrealistically different from standard building type operating hours, then refer to the operating hours defined for midstream lighting, which is based on a program evaluation from CT[4]

For Midstream:

$\Delta kWh = n * (DeltaWatts/1000) * Hours$

$\Delta kW = n * DeltaWatts /1000$

Where:
n = Total number of fixture or lamp types in project.
DeltaWatts = Calculated difference between efficient and baseline wattage (see table below)
1000 = Conversion factor: 1000 watts per kW.
Hours = Lighting annual hours of operation.

The following delta watt values are based on C&I Upstream Lighting, Mass Saves[5]

Product	Product Type	delta Watts[6 7]
BR20/PAR20	Screw-In LEDs	28.1
BR20/PAR30	Screw-In LEDs	38.1
BR40/PAR38	Screw-In LEDs	44.2
MR16	Screw-In LEDs	22.1
A-line, 75/100w	Screw-In LEDs	30.5
Decorative	Screw-In LEDs	13.6
LED Retrofit kit, <25W	Screw-In LEDs	38.4
LED Retrofit kit, >25W	Screw-In LEDs	49.60
Stairwell Kit, Low-Output w/sensor	LED Stairwell Kits	41.30
Stairwell Kit, Mid-Output w/sensor	LED Stairwell Kits	35.60
G24 LED	Screw-In LEDs	15.3
G23 LED	Screw-In LEDs	8.4

Product	Product Type	delta Watts[6 7]
T8 TLED, 4ft	Linear LEDs	13.8
T8 TLED, 2ft	Linear LEDs	6.9
A-line, 40/60w	Screw-In LEDs	21.7
2x4 LED Fixture Standard	Linear LEDs	33.0
2x4 LED Fixture Premium	Linear LEDs	37.0
2x2 LED Fixture Standard	Linear LEDs	29.0
2x2 LED Fixture Premium	Linear LEDs	33.0
1x4 LED Fixture Standard	Linear LEDs	16.0
1x4 LED Fixture Premium	Linear LEDs	20.0
2x4 LED Fixture Standard w Controls	Linear LEDs w Controls	42.9
2x4 LED Fixture Premium w Controls	Linear LEDs w Controls	48.1
2x2 LED Fixture Standard w Controls	Linear LEDs w Controls	37.7
2x2 LED Fixture Premium w Controls	Linear LEDs w Controls	42.9
1x4 LED Fixture Standard w Controls	Linear LEDs w Controls	20.8
1x4 LED Fixture Premium w Controls	Linear LEDs w Controls	26.0
T5 LED	Linear LEDs	20.0
U-Bend LED	Linear LEDs	23.4
High/Low Bay 50-99W	High Bay/Low Bay	174.0
High/Low Bay 100-199W	High Bay/Low Bay	229.0
High/Low Bay >= 200W	High Bay/Low Bay	334,0
Exterior LED 20-99W	Exterior LEDs	101.5
Exterior LED 100-199W	Exterior LEDs	176.5
Exterior LED >= 200W	Exterior LEDs	231.5
1x4 LED Troffer Retrofit Kit - Premium	Linear LEDs	37.3
1x4 LED Troffer Retrofit Kit - Standard	Linear LEDs	29.5

Product	Product Type	delta Watts[6] [7]
2x2 LED Troffer Retrofit Kit - Premium	Linear LEDs	19.6
2x2 LED Troffer Retrofit Kit - Standard	Linear LEDs	18.1
2x4 LED Troffer Retrofit Kit - Premium	Linear LEDs	56.2
2x4 LED Troffer Retrofit Kit - Standard	Linear LEDs	53.5
LED Ambient/Strip/Wrap	Linear LEDs	21.8
Mogul High Bay	High Bay/Low Bay	283.6
Mogul Low Bay	High Bay/Low Bay	191.0
Mogul Ext 175W	Exterior LEDs	141.9
Mogul Ext 250W	Exterior LEDs	184.9
Mogul Ext 400W	Exterior LEDs	283.3
LED Tubes, 3ft Type A	Linear LEDs	12.0
LED Tubes, 8ft Type A	Linear LEDs	25.1
Parking Garage, 20-99W - Standard	Exterior LEDs	122.9
Parking Garage, 20-99W - Premium	Exterior LEDs	130.5
Parking Garage, 100-199W - Standard	Exterior LEDs	249.4
Parking Garage, 100-199W - Premium	Exterior LEDs	253.9
Parking Garage, >= 200W - Standard	Exterior LEDs	561.6
Parking Garage, >= 200W - Premium	Exterior LEDs	583.1
High/Low Bay LED, 20-99W w/controls	High Bay/Low Bay w Controls	189.5
High/Low Bay LED, 100-199W w/controls	High Bay/Low Bay w Controls	260.1
High/Low Bay LED, >= 200W w/controls	High Bay/Low Bay w Controls	388.4

Midstream lighting measures will calculate gross energy savings using annual hours of operation defined for the building type in which the lamp was installed. These categories and hours of use are defined in the table below.

Midstream Hours of Use by Building Type

The following hours of operation are based on a program evaluation from CT. [4] Parking garages are included as an additional building type category that has not yet been evaluated. A review of TRM best practices indicates 8760 hours of use for parking garages.

Building Type	Hours of Use
24x7 lighting	8,760
Automotive	4,056
Education	2,967
Grocery	5,468
Health Care	5,564
Hotel/Motel	3,064
Industrial	5,793
Large Office	4,098
Other	6,211*
Parking Lot/ Streetlights	6,887
Religious Building/ Convention Center	913
Restaurant	5,018
Retail	4,939
Small Office	3,748
Warehouse	5,667
Parking Garage	8,760

*Other includes recreational and entertainment facilities, service-oriented facilities, and other miscellaneous building types.

Measure Life:

The table below summarizes the adjusted measure lives (AML) for each measure. AML values for are estimated based off of historical trajectory for planning purposes. .[5]

Measure Category	Measure	AML
Ambient Linear	TLED	5
Ambient Linear	LED Fixture	5
High/Low Bay	TLED	6
High/Low Bay	LED Fixture	6
High/Low Bay	LED Lamp	6
Exterior/Outdoor	TLED	4
Exterior/Outdoor	LED Fixture	4
Exterior/Outdoor	LED Lamp	4

Other Resource Impacts:

Heating penalties for downstream, interior lighting systems (non-turnkey) are from a 12-month MA data logging study.[3] Penalties for interior turnkey are from the 2018 MA small business lighting impact evaluation.[4]

BC Measure ID	Measure Name	Program	MMBtu/kWh
EC1a012	Interior Lighting	LBES, SBES, MES	-0.000691
EC1a013			
EC2a012			
EC2a013			
EC3a012			
EC3a013			
EC1d014	Interior Lighting (turnkey direct-install)	LBES, SBES, MES	-0.004080
EC1d015			
EC2d014			
EC2d015			
EC3d014			

BC Measure ID	Measure Name	Program	MMBtu/kWh
EC3d015			
EC1a010	Exterior Lighting	LBES, SBES, MES	n/a
EC1a011			
EC1d012			
EC1d013			
EC2a010			
EC2a011			
EC2d012			
EC2d013			
EC3a010			
EC3a011			
EC3d012			
EC3d013			

Midstream: The following heating penalties are associated with lighting projects, determined from MA lighting evaluations.[5]

BC Measure ID	**Measure Name**	**Program**	MMBtu/kWh
EC1c010 EC2c010	LED Downlight	LBES Midstream, SBES Midstream	-0.000329
EC1c011 EC2c011	LED Exterior	LBES Midstream, SBES Midstream	N/A
EC1c012 EC2c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	-0.000162
EC1c013 EC2c013	LED Linear Fixture	LBES Midstream, SBES Midstream	-0.000162
EC1c014 EC2c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	-0.000162

EC1c015 EC2c015	LED Linear Lamp	LBES Midstream, SBES Midstream	-0.000162
EC1c016 EC2c016	LED Screw In	LBES Midstream, SBES Midstream	-0.000329
EC1c017 EC2c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	N/A

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a012 EC1a013	Interior Lighting	LBES	1.000	0.999	1.000	1.000	0.504	0.389
EC2a012 EC2a013 EC3a012 EC3a013	Interior Lighting	SBES, MES	1.000	1.066	1.135	1.000	0.504	0.389
EC1a010 EC1a011	Exterior Lighting	LBES	1.000	0.999	1.000	1.000	0.000	1.000
EC2a010 EC2a011 EC3a010 EC3a011	Exterior Lighting	SBES, MES	1.000	1.027	1.000	1.000	0.000	1.000
EC1d014 EC1d015	Interior Lighting (turnkey direct-install)	LBES	1.000	0.999	1.000	1.000	0.504	0.389
EC2d014 EC2d015 EC3d014	Interior Lighting (turnkey direct-install)	SBES, MES	1.000	1.066	1.135	1.000	0.504	0.389

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC3d015								
EC1d012 EC1d013	Exterior Lighting (turnkey direct-install)	LBES	1.000	0.999	1.000	1.000	0.000	1.000
EC2d012 EC2d013 EC3d012 EC3d013	Exterior Lighting (turnkey direct-install)	SBES, MES	1.000	1.027	1.000	1.000	0.000	1.000

Midstream:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1c010 EC2c010	LED Downlight	LBES Midstream, SBES Midstream	0.859	1.267	1.000	1.000	0.70	0.49
EC1c011 EC2c011	LED Exterior	LBES Midstream, SBES Midstream	0.955	0.989	1.000	1.000	0.00	1.00
EC1c012 EC2c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	0.996	0.747	1.000	1.000	0.83	0.65
EC1c013 EC2c013	LED Linear Fixture	LBES Midstream, SBES Midstream	0.971	1.135	1.000	1.000	0.83	0.65
EC1c014 EC2c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	0.971	1.135	1.000	1.000	0.83	0.65
EC1c015 EC2c015	LED Linear Lamp	LBES Midstream, SBES Midstream	0.971	1.135	1.000	1.000	0.83	0.65
EC1c016	LED Screw In							0.49

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2c016		LBES Midstream, SBES Midstream	0.714	1.712	1.000	1.000	0.70	
EC1c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	0.955	0.989	1.000	1.000	0.82	0.82
EC2c017								

In-Service Rates:

All downstream installations have 100.0% in service rate since programs include verification of equipment installations.

Midstream in-service rates are based on the C1635 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program Report.[7]

Realization Rates:

Large Business Energy Solutions uses a 99.9% realization rate. Realization rates for Small Business Energy Solutions and Municipal Energy Solutions are based on NH evaluation results for municipal and small business facilities.They account for operational hours of use adjustments, electric HVAC interactive adjustments for kWh and summer peak kW, and other adjustments. Exterior lighting realization rates account for the same adjustments except the HVAC interactive adjustment.

Midstream realization rates are based on the C1635 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program Report.[6] The HVAC interaction adjustment factor is determined from MA,[6,2] and CT[6] lighting project evaluations.

Coincidence Factors:

Summer and winter coincidence factors are based on NH evaluation results.[5,7]

Midstream summer and winter coincidence factors are based on MA 2017 Upstream Lighting Impact evaluation.[9] LED screw-in coincident factors also applied to LED downlights.

