September 1, 2020

Via Electronic Mail and US Mail

Debra A. Howland
Executive Director
New Hampshire Public Utilities Commission
21 S. Fruit Street, Suite 10
Concord, NH 03301-2429

Re: DE 20-092 – 2021-2023 New Hampshire Statewide Energy Efficiency Plan

Dear Director Howland:

The New Hampshire Electric and Natural Gas Utilities: Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty Utilities; New Hampshire Electric Cooperative, Inc.; Public Service Company of New Hampshire d/b/a Eversource Energy; Unitil Energy Systems, Inc. (UES); Liberty Utilities (EnergyNorth Natural Gas) Corp d/b/a Liberty Utilities; and Northern Utilities, Inc. (Northern) (collectively, "the NH Utilities") are pleased to submit this 2021-2023 New Hampshire Statewide Energy Efficiency Plan ("Plan").

The triennial plan filing process for the EERS was established in Order No. 25,932: a process where the utilities "would prepare the triennial EERS plans in collaboration with stakeholders and the EESE Board as Advisory Council". On January 2, 2018 in Order No. 26,095, in Docket No. DE 17-136, the New Hampshire Public Utilities Commission ("NHPUC") approved the 2018-2020 Statewide Energy Efficiency Plan. Now, we proudly file the second such plan after a successful stakeholder process for the Commission's consideration and approval.

The successful stakeholder process for this second triennial plan included the EERS Committee of the Energy Efficiency and Sustainable Energy ("EESE") Board, Commission Staff, the stakeholder consultant, other members of the public and the EESE Board itself. Over the course of ten months and two draft plans, the group discussed EERS savings targets, budgets, program design, marketing approaches, development of new offerings, changes in the lighting market, the three-year plan structure and other related topics. Those discussions, and the written and verbal feedback the NH Utilities received, have informed and influenced the Plan. The NH Utilities would like to thank all of the Committee members and participants for their time, effort, and valuable input in this process.

The NH Utilities are proud of the energy savings accomplished to date under the EERS and through our longstanding energy efficiency partnership. These savings are achieved through coordination with a wide network of vendors, contractors, educators, community groups, stakeholders and ultimately, our customers.

This 2021-2023 Statewide Energy Efficiency Plan represents the goals, budgets, and program design for the second triennium under New Hampshire's EERS. The Plan continues the ramp up of energy efficiency savings started in the first triennium and expands on the existing NHSaves programs to deliver those savings. The goals include electric savings of 5% of 2019 sales to be achieved across the term and natural gas savings of 3% of 2019 sales across the term.

The 2021-2023 NH Saves programs will save 6.7 billion electric kWh and 9.6 million natural gas MMBtu. In addition, the 2021-2023 NHSaves Residential and C&I Programs will save 8.3 million MMBtu from other fuels, such as oil and propane and 67 MW from the Active Demand Reduction program. Over the lifetime of these measures, this will result in customer cost savings of more than $1.3 billion.

In order to achieve these savings the Plan includes a revised framework for 36 month budgets and goals providing stability in the marketplace and the flexibility needed to achieve ambitious targets. A mid-term modification process with specific triggers along with quarterly and annual reporting provide for transparency and regulatory oversight of significant adjustments.

Other new initiatives in 2021-2023 include an Energy Optimization Pilot, a focus on workforce development, new measure offerings in both residential and commercial programs, robust financing options. A Technical Reference Manual will provide transparent information on energy saving assumptions and the new benefit cost screening framework developed by the B/C Working Group is in place.

The NH Utilities are pleased and proud to present this 2021-2023 New Hampshire Statewide Energy Efficiency Plan to help New Hampshire achieve the goals of the Energy Efficiency Resource Standard. The NH Utilities look forward to working with the Commission, its Staff, and other stakeholders, to review this plan and to implement it for the benefit of New Hampshire and its utility customers. Please contact me if there are any questions about this filing. Thank you.

Regards,

Jessica A. Chiavara
Counsel, Eversource Energy
o/b/o the NH Utilities

Enclosures
cc: DE 20-092 Service List
DE 17-136 Service List

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

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Attachments

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Executive Summary

For more than two decades, New Hampshire's electric and natural gas utilities have offered energy efficiency and demand response programs to residential and Commercial and Industrial ("C&I") customers across the state.[1] These programs provide energy savings, promote economic development, reduce the need for additional capacity investments and protect the natural environment by reducing the amount of carbon dioxide ("CO_2") and sulfur and nitrogen oxides released into the atmosphere due to reduced energy generation and consumption.

New Hampshire's electric and natural gas utilities ("NH Utilities") are pleased to submit the 2021-2023 Statewide Energy Efficiency Plan ("2021-2023 Plan" or "Plan"). This 2021-2023 Plan is being submitted jointly by Liberty Utilities Corp. (Granite State Electric) d/b/a Liberty Utilities ("Liberty Electric"), New Hampshire Electric Cooperative, Inc. ("NHEC"), Public Service Company of New Hampshire d/b/a Eversource Energy ("Eversource"), and Unitil Energy Systems, Inc. d/b/a Unitil-NH Electric Operations ("Unitil Electric") (hereinafter referred to as the "NH Electric Utilities"), and Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty Utilities ("Liberty Gas"), and Northern Utilities, Inc. d/b/a Unitil-NH Gas Operations ("Unitil Gas") (hereinafter referred to as the "NH Natural Gas Utilities").

Over the last few decades, New Hampshire's energy efficiency programs have achieved significant energy savings for the state's electric and natural gas customers.

Energy efficiency is emission free and the lowest-cost resource available to utilities, customers, and states. Every kilowatt-hour ("kWh") or million natural gas British Thermal Units ("MMBtu") saved through New Hampshire's energy efficiency programs helps the NH Utilities achieve deeper energy savings, reduce harmful greenhouse gas

[1] Hereinafter, the word "customer" will be understood to mean both utility customers and New Hampshire Electric Cooperative members.

("GHG") emissions, save customers money, and mitigate the need to generate additional power. The NH Utilities designed the 2021-2023 Plan to scale up energy savings and program participation, create and promote new and existing "on ramps" to energy efficiency to attract customers, diversify program offerings, tailor marketing solutions and incentives, and broaden outreach to customers and local communities.

Since 2002, New Hampshire's electric and natural gas customers have installed energy efficiency measures that have resulted in lifetime savings of more than 19.1 billion electric kWh and 45.7 MMBtu. This results in a cumulative customer savings in excess of $3.4 billion.

The NH Utilities are proud to deliver innovative energy-efficient solutions to customers—residential, municipal, and C&I—throughout the state. The NH Utilities are well trusted and recognized for their ability to work together, and with stakeholders, legislators, and regulators, to provide continuity in delivering cost-effective energy efficiency solutions across the state facilitated under the NHSaves™ Programs ("NHSaves Programs") brand. The NH Utilities are prepared to help customers achieve increased energy efficiency savings in 2021-2023 in furtherance of the Energy Efficiency Resource Standard ("EERS"), established by the New Hampshire Public Utilities Commission ("Commission"), and other state energy policies (see Chapter One).

The New Hampshire energy efficiency industry supports a robust local and state workforce.

The NH Utilities have designed a dynamic energy efficiency framework to help reduce energy demand and achieve significant energy savings over the next three-year period. The NH Utilities remain focused on directing customers' attention to how they use energy and to provide them accessible paths to saving energy and money over the next three years. The 2021-2023 Plan will provide the following results:

- **More Customer Energy Savings.** The 2021-2023 NHSaves Programs will result in customer energy cost savings of more than $1.3 billion over the lifetime of the measures.

- **Increased Energy Savings.** During the 2021-2023 term, NHSaves Programs will result in savings of 6.7 billion electric kWh and 9.6 million natural gas MMBtu over the lifetime of installed energy-saving measures. In addition, New Hampshire's 2021-2023 energy efficiency programs will save 8.3 million MMBtu from other fuels, such as oil and propane.

- **Increased Peak Demand Reduction Savings.** The NHSaves Programs result in passive demand reduction savings that will reduce summer peak demand by 64.0 megawatts ("MW") and winter peak demand by 57.2 MW. The NHSaves Active Demand Reduction programs will reduce summer peak by an additional 67.7 MW.

2021-2023 Plan programs will reduce GHG emissions by 3.8 million tons.

- **Stronger State Economy.** New Hampshire's energy efficiency investments help support the state's economy in multiple ways. Energy efficiency contractors are necessarily local, so most of the NHSaves Programs funds invested in residential weatherization and other efficiency measures stay in the New Hampshire economy. In turn, lower energy bills free up participating residential customers' household budgets, to be directed to other needs, goods and services.

  Participating C&I customers will lower their energy bills, allowing owners to invest in other company operations, such as labor, materials, and other business-related resources. Energy savings that result from municipal building projects lead to a more efficient use of taxpayer dollars in the community. Funds once allocated to energy costs can now be utilized for increased public services, such as education, health and safety, and public libraries.

- **Highly-Trained Workforce.** The NH Utilities plan to continue providing workforce development opportunities to the growing local labor workforce that supports the implementation of energy efficiency solutions throughout the state. The 2021-2023 NHSaves Programs will support 4,673 full-time equivalents ("FTEs") or 9.7 million work hours.[2]

- **Cleaner Environment.** The energy savings from the NHSaves Programs protect the public health and environment through significant reductions in carbon dioxide, air-polluting sulfur and nitrous oxides, and other air pollutant emissions. The 2021-2023 NHSaves Programs will provide a lifetime reduction of more than 4.4 million tons of GHG emissions, the equivalent of taking 949,313 passenger vehicles off the road for one year.[3]

2 According to a study from the Political Economy Research Institute ("PERI") of the University of Massachusetts at Amherst (2019), 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. See Pollin, R., Wicks-Lim, J., Chakrabortu, S., Hansen, T. *A Green Growth Program for Colorado*. Study available at: https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.

3 Utilizing the Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator. Retrieved from: www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Chapter One: New Hampshire's Energy Efficiency Programs

The 2021-2023 Plan reflects a coordinated and integrated planning effort among the six NH Electric and Natural Gas Utilities, with significant input from a diverse array of energy efficiency stakeholders, contractors, and customers.

The NH Utilities worked extensively and collaboratively with members of the Energy Efficiency and Sustainable Energy ("EESE") Board's EERS Committee, Commission Staff and the stakeholder consultant to develop an energy efficiency and demand management plan that is consistent with the state's energy policies and legislation, including the EERS. During the 2021-2023 term, the NH Utilities will remain focused on implementing high-quality energy efficiency programs that drive energy savings, save customers money, reduce the need for additional capacity investments, and help protect the environment through reduced electricity, natural gas, and delivered fossil fuel consumption.

The 2021-2023 Plan is a strategic guide for the NH Utilities to deliver multiple energy efficiency and demand management programs and initiatives designed for residential, commercial, municipal, and industrial customers. These programs, taken together as an integrated whole, will achieve significant energy savings, protect the environment, help businesses operate more efficiently, and help lead the state into the next decade as a leader in energy efficiency. For the 2021-2023 term, the NH Utilities remain focused on scaling up participation and energy savings for the NHSaves Residential and C&I Programs and will work together to seamlessly deliver customer-centric solutions under the NHSaves brand. As noted in the C&I and Residential sector chapters of this 2021-2023 Plan, the NH Utilities will support these objectives by designing programs that can be modified quickly to address changing energy code standards, customer demand, emerging technologies, and economic conditions affecting customers, vendors, and the energy efficiency marketplace.

1.1 NHSaves Programs

New Hampshire's energy efficiency programs are jointly marketed by the NH Utilities under a statewide umbrella marketing brand—NHSaves. Through this collaboration, the NH Utilities deliver innovative, award-winning programs on a statewide marketing platform ensuring continuity in branding and messaging, consequently increasing brand recognition and customer awareness of the programs. The NHSaves.com website serves as the statewide information portal where customers can learn about incentives and services offered through the NHSaves Programs.

1.2 State Energy Policy

1.2.1 Energy Efficiency Resource Standard

In August 2014, the Commission initiated an informal, non-adjudicative stakeholder process to develop a framework, the EERS, within which the NHSaves Programs would be implemented. The process resulted in an eighteen-month dialogue among the Commission, the NH Utilities, and numerous stakeholders. In 2016, the state's first EERS was established through a settlement agreement filed with the Commission.[4] The EERS is the framework within which the NHSaves Programs have been implemented since 2018, and requires the NH Utilities to file triennial plans, to pursue annual savings goals, and to achieve the long-term objective of achieving all cost-effective energy efficiency.

Coincident with the EERS, the Commission also established a recovery mechanism to compensate the NH Utilities for lost revenue resulting from the implementation of NHSaves Programs under the EERS. The NH Utilities file annual updates with the Commission regarding any necessary changes that need to be made to the Systems Benefit Charge ("SBC") or Local Delivery Adjustment Clause ("LDAC"), the

[4] State of New Hampshire Public Utilities Commission. DE 15-137. *Order No. 25,392: Energy Efficiency Resource Standard*, Aug. 2, 2016. Available at: https://www.puc.nh.gov/Regulatory/Orders/2016orders/25932e.pdf.

primary funding mechanisms for the NHSaves Programs. The SBC and LDAC are nominal charges on customers' electric and natural gas utility bills, respectively.

During the state's transition to the EERS, the Commission extended for an additional year the approved 2015-2016 NHSaves Programs (i.e., the program implementation and established annual savings targets for the 2017 program year). On January 2, 2018, the Commission approved the implementation of the NH Utilities' first three-year plan ("2018-2020 Plan").[5] The NH Utilities filed plan updates in September 2018 ("2019 Plan Update") and September 2019 ("2020 Plan Update") to realign energy-saving goals and program budgets with the Commission-approved 2018-2020 Plan. The 2021-2023 Plan is the second triennial plan filed by the NH Utilities under the EERS.

1.2.2 New Hampshire's 10-Year State Energy Strategy

In April 2018, New Hampshire Governor Christopher T. Sununu and the New Hampshire Office of Strategic Initiatives ("OSI") released the New Hampshire 10-Year State Energy Strategy ("Strategy") in compliance with state legislation and statute.[6] The Strategy established 11 statewide goals that should be pursued to better meet residential and C&I customers' needs, including prioritizing all cost-effective energy policies and achieving environmental protection that enables economic growth. The Strategy noted that, "[i]nvesting in efficiency boosts the state's economy by creating jobs and reducing energy costs for consumers and businesses." During the 2021-2023 term, the NH Utilities will vigorously pursue cost-effective strategies to lower customers' energy bills, decrease demand for new generation capacity on the electric and natural gas systems, and to reduce air pollutant emissions.

1.3 Energy Efficiency and Sustainable Energy Board

In 2008, New Hampshire's legislature created the EESE Board to promote and coordinate energy efficiency, demand response, and other sustainable energy programs in the state.[7] The EERS

[5] State of New Hampshire Public Utilities Commission. DE 17-136. *Order No. 26,905: 2018-2020 New Hampshire Statewide Energy Efficiency Plan*, Jan. 2, 2018. Available at: https://www.puc.nh.gov/Regulatory/Orders/2018orders/26095e.pdf.

[6] New Hampshire Office of Strategic Initiatives. *New Hampshire 10-Year State Energy Strategy.* Apr. 2018. Available at: https://www.nh.gov/osi/energy/programs/documents/2018-10-year-state-energy-strategy.pdf.

[7] RSA 125-O:5-a; Oct.1, 2008.

Committee of the EESE Board serves as the primary stakeholder body in the development of the NH Utilities' triennial plans.

The EERS Committee met twice a month from November of 2019 to August of 2020 for a total of 20 stakeholder meetings to discuss EERS savings targets, budgets, program design, marketing approaches, development of new elements such as codes and standards savings and energy optimization, changes in the lighting market, the three-year plan structure and other related topics. Participating in the meetings were EERS Committee members, the stakeholder consultant, NH PUC Staff and other interested members of the public. Three of the meetings were specifically designed to gather comments and feedback from members of the public who were not able to devote time to the full committee process. The stakeholder consultant held 11 additional meetings with NH Utility staff for deeper review and discussion on program design and implementation elements, and then reported out the results and recommendations from those meetings to the full EERS Committee.

The work of the NH Utilities and the EERS Committee shifted forums with the onset of the COVID-19 pandemic, as meetings and discussion moved to a remote format starting in March. The pandemic has had a significant impact on customers and program implementation in 2020 and pandemic-related impacts will likely continue well into the 2021-2023 Plan performance period. The NH Utilities worked with the Committee, Commission Staff and the Commission, resulting in Order No 26,375, adjusting the filing schedule to allow more time for analysis, adjustment, and discussion related to the pandemic's impacts. The NH Utilities submitted a Draft Plan to the Committee on April 1, 2020, received feedback and had additional discussion with the Committee about that feedback. A Second Draft was submitted to the Committee on July 1, 2020.

This 2021-2023 Plan is the result of additional feedback and discussion on the July 1st Draft, as well as a culmination of the full 10 months of substantive stakeholder process. The EERS Committee voted 11-0 in unanimous support of the Plan approach at its August 10, 2020 meeting and the EESE Board voted 9-2 in support of the Plan approach at its August 14, 2020 meeting.

1.4 2021-2023 Plan Goals

With more than two decades of experience in jointly operating successful energy efficiency programs across the state, the NH Utilities have the expertise, infrastructure, and relationships in place to meet the EERS program goals for the 2021-2023 term. During the 2018-2020 term, the NH Utilities are pursuing increased energy efficiency savings goals under the EERS.

To meet the 2021-2023 EERS goals laid out in this Plan, the NH Utilities will develop new market-friendly offerings and heavily promote existing programs to increase customer participation and drive energy savings. Between 2021 and 2023, the NH Utilities will achieve cumulative energy savings of five percent of the NH Electric Utilities' 2019 kWh delivery sales and three percent of the NH Natural Gas Utilities' 2019 MMBtu delivery sales. The data in Tables 1-1 and 1-2 provide a comparison to the 2018-2020 Plan.

Table 1-1: Comparison to 2018-2020 Plan (Electric)

Electric Programs	2018-2020 Plan	2021-2023 Plan
Cumulative Lifetime MWh Savings	4,038,590	6,681,441
Cumulative Annual MWh Savings	334,273	525,333
Cumulative Annual Savings as a % of 2019 Delivery Sales	3.2%	5.0%
Cumulative Program Funding	$154,142,047	$350,828,573
Program Cost per Lifetime kWh Savings	$0.038	$0.053

Table 1-2: Comparison to 2018-2020 Plan (Natural Gas)

Natural Gas Programs	2018-2020 Plan	2021-2023 Plan
Cumulative Lifetime MMBtu Savings	7,509,343	9,619,232
Cumulative Annual MMBtu Savings	525,575	753,581
Cumulative Annual Savings as a % of 2019 Delivery Sales	2.1%	3.0%
Cumulative Program Funding	$31,396,650	$41,882,264
Program Cost per Lifetime MMBtu Savings	$4.18	$4.35

1.5 2021-2023 Plan Priorities

For the 2021-2023 term, the NH Utilities are focused on scaling up energy savings and increasing customer participation in the NHSaves Programs. New Hampshire was ranked twentieth in the American Council for an Energy-Efficient Economy's ("ACEEE") *2019 State Energy Efficiency Scorecard* ("Scorecard"), a one-place improvement from the 2018 and 2017 Scorecards.[8] In the portion of the Scorecard for Utility and Public Benefits Program and Policies, New Hampshire was ranked thirteenth. In preparation for the 2021-2023 Plan filing, the NH Utilities reviewed other states' energy efficiency portfolios to determine additional opportunities to modify, improve, and lead the NHSaves Programs toward cost-effective, comprehensive energy savings over the next three years, and improve the state's ACEEE ranking.

The 2021-2023 Plan's program offerings and incentives are designed to increase New Hampshire's leadership in energy efficiency and demand management programs. Market trends, new federal regulations and policies, changing state building codes, emerging technologies, and baseline studies were all incorporated into the NH Utilities' planning process. In addition, the NH Utilities used evaluation results during the 2018-2020 term to help steer the NHSaves Programs toward greater efficacy while driving energy savings, GHG emissions reductions, and increased economic benefits.

The NH Utilities developed the following 2021-2023 Plan priorities building on discussions with the EERS Committee and its consultant. *The order of this list does not necessarily correlate to prioritization.*

Priority One: Commitment to Deliver Cost-Effective Energy Efficiency

Energy efficiency is emissions free and is the lowest-cost energy resource available to New Hampshire's homes, businesses, and municipalities. The NH Utilities recognize that it is imperative to communicate the important benefits that energy efficiency provides to customers and to motivate them to actively pursue all cost-effective energy efficiency measures and behaviors. The 2021-2023

[8] ACEEE. *2019 State Energy Efficiency Scorecard.* Rel. Sep. 2019. Available at: https://www.aceee.org/sites/default/files/pdf/state-sheet/2019/new-hampshire.pdf.

term represents a continued increase in electric, natural gas, and fuel-neutral energy savings in New Hampshire.

Figure 1-1: Electric Programs Over Time

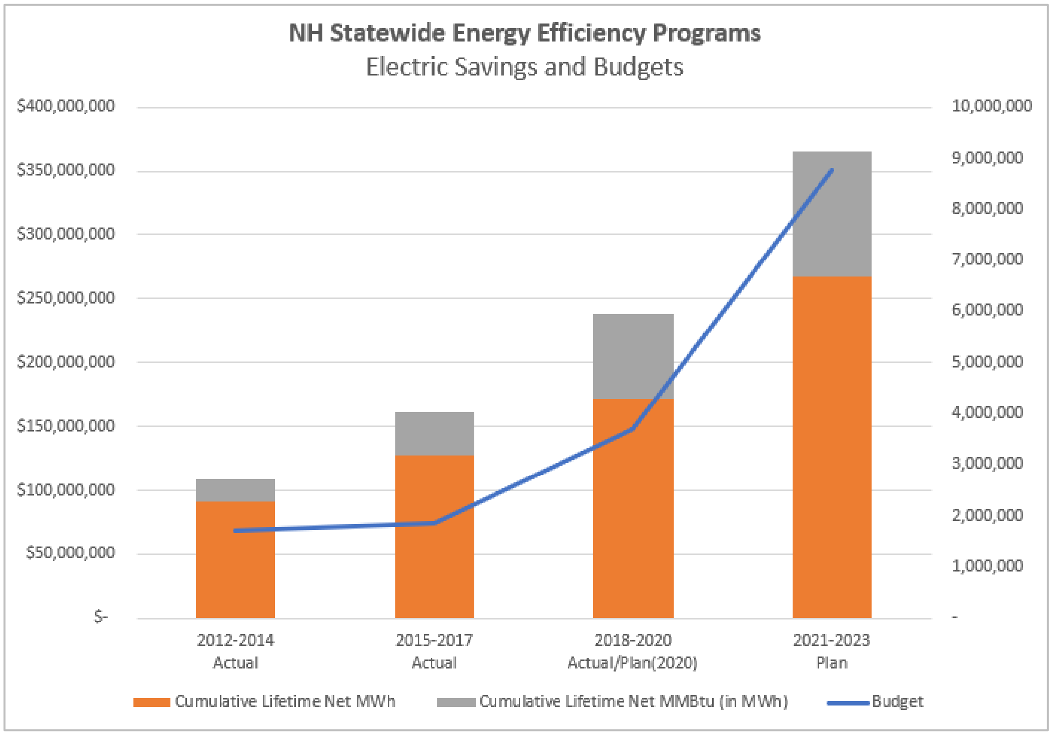
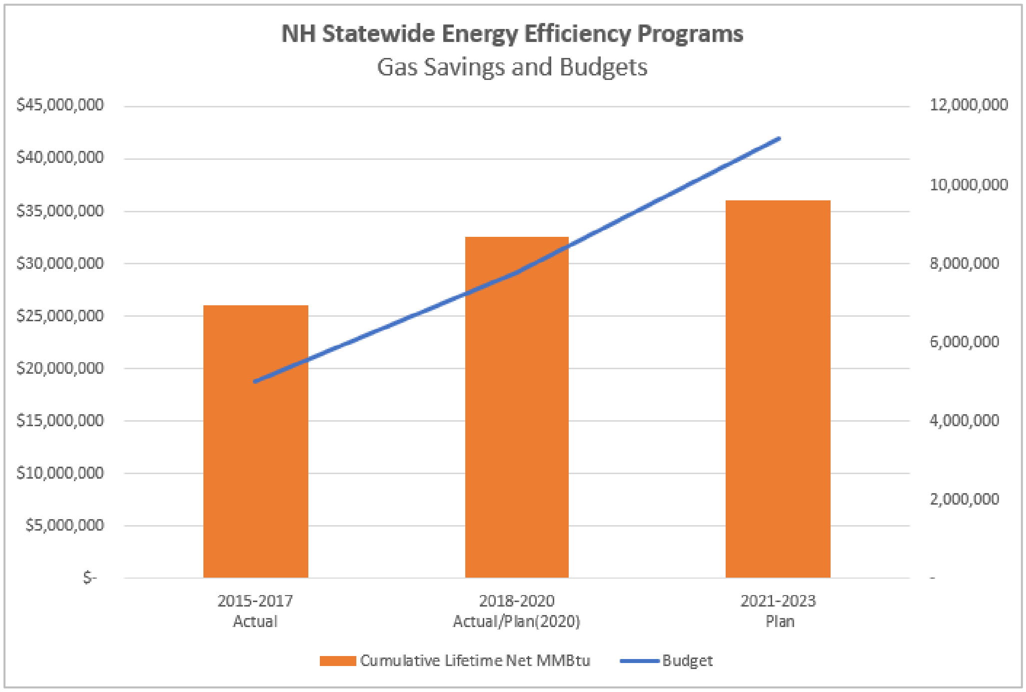


Figure 1-2: Natural Gas Programs Over Time



Throughout the 2021-2023 term, the NH Utilities plan to deliver tailored, comprehensive solutions to customers that will drive electric and natural gas savings. The electric programs are deliberately expanding beyond lighting measures, which have provided an inexpensive and relatively easy means of reducing electricity use for the past decade.