Energy Load Shape:

Energy load shapes are based on site-level metering of project sites in MA.[9]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	34.30%	30.30%	18.10%	17.40%

Exterior Lighting	19.20%	20.10%	29.00%	31.60%

Impact Factors for Calculating Net Savings:

Midstream and downstream free-ridership and spillover are based on study results from CT—which is the nearby jurisdiction with programs and markets most similar to those in NH.[11]

BC Measure ID	Measure Name	Program	FR	SOP	SONP	NTG
EC1c010	LED Downlight	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c010						
EC1c011	LED Exterior	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c011						
EC1c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c012						
EC1c013	LED Linear Fixture	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c013						
EC1c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c014						
EC1c015	LED Linear Lamp	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c015						
EC1c016	LED Screw In	LBES Midstream, SBES Midstream	50%	23%	0%	73%
EC2c016						
EC1c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	27%	11%	0%	84%
EC2c017						
EC1a012	Interior Lighting	LBES, SBES, MES	11%	5%	0%	94%
EC1a013						
EC2a012						
EC2a013						

BC Measure ID	Measure Name	Program	FR	SOP	SONP	NTG
EC3a012						
EC3a013						
EC1d014	Interior Lighting (turnkey direct-install)	LBES, SBES, MES	11%	5%	0%	94%
EC1d015						
EC2d014						
EC2d015						
EC3d014						
EC3d015						
EC1a010	Exterior Lighting	LBES, SBES, MES	11%	5%	0%	94%
EC1a011						
EC2a010						
EC2a011						
EC3a010						
EC3a011						
EC1d012	Exterior Lighting (turnkey direct-install)	LBES, SBES, MES	11%	5%	0%	94%
EC1d013						
EC2d012						
EC2d013						
EC3d012						
EC3d013						

Revision History:

Revision Number	Date	Description

56	1/14/2022	Corrected the three typos resulting from a copy and paste error in the delta watt column of the upstream lighting delta watt value table. Updated line items are LED Retrofit kit, >25 KW, Stairwell kit, low-output w/ sensor and stairwell kit, mid-output w/sensor.
158	12/1/2022	Updated AMLs to align with latest MA study.
187	1/1/2024	Updated AML table to remove past year AML's

Endnotes:

1 : DNV GL, June 30, 2020. C1635 Impact Evaluation of PY 2016 & 2017 Energy Opportunities Program, Draft Report. Table 5-17. Interior Fixture Hours of Use Results by Building Type. Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports
2 : C&I Upstream Lighting Program. Mass Saves. Available at: https://www.masssave.com/en/learn/partners/upstream-lighting/
3 : DNV GL, April 6, 2020. MA19C14-E-LGHTMKT: 2019 C&I Lighting Inventory and Market Model Updates. https://ma-eeac.org/wp-content/uploads/MA19C14-E-LGHTMKT_2019-CI-Lighting-Inventory-and-Market-Model-Report_Final_2020.04.06.pdf
4 : DNV KEMA, June 21, 2013. Impact Evaluation of 2010 Prescriptive Lighting Installations. https://ma-eeac.org/wp-content/uploads/Impact-Evaluation-of-2010-Prescriptive-Lighting-Installations-Final-Report-6-21-13.pdf
5 : 2021_DNV_CI Lighting_Adjusted Measure Life_2021-2022_Memo https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/612fa8b0e64ea03a06fb1cd8/view?authToken=0c458a59a737a6e36de9458a06815b7587cf1f39c723de24ad8e6457c894e5750c57139caf07bb075c4a384aaac17b4e29477984faefd51efcb302a806d627adce2708ed097215
6 : DNV GL, June 21, 2018. Impact Evaluation of 2016 New Hampshire Commercial & Industrial Small Business and Municipal Lighting. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/small-business-and-municipal-lighting-impact-evaluation.pdf
7 : DNV GL, June 30, 2020, C1635 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program. Table 6-14: Upstream Lighting In-Service Rate Results and Table 6-19: Upstream Lighting kWh Realization Rate Recommendations Without In-Service Rates. Prepared for Connecticut Energy Efficiency Board (EEB). Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports
8 : DNV GL, September 25, 2015. New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Program Impact Evaluation. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/New%20Hampshire%20Large%20C&I%20Program%20Impact%20Study%20Final%20Report.pdf
9 : DNV GL, November 22, 2017. Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative. https://ma-eeac.org/wp-content/uploads/Upstream-Lighting-Initiative-Impact-Evaluation-PY2015.pdf
10 : DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings.
11 : EMI, September 25, 2019 . C1644 EO Net-to-Gross Study, Final Report. https://www.energizect.com/sites/default/files/C1644%20-%20EO%20NTG%20Final%20Report_9.25.19.pdf Mistream NTG values are based on Recommendation

2 on p. ES-6 and p. 51. For midstream, screw in values are applied to screw in lights, and linear values are applied to all other light types, which is consistent with the application of screw in and linear NTG values in the MA TRM. Downstream NTG values are based on Energy Opportunities NTG Study Results for Lighting shown in Table ES-1-1 on p. ES-3.

2.61. Variable Frequency Drive

Measure Code	COM-MND-VFD
Markets	Commercial
Program Types	Retrofit/Lost opportunity
Categories	Motors and Drives

Measure Description:

This measure covers the installation of variable speed drives according to the terms and conditions stated on the statewide worksheet. The measure covers multiple end use types and building types. The installation of this measure saves energy since the power required to rotate a pump or fan at lower speeds requires less power than when rotated at full speed.

Baseline Efficiency:

The baseline efficiency case measure varies with equipment type. All baselines assume either a constant or 2-speed motor. Air or water volume/temperature is controlled using valves, dampers, and/or reheats. If the project includes a motor replacement, additional savings may result from improved motor efficiency. Motors controlled by VFDs need to be “inverter rated” or may fail prematurely, thus requiring a simultaneous VFD addition and motor replacement project.

High Efficiency:

In the high efficiency case, pump flow or fan air volume is directly controlled by the VFD based on input from the system or process controller. The pump or fan will automatically adjust its speed based on inputted set points, control strategies and the downstream feedback it receives from the system or process controller.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = HP \ x \ \frac{kWh}{HP}$$

$$\Delta kW_{SP} = HP \ x \ \frac{kW_{SP}}{HP}$$

$$\Delta kW_{WP} = HP \ x \ \frac{kW_{WP}}{HP}$$

Where:

HP = Rated horsepower for the impacted motor

η = Motor efficiency

$\frac{kWh}{HP}$ = Annual electric energy reduction based on building and equipment type. See table below.

$\frac{kW_{SP}}{HP}$ = Summer demand reduction based on building and equipment type. See table below.

$\frac{kW_{WP}}{HP}$ = Winter demand reduction based on building and equipment type. See table below.

Savings factors below already account for motor efficiency and consequently an adjustment is not required in the algorithm.

Savings Factors for C&I VFDs without Motor Replacement (kWh/HP [1] 1 and kW/HP) [2]

Building Type[3]	**Building Exhaust Fan**	**Cooling Tower Fan**	**Chilled Water Pump**	**Boiler Feed Water Pump**	**Hot Water Circulating Pump**	**MAF - Make-up Air Fan**	**Return Fan**	**Supply Fan**	**WS Heat Pump**
Corresponding Fan or Pump Application Codes: [4]	PEF	CTF CWP PCP HYP RAS WTP	CHWP	FWP	HWP	MAF	RFA	SFA BEF HEF RFP SFP	WHP
Annual Energy Savings Factors (kWh/HP)									
University/College	3641	449	745	2316	2344	3220	1067	1023	3061
Elem/High School	3563	365	628	1933	1957	3402	879	840	2561
Multi-Family	3202	889	1374	2340	2400	3082	1374	1319	3713
Hotel/Motel	3151	809	1239	2195	2239	3368	1334	1290	3433
Health	3375	1705	2427	2349	2406	3002	1577	1487	3670
Warehouse	3310	455	816	2002	2087	3229	1253	1205	2818
Restaurant	3440	993	1566	1977	2047	2628	1425	1363	3542
Retail	3092	633	1049	1949	2000	2392	1206	1146	2998
Grocery	3126	918	1632	1653	1681	2230	1408	1297	3285
Offices	3332	950	1370	1866	1896	3346	1135	1076	3235
Summer Demand Savings Factors (kW/HP_{SP})									
University/College	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Elem/High School	0.377	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218

Building Type[3]	Building Exhaust Fan	Cooling Tower Fan	Chilled Water Pump	Boiler Feed Water Pump	Hot Water Circulating Pump	MAF - Make-up Air Fan	Return Fan	Supply Fan	WS Heat Pump
Multi-Family	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Hotel/Motel	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Health	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Warehouse	0.109	-0.023	0.174	0.457	0.091	0.261	0.287	0.274	0.218
Restaurant	0.261	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Retail	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Grocery	0.261	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Offices	0.109	-0.023	0.174	0.457	0.091	0.109	0.287	0.274	0.218
Winter Demand Savings Factors (kW/HP_{WP})									
University/College	0.377	-0.006	0.184	0.457	0.21	0.109	0.26	0.252	0.282
Elem/High School	0.457	-0.006	0.184	0.457	0.21	0.109	0.26	0.252	0.282
Multi-Family	0.109	-0.006	0.184	0.355	0.21	0.109	0.26	0.252	0.282
Hotel/Motel	0.109	-0.006	0.184	0.418	0.21	0.109	0.26	0.252	0.282
Health	0.377	-0.006	0.184	0.275	0.21	0.109	0.26	0.252	0.282
Warehouse	0.377	-0.006	0.184	0.178	0.21	0.261	0.26	0.252	0.282
Restaurant	0.109	-0.006	0.184	0.355	0.21	0.109	0.26	0.252	0.282
Retail	0.109	-0.006	0.184	0.275	0.21	0.109	0.26	0.252	0.282
Grocery	0.457	-0.006	0.184	0.418	0.21	0.109	0.26	0.252	0.282
Offices	0.457	-0.006	0.184	0.418	0.21	0.109	0.26	0.252	0.282

Savings Factors for C&I VFDs with Motor Replacement (kWh/HP_1 and kW/HP_2) :

Building Type[5]	Building Exhaust Fan	Cooling Tower Fan	Chilled Water Pump	Boiler Feed Water Pump	Hot Water Circulating Pump	MAF - Make-up Air Fan	Return Fan	Supply Fan
Corresponding Fan or Pump Application Codes:[6]	PEF	CTF CWP PCP HYP RAS WTP	CHWP	FWP	HWP	MAF	RFA	SFA BEF HEF RFP SFP