For the C&I Programs, “tailored, comprehensive solutions” will involve testing various channels, incentive models, and strategies to identify more precisely what motivates customers and contractors to implement comprehensive energy-saving projects. The NH Utilities will explore offering a tiered incentive design focused on the delivered energy savings of an entire project, rather than the current approach of incentivizing single measures. For the 2021-2023 term, the NH Utilities will continue to offer cost-sharing comprehensive audits and determine if this incentivizes more C&I customers to invest in deeper energy-saving projects.

The NH Utilities will promote comprehensiveness in the 2021-2023 Residential Programs through the introduction and heavy promotion of multiple “on ramps” to energy efficiency (referenced in Priority Three) that will be utilized to encourage investment in multiple-measure projects over the next three-year period.

Priority Two: Provide Significant Benefits to New Hampshire’s Economy

New Hampshire’s energy efficiency investments help support the state’s economy in multiple ways. Delivering cost-effective energy efficiency programs to customers helps lower energy bills, generates local jobs, reduces the energy dollars that go toward out-of-state energy generation, and increases the quality of the state’s building stock. Businesses can invest energy savings toward making their companies more profitable, and into operations and personnel. Towns and cities can use taxpayers’ dollars to fund critical infrastructure projects and public services. Homeowners, particularly limited-income customers, can use their energy savings toward their most critical needs, with their dollars staying in the local economy.

Priority Three: Increasing Participation through New and Expanded Program Pathways

The NH Utilities remain focused on transforming the way customers think about and use energy by providing them a variety of innovative energy efficiency services and information that will help them to better manage their energy use and costs, moving them toward adoption of efficiency measures as a standard practice. The NH Utilities will effectively scale up the NHSaves Programs to increase energy savings and program participation by introducing or reinforcing multiple “on ramps” with varied levels of participation requirements for different customer types. These new or more heavily promoted program pathways create easily accessible avenues for customers to achieve energy savings. Through targeted marketing efforts, the NH Utilities can re-engage these customers to purchase additional energy-efficient equipment, use that equipment more effectively, and dive deeper into energy savings.

The NHSaves Residential Programs will introduce or more heavily promote several pathways, including: code-plus initiatives, online platforms, single-measure rebates, energy kits, and visual audits. For the C&I sector, the NH Utilities will encourage additional participation through the expansion of their “Main Street” efforts and community outreach initiatives, as well as the creation of standard marketing collateral targeting C&I customers and market segments (see Priority Four).

Priority Four: Offer Effectively-Packaged Solutions to Engage Customers

To increase program participation and energy savings, the NH Utilities must effectively market and package energy efficiency solutions to residential, municipal, and C&I customers. During the 2021-2023 term, the NH Utilities will expand midstream and point-of-purchase rebate offerings for the NHSaves Residential Programs, as well as include additional tiers and bonus incentives for the residential new construction marketplace.

For the NHSaves C&I Programs, the NH Utilities will create standard offer marketing pieces, such as sell sheets and presentations, specifically developed for target C&I market segments and end-use equipment. These tailored marketing collateral packages will make it easier for customers to understand the potential incentives and estimated energy savings associated with common high-efficiency measures applicable to their specific type of business, such as a marketing package for restaurants presenting light-emitting diode ("LED") fixtures and controls and commercial refrigeration, kitchen, and heating, ventilation, and air conditioning ("HVAC") equipment.

Priority Five: Develop and Implement a Workforce Development Strategy

A skilled workforce is a critical component of successfully moving the state toward the EERS' increased energy savings goals. The NH Utilities will work with an experienced vendor, as well as knowledgeable and interested New Hampshire stakeholders to train and recruit a qualified energy efficiency workforce. The NH Utilities will also leverage regional activities, best practices and research to inform the workforce development strategy. If needed, the strategy will also be supplemented by a needs assessment or additional research to better understand workforce barriers specific to New Hampshire. In particular, the NH Utilities will be closely examining the outcome of the COVID-19 pandemic on the New Hampshire workforce. The NH Utilities anticipate working more closely with key state agencies, such as the NH Employment Security Office, and the community college system, in order to develop this comprehensive workforce development strategy for (re)building the energy efficiency workforce. For more information regarding the NH Utilities' workforce development plan, please see Chapter Nine.

Priority Six: Increase Outreach to Main Streets, Municipalities and Rural Areas

For both the Residential and C&I sectors, the NH Utilities will expand efforts to reach customers in hard-to-serve and rural communities, including municipalities, businesses, and residential customers. Part of the NH Utilities' strategy will consist of building a community network of energy champions that includes municipal representatives, sustainability groups, energy committees, and economic development commissions. In addition, the NH Utilities plan to expand Main Streets efforts and community blitzes to further engage local businesses and community groups.

Priority Seven: Upgrading Weatherization Systems and Data Sharing

The NH Utilities are currently working to expand and refine the capabilities of Information Technology ("IT") data sharing, energy modeling and tracking systems for certain statewide programs. For the NHSaves Residential weatherization programs, the home audit and tracking system will be upgraded and deployed in 2021, which will allow the NH Utilities to streamline contractor interactions and provide better energy-savings information to customers.

In the December 13, 2018 settlement, Eversource agreed to review further integration of *Green Button Connect My Data*, which allows utility customers to automate the secure transfer of their own energy usage data to third parties, based on affirmative (opt-in) customer consent and control.[9] Each of the regulated NH Utilities has been investigating the IT requirements and deployment costs associated with the sharing of customer energy use data.

Priority Eight: Implement Effective Active Demand Reduction Strategies

Effective demand-reduction strategies can help reduce energy prices and price spikes during summer. For the 2021-2023 term, the NH Electric Utilities will develop and deploy several Active Demand Reduction ("ADR") strategies to flatten peak loads, improve system load factors, and reduce costs for all electric customers.

The NH Electric Utilities plan to implement two C&I ADR offerings: Load Curtailment and Storage Performance. The Load Curtailment offering will be technology agnostic and allow customers to earn an incentive based on their curtailment performance. The Storage Performance offering consists of a bring-your-own device ("BYOD") offering for C&I customers with behind-the-meter storage. Participating customers will earn a performance-based incentive for responding to peak demand events initiated or called by their respective NH Electric Utility.

For the 2021-2023 term, the NH Electric Utilities will include two residential ADR offerings: Battery Storage and wirelessly communicating ("Wi-Fi") Thermostat Direct Load Control ("DLC"). In addition, the

[9] The Green Button initiative is an industry-led effort that responded to a 2012 White House call-to-action to provide utility customers with easy and secure access to their energy usage information in a consumer-friendly and computer-friendly format for electricity, natural gas, and water usage. Customers are able to securely download their own detailed energy usage with a simple click of a literal "Green Button" on utility websites. US DOE, "Green Button". Available at: https://www.energy.gov/data/green-button.

NH Electric Utilities will explore implementing an Electric Vehicle ("EV") pilot. The Battery Storage offering will incentivize participants to discharge stored energy from their batteries in response to a signal from their NH Electric Utility. DLC offering participants will be incented to allow brief, limited adjustments to their Wi-Fi thermostats during periods of peak demand. If implemented, the EV measure would utilize incentive strategies to reduce charging demand during peak hours. The NH Utilities will explore this program offering and implement it if deemed feasible during the 2021-2023 term.

For more information regarding the NH Utilities' Residential and C&I ADR offerings, see Chapter Five.

Priority Nine: Implementing an Energy Optimization Pilot

Energy optimization is an energy resource framework that guides customers to make the most efficient use of all energy sources: for heating and cooling, electrification, charging, and even transportation, while maximizing energy and non-energy benefits. With this Plan, the NH Utilities are proposing an Energy Optimization pilot, based on learnings from pilots and programs in other states and from work performed by NHEC. The NHSaves pilot will be focused on conversions from delivered fossil-fuel systems to higher-efficiency electric heating and cooling systems. The pilot will be carefully evaluated in order to guide future decisions on expanding to a full-scale program and to assess the benefits of energy optimization to customers and the electric grid. For more information on the NH Utilities' Energy Optimization pilot, see Chapter Seven.

Priority Ten: Increase Energy Efficiency Portfolio Savings from Non-Lighting Measures

The NH Utilities have carefully considered and accounted for the significant ongoing changes in the residential and C&I lighting marketplaces in the development of the Plan. The NH Utilities' strategy is to actively seek out cost-effective, non-lighting measures wherever possible to provide a robust portfolio during the 2021-2023 term. Several factors were considered to make this determination, including significant discussion with stakeholders at EERS Subcommittee working sessions, as well as among members of the Evaluation, Measurement and Verification ("EM&V") Working Group. Most influential in this decision were the federal roll-back of minimum efficiency standards for lighting (see

Section 4.1.3 for a full discussion), results from the Energy Efficiency Baseline and Potential study and other studies conducted in the region (see Section 10.4 for a full discussion), and the need to pursue comprehensive energy efficiency projects to capture all achievable energy savings.

Despite the federal roll-back of minimum efficiency standards, the lighting market has continued to drive the transition to LEDs in the marketplace. In order to help maintain and accelerate the strong demand for high-efficiency ENERGY STAR LED technologies, the NH Utilities will continue to aggressively support and incentivize energy-efficient bulbs and fixtures for the NHSaves Residential Programs through the end of 2021. Beginning in 2022 and depending on how the marketplace responds to the relaxed federal standards, the NH Utilities will transition program support to discount retailers focused on reaching the last-to-adopt and hard-to-reach customers.

For the NHSaves C&I Programs, an emphasis on contractor trainings and the introduction of tiered incentives should encourage comprehensiveness in energy efficiency projects and increase the share of energy savings from non-lighting measures during the 2021-2023 term.

1.6 Benefits of Energy Efficiency Programs

The NHSaves Programs provide significant value to all customers, both participants and non-participants. As noted in the Executive Summary section, the benefits associated with improving the energy performance of residential and C&I buildings and facilities are numerous and include reduced GHG emissions, direct energy and cost savings, direct and indirect jobs creation, lower municipal spending, reinvestment in local New Hampshire communities, and a variety of other non-energy benefits.

Participation in the NHSaves Programs delivers additional benefits, such as lower asthma rates and other health-related improvements due to better air quality (indoor and outdoor). In addition, businesses can realize improved performance and productivity due to the installation of high-efficiency equipment, such as LED lighting controls and commercial kitchen equipment. Other non-energy benefits include: increased comfort, reduced maintenance costs, improved building value, and healthier buildings in which homeowners or renters are spending a significant portion of their day, whether working or relaxing at home.