Building Type[5]	Building Exhaust Fan	Cooling Tower Fan	Chilled Water Pump	Boiler Feed Water Pump	Hot Water Circulating Pump	MAF - Make-up Air Fan	Return Fan	Supply Fan
Annual Energy Savings Factors (kWh/HP)								
University/College	3,802	486	780	2,415	2,442	3,381	1,143	1,100
Elem/High School	3,721	396	657	2,015	2,040	3,561	941	903
Multi-Family	3,368	954	1,435	2,443	2,504	3,248	1,466	1,412
Hotel/Motel	3,317	866	1,294	2,291	2,335	3,534	1,425	1,381
Health	3,541	1,815	2,535	2,453	2,510	3,168	1,676	1,586
Warehouse	3,476	496	853	2,098	2,183	3,396	1,342	1,294
Restaurant	3,606	1,066	1,636	2,067	2,138	2,794	1,519	1,457
Retail	3,258	685	1,097	2,036	2,087	2,558	1,288	1,229
Grocery	3,292	1,001	1,710	1,724	1,753	2,396	1,498	1,386
Offices	3,498	1,014	1,432	1,947	1,977	3,512	1,210	1,151
Summer Demand Savings Factors (kW/HP_{SP})								
University/College	0.257	(0.004)	0.465	0.952	0.190	0.257	0.679	0.706
Elem/High School	1.187	(0.006)	0.697	1.428	0.286	0.385	1.019	1.058
Multi-Family	0.385	(0.006)	0.697	1.428	0.286	0.385	1.019	1.058
Hotel/Motel	0.257	(0.004)	0.465	0.952	0.190	0.257	0.679	0.706
Health	0.128	(0.002)	0.232	0.476	0.095	0.128	0.340	0.353
Warehouse	0.770	(0.012)	1.394	2.855	0.571	1.677	2.038	2.117
Restaurant	0.839	(0.006)	0.697	1.428	0.286	0.385	1.019	1.058
Retail	0.514	(0.008)	0.930	1.904	0.381	0.514	1.358	1.411
Grocery	0.280	(0.002)	0.232	0.476	0.095	0.128	0.340	0.353
Offices	0.257	(0.004)	0.465	0.952	0.190	0.257	0.679	0.706
Winter Demand Savings Factors (kW/HP_{WP})								
University/College	0.791	(0.001)	0.384	0.952	0.437	0.257	0.563	0.544
Elem/High School	1.428	(0.002)	0.575	1.428	0.655	0.385	0.844	0.816
Multi-Family	0.385	(0.002)	0.575	1.123	0.661	0.385	0.844	0.816
Hotel/Motel	0.257	(0.001)	0.384	0.874	0.438	0.257	0.563	0.544

Building Type[5]	**Building Exhaust Fan**	**Cooling Tower Fan**	**Chilled Water Pump**	**Boiler Feed Water Pump**	**Hot Water Circulating Pump**	**MAF - Make-up Air Fan**	**Return Fan**	**Supply Fan**
Health	0.396	(0.001)	0.192	0.294	0.223	0.128	0.281	0.272
Warehouse	2.374	(0.003)	1.151	1.181	1.384	1.677	1.688	1.632
Restaurant	0.385	(0.002)	0.575	1.123	0.661	0.385	0.844	0.816
Retail	0.514	(0.002)	0.767	1.178	0.893	0.514	1.125	1.088
Grocery	0.476	(0.001)	0.192	0.437	0.219	0.128	0.281	0.272
Offices	0.952	(0.001)	0.384	0.874	0.438	0.257	0.563	0.544

Measure Life:

The measure life for lost opportunity is 15 years. For retrofit, this measure was determined to be an add on, single baseline measure, so it will leverage the same 15 year life as lost opportunity. [4]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a043 EC1d043 EC2a043 EC2d043 EC3a087 EC3d087	Variable Frequency Drive	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	0.95	n/a	1.27	1.42	1.00	1.00
EC1a044 EC1d044 EC2a044		LBES Retro LBES DI							

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2d044 EC3a088 EC3d088	Variable Frequency Drive with Motor	SBES Retro SBES DI	1.00	0.95	n/a	1.27	1.42	1.00	1.00
		Muni Retro Muni DI							

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Realization rates are based on study results.[6]

Coincidence Factors:

CFs for all programs set to 100% since summer and winter demand savings are based on evaluation results.

Energy Load Shape:

See Appendix 1 C&I Load Shape "C&I VFD (Combined)".

Revision History:

Revision Number	Date	Description
57	1/14/2022	Changed the formatting of the algorithm for calculating energy impact for clarity.
71	3/1/2022	Included explanations of how project information verbiage and VFD application codes map to the savings values in the TRM.

Endnotes:

1 : Chan, Tumin (2010). Formulation of a Prescriptive Incentive for the VFD and Motors & VFD impact tables at NSTAR
2 : For Chilled Water Pump, Hot Water Circ. Pump, Return Fan, Supply Fan, and WSHP Circ. Loop:

kW/HP estimates derived from Cadmus (2012). Variable Speed Drive Loadshape Project. Prepared for the NEEP Regional Evaluation, Measurement & Verification Forum. Other drive type kW/HP savings estimates based on Chan, Tumin (2010). Formulation of a Prescriptive Incentive for the VFD and Motors & VFD impact tables at NSTAR. Prepared for NSTAR.
3 : Building types listed in the project information map to the building types listed in the TRM as follows: TRM Project Info Bldg Type Matched to TRM Bldg Types for VFD Calc Elm/H School Daycare Education - K-12 School Grocery Grocery Health Exercise center Gymnasium Health/Medical - Clinic Hospital Sports arena Hotel/Motel Hotel/Motel/Lodging Penitentiary Multi-Family Multifamily Nursing Home Offices Convention center Courthouse Library Office - Medium/Large (> 20,000 ft²) Office - Small (< 20,000 ft²) Police station Religious Worship/Church Town hall Restaurant Dining: bar/lounge/leisure Dining: Cafeteria/Fast Food Dining: Family Retail Motion picture theater Museum Performing arts theater Post office Retail University/College Dormitory Education - College/University Education - Community College Warehouse Automotive facility Fire station Industrial/Manufacturing - 1 Shift Industrial/Manufacturing - 2 Shifts Industrial/Manufacturing - 3 Shifts Parking garage Storage Facility Transportation Warehouse - Distribution Center Warehouse - Inactive Storage Workshop
4 : The corresponding measure names for the application codes are: Code Application BDF Boiler Draft Fan CHWP Chilled Water Pump CTF Cooling Tower Fan CWP Condenser Water Pump FWP Boiler Feed Water Pump HWP Hot Water Circulator Pump MAF Make-up Air Fan (CHW Cooling Only) PCP Process Cooling Pump PE Process Exhaust and Make-up Fan RFA HVAC Return Air Fan (CHW Cooling Only) SFA HVAC Supply Air Fan (CHW Cooling Only) WHP WS Heat Pump Loop Circulator Pump BEF BEF - Building Exhaust Fan HEF HEF - Fume Hood Exhaust & Makeup Air Fan HP HYP - Hydraulic Pump RAS RAS - RAS Pump in Wastewater Treatment Plant RFP RFP - Return Fan on VAV Packaged HVAC Unit WFP SFP - Supply Fan on VAV Packaged HVAC Unit WTP WTP - Water Supply or Wastewater Treatment Pump
5 : Energy & Resource Solutions, November (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf, Baseline Categories and preliminary Out Year Factors are described at a high level in DNV GL, ERS (2018). Portfolio Model Companion Sheet. Additional background on the baseline categorization given in DNV GL, ERS (2018). Portfolio Model Methods and Assumptions – Electric and Natural Gas Memo
6 : DNV GL (2020). Impact Evaluation of PY 2017 Small Business Initiative Non-Lighting Measures.

2.62. Case Motor Replacement

Measure Code	COM-REFR-RMCR
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Replacement of shaded-pole (SP) or permanently-split capacitor (PSC) motors with electronically commutated motors (ECMs) in the evaporators for multi-deck and freestanding coolers and freezers, typically on the retail floor of convenience stores, liquor stores, and grocery stores.[1]

Baseline Efficiency:

The baseline efficiency case is the existing case motor, either SP or PSC type.

High Efficiency:

The high efficiency case is the replacement of the existing case motor with an ECM.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = \Delta kWh_{Motor} + \Delta kWh_{Heat}$$
$$\Delta kWh_{Motor} = kW_{Motor} \times LRF \times Hours$$
$$\Delta kWh_{Heat} = \Delta kWh_{Motor} \times 0.28 \times Eff_{RS}$$
$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

Where:

ΔkWh_{Motor} = Energy savings due to increased efficiency of case motor
ΔkWh_{Heat} = Energy savings due to reduced heat from evaporator fans
kW_{Motor} = Rated input power of the existing case motor
LRF = Load reduction factor: 53% when SP motors are replaced, 29% when PSC motors are replaced[2].
.$Hours$ = Average runtime of case motors (8,500 hours)[3]
0.28 = Conversion of kW to tons: 3,413 Btuh/kW divided by 12,000 Btuh/ton.
Eff_{RS} = Efficiency of typical refrigeration system (1.6 kW/ton)[4]
ΔkW = Average demand savings
8,760 = Hours per year

Measure Life:

The measure life is 15 years[5]. This measure is determined to have an add-on single baseline in retrofit scenarios.

This measure is determined to have an add-on single baseline in retrofit scenarios.

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a016	Case Motor Replacement	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC1d018	Case Motor Replacement	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC2a016	Case Motor Replacement	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2d018	Case Motor Replacement	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3a016	Case Motor Replacement	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3d018	Case Motor Replacement	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are representative of C&I Refrigeration

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Refrigeration".

Revision History:

Revision Number	Date	Description
188	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : The assumptions and algorithms used in this section are specific to NRM products.
2 : Load factor is an estimate by NRM based on several pre- and post-meter readings of installations
3 : Conservative value based on 15 years of NRM field observations and experience.
4 : Select Energy (2004). Cooler Control Measure Impact Spreadsheet Users' Manual. Prepared for NSTAR.
5 : Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; 15-year measure life for retrofit motor installations.

2.63. Cooler Night Cover

Measure Code	COM-HVAC-CNC
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of retractable aluminium woven fabric covers for open type refrigerated display cases, where the covers are deployed during the facility unoccupied hours in order to reduce refrigeration energy consumption.

Baseline Efficiency:

The baseline efficiency case is the annual operation of open-display cooler cases.

High Efficiency:

The high efficiency case is the use of night covers to protect the exposed area of display cooler cases during unoccupied hours.

Algorithms for Calculating Primary Energy Impact:

ΔkWh = (Width) x (Save) x (Hours)
Δ kW = (Width) x (Save)
Where:
Δ kWh = Energy Savings
Δ kW = Connected load reduction
Width = Width of the opening that the night covers protect (ft)
Save = Savings factor based on the temperature of the case (kW/ft). See table below[1]
Hours = Annual hours that the night covers are in use

Cooler Case Temperature	Savings Factor
Low Temperature (-35 F to -5 F)	0.03 kW/ft
Medium Temperature (0 F to 30 F)	0.02 kW/ft
High Temperature (35 F to 55 F)	0.01 kW/ft

Cooler Case Temperature	Savings Factor
Low Temperature (-35 F to -5 F)	0.03 kW/ft
Medium Temperature (0 F to 30 F)	0.02 kW/ft
High Temperature (35 F to 55 F)	0.01 kW/ft

Measure Life:

The measure life for refrigeration add-on measures are 10 years.[2]

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a017 EC1d019	Cooler Night Covers	LBES Retro LBES DI	1.000	0.999	n/a	1.000	1.000	0.000	0.000
EC2a017 EC2d019	Cooler Night Covers	SBES Retro SBES DI	1.000	1.000	n/a	1.000	1.000	0.000	0.000
EC3a023 EC3d025	Cooler Night Covers	Muni Retro Muni DI	1.000	1.000	n/a	1.000	1.000	0.000	0.000

In-Service Rates:

All installation have 100% in-service rate since all programs require verification of equipment installation.

Realization Rates:

Large Business Energy Solution uses a 99.9% realization rate. All other programs use a 100.0% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are 0.0% since night cover usage occurs outside of peak demand hours.

Energy Load Shape:

See Appendix 1 – “C&I Refrigeration”

Endnotes:

1 : CL&P Program Savings Documentation for 2011 Program Year, 2010. Factors based on Southern California Edison (1997). Effects of the Low Emissive Shields on Performance and Power Use of a Refrigerated Display Case. https://www.econofrost.com/wp-content/uploads/2016/03/Ashrae.pdf
2 : Energy & Resource Solutions, November 2005. Measure Life Study. Prepared for The Massachusetts Joint Utilities; Page 4-5 to 4-6. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-LifeStudy_MA-Joint-Utilities_ERS.pdf

2.64. Door Heater Controls

Measure Code	COM-RFGN-DHC
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of controls to reduce the run time of door and frame heaters for freezers and walk-in or reach-in coolers. The reduced heating results in a reduced cooling load.

Baseline Efficiency:

The baseline efficiency case is a cooler or freezer door heater that operates 8,760 hours per year without any controls.

High Efficiency:

The high efficiency case is a cooler or freezer door heater connected to a heater control system, which controls the door heaters by measuring the ambient humidity and temperature of the store, calculating the dew point, and using pulse width modulation (PWM) to control the anti-sweat heater based on specific algorithms for freezer and cooler doors. Door temperature is typically maintained about 5°F above the store air dew point temperature.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kW = \frac{V \times A}{1{,}000} \times \%Off$$

$$\Delta kWh = \Delta kW \times 8{,}760$$

Where:

V = Nameplate heater voltage
A = Nameplate heater amperage
$\%Off$ = Controlled door heater off time: 46% for freezers and 74% for coolers[1]
8,760 = Hours per year

Measure Life:

The measure life is 10 years[2].

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a019	Door Heater Controls	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC1d021	Door Heater Controls	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC2a019	Door Heater Controls	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2d021	Door Heater Controls	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3a025	Door Heater Controls	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3d027	Door Heater Controls	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are representative of C&I Refrigeration

Energy Load Shape:

See Appendix 1 C&I Load Shapes “C&I Refrigeration”.

Revision History:

Revision Number	Date	Description
189	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : The value is an estimate by NRM based on hundreds of downloads of hours of use data from Door Heater controllers. These values are also supported by Select Energy Services, Inc. (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.
2 : Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-1
3 : MA TRM (2020). 2019 Pan-Year Report Version. 3.82. Refrigeration – Door Heater Controls

2.65. ECM Evaporator Fan Motors for Walk-in Coolers and Freezers

Measure Code	COM-RFGN-ECMFM
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of various sizes of electronically commutated motors (ECMs) in walk-in coolers and freezers to replace existing evaporator fan motors.

Baseline Efficiency:

The baseline efficiency case is an existing evaporator fan motor which is not ECM.

High Efficiency:

The high efficiency case is the replacement of existing evaporator fan motors with ECMs.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = \Delta kWh_{Motor} + \Delta kWh_{Heat}$$

$$\Delta kWh_{Motor} = \frac{V \times A \times PF \times \sqrt{Phase}}{1{,}000} \times LRF \times Hours$$

$$\Delta kWh_{Heat} = \Delta kWh_{Motor} \times 0.28 \times Eff_{RS}$$

$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

Where:

ΔkWh_{Motor} = Energy savings due to increased efficiency of evaporator motor

ΔkWh_{Heat} = Energy savings due to reduced heat from evaporator fans

V = Rated fan motor voltage

A = Rated fan motor amperage per, phase-to-ground

PF = Typical existing fan motor power factor, 0.55[1]

$Phase$ = Phase of electric power supplying the evaporator motor

LRF = Load reduction factor of 59%[2] .

$Hours$ = Annual fan operating hours

0.28 = Conversion of kW to tons: 3,413 Btuh/kW divided by 12,000 Btuh/ton.

Eff_{RS} = Efficiency of typical refrigeration system (1.87 kW/ton for freezer system, 1.05 for refrigerator system)[3]

ΔkW = Average demand savings

8,760 = Hours per year

Measure Life:

The measure life is 15 years[4].

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a023	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.90	0.90
EC1d025	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.90	0.90
EC2a023	ECM Evaporator Fan	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.90	0.90

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
	Motors for Walk-in Cooler/Freezer									
EC2d025	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC3a036	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.90	0.90
EC3d038	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.90	0.90

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are representative of C&I Refrigeration Energy Load Shape:

See Appendix 1 C&I Load Shapes “C&I Refrigeration”.

Revision History:

Revision Number	Date	Description

149	12/1/2022	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Updated LRF based on MA Refrigeration Load Shape Study
190	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : Conservative value based on 15 years of NRM field observations and experience.
2 : Load factor is based on 2015 MA Commercial Refrigeration Load Shape Study
3 : New efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Converted from ACOP 1.88 for freezer and 3.35 for refrigerator system.
4 : Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; 15-year measure life for retrofit motor installations.

2.66. Electronic Defrost Control

Measure Code	COM-RFGN-EDC
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Install a controller to activate evaporator defrost only when necessary in a refrigeration system.

Baseline Efficiency:

The baseline efficiency case is an evaporator electric defrost system that uses a time clock to initiate defrost.

High Efficiency:

The high efficiency case is an evaporator electric defrost system with defrost controls based on refrigeration system runtime or load conditions.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = \Delta kWh_{Defrost} + \Delta kWh_{Heat}$$
$$\Delta kWh_{Defrost} = kW_{Defrost} \times Hr/Day \times 365 \times DRF$$
$$\Delta kWh_{Heat} = \Delta kWh_{Defrost} \times 0.28 \times Eff_{RS}$$
$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

Where:

$\Delta kWh_{Defrost}$ = Energy savings due to reduced runtime of defrost heaters
ΔkWh_{Heat} = Energy savings due to reduced heat from the defrost heaters
$kW_{Defrost}$ = Rated input power of the defrost heater
Hr/Day = Existing scheduled defrost hours per day
DRF = Defrost reduction factor – annual average of 35%[1]
365 = Days per year
0.28 = Conversion of kW to tons: 3,413 Btuh/kW divided by 12,000 Btuh/ton.
Eff_{RS} = Efficiency of typical refrigeration system (1.87 kW/ton for freezer system, 1.05 for refrigerator system)[2]
ΔkW = Average demand savings

8,760 = Hours per year

Measure Life:

The measure life is 10 years[3].

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a024	Electronic Defrost Control	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC1d026	Electronic Defrost Control	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC2a024	Electronic Defrost Control	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2d026	Electronic Defrost Control	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3a037	Electronic Defrost Control	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3d039	Electronic Defrost Control	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are representative of C&I Refrigeration.

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Refrigeration".

Revision History:

Revision Number	Date	Description
148	12/1/2022	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study.
191	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : Supported by 3rd party evaluation: Independent Testing was performed by Intertek Testing Service on a Walk-in Freezer that was retrofitted with Smart Electric Defrost capability.
2 : New efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Converted from ACOP 1.88 for freezer and 3.35 for refrigerator system.
3 : Energy & Resource Solutions (2005). Measure Life Study – refrigeration controls for large C&I retrofit. Prepared for The Massachusetts Joint Utilities.

2.67. Evaporator Fan Control

Measure Code	COM-RFGN-EFC
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of controls to modulate the evaporator fans based on the temperature in a refrigerated space.

Baseline Efficiency:

The baseline efficiency case is an evaporator fan which runs for 8,760 annual hours.

High Efficiency:

The high efficiency case is an evaporator fan with controls to reduce the fan speed or cycle the fan off when the refrigerated space temperature setpoint is met.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = \Delta kWh_{Fan} + \Delta kWh_{Heat} + \Delta kWh_{Control}$$

$$kW_{Fan} = \frac{V \times A \times PF \times \sqrt{Phase}}{1{,}000}$$

$$\Delta kWh_{Fan} = kW_{Fan} \times \%Off \times 8760$$

$$\Delta kWh_{Heat} = \Delta kWh_{Fan} \times 0.28 \times Eff_{RS}$$

$$\Delta kWh_{Control} = [\mathrm{kW_{CP}} \times Hours_{CP} + kW_{Fan} \times (1 - \%Off) \times 8760] \times 5\%$$

$$\Delta kW = \frac{\Delta kWh}{8760}$$

Where:

ΔkWh_{Fan} = Energy savings due to reduced runtime of evaporator fans

ΔkWh_{Heat} = Energy savings due to reduced heat from the defrost heaters

$\Delta kWh_{Control}$ = Energy savings due to optimized controls, estimated at 5% of compressor and fan energy by consensus estimates used in MA TRM

V = Rated fan motor voltage

A = Rated fan motor amperage per, phase-to-ground

PF = Typical evaporator fan motor power factor, 0.55[1]

$Phase$ = Phase of electric power supplying the evaporator motor

$\%Off$ = Reduction in annual evaporator fan run hours, 33.5%[2] .

8760 = Hours per year

kW_{CP} = Nameplate input kW of the compressor

$Hours_{CP}$ = Equivalent full load hours of compressor operations: 4,072 hours[3]

0.28 = Conversion of kW to tons: 3,413 Btuh/kW divided by 12,000 Btuh/ton.

Eff_{RS} = Efficiency of typical refrigeration system (1.87 kW/ton for freezer system, 1.05 for refrigerator system)[4]

ΔkW = Average demand savings

8,760 = Hours per year

Measure Life:

The measure life is 10 years[5] .

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a027	Evaporator Fan Control	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	1.00	1.00
EC1d029	Evaporator Fan Control	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	1.00	1.00

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC2a027	Evaporator Fan Control	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
EC2d029	Evaporator Fan Control	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
EC3a043	Evaporator Fan Control	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
EC3d045	Evaporator Fan Control	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

All programs use CF values of 100% since demand savings are average and expected to be consistent.

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Refrigeration".

Revision History:

Revision Number	Date	Description
147	12/1/2022	Updated refrigeration efficiency and %Off based on CT X1931-5 PSD Study and MA Refrigeration Load shape study.

Endnotes:

1 : Conservative value based on 15 years of NRM field observations and experience.
2 : The value is based on 2015 MA Commercial Refrigeration Load Shape study
3 : Conservative value based on 15 years of NRM field observations and experience. Value supported by

Select Energy (2004). Cooler Control Measure Impact Spreadsheet Users' Manual. Prepared for NSTAR.
4 : New efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Converted from ACOP 1.88 for freezer and 3.35 for refrigerator system.
5 : Energy & Resource Solutions (2005). Measure Life Study – fan control retrofit. Prepared for The Massachusetts Joint Utilities.