1.6.1 Direct Energy Savings and Demand Reduction

Since 2002, New Hampshire electric and natural gas customers have installed energy efficiency measures that have saved more than 19.1 billion electric kWh and 45.7 million natural gas MMBtu, resulting in cumulative customer savings in excess of $3.4 billion. Furthermore, the 2019 Independent System Operator-New England ("ISO-NE") Energy Efficiency Forecast found that energy efficiency programs in New England will save over 2,460 MW of peak demand from efficiency projects installed between 2020 and 2028.[10] The 2021-2023 NHSaves Programs will save 6.7 billion electric kWh and 9.6 million natural gas MMBtu. In addition, the 2021-2023 NHSaves Residential and C&I Programs will save 8.3 million MMBtu from other fuels, such as oil and propane. Over the lifetime of these measures, this will result in customer cost savings of more than $1.3 billion.

1.6.2 Cost Savings

Energy efficiency program participants receive significant direct benefits from energy efficiency programs; however, all customers benefit from the reduction in energy consumption through efficiency and conservation resulting from NHSaves Programs. Energy efficiency improvements can defer the costs of building new power plants and are less expensive than new energy generation. According to the US Energy Information Administration ("EIA"), nationwide residential and commercial sector energy efficiency improvements were responsible for partially offsetting increasing energy demand resulting from the country's higher growth rates in population, number of households, and commercial floorspace.[11]

[10] ISO New England, Inc. *Final 2019 Energy Efficiency Forecast.* May 12, 2019. Available at: https://www.iso-ne.com/static-assets/documents/2019/04/eef2019_final_fcst.pdf.

[11] EIA. *Annual Energy Outlook 2020.* Available at: https://www.eia.gov/outlooks/aeo/.

1.6.3 Environmental Benefits

Energy efficiency programs help reduce energy consumption, which in turn reduces the amount of fossil fuels burned by power plants. This reduces GHG emissions that contribute to climate change and air pollution across the region, thereby helping to minimize the cost of mitigation at the state and federal level. Since inception, the NHSaves Programs have helped reduce GHG emissions by more than 11.8 million tons, the equivalent of taking 2.6 million passenger vehicles off the road for one year. The 2021-2023 NHSaves Programs will lead to a reduction of more than 4.4 million tons of GHG emissions, the equivalent of taking 949,313 passenger vehicles off the road for one year.

1.6.4 Economic Benefits

Spending on energy efficiency services and technologies supports the local workforce in New Hampshire. For every million dollars spent on energy-efficient measures, such as building retrofits or new equipment, an estimated 6.2 direct jobs and 2.7 indirect jobs are supported.[12] Using this calculation, the 2021-2023 NHSaves Programs will support 4,673 FTEs or 9.7 million work hours.

Direct jobs are defined as those that perform energy services or install equipment in a home or a building, such as a home energy auditor, installation contractor, or energy service company. Typically, direct jobs in the energy efficiency industry are located close to where building retrofits and new construction take place, thereby stimulating the local economy. Indirect jobs are defined as those that supply direct-install companies with the equipment needed for building retrofits and construction, such as high-efficiency commercial kitchen equipment, insulation, LED lighting and controls, and refrigeration equipment.

Across the state, the NH Utilities work directly with approximately 1,200 architects, builders, distributors, electricians, energy auditors, engineers, energy service companies, retailers, and other

[12] Pollin, R., Wicks-Lim, J., Chakrabortu, S., Hansen, T. *A Green Growth Program for Colorado*. Available at: https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.

energy efficiency professionals. As noted in Priority Five, the NH Utilities are developing a regional comprehensive plan to facilitate workforce development strategies for the energy efficiency industry.

1.7 2021-2023 Program Goals

Table 1-3: Electric Program Annual Savings, by Utility

	2021	2022	2023	2021-2023	Percentage of 3-year Savings
Electric Annual Savings (MWh)					
Eversource	110,672	130,959	160,737	**402,368**	77%
Liberty Electric	13,074	14,488	16,624	**44,185**	8%
NHEC	9,144	8,382	7,874	**25,400**	5%
Unitil Electric	15,914	17,150	20,315	**53,380**	10%
Total	**148,804**	**170,978**	**205,551**	**525,333**	**100%**

Table 1-4: Electric Program Annual Savings, by Sector

	2021	2022	2023	2021-2023	Percentage of 3-year Savings
Electric Annual Savings (MWh)					
C&I and Municipal	117,997	146,379	180,990	**445,365**	85%
Residential	28,176	21,264	20,530	**69,970**	13%
Income-Eligible	2,631	3,336	4,031	**9,998**	2%
Total	**148,804**	**170,978**	**205,551**	**525,333**	**100%**

Table 1-5: Natural Gas Program Annual Savings, by Utility

	2021	2022	2023	2021-2023	Percentage of 3-year Savings
Natural Gas Annual Savings (MMBtu)					
Liberty Gas	153,886	191,719	219,574	**565,179**	75%
Unitil Gas	44,150	61,938	82,314	**188,402**	25%
Total	**198,036**	**253,657**	**301,888**	**753,581**	**100%**

Table 1-6: Natural Gas Program Annual Savings, by Sector

	2021	2022	2023	2021-2023	Percentage of 3-year Savings
Natural Gas Annual Savings (MMBtu)					
C&I and Municipal	129,917	151,159	177,362	458,438	61%
Residential	58,569	91,891	112,498	262,959	35%
Income-Eligible	9,550	10,606	12,028	32,184	4%
Total	**198,036**	**253,657**	**301,888**	**753,581**	**100%**

1.8 Energy Efficiency Program Funding

1.8.1 Electric Energy Efficiency Funding

There are three main funding sources for the NHSaves electric programs: (1) a portion of the SBC that is applied to the electric bills of all customers receiving delivery service from one of the NH Electric Utilities; (2) a portion of the Regional Greenhouse Gas Initiative ("RGGI") auction proceeds; and (3) proceeds earned by each of the NH Electric Utilities from ISO-NE for participation in ISO-NE's Forward Capacity Market ("FCM").

All electric utility FCM revenues are derived from the NH Utilities' energy efficiency programs and support NHSaves electric programs. Any balance of funds, positive or negative, from prior program years is carried forward to future years. This includes interest applied on the monthly balance at the prime rate. The NH Utilities have either estimated prior year carryforwards for calculation of 2021-2023 funding or intend to utilize all prior year funding within the 2020 program year or for additional on-bill loan capital. Any transfers of 2020 funding between programs or to loan funds will follow applicable requirements for notification and/or approval under DE 17-136 and the approved 2020 Plan Update. True-up of actual carryforward from 2020 will take place with the 2020 Annual Report and, if needed, the following SBC or LDAC rate adjustment.

The Commission's staff provides an estimate of RGGI revenue figures to be dedicated to the energy efficiency programs. ISO-NE's FCM revenues are estimated based on the market price for passive demand savings and the obligation of each NH Electric Utility during the two commitment periods covered by calendar years 2021-2023. These figures differ by each NE Electric Utility and can be subject to adjustment based on actual performance.

Table 1-7: Electric Program Funding

2021	Sector	Carryover	HEA Carryover	RGGI	FCM	SBC Funds	Total
Eversource	Residential	$0	$0	$377,341	$1,557,889	$20,673,489	$22,608,719
	C&I	$0	$0	$1,531,542	$3,635,073	$46,577,169	$51,743,785
NHEC	Residential	$407,827	$0	$34,612	$30,000	$3,934,561	$4,407,000
	C&I	$28,157	$0	$172,873	$70,000	$2,710,970	$2,982,000
Liberty	Residential	$598,262	$19,796	$44,153	$263,079	$1,636,452	$2,561,742
	C&I	$755,404	$0	$177,584	$348,732	$3,571,782	$4,853,502
Unitil	Residential	$480,100	$0	$56,687	$168,524	$3,972,213	$4,677,524
	C&I	($111,241)	$0	$228,000	$393,222	$4,382,004	$4,891,985

2022	Sector	Carryover	HEA Carryover	RGGI	FCM	SBC Funds	Total
Eversource	Residential	$0	$0	$362,535	$1,433,201	$20,620,060	$22,415,796
	C&I	$0	$0	$1,531,542	$3,344,136	$67,090,791	$71,966,469
NHEC	Residential	$0	$0	$34,612	$30,000	$4,100,388	$4,165,000
	C&I	$0	$0	$172,873	$70,000	$3,100,127	$3,343,000
Liberty	Residential	$0	$0	$42,420	$233,584	$2,496,480	$2,772,483
	C&I	$0	$0	$177,584	$309,634	$5,398,895	$5,886,113
Unitil	Residential	($879)	$0	$54,463	$140,137	$4,964,828	$5,158,548
	C&I	($852)	$0	$228,000	$326,985	$5,633,809	$6,187,942

2023	Sector	Carryover	HEA Carryover	RGGI	FCM	SBC Funds	Total
Eversource	Residential	$0	$0	$347,726	$1,198,252	$21,735,949	$23,281,927
	C&I	$0	$0	$1,531,542	$2,795,920	$91,149,205	$95,476,667
NHEC	Residential	$0	$0	$34,612	$30,000	$4,006,388	$4,071,000
	C&I	$0	$0	$172,873	$70,000	$3,005,127	$3,248,000
Liberty	Residential	$0	$0	$40,687	$150,966	$2,651,629	$2,843,282
	C&I	$0	$0	$177,584	$200,117	$6,770,979	$7,148,680
Unitil	Residential	$0	$0	$52,238	$133,129	$5,159,285	$5,344,652
	C&I	$0	$0	$228,000	$310,634	$7,212,807	$7,751,441

1.9 Natural Gas Energy Efficiency Funding

The NHSaves natural gas programs are funded by a portion of the LDAC, which is applied to natural gas bills for customers of the NH Natural Gas Utilities. Similar to the NHSaves electric programs, the balance of funds from prior program years is carried forward to future years, including interest earned on monthly balances applied at the prime rate.

The NH Natural Gas Utilities determine the overall budget requirements to meet the required energy savings targets. LDAC rates are then set by program sector by each of the NH Natural Gas Utilities based on revenue needs and sales forecasts.

Table 1-8: Natural Gas Program Funding

2021	Sector	Carryover	HEA Carryover	LDAC Funds	Total
Liberty	Residential	$ 55,173	$ -	$ 5,694,467	$ 5,749,640
	C&I	$ (29,094)	$ -	$ 3,734,528	$ 3,705,434
Unitil	Residential	$ (276,963)	$ -	$ 1,557,446	$ 1,280,483
	C&I	$ 60,459	$ -	$ 1,704,995	$ 1,765,455

2022	Sector	Carryover	HEA Carryover	LDAC Funds	Total
Liberty	Residential	$ -	$ -	$5,999,242	$ 5,999,242
	C&I	$ -	$ -	$ 4,100,187	$ 4,100,187
Unitil	Residential	$ 7,185	$ -	$ 1,548,992	$ 1,556,177
	C&I	$ 10,794	$ -	$ 2,548,396	$ 2,559,190

2023	Sector	Carryover	HEA Carryover	LDAC Funds	Total
Liberty	Residential	$ -	$ -	$ 6,510,458	$ 6,510,458
	C&I	$ -	$ -	$ 4,624,437	$ 4,624,437
Unitil	Residential	$ -	$ -	$ 1,892,786	$ 1,892,786
	C&I	$ -	$ -	$ 3,644,397	$ 3,644,397

1.10 Annual Program Budgets

Table 1-9: Annual Electric Budget, by Utility

	2021	2022	2023	2021-2023	Percentage of 3-year Budget
Electric Budget ($000)					
Eversource	$70,478	$89,464	$112,569	**$272,511**	78%
Liberty Electric	$7,030	$8,207	$9,471	**$24,708**	7%
NHEC	$7,004	$7,129	$6,960	**$21,093**	6%
Unitil Electric	$9,070	$10,755	$12,691	**$32,516**	9%
Total	**$93,582**	**$115,554**	**$141,692**	**$350,829**	**100%**

Table 1-10: Annual Natural Gas Budget, by Utility

	2021	2022	2023	2021-2023	Percentage of 3-year Budget
Natural Gas Budget ($000)					
Liberty Gas	$8,962	$9,573	$10,554	**$29,089**	69%
Unitil Gas	$3,076	$4,133	$5,583	**$12,793**	31%
Total	**$12,038**	**$13,706**	**$16,137**	**$41,882**	**100%**

Budget allocations by sector are informed by the source of the funds, and each NH Utility's forecasted delivery sales to each customer sector. The Home Energy Assistance (income-eligible) program budget is not less than 17 percent of each NH Utility's total portfolio budget exclusive of any unspent income-eligible program funds from the prior year and meets New Hampshire legislative requirements that 20 percent of the SBC funds be directed toward limited-income programs.[13]

[13] RSA 374-F.3 VI: *Electric Utility Restructuring Act*, 1996. VI. Benefits for All Consumers. "Restructuring of the electric utility industry should be implemented in a manner that benefits all consumers equitably and does not benefit one customer class to the detriment of another. Costs should not be shifted unfairly among customers. A non-by-passable and competitively neutral system benefits charge applied to the use of the distribution system may be used to fund public benefits related to the provision of electricity. Such benefits, as approved by regulators, may include, but not necessarily be limited to, programs for low-income customers, energy efficiency programs, funding for the electric utility industry's share of commission expenses pursuant to RSA 363-A, support for research and development, and investments in commercialization strategies for new and beneficial technologies...".

Monthly interest at the prime rate is applied to fund balances and reinvested into programs. Funding estimates from the SBC and LDAC are based on each of the NH Utility's sales projections. Actual sales may differ, resulting in potentially more or less SBC or LDAC revenue available for energy efficiency programs. In addition, RGGI and FCM proceeds are estimated and are also likely to differ from actual revenues. When planning program budgets and reporting expenses, the NH Utilities summarize expenses by specific tracking activities, defined as follows in Table 1-11:

Table 1-11: Tracking Activities for Expenses

Tracking Activity	Description
Administration—Internal	Internal utility costs associated with program design, development, regulatory support, and quality assurance. Costs include: employee labor, benefits, expenses, materials, and supplies.
Administration—External	Costs associated with external costs of program administration. This includes contractors and consultants used in support of program design, development, regulatory support, and quality assurance.
Customer Rebates and Services	Includes 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	Tracks costs associated with delivering programs to customers, including labor, benefits, expenses, materials, and supplies.
Marketing	Includes 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.

Chapter Two: Three-Year Planning Structure

This chapter outlines the NH Utilities' proposal to effectuate a true triennial program operating period with a single planning and settlement effort and three-year goals, rather than three distinct annual operating periods with distinct planning efforts, budgets, and goals.

This chapter describes the rationale and details behind the NH Utilities' proposal, unanimously supported by the EESE Board and stakeholders to the EERS process, to transition from a three-year plan punctuated by significant annual updates to a true three-year plan that emphasizes long-term goals and three-year budgets. This change will provide the NH Utilities the flexibility of the full term to successfully implement the plan while maintaining transparency and accountability with both the Commission and stakeholders.

Adoption of a true three-year plan structure will improve program delivery to customers, foster innovation, provide vendors and contractors with greater flexibility to adapt to fluid and evolving market conditions, and result in a more cost-effective and efficient process for the NH Utilities and stakeholders. Many of the leading states for energy efficiency (e.g., Massachusetts, California, and Vermont) implement true three-year or multi-year plan operating cycles, allowing them to focus on longer term goals, new technologies, innovative program designs, and more effective targeting of all customer demographics.[14]

2.1 A Three-Year Plan

Commencing with the 2021-2023 Plan term, the NH Utilities propose to fully transition the NHSaves Programs to a 36-month operating structure, for which the program budgets, energy savings goals, and planned program designs are approved by the Commission for the entire triennium, rather than for

[14] ACEEE. 2019 State Scorecard. Available at: https://database.aceee.org/state-scorecard-rank. In the 2019 State Scorecard, Massachusetts, California, and Vermont, were ranked first, second, third, respectively.

each year of the term. Once approved by the Commission, the NH Utilities will implement the three-year plan consistent with such approval and will only seek to modify budgets or goals if certain triggers discussed in Section 2.1.6 occur. During the three-year term, the NH Utilities will apply new evaluation results and updated avoided costs to the actual results on a prospective basis beginning on January 1st of the year after the results are finalized.

The final calculation of achievement of the Commission ordered three-year term energy savings and benefits goals. The resulting Performance Incentive ("PI") earned will be finalized following the conclusion of the third and final year of the term, in a comprehensive term report ("Term Report") to be filed by each NH Utility, along with a statewide summary. Planned and approved targets will not change during the term. However, the actual savings and benefits resulting from the portfolio of programs will be reported using the prospective application of results from evaluations as well as the Avoided Energy Supply Components study ("AESC Study"), which is scheduled to be completed in the spring of 2021. While the plan will be triennial, stakeholders will remain fully engaged with the NH Utilities' progress toward achieving the term goals through quarterly and annual reports and participate in information sharing and feedback during quarterly meetings and other updates.

A true triennial plan term will improve program delivery and eliminate some of the barriers facing customers and contractors, including the stop/start of programs due to annual budget constraints. Contractors, installers, NH Utility staff, and other local and regional stakeholders will be afforded a longer view and greater ability to improve programs and adapt over time. Setting three-year budgets and goals will allow the NH Utilities the necessary flexibility to respond to changing economic conditions, seasonal anomalies, and the evolving energy efficiency marketplace. This new structure will also allow for the introduction of new measures and innovations, with the ability to learn and adjust during the three-year period without undue focus on annual goals.

With a three-year planning structure, programs and measure offerings can be emphasized or de-emphasized based on market needs, and resources can be deployed when opportunities arise rather than being constrained by one-year budgets and goals. Three-year budgets and the ability to shift funds from one program to another will minimize disruption in the marketplace caused by programs opening and closing on a calendar-year basis and maximize efficient use of funds.

Budget flexibility across program years will also allow the NH Utilities to effectively execute multi-year commitments with large C&I and municipal customers, which the NH Utilities are confident will result in sustained, long-term, and comprehensive energy savings and potential reductions in administrative costs. Furthermore, a three-year plan, budget, and goals support a sustainable energy efficiency economy by providing more stability and certainty for contractors and partners that invest in training and workforce development over a longer time horizon than 12 months. Moving to a 36-month budget will reduce administrative resources needed to design and approve annual planning efforts and program changes, and will put a greater focus on program implementation, innovation, and achievement of goals.

Prior to implementation of the EERS, the NH Utilities filed biannual energy efficiency plans, which were updated annually. During the course of the 2018-2020 term, the NH Utilities filed two plan update filings with the Commission (2019 Plan Update and 2020 Plan Update). These annual filings and plan updates require an enormous amount of time and resources for the NH Utilities to prepare, beginning in the early summer of the preceding year. Following the filing of a plan or plan update, the NH Utilities and numerous other parties, including Commission Staff, must participate in public input and stakeholder sessions, as well as a four-month adjudicative proceeding including tech sessions, discovery and settlement, and culminating in hearings before the Commission.

An EERS plan that truly spans a three-year period will reduce the time and resources spent in adjudicative proceedings for all parties, thereby allowing resources to be dedicated to serving customers rather than administrative matters. The NH Utilities propose to provide regular and transparent reporting, including robust quarterly and annual reports to the Commission regarding progress toward the three-year goals, significant changes to NHSaves Program delivery or design, and the results from evaluations, including updates to the Technical Reference Manual ("TRM") and the AESC Study. Triggers for mandatory review of one or more of the NH Utilities' plans ensure that proposals for significant mid-term modifications are reviewed and approved by the Commission, with opportunity for stakeholder input.

This proposal strikes the appropriate balance between improved program flexibility with reduced administrative burden, while maintaining robust accountability and Commission oversight.

2.1.1 Savings Goals

In a triennial plan structure, energy savings and benefits goals will be set for the entire three-year period. The NH Utilities will provide a savings target for each program year of the term. This annual target, however, shall be considered a directional indicator, while the binding goal for each utility will be based on the cumulative activity over the three-year term.

The NH Utilities will report actual savings and benefits, applying relevant evaluation findings prospectively The NH Utilities will also update benefits calculations resulting from the 2021 AESC Study in their reporting for program years 2022 and 2023.

Approved term goals *will not change without the Commission's approval* regardless of the results of evaluations and the avoided cost study. However, in order to maximize savings and benefits for customers, the NH Utilities are likely to implement changes to program delivery and measure mix as a result of changing market conditions, evaluation findings, and other market intelligence gained during the term. For example, if an evaluation finds that a specific measure saves less energy than was estimated in the approved triennial plan, the NH Utilities will apply the updated values to the following year's TRM, as well as the benefit-cost model used for the calculation of actual savings and benefits. The NH Utilities may also choose to modify the measure offering by adjusting incentive levels or even discontinuing incentive support for the affected measures.

Stakeholders will be made aware of these changes through several channels:

- The EM&V Working Group will be made aware of the evaluation impacts to measures and programs as evaluations are drafted and finalized, and other interested parties will have access to final reports once posted to the Commission's website;

- A searchable, electronic TRM, developed by the NH Utilities in coordination with the EM&V Working Group, will be updated and published annually to a public website and will highlight changes to measure assumptions to be applied to the following year;
- The NH Utilities will continue to report any changes to measure incentives in each quarterly report, which is distributed to the service list and subject to discussion at quarterly meetings; and
- The NHSaves website will reflect up-to-date information regarding what equipment and other energy efficiency measures are eligible for incentives, which measures are offered through mail-in rebate, retail/distributor or online channels, and the dollar amount of all incentives.[15]

These changes, however, will only impact the reporting of savings, and not the planned and approved term goals or budgets. The exception is if a mid-term modification trigger occurs, requiring Commission review and approval of the impacts before changes can be considered official. Under the three-year term construct, the NH Utilities will gain the flexibility to adapt to evaluation impacts and pursue cost-effective energy efficiency opportunities in order to achieve the term goals within the approved budget.

2.1.2 Budgets

Each NH Utility will develop individual program budgets for the term, as well as an estimate of the annual budgets. Any budgeted but underspent funds from one year will be carried over into the next program year (until the conclusion of the three-year term), remaining in the relevant energy-saving program. Overspending in the initial program years would reduce the remaining funds available for the remainder of the term. In order to ensure that the NH Utilities are not unduly constrained, while also ensuring significant increases in spending are subject to Commission review, the NH Utilities propose to allow each NH Utility to spend up to 110 percent of each sector’s approved term budget without requiring Commission approval.

[15] Note: Some rebates are determined on a case-by-case basis and depend on the size, savings, total cost, efficiency rating, etc.

2.1.3 Funding

The three-year plan includes estimated customer bill and rate impacts by utility for each year of the triennium (see Section 10.4). Commission approval of the triennial plan will constitute approval of each of the NH Utility's three-year term budget, as well as the term budgets for each program; non-binding *annual* program budgets are also provided.

The three-year plan includes proposed SBC rates and LDAC rates for each year of the triennial plan, based on the projected annual budgets and other funding sources. Commission approval of the triennial plan will constitute approval of the SBC rates for each year. Annually, each of the NH Electric Utilities will review actual sales and revenues to determine whether the approved SBC rate for the next year is still applicable for collection of the approved budget. If this reconciliation results in the need to increase or decrease the rate by no more than 10 percent of the approved rate, the NH Utility will file a technical statement with the projected over or under calculation, along with the resulting energy efficiency portion of the SBC rate and adjust the rate without the need for a formal procedure and hearing. The NH Utility will also file a revised tariff page reflecting the change. At the end of the three-year period, a final reconciliation will be filed to reconcile the final three-year program budgets and expenses. Additional discussion of the proposed rates for the 2021-2023 term and adjustment procedures can be found in Attachment K.

The model for this proposal is the LDAC charges currently utilized by the NH Natural Gas Utilities. With this approach, energy efficiency budgets are developed and approved in the energy efficiency docket, while the LDAC rate itself is considered and approved in Liberty Gas's and Unitil Gas's utility-specific cost-of-gas filings. Additionally, in Docket No. DR 98-015, the Commission approved in Order No. 22,890, a monthly adjustment to the cost of natural gas that does not require a filing for rate approval, similar to the mechanism proposed in this Plan filing for handling yearly adjustments to the SBC.

The NH Electric Utilities are filing separate SBC rates with the Commission based on the funding needed to execute individual portfolio and sector energy efficiency programs. This methodology will streamline the manner in which actual collections and expenditures are reconciled for each NH Electric

Utility and allow each utility to collect only those funds needed to execute proposed programs, rather than being tied to a specific rate set for a statewide savings goal.