2.68. Novelty Cooler Shutoff

Measure Code	COM-RFGN-NCS
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of controls to shut off a facility's novelty coolers for non-perishable goods based on pre-programmed store hours.

Baseline Efficiency:

The baseline efficiency case a novelty cooler energized for 8,760 annual hours.

High Efficiency:

The high efficiency case is a novelty cooler whose energized hours follow the store's occupied hours, and is de-energized during unoccupied hours.

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = kW_{NC} \times \mathrm{DC}_{\mathrm{AVG}} \times (Hours_{UNOCC} - 1) \times 365$
$\Delta kW = \Delta kWh/Hours$ x CF

Where:

kW_{NC} = Rated nameplate input power to the novelty cooler

$\mathrm{DC}_{\mathrm{AVG}}$ = Weighted average annual duty cycle: 49%[1]

$Hours_{UNOCC}$ = Daily unoccupied hours of the store

365 = Days per year

CF = .9

Measure Life:

The measure life is 10 years[2] .

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a037	Novelty Cooler Shutoff	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC1d037	Novelty Cooler Shutoff	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC2a037	Novelty Cooler Shutoff	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2d037	Novelty Cooler Shutoff	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3a066	Novelty Cooler Shutoff	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3d066	Novelty Cooler Shutoff	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9

<u>In-Service Rates:</u>

All installations have a 100% in service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

All programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

Coincidence factors are representative of C&I Refrigeration

Energy Load Shape:

See Appendix 1 C&I Load Shapes "C&I Refrigeration".

Revision History:

Revision Number	Date	Description
192	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : Estimated value from NRM experience, supported by Select Energy Services, Inc. (2004). Cooler Control Measure Impact Spreadsheet Users' Manual. Prepared for NSTAR. The study gives a less conservative value than used by NRM.
2 : Energy & Resource Solutions (2005). Measure Life Study – cooler shutoff retrofit. Prepared for The Massachusetts Joint Utilities.

2.69. Vending Miser

Measure Code	COM-RFGN-VM
Markets	Commercial
Program Types	Retrofit
Categories	Refrigeration

Measure Description:

Installation of controls intended to reduce the energy consumption of vending machine lighting and refrigeration systems. Qualifying controls must power down these systems during periods of inactivity but, in the case of refrigerated machines, must always maintain a cool product that meets customer expectations. This measure applies to refrigerated beverage vending machines, non-refrigerated snack vending machines, and glass front refrigerated coolers. This measure should not be applied to ENERGY STAR® qualified vending machines, as they already have built-in controls.

Baseline Efficiency:

The baseline efficiency case is a standard efficiency refrigerated beverage vending machine, nonrefrigerated snack vending machine, or glass front refrigerated cooler without a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

High Efficiency:

The high efficiency case is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler with a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

Algorithms for Calculating Primary Energy Impact:

ΔkWh = (kWRATED)(Hours)(SAVE)

ΔkW = ΔkWh / Hours

Where:

kW_{rated} = Rated kW of connected equipment; if not available, use default values in table below

$Hours$ = Annual operating hours of connected equipment; if not available, use default value of 8,760

$SAVE$ = Percent savings factor, see table below for values

Vending Machine and Cooler Controls Savings Factors[1]

Equipment Type	kW rated	SAVE
Refrigerated Beverage Vending Machines	0.40	46%
Non-Refrigerated Snack Vending Machines	0.085	46%
Glass Front Refrigerated Coolers	0.46	30%

Measure Life:

The measure life is 5 years[2] .

Other Resource Impacts:

There are no other resource impacts for this measure.

Impact Factors for Calculating Adjusted Gross Savings:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
EC1a045	Vending Miser	Electric	LBES - Retrofit	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC1d045	Vending Miser	Electric	LBES – Direct Install	1.00	0.999	n/a	1.00	1.00	0.9	0.9
EC2a045	Vending Miser	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC2d045	Vending Miser	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3a089	Vending Miser	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.9	0.9
EC3d089	Vending Miser	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.9	0.9

In-Service Rates:

All installations have a 100% in service rate unless an evaluation finds otherwise.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Coincidence factors are representative of C&I Refrigeration

Energy Load Shape:

See Appendix 1 C&I Load Shapes " C&I Refrigeration".

Revision History:

Revision Number	Date	Description
130	12/1/2022	Updated savings factors for snack vending machines and glass front refrigerated coolers to match study.
193	1/1/2024	Updated CF's to align with energy load shape

Endnotes:

1 : USA Technologies Energy Management Product Sheets (2006). https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee488706996f2eb697df798/view?authToken=a922d9227194493fd4df24a36b1bbbf4a87e5da3bb19d4407fdc2db995a43e3e73766bce98d5ab32eaefef84810bdaeb27d49282815e4cc58edac147714d304062a99db42de196
2 : Energy & Resource Solutions (2005). Measure Life Study – vending control retrofit. Prepared for The Massachusetts Joint Utilities.

Endnotes:

Appendix 1: Energy Load Shapes

The section includes a table or reference with the time-of-use pattern of a typical customer's electrical energy consumption for each segment and end use. Because the value of avoided energy varies throughout the year, load shapes are used to allocate energy savings into specific time periods to better reflect its time-dependent value. Load shapes are defined as follows based on ISO-NE definitions:

- Summer On-Peak: 7 am to 11 pm, weekdays, during the months of June through September, except ISO-NE holidays.
- Summer Off-Peak: All other hours during the months of June through September (includes weekends and holidays).
- Winter On-Peak: 7 am to 11 pm, weekdays, during the months of October through May, except ISO-NE holidays; and
- Winter Off-Peak: All other hours during the months of October through May (includes weekends and holidays).

Table A1.1. Residential Energy Load Shapes

Load Shape Description	Total Energy			
	Summer		Winter	
	On Peak	Off Peak	On Peak	Off Peak
Non-Electric Measures	0.0%	0.0%	0.0%	0.0%
Clothes Washer	18.3%	15.4%	36.4%	29.9%
24-hour operation	15.2%	18.3%	30.5%	36.1%
Clothes Dryer - Electric	16.9%	14.2%	38.9%	30.0%
Clothes Dryer - Natural Gas	15.9%	16.4%	37.6%	30.1%
Hardwired Electric Heat	0.0%	0.0%	43.1%	56.9%
Lighting	19.0%	15.1%	35.1%	30.7%
Primary TV and Peripherals	15.4%	17.6%	32.2%	34.8%
Primary Desktop Computer	17.5%	17.3%	33.5%	31.7%
Primary Refrigerator	18.2%	20.9%	29.0%	31.9%
Secondary Refrigerator	19.9%	23.6%	26.3%	30.2%
Freezer	17.1%	20.7%	28.7%	33.6%
Dehumidifier	24.9%	29.7%	22.0%	23.3%
Pool Pump	54.5%	38.2%	4.9%	2.4%
Dishwasher	14.8%	16.3%	34.1%	34.8%
Water Heater - Electric	15.2%	11.9%	41.5%	31.4%
Water Heater - Heat Pump	14.9%	13.0%	39.1%	33.0%

Water Heater - Natural Gas/Fuel Oil	13.3%	11.6%	40.9%	34.2%
Central Air Conditioner/Heat Pump (Cooling)	47.3%	42.2%	6.6%	3.8%
Room or Window Air Conditioner	47.5%	47.4%	2.9%	2.2%
Mini-Split Air Conditioner/Heat Pump (Cooling)	43.4%	40.2%	7.4%	9.0%
Mini-Split Heat Pump (Heating)	0.0%	0.0%	42.9%	57.1%
Furnace Fan	0.0%	0.0%	44.6%	55.4%
Boiler Distribution	0.0%	0.0%	45.0%	55.0%
Weighted HVAC - All Homes	23.2%	21.7%	25.4%	29.7%
Weighted HVAC - Multi-family	25.2%	23.7%	23.2%	27.9%
Weighted HVAC - Multi-family Low Income	22.4%	21.6%	25.4%	30.6%
Weighted HVAC - Single Family	22.5%	20.8%	26.1%	30.5%
Weighted HVAC - Single Family Low Income	23.1%	21.7%	25.3%	29.9%
Central Heat Pump	10.1%	9.0%	35.1%	45.7%
DMSHP	8.0%	7.4%	36.4%	48.2%
Electric Resistance with AC	6.0%	5.0%	45.0%	44.0%

Source: Navigant (2018). RES1 Demand Impact Model Update

Table A1.2. Commercial and Industrial Energy Load Shapes

C&I energy load shapes, except where noted in the chapters, are derived from site-level metering of project sites in MA. See DNV GL, 2018. P72 Prescriptive C&I Load shapes of Savings.

Load Shape Description	Total Energy			
	Summer		Winter	
	On Peak	Off Peak	On Peak	Off Peak
C&I Compressed Air - VFD Compressor	26.5%	23.7%	25.9%	23.9%
C&I Compressed Air - Air Dryer	22.4%	27.7%	21.7%	28.1%
C&I Electric Chiller (Combined)	39.4%	38.5%	11.3%	10.8%
C&I Electric Cooling Unitary Equipment	52.7%	34.1%	8.6%	4.6%
C&I Exterior Lighting	19.2%	29.0%	20.1%	31.6%
C&I Interior Lighting - Prescriptive	34.3%	18.1%	30.3%	17.4%
C&I Interior Lighting - Custom	32.3%	19.4%	29.8%	18.6%
C&I Lighting Controls	32.1%	17.7%	31.3%	19.0%
C&I Refrigeration	23.3%	26.8%	22.6%	27.3%
C&I VFDs (Combined)	23.8%	25.3%	23.7%	27.2%
C&I Food Services	16.0%	17.0%	32.0%	35.0%
C&I Heating & Cooling	34.9%	22.1%	26.4%	16.6%

Appendix 2: Equivalent Full Load Hours

Equivalent full load hours (EFLH) are the number of hours a heating or cooling system would have to operate at full load to equal the amount of heating or cooling delivered by the system. Heating and cooling EFLH are tabulated for 21 standard building types and three representative cities in New Hampshire. The EFLH values are based on building energy simulations of prototypical buildings.[4] TMY3 long term average weather data for the three New Hampshire cities were used to drive the simulation models.

Zone	**Representative Cities**
Zone 1- South	Manchester, Portsmouth
Zone 2 - Central	Concord, Keene, Laconia, Lebanon
Zone 3- North	Berlin

The building types are described as follows:

Building Type	*Description*
Assembly	Public buildings that include community centers, libraries, performance and movie theaters, auditoria, police and fire stations, gymnasia, sports arenas, andtransportation terminals
Auto	Repair shops and auto dealerships, including parking lots and parking structures.
Big Box	Single story, high-bay retail stores with ceiling heights of 25 feet or more. Majority of floor space is dedicated to non-food items but could include refrigerated andnon-refrigerated food sales areas.
Community College	Community college campus and post-secondary technical and vocational education buildings, including classroom, computer labs, dining, and office. Conditioned by packaged HVAC systems
Dormitory	College or University dormitories
Fast Food	Self-service restaurants with primarily disposable plates, utensils etc.
Full-ServiceRestaurant	Full-service restaurants with full dishwashing facilities
Grocery	Refrigerated and non-refrigerated food sales, including convenience stores and specialty food sales
Hospital	Inpatient and outpatient care facility conditioned by built-up HVAC systems.Excludes medical offices
Hotel	Multifunction lodging facility with guest rooms, meeting space, foodservice conditioned by built-up HVAC system
Large Office	Office space in buildings greater than 3 stories conditioned by built-up HVACsystem.
Light Industrial	Single story workspace with heating and air-conditioning; conditioned by packaged

[4] Prototypical building models are described in the New York Technical Reference Manual v. 8 Appendix A.