An important element of this proposal is that, as with the revenue-raising mechanism utilized by the natural gas energy efficiency programs, each NH Electric Utility will set a distinct SBC rate for each sector (Residential and C&I), based on the approved annual energy efficiency budget for that sector in each program year. As the opportunities for energy efficiency evolve in the marketplace, the need for distinct SBC rates for the residential and C&I sectors becomes paramount. In order to achieve increasingly ambitious EERS goals for kWh savings and demand reduction, it is imperative that the NH Utilities have the flexibility to collect revenues at different rates between the sectors.

A relatively high percentage of the investment in the residential sector results in fuel-neutral energy efficiency savings (i.e., heating and water heating savings from weatherization programs, which disproportionately reduces more fossil fuel use than electricity). This dynamic leads to a high cost to achieve kWh savings in the residential sector relative to the C&I sector. Maintaining an identical SBC rate for residential and C&I customers would lead to a disproportionate amount of funding for NHSaves Residential Programs, as well as residential rates that are unnecessarily high, and which contribute relatively little to the EERS' electricity savings goals. This disconnect will be exacerbated as the opportunity for claimable energy efficiency savings from residential lighting is greatly reduced over the coming term as a result of market transformation to LED technology.

A review of other jurisdictions shows that setting distinct energy efficiency rates for each customer sector is the norm.[16] By following suit, the NH Electric Utilities will be able to better target electric

[16] Eversource, MA (2020). Summary of Eastern Massachusetts Electric Rates for Greater Boston Service Area, Effective Jan. 1, 2020. Retrieved from: https://www.eversource.com/content/docs/default-source/rates-tariffs/ema-greater-boston-rates.pdf?sfvrsn=c27ef362_40.
Baltimore Gas & Electric (2020). Electric Efficiency Charge. Filed Nov. 18, 2019 and Effective Jan 1. 2020. Retrieved from https://www.bge.com/MyAccount/MyBillUsage/Documents/Electric/Rdr_2.pdf.
Efficiency Vermont (2019). Summary of Energy Efficiency Charges for 2019. Retrieved from https://www.efficiencyvermont.com/Media/Default/docs/EEC-rates/VECBill_Insert2018_Final.pdf.

funding to where it is most cost effective, capturing electric savings opportunities where they exist in order to achieve increasingly ambitious EERS goals.

Pursuant to state legislation, at least 20 percent of all SBC funds for energy efficiency shall be budgeted for low-income energy efficiency programs.[18] Additionally, the NH Utilities have committed to budgeting and spending at least 17 percent of the total portfolio investment on low-income energy efficiency programs. Other than the revenues needed for the low-income programs (which are funded by both the residential and C&I sectors, relative to revenues), SBC and LDAC funds will continue to be dedicated to the sector from which they are collected.

The electric energy efficiency programs will continue to receive and rely on revenues from two other sources: the proceeds from each NH Electric Utility's participation in ISO-NE's FCM, and New Hampshire's participation in RGGI. FCM revenues are unique to each utility and are based on the amount of capacity each NH Electric Utility has bid into and delivered to the market over the past decade. Revenues from RGGI have been relatively fixed for the past several years based on legislation that limits to $1 per allowance the amount of funding made available to the energy efficiency programs. Further restrictions on how the RGGI revenues can be spent limit most funding to the Municipal (C&I) and Home Energy Assistance (Residential) programs.

Actual and expected revenues from these two streams, as well as interest earned on balances, offset revenues needed by each of the NH Electric Utilities when proposing each year's SBC rate.

2.1.4 Performance Incentive

Under the proposed three-year planning structure, each NH Utility's PI will be determined based on achievement over the full three-year term. The NH Utilities propose to retain the new PI framework

Georgia Power (2020). Demand Side Management Residential & Commercial Schedules: "DSM-R-8". Retrieved from, 1) https://www.georgiapower.com/content/dam/georgia-power/pdfs/residential-pdfs/residential-rate-plans/DSM-R-8.pdf, and 2) https://www.georgiapower.com/content/dam/georgia-power/pdfs/business-pdfs/rates-schedules/small-business/DSM-C-7.pdf.
CenterPoint Energy Houston Electric, LLC (2020). Tariff for Retail Delivery Service. Retrieved from https://www.centerpointenergy.com/PublishingImages/CNP/Common/SiteAssets/doc/CNPRetailDeliveryTariffBook12107.pdf.

approved by the Commission in Order 26,323 for the 2021-2023 term, with a modification to incorporate the active demand response kW goal in the calculation and adjustment to the threshold percentages as explained in Section 10.2. More substantively, the calculation of the Benefit-Cost Ratio ("BCR") will be amended to reflect the new Granite State Cost Test, which removes customer costs and non-energy benefits from the calculation of the BCR.

For the NH Utility annual reports, each NH Utility will complete a preliminary PI calculation based on actual costs, savings, and benefits for the program year. At the end of the third year of the three-year term, each NH Utility will perform a final calculation of earned PI, based on actual achievement over the term compared to the three-year term goals. After the Commission's final audit is complete, the resulting PI for the entire term will be considered approved, and subsequent SBC filings will adjust rates to account for any over or under recovery of PI.

Additional discussion of the PI calculation, drawing from the 2019 PI Working Group Report, can be found in Chapter Ten.[17]

2.1.5 Reporting

As discussed above, each NH Utility will calculate actual achievement of term goals, budgets, and PIs as part of a comprehensive Term Report. The NH Utilities will report actual achievement relative to planned goals, as adjusted by any mid-term modifications (see Section 2.1.6, "Commission Notification and Mid-Term Modifications"). The Term Reports, along with a statewide summary, will be filed with the Commission no later than August 1st after the conclusion of the final year of the three-year term. The Commission will perform its final audit of the 2021-2023 term based on the Term Report and grant final cost recovery and PI following such investigation.

In addition to the Term Report, quarterly reporting over the course of the 2021-2023 term will ensure continued transparency into the progress of the NH Utilities in achieving the proposed goals, as well as

[17] 2019 PI Working Group Report. Available at: https://www.puc.nh.gov/EESE%20Board/EERS_WG/20190913-EERS-WG-PI-FINAL-REPORT.pdf.

provide an opportunity for New Hampshire's regulators and stakeholders to engage with the NH Utilities to provide feedback on the evolving market for energy efficiency. The NH Utilities will continue to submit a joint Quarterly Report no later than 60 days after the end of each quarter.

For the first and second years of the term, a statewide Annual Report will be filed with the Commission. Assumptions underlying the reported savings and benefits will be based on that year's Report and TRM, as discussed in more detail below. Updated avoided costs from the 2021 AESC Study will also be applied to the 2022 and 2023 Annual Reports for the purpose of calculating benefits. In addition, each Annual Report will detail the progress made by the NH Utilities individually and as a group toward achieving the three-year goals, as well as estimated PI earned that year for each of the NH Utilities.

Each NH Utility's Annual Report will also include a projection of anticipated term spending, savings and benefits over the term. While the Term Report will be subject to a comprehensive review by the Commission, the Annual Report filing will not include a formal adjudicative process unless the Commission deems further investigation necessary. This structure will provide the Commission and stakeholders the continued ability to assess cost effectiveness and progress toward goals on an annual basis. In addition, the structure will reduce administrative time and cost burdens, and will continue to provide the opportunity for comprehensive review after the term has concluded but before the final PI is booked.

By December 1st of each year, the NH Utilities will file an updated TRM, reflecting prospective changes to measure assumptions that will take effect on January 1st of the following program year. This TRM will incorporate all evaluation findings, marketplace changes, emerging technologies, changing federal and state regulations, building code standards, and other pertinent information impacting measure savings assumptions. For the 2021-2023 term, the NH Utilities anticipate producing three TRMs, which are detailed in Table 2-1 on the next page:

Table 2-1: Planned TRMs during the 2021-2023 Plan Term

TRM Version	Used for:
2021-2023 Plan TRM, revised draft filed with Plan[18]	Planned 2021-2023 activity Reporting 2021 actual activity
2022 TRM for Reporting, to be filed 12/1/2021	Reporting 2022 actual activity
2023 TRM for Reporting, to be filed 12/1/2022	Reporting 2023 actual activity

This TRM update process will be managed by the EM&V Working Group, which consists of NH Utility members, as well as the Commission's evaluation consultants, Commission Staff representatives, and a liaison to the EESE Board who is nominated and approved by vote of the EESE Board representatives. The NH Utilities will strive to include consensus-based assumptions for all measures and offerings included in the NHSaves Programs. Should consensus not be reached, members of the EM&V Working Group may petition the Commission for resolution on the matter. For more information regarding the EM&V process, see Chapter 11.

In order to provide the Commission and EESE Board with information on the results of the 2021 regional AESC Study, the NH Utilities will also submit an informational report to the Commission and EESE Board in the fall of 2021, documenting the impact on planned benefits over the three-year term. As part of this informational report, each NH Utility will calculate the impact of the updated avoided costs on the approved plan for 2022 and 2023. The report will allow for a comparison by year of 2022 and 2023 Commission-approved benefits and cost-effectiveness calculations with the projected benefits and cost effectiveness applying the results of the AESC Study.

As noted above, while the new AESC Study will impact reported benefits, the NH Utilities will not change their *planned* savings or benefits goals unless a mid-term modification trigger occurs, and the Commission approves a requested change. If the impact of the AESC Study (alone or in conjunction with other evaluation results) is substantial enough to require a modification, each of the impacted NH

[18] The 2021-2023 Plan TRM is substantially complete, but some chapters are still under review by members of the EM&V Working Group. The NH Utilities will finalize and publish the complete TRM as soon as possible, in accordance with the 2018-2020 settlement agreement to complete a TRM by December 31st of the final year of the triennium. See Section 10.3 for further details.

Utilities will develop and file a proposed revision of plan goals and budgets in accordance with the process set forth in Section 2.1.6.

2.1.6 Commission Notification and Mid-Term Modifications

While a true three-year plan will lead to improved continuity of programs, flexibility, and minimization of time spent in adjudicative proceedings, some changes may be significant enough to necessitate a mid-course correction that requires adjustments to the NH Utilities' approved plans. The NH Utilities propose two mechanisms for amending the term plan based on the significance of the change(s) requested. The first mirrors the current practice of alerting the Commission and stakeholders regarding relatively modest changes in program budgets, program design or delivery, or measure offerings. The second type of amendment will require one or more individual utilities to file a mid-term modification, which the Commission must approve in order for the proposed change to take effect.

Circumstances Requiring Notification to the Commission:

- Adjusting program budgets by less than 20 percent of its approved term budget.
- The transition from a pilot offering to a full offering that does not trigger one or more of the conditions requiring a mid-term modification.
- The annual filing of the TRM, which includes modifications to measure level assumptions (e.g., measure life, gross savings, in-service rates, net-to-gross factors, load shape, coincidence factors, algorithms, etc.) that will be used in reporting savings and benefits.

A Commission notification under this section will not result in a change to approved three-year plan goals or budgets.

Circumstances Requiring a Mid-Term Modification and Approval by the Commission (by one or more of the NH Utilities):

- Inclusion of a new program.
- The suspension or closure of an approved energy savings program.
- An increase in a sector's approved term budget exceeding 110 percent of the original budget dollar amount:

  - The NH Utility proposing such change will also file an associated change to the budget for income-eligible programs in order to satisfy NH Rev Stat 374-F:3, VI.

- A projected decrease to the planned and approved benefits or primary annual energy savings (kWh or kW) for NH Electric Utilities; MMBtu for NH Natural Gas Utilities) in a particular sector of greater than 25 percent over the term.
- A change to the planned and approved Granite State Test's portfolio benefits or primary energy savings (kWh or summer kW for NH Electric Utilities, MMBtu for NH Natural Gas Utilities) greater than 10 percent in either direction over the term resulting from:
  - An update to the AESC Study; and/or
  - Evaluation findings.
- An approved mid-term modification under this section will result in a corresponding change to a NH Utility's plan goals or budgets. The NH Utility will compare actual term performance with the modified and Commission-approved plan goals and budgets in its respective Term Report.

2.1.7 Exceptions

In exigent circumstances, a NH Utility may petition the Commission for an exception to the specific mid-term modification triggers and procedures set forth above. The NH Utility shall have the burden to demonstrate the compelling nature of such request.