Building Type	*Description*
	HVAC systems
Motel	Lodging facilities with primarily guest room space served by packaged HVACsystems
Large Retail	Retail building with 2 or more stories served by built-up HVAC system
Primary School	K-8 school
Religious	Religious worship
Secondary School	9-12 school
Small Office	Office occupancy in buildings 3 stories or less served by packaged HVAC systems; includes Medical offices
Small Retail	Single story retail with ceiling height of less than 25 feet; primarily non-food retail and storage areas served by packaged HVAC systems. Includes service businesses, post offices, Laundromats, and exercise facilities.
University	University campus buildings, including classroom, computer labs, biological and/or chemical labs, workshop space, dining, and office. Conditioned by built-up HVAC systems
Warehouse	Primarily non-refrigerated storage space could include attached offices served by packaged HVAC system.
Other	Use these values if building type is not known

EFLH data for large commercial buildings with built-up HVAC systems are broken out by HVAC system type:

- CV noecon Constant volume reheat system without an airside economizer
- CV econ Constant volume reheat system with an airside economizer
- VAV Variable air volume system with an airside economizer
- Unknown Weighted average of the three HVAC types above used if HVAC system type is not known

Small Commercial Cooling Full Load Hours

Building Type	Berlin	Concord	Manchester
Assembly	448	538	492
Auto Repair	186	304	341
Big Box Retail	734	841	786
Dormitory	638	698	705
Fast Food Restaurant	427	539	521
Full-Service Restaurant	391	512	479
Grocery	2,143	2,188	2,028
Light Industrial	350	435	419
Motel	670	900	909
Primary School	167	304	278
Religious	171	220	261
Small Office	563	786	758
Small Retail	575	716	685
Warehouse	172	249	275
Other	545	659	638

Small Commercial Heating Full Load Hours

Building Type	Berlin	Concord	Manchester
Assembly	1,234	960	908
Auto Repair	4,173	3,370	3,379
Big Box Retail	744	602	474
Dormitory	686	544	452
Fast Food Restaurant	1,837	1,400	1,249
Full-Service Restaurant	1,886	1,303	1,275
Grocery	951	1,064	988
Light Industrial	1,379	1,265	949
Motel	736	626	499
Primary School	1,551	1,309	1,094
Religious	1,129	1,012	928
Small Office	894	760	588
Small Retail	1,264	1,052	795
Warehouse	1,172	920	829
Other	1,403	1,156	1,029

Large Commercial Cooling Full Load Hours

Building Type	HVAC Type	Berlin	Concord	Manchester
Community College	CV econ	412	627	581
	CV noecon	612	874	789
	VAV	299	489	460
	Unknown	365	570	530
High School	CV econ	252	398	330
	CV noecon	707	837	741
	VAV	148	255	196
	Unknown	251	368	301
Hospital	CV econ	1,037	1,132	1,115
	CV noecon	2,248	2,117	1,865
	VAV	1,014	1,089	1,079
	Unknown	1,115	1,175	1,145
Hotel	CV econ	2,838	3,033	2,763
	CV noecon	3,035	3,219	2,983
	VAV	2,811	3,014	2,726
	Unknown	2,937	3,126	2,873
Large Office	CV econ	885	1,095	1,002
	CV noecon	2,500	2,541	2,276
	VAV	584	758	675
	Unknown	739	906	810
Large Retail	CV econ	701	848	832
	CV noecon	1,695	1,654	1,665
	VAV	560	662	656
	Unknown	662	756	750
University	CV econ	566	722	760
	CV noecon	1,334	1,543	1,689
	VAV	413	592	619
	Unknown	579	760	807

Large Commercial Heating Full Load Hours

Building Type	HVAC Type	Berlin	Concord	Manchester
Community College	CV econ	1,103	1,098	939
	CV noecon	982	1,014	863
	VAV	704	462	642
	Unknown	809	646	723
High School	CV econ	806	744	724
	CV noecon	721	699	652
	VAV	383	289	274
	Unknown	501	423	402
Hospital	CV econ	1,140	1,052	703
	CV noecon	1,068	971	641
	VAV	738	781	437
	Unknown	797	818	474
Hotel	CV econ	1,111	955	909
	CV noecon	917	771	671
	VAV	571	432	350
	Unknown	1,014	863	790
Large Office	CV econ	2,140	2,046	1,683
	CV noecon	2,046	1,985	1,620
	VAV	518	428	309
	Unknown	739	651	497
Large Retail	CV econ	1,878	1,827	1,735
	CV noecon	1,755	1,728	1,620
	VAV	775	681	549
	Unknown	942	856	729
University	CV econ	1,515	1,404	1,342
	CV noecon	1,279	1,195	1,135
	VAV	615	852	797
	Unknown	858	991	933

Appendix 3: Table of Revisions and Changes

Revision Number	Date	Chapter	Description
1	1/14/2022	All	Removed “DRAFT” water mark on document
2	1/14/2022	Appendix 1	Added C&I Load Shape table to appendix 1 for clarity.
3	1/14/2022	Table of Contents	Updated table of contents to fix chapter numbering error.
4	1/14/2022	Table of Contents	Removed tracked changes marking from table of contents
5	1/14/2022	Table of Revisions and Changes	Added “Table of Revisions and Changes”. Also added revision history to each applicable chapter.
6	3/1/2022	Appendix 2: EFLH	Added “Appendix 2: Equivalent Full Load Hours”.
7	1/14/2022	1.0 Active Demand Response – Residential	The deemed savings number for thermostat ADR’s was updated to 0.60 kw from 0.67 kw.
8	1/14/2022	1.0 Active Demand Response – Residential	Fixed broken links in references
9	1/14/2022	1.1Appliances - Advanced Power Strip	Fixed broken links in references.
10	1/14/2022	1.2 Appliances – Clothes Dryer	Added savings values for retrofit clothes dryers. Previously were vendor calculated.
11	1/14/2022	1.3 Appliances – Clothes Washer	Added option to use EPA calculator for retrofit savings values. were vendor calculated.
12	1/14/2022	1.12 Building Shell – Air Sealing	Updated to reference the “Weighted Whole Home HVAC” load shape for air sealing, rather than the hardwired electric heat load shape.
13	1/14/2022	1.12 Building Shell – Air Sealing	Added ancillary heating and cooling savings and separate BC measure ID’s
14	1/14/2022	1.12 Building Shell – Air Sealing	Updated the air sealing load shape to “Weighted Whole Home HVAC”, and added load shapes for ancillary savings.
15	1/14/2022	1.13 Building Shell – Insulation	Updated to reference the “Weighted Whole Home HVAC” load shape for air sealing, rather than the hardwired electric heat load shape.
16	1/14/2022	1.13 Building Shell – Insulation	Added ancillary heating and cooling savings and separate BC measure ID’s

17	1/14/2022	1.13 Building Shell – Insulation	Updated the air sealing load shape to "Weighted Whole Home HVAC", and added load shapes for ancillary savings.
18	1/14/2022	1.13 Building Shell – Insulation	Updated to include duct insulation measures
19	1/14/2022	1.14 Building Shell – Door Replacement	Omitted measure added
20	1/14/2022	1.15 Building Shell – Window Replacement	Omitted measure added
21	1/14/2022	1.17 Hot Water – Heat Pump Water Heater	Measure names of the residential ES products heat pump water heater offerings updated to match implementation's naming conventions.
22	1/14/2022	1.17 Hot Water – Heat Pump Water Heater	Added BC Measure ID's to encompass all measures in BC mode.
23	1/14/2022	1.19 Hot Water – Setback	Added BC MEASURE ID's and HEA and HPwES measures for the Kerosene fuel type.
24	1/14/2022	1.20 Hot Water – Showerhead	Added missing BC measures ID's to the algorithms for primary energy impact tables.
25	1/14/2022	1.20 Hot Water – Showerhead	Updated typos in footnote numbering.
26	1/14/2022	1.21 Hot Water – Water Heater	Fixed broken link in reference #3 for Navigant (2018). Home Energy Service Impact Evaluation. Prepared for program administrators in Massachusetts.
27	1/14/2022	1.21 Hot Water – Water Heater	Added entries for non-gas water heaters which had been omitted from the TRM. New entries include BC MEASURE ID's E21B1a096, E21B1a097, E21B1a099, E21B1a098, E21A2a082, E21A2a083
28	1/14/2022	1.22 HVAC – Boiler	Added omitted measures for Kerosene Boiler Replacements for HEA and HPwES
29	1/14/2022	1.23 HVAC – Boiler Reset Control	Removed copy and paste formatting error. Baseline verbiage was originally in red text, change to black text.
30	1/14/2022	1.25 HVAC – Repair and Cleaning	Omitted Measure Added
31	1/14/2022	1.26 HVAC – ENERGY STAR Central Air Conditioning	Formatting, added correct BC MEASURE ID's
32	1/14/2022	1.26 HVAC – ENERGY STAR Central Air Conditioning	Updated baseline for lost opportunity to reflect NH Building code.
33	1/14/2022	1.27 HVAC – ENERGY STAR Room Air Conditioning	Updated HPwES RR in 'Realization Rate' sub section. The RR was correct in the table, but incorrect in the verbiage.

34	1/14/2022	1.28 HVAC – Furnace	Corrected typo in E21B1b007 delta kWh savings. Originally read 6.700, should instead match the propane savings.
35	1/14/2022	1.29 HVAC – Central Air-source Heat Pump	Updated SEER to EER conversion factor used.
36	1/14/2022	1.29 HVAC – Central Air-source Heat Pump	Added omitted ductless mini split heating only and cooling only measures
37	1/14/2022	1.30 HVAC – Ductless Mini-Split Heat Pump	Updated SEER to EER conversion factor used.
38	1/14/2022	1.36 Thermostat – Programmable	Corrected E21A2b010 G21A2b003 to reflect kWh savings.
39	1/14/2022	1.36 Thermostat – Programmable	Corrected realization rate verbiage to reflect the correct data shown in the table.
40	1/14/2022	1.37 Whole Home – New Construction	Fixed broken link in references
41	1/14/2022	1.38 Whole Home – Energy Report	Fixed broken link in references
42	1/14/2022	2.3 Compressed Air – Air Nozzle	Fixed broken link in references
43	1/14/2022	2.17 Food Service – Ice Machine	Corrected algorithms to provide annualized savings, updated baselines
44	1/14/2022	2.17 Food Service – Ice Machine	Added other resource impacts.
45	1/14/2022	2.32 HVAC-Demand Control Ventilation	Updated midstream and retrofit baselines.
46	1/14/2022	2.32 HVAC-Demand Control Ventilation	Fixed broken link.
47	1/14/2022	2.36 HVAC – Energy Management System	Corrected baseline from “assumes the relevant HVAC equipment has no centralized control” to “site specific”
48	1/14/2022	2.37 HVAC – Heat and Hot Water Combo Systems	Update baseline. Baseline boiler should be 85% consistent with treatment elsewhere in the TRM. 30.5 MMBtu/unit savings are OK, consistent with MA assumptions:
49	1/14/2022	2.39 HVAC – Heating Systems – Condensing Unit Heaters	Corrected baseline to reference most current code.
50	1/14/2022	2.41 HVAC – Heating Systems – Infrared Heater	Corrected baseline to reference most current code.

51	1/14/2022	2.35 HVAC – High Efficiency Chiller	Added EFLH based on 2015 DNV GL study. EFLH value was previously missing.
52	1/14/2022	2.42 HVAC – High Efficiency Chiller	Fixed error under baseline efficiency, high efficiency, and references section. Document originally labelled the referenced code as “Massachusetts” building code, rather than “New Hampshire”. The referenced code, IECC 2015 Energy Conservation, and the values listed were correct but were incorrectly labelled with “Massachusetts”. Additionally, the reference to the code was updated as it was not included originally.
53	1/14/2022	2.46 HVAC – Unitary Air Conditioner	Removed algorithms for units with cooling capacities equal to or greater than 65 kBtu/h and **IEER available,** as EER calculations are preferred.
54	1/14/2022	2.46 HVAC – Unitary Air Conditioner	Updated baseline table for clarity and to reference most recent code.
55	1/14/2022	2.47 HVAC – Heat Pump Systems	Updated SEER to EER conversion factor
56	1/14/2022	2.51 Lighting - Retrofit	Corrected the three typos resulting from a copy and paste error in the delta watt column of the upstream lighting delta watt value table. Updated line items are LED Retrofit kit, >25 KW, Stairwell kit, low-output w/ sensor and stairwell kit, mid-output w/sensor.
57	1/14/2022	2.53 Motors & Drives - Variable Frequency Drive	Changed the formatting of the algorithm for calculating energy impact for clarity.
58	1/14/2022	1.24 HVAC – Duct Sealing	Omitted gas measures added
59	3/1/2022	2.21 Food Service-Refrigerated Chef Base	New Measure Added
60	3/1/2022	2.9 Food Service-Conveyor Broiler	New Measure Added
61	3/1/2022	2.10 Food Service-Deck Oven	New Measure Added
62	3/1/2022	2.15 Food Service – Hand Wrapper	New Measure Added
63	3/1/2022	2.16 Food Service- High Efficiency Condensing Unit	New Measure Added
64	3/1/2022	2.23 Food Service -Ultra Low Temp Freezer	New Measure Added

65	3/1/2022	2.24 Food Service – Underfired Broiler	New Measure Added
66	3/1/2022	1.26 HVAC – Central Air Conditioning	Replaced EFLH value of 385, based on 2002 EPA calculator. Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
67	3/1/2022	1.29 HVAC – Central Air-source Heat Pump	Added reference to appendix 2 for new EFLH values Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
68	3/1/2022	1.30 HVAC – Ductless Mini-Split Heat Pump	Added reference to appendix 2 for new EFLH values Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
69	3/1/2022	2.46 HVAC – Unitary AC	Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
70	3/1/2022	2.47 HVAC – Heat Pump Systems	Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
71	3/1/2022	2.41- HVAC Heating Systems – Infrared Heater	Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
72	3/1/2022	2.47 – HVAC Heat Pump Systems	Updated with reference to appendix 2 for new EFLH values based on NH TMY3 Data.
73	6/1/2022	2.24 Food Service – Underfired Broiler	Added BC MEASURE ID to BC MEASURE ID fields.
74	6/1/2022	1.25 HVAC – Repair and Cleaning	Added omitted gas measures ID's to the TRM, updated electric measures to correspond with electric utility names.
75	6/1/2022	Introduction: Impact Factors for Calculating Net Savings:	Verbiage updated to the current application of net to gross, not limited to midstream and upstream measures.
76	6/1/2022	2.9 Food Service - Conveyor Broiler	Added new downstream measure
77	6/1/2022	2.10 Food Service-Deck Oven	Added new downstream measure
78	6/1/2022	2.22 Food Service - Freezer	Added new downstream measures.
79	6/1/2022	2.20 Food Service-Refrigerator	Added new downstream measures.
80	6/1/2022	2.23 Food Service -Ultra Low Temp Freezer	Added new downstream measure.
81	6/1/2022	2.16 Food Service- High	Added new downstream measure.

		Efficiency Condensing Unit	
82	6/1/2022	2.15 Food Service – Hand Wrapper	Added new downstream measure.
83	6/1/2022	1.3 Appliances - Clothes Washer	Updated capacity savings calculation to match methodology used by the NH utilities in the benefit cost models.
84	12/1/2022	1.7Appliances - Recycling	Added Dehumidifier measure and updated demand and kwh savings calculation to match updated evaluation results.
85	12/1/2022	1.35 Lighting - LED Lamp	Updated Baseline to reflect EISA backstop. Reduced AML's affected by EISA back stop to 1. Added missing links for studies in references. Removed drop ship measures as they are not offered.
86	12/1/2022	1.39 Whole Home – New Construction	Updated evaluation and code references to latest versions and added reference to Energy Star v3.1 baseline doc.
87	12/1/2022	2.7Compressed Air - Air Compressor	Updated evaluation references to latest versions.
88	12/1/2022	1.19 - Boiler Reset Controls	Updated evaluation references to latest versions; remove LS table and refer to Appendix 1.
89	12/1/2022	1.15 Building Shell- Window Inserts	Added new measure
90	12/1/2022	1.34 Hot Water-Water heaters	Added values for midstream heat pump water heaters and updated references to NH building code.
91	12/1/2022	1.14 Building Shell- Insulation	Fixed broken links in references
92	12/1/2022	1.30 Hot Water-Pump Water Heater	Updated measure savings to reflect a lost opportunity offering, as this most closely reflects the currently offerings.
93	12/1/2022	1.30 Hot Water-Heat Pump Water Heater	Updated measure life based on latest measure life study from CT.
94	12/1/2022	1.20 HVAC-Central Air Source Heat Pump	Updated high efficiency requirements to align with Energy Star Criteria Version 6.1
95	12/1/2022	1.20 HVAC-Central Air Source Heat Pump	Updated baseline values to align with federal energy standards, effective 1/1/2023.
96	12/1/2022	1.21 HVAC-Ductless Mini Split Heat Pump	Updated high efficiency requirements to align with Energy Star Criteria Version 6.1
97	12/1/2022	1.21 HVAC-Ductless Mini Split Heat Pump	Updated baseline values to align with federal energy standards, effective 1/1/2023.
98	12/1/2022	1.22 HVAC - ENERGY STAR Central AC	Updated baseline values to align with federal energy standards, effective 1/1/2023. Updated high efficiency case to align with Energy Star 6.1. Corrected algorithms to align with updated baseline and high efficiency cases, and added a conversion table

			for M to M1 ratings. Corrected HPwES RR value in verbiage to align with table.
99	12/1/2022	2.41 HVAC- High Efficiency Chiller	Updated methodology to align with latest study, Kema, 2015. Impact of Prescriptive Chiller and Compressed Air Installations. Note, since NH RR is applied under impact factors section, the RR adjustment was removed from the algorithm. Also updated equation to use EFLH from appendix 2, where building type is available. Added conversion factor for kw/ton to EER
100	12/1/2022	2.8 Compressed Air- Air Nozzle	Updated default pressure from 100psi to 80psi. Added operating hour description and use factor based on MA TRM assumption
101	12/1/2022	1.27 HVAC- Programmable Thermostat	Added KW savings. Updated mmbtu savings reflect a more recent follow up study from MA. Added load shape for cooling
102	12/1/2022	2.3 Appliance - Dehumidifier	Added new measure: C&I OMP Dehumidifier
103	12/1/2022	2.2 Appliance- Advanced Power Strip	Added new measure: C&I OMP advanced smart strip tier 1, advanced smart strip tier 11
104	12/1/2022	2.4 Appliance - Room Air Purifier	Added new measure: C&I OMP Room air purifier
105	12/1/2022	2.52 Hot Water - Showerhead	Added new measure: C&I OMP gas and electric Low flow shower head, thermostatic shut off valve stand alone, low flow shower head with integrated thermostatic shut off valve.
106	12/1/2022	2.50 Hot Water- Faucet aerator	Added new measure: C&I OMP Electric and gas faucet aerator
107	12/1/2022	2.51 Hot Water - Pre-Rinse Spray Valve	Added new measure: C&I OMP Electric and Gas pre rinse spray valve
108	12/1/2022	2.44 Hot Water Pipe Wrap	Added new measure: C&I OMP Electric and Gas pipe wrap
109	12/1/2022	2.45 HVAC- Programmable Thermostat	Added new measure: C&I OMP Programmable thermostat, gas
110	12/1/2022	2.47 HVAC- Communicating Thermostat	Added new measure: C&I OMP Wifi thermostat, gas
111	12/1/2022	2.52 Hot Water - Showerhead	Updated measure life for stand alone thermostatic valve
112	12/1/2022	1.4 Appliances - Clothes Washer	Included additional information on software used for the vendor calculated savings.
113	12/1/2022	1.3 Appliances - Clothes Dryer	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
114	12/1/2022	1.12 Building Shell-Door Replacement	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
115	12/1/2022	1.15 Building Shell- Window Replacement	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
116	12/1/2022	1.11 Building Shell - Air Sealing	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings and added gas measure IDs.