2.1.8 Program Continuity

The NH Utilities have designed the NHSaves Programs to be open and available year round throughout the three-year term in order to achieve the planned energy savings and to maximize customer satisfaction and minimize market disruption with key channel partners such as contractors, equipment suppliers, and distributors. In order to be responsive to the market, ensure consistent program availability and achieve goals, the NH Utilities may make specific program changes as needed during the term, including:

- Adjusting program marketing activity levels to ramp up or slow down demand;

- Modifying incentive levels for certain programs or measure categories;
- Introducing time-based incentives, which could involve promoting more limited period offerings, as well as potentially promoting higher incentive offers during periods of lower or seasonal demand where there may be greater contractor availability;
- Transferring available program funds from underperforming programs into programs with higher demand within the same sector; and
- Amending per-customer maximum project cap levels to help extend program availability.

Chapter Three: NHSaves C&I Energy Efficiency Programs

Since 2002, the NH Utilities have implemented programs to help improve the efficiency of small and midsize businesses, municipalities, and large C&I customers across New Hampshire. The NHSaves C&I Programs are designed to help businesses and municipalities reduce operating costs, purchase high-efficiency equipment and technologies, and increase productivity. Also, the C&I Programs defer the need for additional generation on the electric grid and protects the environment through reduced electricity, natural gas, and fossil fuel consumption.

3.1 Overview

In addition to serving customers, the NHSaves C&I Programs collaborate with a mature and robust network of stakeholders, including but not limited to: energy efficiency contractors, architects, developers, distributors, manufacturers, and retailers. The NH Utilities provide education, incentives, design and technical assistance, and workforce development opportunities to promote investment in energy-efficient technologies and designs in C&I buildings and facilities.

For the 2021-2023 term, the NH Utilities are focused on scaling up energy savings and program participation for the NHSaves C&I Programs. The NH Utilities will support these goals by expanding their outreach to towns and business customers, incentivizing emerging energy-efficient technologies, ensuring convenient customer access to capital, developing an enhanced workforce development strategy, and encouraging customer participation through standard offer marketing pieces.

Through market research and data analytics, the NH Utilities can identify what financing mechanisms, incentives, and market actions are needed to convince a C&I customer or market segment to invest in energy-efficient equipment and process improvements. Over the next three-year period, the NH Utilities will continue to apply market research and customer insights gleaned from data analysis to identify key C&I segments and customers and deliver packaged marketing and incentive solutions tailored to their needs. During the 2021-2023 term, the NH Utilities will also develop standard offer marketing pieces for targeted market segments and end-use equipment.

The NHSaves' C&I Programs are continuously evaluated by independent third parties to determine how processes, procedures, energy savings calculations, and incentives can be improved. Once these evaluations are completed, the NH Utilities review the third-party's findings and recommendations to determine how they can improve the delivery of the NHSaves C&I Programs. The flexibility in design allows the NH Utilities to respond quickly to changing codes and standards, customer demand, economic conditions, emerging technologies, market transformation, and new federal and state laws.

3.1.1 2021-2023 C&I Program Priorities

For more than 20 years, the NH Utilities have designed and delivered valuable energy efficiency services to municipalities, small businesses, commercial entities, and industries across the state. The primary focus of the NH Utilities during the 2021-2023 term is to tailor energy efficiency solutions to the customer. Each C&I customer's business needs, energy consumption, on-site technical expertise in energy-efficient technologies and design, and access to capital are varied and unique. Different market segments, such as municipal buildings, convenience stores, manufacturers, and ski resorts, demand different solutions that do not fit into a one-size-fits-all approach.

To realize investment in energy-efficient technologies and building design, the 2021-2023 term will emphasize the following C&I Programs' priorities:

1. **Achieve Cost-Effective and Comprehensive Energy Savings.** The NH Utilities will continue their long-term push to motivate C&I customers and contractors toward implementing cost-effective, comprehensive projects at customer facilities and buildings. To promote

comprehensiveness, the NH Utilities may implement a tiered incentive approach for all C&I Programs to encourage multi-measure projects that move beyond common lighting upgrades.

2. **Scale Up to Deliver Increased Savings While Stimulating Market Transformation.** During the 2021-2023 term, the NH Utilities will look to develop strategic initiatives and support emerging technologies in the marketplace to create market demand for energy-efficient products and building design.

3. **Expand Reach of Programs by Serving More Customers.** The NH Utilities will expand efforts to reach hard-to-serve and rural small businesses, municipalities, and large C&I enterprises throughout the 2021-2023 term. The Small Business Energy Solutions and Municipal programs' turnkey direct-install pathways will support Main Street efforts and community blitzes targeting microbusinesses, small municipal accounts (libraries and town halls), and downtown areas to engage C&I customers in energy efficiency efforts.

4. **Deliver Excellent Customer Experience.** The NHSaves Programs provide great opportunities for the NH Utilities, as trusted entities within the state and local communities, to engage customers in energy efficiency and deliver excellent customer experience. The NH Utilities have refined and streamlined the C&I Programs' design for the 2021-2023 term that will deliver packaged marketing and tailored solutions to New Hampshire's businesses and municipalities.

5. **Encourage Customer Participation with "Standard Offer" Information.** For the 2021-2023 term, the NH Utilities will create standard offer marketing pieces, such as sell sheets and presentations, specifically developed for market segments (e.g., convenience stores, manufacturing, multifamily buildings, restaurants, retail stores, etc.) and end-use equipment (e.g., compressed air, industrial boilers, LED fixtures and controls, motors, retro-commissioning, VFDs and controls, HVAC including heat pumps, low-energy snowmaking guns, etc.). Standard offer marketing collateral packages will serve as market and facility-specific energy efficiency guides to help small and large C&I customers and contractors understand potential incentives, energy-efficient measures, and other energy-saving opportunities.

The NH Utilities have extensive expertise in effectively implementing the NHSaves C&I Programs and understand the target markets, end-use systems and equipment, participation barriers, and market actors (i.e., trade ally networks). The creation of a targeted, streamlined presentation of incentive options will encourage additional participation in the C&I Programs.

6. **Engage with Stakeholders to Increase Customer Participation.** For the Municipal and Small Business Energy Solutions programs, the NH Utilities will increase collaboration with New Hampshire's towns and cities by building a community network of energy champions that includes municipal representatives, sustainability groups, energy committees, and economic development commissions.

7. **Expand Product and Service Provider Infrastructure.** During the 2021-2023 term, the NH Utilities will continue to expand point-of-sale (midstream) incentive offerings by working with distributors and equipment manufacturers to monitor and evaluate new and emerging technologies. In collaboration with regional distributors, the NH Utilities will conduct periodic refreshes and introduce technologies to align efforts with customer demand and emerging technologies.

8. **Stimulate Customer and Other Private Investment.** To encourage C&I customer investment in energy efficiency projects, the NH Utilities will continue to explore and evaluate financing mechanisms throughout the 2021-2023 term. For the Small Business Energy Solutions program, the NH Utilities will look to establish a permanent source of capital for financing energy efficiency projects.

3.1.2 C&I Programs

The NH Utilities have three statewide C&I Programs that deliver vital energy efficiency services, technical assistance, and incentives to New Hampshire's industrial, large commercial, municipal, and small business customers. Figure 3-1 details the 2021-2023 NHSaves C&I Programs.

Figure 3-1: 2021-2023 C&I Programs (Statewide)

- **Small Business Energy Solutions Program.** Small businesses are the backbone of the state's charm and economic development. This retrofit and new equipment & construction initiative offers technical expertise and incentives to small business customers who lack the dedicated staff, time, or resources to address energy costs. This program allows small business owners to achieve energy savings while continuing to invest their time and resources in the business market they're operating in, customer service, and innovation.

- **Municipal Program.** This NHSaves energy efficiency solution provides technical assistance and incentives to municipalities and school districts to help them identify energy-saving opportunities and implement projects. The Municipal program was established by legislation and is administered by the NH Electric Utilities and provides fuel-neutral opportunities for energy savings. The NH Natural Gas Utilities also service municipalities by seamlessly providing the same key services and incentives to towns and cities through the Small Business Energy Solutions and Large Business Energy Solutions programs.

  Energy efficiency programs help town and school officials reduce their buildings' high energy costs, often a large component of their operations and maintenance ("O&M") budgets. This allows these entities to reduce O&M budgets or redirect the savings toward other priorities.

- **Large Business Energy Solutions (Retrofit and New Equipment & Construction) Program.** The program offers technical services and incentives to assist large C&I customers who are retrofitting existing facilities or equipment, adding or replacing equipment that is at the end of its useful life, or constructing new facilities or additions.

In addition to the three statewide programs referenced above, Eversource implements a Large Business Energy Rewards Request for Proposal ("RFP") program.

Figure 3-2: C&I Programs (Eversource Only)

- **Large Business Energy Rewards RFP ("Energy Rewards") Program.** The Energy Rewards program encourages customers to propose energy efficiency projects through a competitive solicitation process.

Multifamily Offering

During the 2021-2023 term, the NH Utilities will continue to work with multifamily building owners to encourage investment in energy-efficient measures through both the NHSaves Residential and C&I Programs. The NH Utilities will create a standard offer for multifamily buildings which will include marketing sell sheets, presentations, and targeted incentives to reach this market segment. This will provide multifamily building owners an overview of the NHSaves Programs.

The Large Business Energy Solutions program will target multifamily buildings where there are common-area lighting and master-metered natural gas heat energy-saving opportunities. Tenant area energy-efficient measures (e.g., appliances, lighting, water-saving devices, plug load, etc.) will be served through the NHSaves Residential Programs. In addition, the NH Utilities will investigate creating a pathway for multifamily buildings over the next three-year period to incentivize comprehensive energy approaches that optimize the energy performance of common areas and tenant units.

3.1.3 Incentives

The NH Utilities are responsible for managing the overall energy efficiency budgets and for achieving an equitable distribution of program funds across customer types and market segments. To move customers to action once opportunities have been identified, the NH Utilities offer various financial incentives and resources that are calibrated to match customer investment criteria and reduce barriers to adoption, while maintaining cost effectiveness and minimizing costs of acquisition. Each of the NH Utilities may establish caps on the level of incentives offered by that utility to serve as guideposts for disbursing incentives.

3.1.4 Workforce Development

To scale up participation and drive deeper energy savings for the 2021-2023 NHSaves Programs, the NH Utilities and a consultant will develop a cohesive statewide workforce development strategy for understanding workforce development priorities and what training is needed for vendors, community action agencies, distribution contractors, building operators, and other energy efficiency stakeholders. For more information regarding the NH Utilities' planned workforce development strategy, see Chapter Nine.

3.1.5 Marketing and Outreach

During the 2021-2023 term, the NH Utilities will create standard offer marketing collateral packages (as described in Section 3.1.1.), including sell sheets and presentations designed to deliver C&I customers targeted, industry-specific information regarding energy-efficient incentive offerings that can help their business maximize energy savings, improve productivity, and reduce O&M costs.

In addition to the creation of the standard offer marketing collateral, the NH Utilities will market the C&I Programs through a variety of proven marketing channels, both directly to individual companies as well as broadly through a statewide marketing approach. These channels include but are not limited to: the NHSaves website, program promotional materials, direct mail, distributor engagement, e-mail, outbound calling, active social media campaigns, paid digital advertising, billboards, radio/TV/music streaming advertisements, trade shows, public relations efforts (statewide and utility-driven), providing presentations for and hosting energy efficiency trainings, forums, and events, and providing content for partners' blogs, newsletters, and websites.

3.1.6 Financing

The NH Utilities recognize that financing mechanisms are effective in encouraging C&I customers to invest in comprehensive energy efficiency projects, especially when combined with the NHSaves Programs' energy-efficient incentives. The NH Utilities currently offer several financing options, including on-bill financing and low-interest/interest-free loans, to commercial, municipal, and industrial customers. During the 2021-2023 term, the NH Utilities will continue to offer several financing options to encourage C&I customers to pursue comprehensive and cost-effective energy efficiency projects.