117	12/1/2022	1.14 Building Shell- Insulation	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
118	12/1/2022	1.25 HVAC- Repair and Cleaning	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings. Updated back up algorithm to align with 2022 CT PSD.
119	12/1/2022	1.29 Hot Water - Faucet Aerator	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
120	12/1/2022	1.33 Hot Water- Showerhead	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings.
121	12/1/2022	1.32 Hot Water - Setback	Updated to vendor calculated for HEA and HPwES and now includes information on software used for the vendor calculated savings and added gas measure IDs.
122	12/1/2022	1.18 HVAC - Boiler	Updated HPwES savings to reflect they are now calculated using Surveyor software. Added additional verbiage about the TREAT software used to calculate savings. Removed "Forced Hot Water" text and added avg system sizing for reference from Baseline study.
123	12/1/2022	1.24 HVAC - Furnace	Updated HPwES savings to reflect they are now calculated using Surveyor software. Added additional verbiage about the TREAT software used to calculate savings and added avg system sizing for reference from Baseline study.
124	12/1/2022	1.3 Appliances - Clothes Dryer	Corrected HPwES Realization Rate verbiage to 96% from 100% to align with table, study and model.
125	12/1/2022	1.4 Appliances - Clothes Washer	Corrected HPwES Realization Rate verbiage to 96% from 100% to align with table, study and model. Corrected kWh, kW and water savings to align referenced TRM.
126	12/1/2022	1.5 Appliances - Dehumidifier	Corrected HPwES Realization Rate verbiage to 96% from 100% to align with table, study and model.
127	12/1/2022	1.6 Appliances - Freezer	Corrected HPwES Realization Rate verbiage to 96% from 100% to align with table, study and model.
127	12/1/2022	1.8 Appliance - Refrigerator	Corrected HPwES Realization Rate verbiage to 96% from 100% to align with table, study and model.
128	12/1/2022	1.26 HVAC- _Heat Recovery Ventilator	Removed reference to ERVs and updated reference to Appendix 1 for Load Shapes.
129	12/1/2022	1.19 HVAC- Boiler Reset Controls	Removed reference to electric measures.
130	12/1/2022	2.65 – Refrigeration Vending Miser	Updated savings factors for snack vending machines and glass front refrigerated coolers to match study.
131	12/1/2022	1.2 Appliances - Advanced Power Strip	Updated kWh, kW savings for Tiers 1 and 2 to match referenced study. Updated ISR based on recent MA study.
132	12/1/2022	1.36 Lighting- Fixture	Added back in measure life table, updated delta watts to reflect latest study values for 2021, updated savings accordingly.
133	12/1/2022	1.23 HVAC - ENERGY STAR ROOM AC	Added references for baseline federal code and energy star. Updated algorithm verbiage for vendor calculated savings in HEA and HPwES. Updated ES products savings from 33 kwh to 36 kwh based on VT TRM.

134	12/1/2022	1.9 Appliances - Room Air Purifier	Updated savings values to align with the most recent MA study.
135	12/1/2022	2.12 Custom Measures	Added verbiage to clarify process for baseline and measure life calculation.
136	12/1/2022	1.17 Custom- Swimming Pool Heater	Updated algorithms from deemed values to calculated values based on the NYSERDA and Illinois TRMS. Updated Measure life from 13 to 15 years.
137	12/1/2022	1.31 Hot Water- Pipe insulation	Updated RR verbiage to align with table values for HPwES. Updated back up calculations to align with 2022 CT PSD.
138	12/1/2022	1.38 Motors and Drives - Pump	Clarified high efficiency values from Energy Star
139	12/1/2022	2.33 HVAC Demand Control Ventilation	Added federal code to measure description.
140	12/1/2022	2.34 HVAC_ Dual enthalpy economizer	Updated baseline to be a unit w/ no economizer. Removed KW savings as economizers are generally closed under peak summer conditions.
141	12/1/2022	2.15 Food Service- Dish Washer	Updated high efficiency case, all kW, kWh and water savings according to the new Energy Star Food Service Calculator release in 2021.
142	12/1/2022	2.26 Food Service - Steam Cooker	Updated deemed kWh, kW, MMBtu and water according to the Savings Calculator for ENERGY STAR Commercial Food Service (CFS) Products release in 2021.
143	12/1/2022	2.43 HVAC - Infrared heater	Removed algorithm for calculation. Current program design is prescriptive.
144	12/1/2022	2.9 Compressed Air - low pressure drop filter	Added clarified baseline set point where existing system data is unavailable. Added in default hours table.
145	12/1/2022	2.11 Compressed Air - Zero Loss Condensate Drain	Added default operating hours based on CT PSD
146	12/1/2022	2.10 Compressed Air - Refrigerated Air Dryer	Added default operating hours based on CT PSD
147	12/1/2022	2.63 Refrigeration - Evaporator Fan Control	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study.
148	12/1/2022	2.62 Refrigeration - Electronic Defrost Control	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study.
149	12/1/2022	2.61 Refrigeration - ECM Evaporator Fan Motors for Walk-in Coolers and Freezers	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Updated LRF based on MA Refrigeration Load Shape Study

150	12/1/2022	2.49 HVAC - VRF Systems	Updated baseline tables to include capacity and subcategory. Update EFLH to refer to appendix 2 where possible and included default values for where building type is not available.
151	12/1/2022	2.48 HVAC- Unitary Air Conditioner	Updated baseline values to align with 2023 code update. Added default value for EFLH where building type is not available.
152	12/1/2022	2.17 - Food Service Fryer	Updated electric and gas savings to align with 2021 Energy Star Commercial Food Service Calculator.
153	12/1/2022	2.23 Food Service Oven	Updated high efficiency case to align with new version 3.0 Energy Star program requirements effective 1/12/2023. Updated savings to align with updated new efficiency standards and updated 2021 efficiency calculator.
154	12/1/2022	2.54 Lighting Control	Updated efficiency for refrigerated LED based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Added HOU table for where site specific hours are unavailable.
155	12/1/2022	2.18 Food Service- Griddle.	Updated high efficiency case with energy star program requirements citation. Updated savings calcs to align with latest energy star commercial food services calculator.
156	12/1/2022	2.5 Building Shell -Air Sealing and Insulation	Updated algorithm and baselines for air sealing as previously unable to trace baseline and high efficiency to sources.
157	12/1/2022	2.55- Lighting - New construction and Major Renovation	Added HOU table, link to LPD table.
158	12/1/2022	2.56 Lighting - Retrofit.	Updated AMLs to align with latest MA study.
159	12/1/2022	2.24 Food Service - Refrigerated Chef Base	Added in missing impact factor table.
160	3/1/2022	Chp 1.15 window inserts	Added in missing BC ID's for electric, gas, cord wood, propane, oil and kerosene. G21b1A017,E21B1a101,E21B1a102,E21B1a103,E21B1a104, E21B1a105
161	3/1/2022	chp 1.16 window replacement	Added in missing BC ID for gas; g21b1A016
162	3/1/2022	chp 1.12 door replacement	Added in missing BC ID's for gas; g21b1a015
163	3/1/2022	chp 2.35 duct insulation	Added in missing BC ID's for gas; g21b1A018
164	3/1/2022	chp 2.35 duct insulation	TRM chapter originally listed the residential air purifier BC ID. Corrected to list the C&I BC ID's. ; e21c2c054 e21c1c054
165	3/1/2023	1.18 boilers	Added the missing impact factors for g21A3b006 and G21A3b007. The were included in the model, but omitted from the TRM.
166	3/1/2023	1.24 Furnaces	Added the missing impact factors for g21A3b008 and G21A3b009
167	3/1/2023	2.21 Holding Cabinets	Updated kWh and kW savings to align with Energy Star CFS Calculator. E21C1b037, e21c1b036, e21c1b038
168	3/1/2023	1.34 Water Heater	Gas HEA BC ID's were missing adding in the following BC ID's G21B1b010 , G21B1b011 and updated verbiage to reflect measure

			savings are modeled, however the deemed savings can be used for planning purposes.
169	3/1/2023	2.58 Case Motor Replacement	Updated refrigeration efficiency based on CT X1931-5 PSD Commercial Refrigeration Efficiency Update Study. Updated LRF based on MA Refrigeration Load Shape Study
170	1/1/2024	1.13 Duct Sealing	corrected table headers for kW and MMBTU savings; added gas measure ID G21B1a020
171	1/1/2024	2.30 Boilers	Removed Efficiency Table (not relevant); updated endnote reference links
172	1/1/2024	2.32 Condensing Unit Heaters	Updated endnote reference links
173	1/1/2024	2.33 Demand Control Ventilation	Updated endnote reference links
174	1/1/2024	2.40 Heat and Hot Water Combo Systems	Updated endnote reference links
175	1/1/2024	2.53 Water Heaters	Added measures and IDs for Downstream Indirect, On-Demand, Volume and Condensing water heaters.
176	1/1/2024	1.21 Resi Ductless Mini Split Heat Pump	Updated verbiage to show the offering is specific to cold climate heat pumps
177	1/1/2024	1.22 ENERGY STAR Central Air Conditioning	Updated SEERee to most recent available annual average of rebated units, 2020-2021
178	1/1/2024	1.38 Pool Pump	Updated baseline to align with new federal standard and savings.
179	1/1/2024	1.38 Pool Pump	Updated measure life to reflect most recent study
180	1/1/2024	2.5 Clothes Washer, High Speed	Added New Measure
181	1/1/2024	2.10 Compressed Air Leak Detection	Added New Measure
182	1/1/2024	2.20 Pasta Cooker	Added New Measure
183	1/1/2024	2.25 Ice Machine	Updated usage of H for Harvest Rate to IHR for clarity and consistency
184	1/1/2024	2.29 Steam Cooker	Updated end notes for high efficiency section and added table from Energy Star Requirements documentation
185	1/1/2024	2.30. Ultra Low Temp Freezer	Changed name of measure from Ultra Low Temp Freezer to Cold Storage Suggest changing the name of this chapter to "Cold Storage" as there are a number of lab grade freezers and refrigerators that are available under the offering.
186	1/1/2024	2.32 Induction Cooktop	New Measure Added
187	1/1/2024	2.60. Lighting - Retrofit	Updated AML table to remove past year AML's
188	1/1/2024	2.62 Case Motor Replacement	Updated CF's to align with energy load shape
189	1/1/2024	2.64 Door Heater Controls	Updated CF's to align with energy load shape
190	1/1/2024	2.65 ECM Evaporator Fan Motors for	Updated CF's to align with energy load shape

		Walk-in Coolers and Freezers	
191	1/1/2024	2.66 Electronic Defrost Control	Updated CF's to align with energy load shape
192	1/1/2024	2.68 Novelty Cooler Shutoff	Updated CF's to align with energy load shape
193	1/1/2024	2.69 Vending Miser	Updated CF's to align with energy load shape
194	1/1/2024	2.37 Demand Control Ventilation	Updated savings algorithm to use a temperature BIN spreadsheet that uses the reduction of outside air to calculate the energy saved by not having to condition that air with NH specific TMY3 data
195	1/1/2024	2.40 Commercial Duct sealing	Updated section based on NY TRM v. 10.
196	1/1/2024	TBD Ultra Low Temp Freezer	Added deemed kW savings from CT PSD.
197	1/1/2024	Measure Characterization Structure (intro)	Under the "Primary Granite State Test" description, updated the measure life of weatherization projects to a weighted average of 21 years from a 15 year measure life.
198	1/1/2024	Multiple chapters	Home Performance with Energy Star
199	1/1/2024	1.11 Air Sealing	Corrected HVAC loads shape CF for electric homes and added cooling CF for FF heated homes.
200	1/1/2024	1.36 Lighting-Fixture	Added Home Performance Multifamily BC measure ID's
201	1/1/2024	1.36 Lighting-LED bulb	Added Home Performance Multifamily BC measure ID's
202	1/1/2024	1.25 HVAC Repair and Cleaning	Added heat pump clean and repair BC ID's that are offered in HEA
203	1/1/2024	1.12 Door Replacement	Corrected CF's and load shape
204	1/1/2024	1.12 Door Replacement	Corrected CF's and load shape
204	1/1/2024	1.13 Duct Sealing	Corrected CF's and load shape
205	1/1/2024	1.13 Insulation	Corrected CF's and load shape
206	1/1/2024	1.13 Window Insert	Corrected CF's and load shape
207	1/1/2024	1.16 Window Replacement	Corrected CF's and load shape