On-Bill Financing

All of the NH Utilities offer on-bill financing mechanisms for commercial, industrial, and municipal customers. On-bill financing mechanisms help reduce upfront costs and allow C&I customers to repay loans through their monthly natural gas or electric bills. Customers gravitate toward on-bill financing due to the simplicity in applying for loans, and the fact that repayment is typically treated as an operating expense rather than a capital investment. These financing tools allow for more comprehensive energy-saving projects by reducing cost and transaction barriers. These offerings, including flexible caps and repayment periods, depend upon the NH Utilities having sufficient capital available in on-bill loan pools.

The NH Utilities will continue to focus the marketing of on-bill financing towards small and medium businesses that are prone to face more significant barriers to access low-cost capital. Small business customers are more likely to commit to comprehensive energy-saving projects if they can overcome the upfront cost barriers of installing high-efficiency equipment and controls through on-bill, zero-percent interest loans.

Traditional On-Bill Financing

All NH Utilities offer a zero-percent on-bill financing revolving loan program to small business customers. Thanks to these programs, customers can install energy efficiency measures with no upfront costs and pay for them over time on their electric bills. Liberty Electric, Liberty Gas, Unitil Electric, and Unitil Gas also make on-bill loans available to municipal and large business customers. NHEC added $300,000 from Commercial carry over funds to its existing commercial on-bill revolving loan program for 2021.

Smart Start

Eversource and NHEC offer Smart Start tariffs, tied to the meter, on-bill repayments to municipal customers. This financial offering provides municipal customers with the opportunity to install energy-saving measures with no upfront costs and the ability to pay for the measures over time on their electric bill with the savings realized from lower energy costs. Municipalities reimburse their utility (Eversource or NHEC) through charges added to their regular monthly electric bill.[19] [20] The Smart Start charges are calculated to be less than or equal to the customer's estimated monthly energy savings. NHEC also offers Smart Start to commercial customers.

Additional Financing Offerings

In addition to on-bill financing offerings, the NH Utilities provide customers with or can connect customers to other options that can help them invest in energy efficiency. These include an online competitive loan platform (described below), as well as loan options offered by the Community Development Finance Authority ("CDFA"), the New Hampshire Business Finance Authority ("NHBFA"), and Property Assessed Clean Energy ("PACE") financing where available, and from other banks and lending institutions across the state.

[19] Eversource Delivery Service Tariff Rate SSP106 outlines the requirement for service under the SmartSTART financing option.

[20] NHEC pays all costs associated with the purchase and installation of approved energy efficiency measures. A SmartSTART Delivery Charge, calculated to be less than or equal to the monthly savings, is added to the member's monthly electric bill until all costs are repaid. NHEC's Delivery Service Tariff Rate SmartSTART SDC 107 outlines the requirements for service under the SmartSTART financing option.

Online Competitive Loan Platform

In 2019, the National Energy Improvement Fund ("NEIF") presented its online competitive loan platform to the NH Utilities and Financing and Funding Working Group. The NEIF platform can be utilized by energy efficiency installation contractors to better market their services by presenting a variety of financing options directly to the customer at the point of sale. By entering the customer's specific project details into the platform, the contractor can match the project with lenders willing and able to satisfy the lending needs of the customer. If the customer chooses to follow through with one of the loans included in the platform, a portion of their project incentive can be utilized to buy down the interest rate to zero percent. The customer and their contractor are able to explore an initial analysis of cashflow and paybacks to help them choose the best loan option. Eversource began including the loan platform as one element in the portfolio of financing supports to its vendors and C&I customers in 2019.

3.2 Small Business Energy Solutions Program

3.2.1 Program Objective

The NH Utilities' energy efficiency offering for small and midsize businesses is the Small Business Energy Solutions program. This is both a turnkey retrofit, and new equipment & construction initiative that provides small commercial customers with technical expertise and incentives to improve the energy performance of their businesses and facilities.

Many small business owners face a variety of needs and market barriers that limit or prevent them from pursuing energy efficiency opportunities. These needs and barriers include a shortage of capital resources, lack of staff dedicated to operations and facility issues, time, expertise or awareness of energy efficiency programs and opportunities, and splitting incentives between a building owner and the tenants. The Small Business Energy Solutions program helps identify electric and natural gas-saving opportunities and guides business owners through the energy efficiency process. This allows small business owners to focus on customer service, entrepreneurship, and creating a competitive niche within their market segments.

3.2.2 Target Market

Small and midsize energy users are the target market for the program, and specifically those customers who use less than 200 kW annual demand (electric) or 40,000 Therms (natural gas), which represent 97 percent of the NH Utilities' C&I customer accounts.

The small and midsize business market segment has a diverse set of customer types, including convenience stores, dry cleaners, office buildings, private schools, repair and professional services, restaurants, general and specialty retail stores, and commercially or master-metered multi-tenant facilities just to name a few.

Throughout the 2021-2023 term, the NH Utilities will continue to apply data analytics to identify underserved small business market segments and determine if new measures or tailored solutions should be employed to engage them in energy efficiency programs. These include small businesses that are in rural or hard-to-serve markets where energy efficiency contractors and program outreach have traditionally been limited.

3.2.3 2021-2023 Priorities

During the 2021-2023 term, the NH Utilities will expand the design of the Small Business Energy Solutions program to drive electric and natural gas energy savings and develop multiple pathways to engage the hard-to-reach small business customer in energy efficiency. This includes the following priorities:

Developing a Comprehensive Energy Efficiency Approach

The NH Utilities plan to deliver tailored, comprehensive solutions to small business customers and drive electric and natural gas savings beyond lighting measures. This will be a long-term effort testing various channels, incentive models, on-bill financing mechanisms, and strategies to identify what motivates customers and contractors toward implementing cost-effective, comprehensive projects. The NH utilities offer no-cost walk through project scoping audits. The NH Utilities will also continue to offer cost-sharing comprehensive audit expenses with small business customers in order to help reduce barriers related to exploring holistic energy efficiency solutions.

To encourage comprehensiveness in the Small Business Energy Solutions program, the NH Utilities are exploring a tiered incentive approach for the 2021-2023 term. The NH Utilities' tiered incentive design would package rebates based on delivered energy savings of an entire project, rather than the current prescriptive approach of incentivizing individual energy-efficient measures. To complement this approach, the NH Utilities will increase the number of contractor trainings on non-lighting measures, including HVAC equipment and controls, Wi-Fi thermostats, and building controls.

Incentivizing New Energy Efficiency Measures

With the diverse priorities of the state's small businesses, the NH Utilities recognize that varied business operations and needs require different equipment, systems, and "on ramps" to participate in energy efficiency. Throughout the 2021-2023 term, the NH Utilities will introduce new and emerging technologies to diversify the energy efficiency measure portfolio, including products such as high-efficiency VFDs for distribution systems, heat recovery ventilators ("HRVs"), and energy recovery ventilators ("ERVs"). The NH Utilities will look to align the state's energy-efficient product qualifications with other New England and neighboring states to create regional continuity.

For the 2021-2023 term, the NH Utilities will expand the program's point-of-service (midstream) distributor incentives now offered for commercial kitchen equipment (i.e., dishwashers, fryers, griddles, and ice machines) and HVAC equipment (i.e., heat pump water heaters ("HPWHs")) and gas water heating equipment. The NH Utilities will work to provide consistent qualified product offerings across all New England states and will also partner with distributors, equipment manufacturers, and the Massachusetts & Connecticut Technical Assessment Center to monitor and evaluate emerging energy-efficient technologies. This continual review will ensure that the NH Utilities are incentivizing up-to-date, energy-efficient solutions tailored to optimizing building performance and ensuring that distributors are stocking high-efficiency equipment.

Outreach Initiatives

Small businesses are the backbone of New Hampshire's economy and vital to local communities. In an effort to extend the reach of the Small Business Energy Solutions program, the NH Utilities will continue to employ outreach initiatives, such as Main Street efforts and community blitzes, to meet small and midsize C&I customers where they conduct business.

These outreach initiatives are collaborations between the NH Utilities and the cities and towns they serve to create small business communities engaged in saving energy. These efforts provide targeted communications and direct outreach to customers explaining the Small Business Energy Solutions program, its benefits, and what customers can do to begin their energy efficiency journey. Participating small business customers receive energy assessments and recommended energy efficiency solutions tailored to their business' needs, priorities, and energy-consuming equipment and practices. These marketing and outreach activities engage small business customers in NHSaves C&I Programs and efforts, thereby helping Main Street reinvest in employees, business operations, and the local economy. Please see Section 3.3.3 for more information about Main Street efforts and community blitzes.

3.2.4 Program Design

The NH Utilities are exploring segment- and facility-specific energy efficiency guides and standard offer marketing packages that enable small business customers and contractors to plan for more comprehensive energy-saving projects. In the 2021-2023 term, the NH Utilities will work with program contractors to develop these types of resources.

Small business customers are offered a number of channels to participate in the NHSaves C&I Programs and throughout the 2021-2023 term the NH Utilities will continue to simplify this process. For instance, small business customers can install high-efficiency lighting through multiple pathways, including: direct installation by program contractors, applying for downstream rebates for prescriptive and custom projects, and receiving midstream rebates. The NH Utilities will continue to look for new pathways to better align with contractor distribution models and customer engagement within the small business market segment.

As noted in the C&I Program priorities section (3.1.3), during the 2021-2023 term, the NH Utilities will create standard offer marketing collateral, including sell sheets and presentations, to provide targeted small business market segments with specific information and incentives tailored to their market's end-use systems and equipment. For example, a food and grocery store sell sheet would identify the incentives for commonly-incentivized measures, such as high-efficiency lighting and controls, HVAC systems and controls, and commercial refrigeration equipment.

In addition, the NH Utilities will focus efforts on developing the state's workforce to increase program participation and encourage comprehensive, cost-effective efficiency projects. The Small Business Energy Solutions program, like the other NHSaves Programs, is dependent upon a well-trained and customer-oriented contractor network to promote its benefits, energy-efficient measures, incentives, financing mechanisms, and to help identify tailored solutions for New Hampshire's small business community.

Incentives

The program provides incentives to customers to encourage the implementation of cost-effective, energy efficiency projects. For the 2021-2023 term, the Small Business Energy Solutions program will continue to develop and refine measure initiatives over time. There are two types of incentives for energy-efficient measures—prescriptive and custom.

- **Prescriptive Incentives.** These incentives are fixed-price rebates for pre-qualified energy efficiency measures and are designed to streamline the process for customers who are installing common technologies.
- **Custom Incentives.** These incentives are flexible and allow customers to determine if a non-standard (not on the prescriptive list or overly complex) energy efficiency measure is cost effective. These types of incentives rely on engineering calculations to evaluate cost effectiveness and determine energy savings. As these incentives are more customer centric, custom rebates allow for more comprehensive energy efficiency projects that are tailored and unique to a particular small business. Custom projects are reviewed on a case-by-case basis and may require a technical study to present the planned energy savings and project costs.

For the 2021-2023 term, the NH Utilities will implement a tiered incentive level design for comprehensive energy efficiency projects with multiple measures. For lighting projects beyond fixture replacements only, incentives may be increased to account for greater savings derived by the addition of one or more control strategies. For projects that have a minimum of one or more non-lighting end uses with each end-use defined as a natural gas or electric measure impacting heating, cooling, lighting, process, domestic water heating, refrigeration, motors and drives, etc., incentives could be enhanced for each additional measure that increases savings beyond that single measure. Savings from each additional measure must be significant enough to warrant the additional incentives.

In addition, the Small Business Energy Solutions program may offer higher incentive levels for small microbusinesses, nonprofits, or customers in rural areas to broaden the NH Utilities' reach into hard-to-serve and underserved markets.

Measures

Throughout the 2021-2023 term, the NH Utilities will continuously look for new energy efficiency measures to incentivize through the Small Business Energy Solutions program. This will include reviewing new and emerging technologies, such as controls, evaluated by the Massachusetts and Connecticut Technical Assessment Center.

The program will provide incentives for prescriptive high-efficiency equipment, including, but not limited to: air compressors, commercial kitchen equipment (e.g., dishwashers and ice machines), electric HVAC equipment (e.g., heat pumps and unitary air conditioners), HVAC controls, LED lighting, lighting controls, motors, spray rinse valves, variable speed drives ("VSDs"), water heating equipment, and Wi-Fi thermostats.

Throughout the three-year plan, the NH Utilities will pursue more comprehensive projects that look at energy efficiency as a long-term journey for the small business customer. This new approach can include a tiered incentive structure encouraging the installation of non-lighting measures in small business customers' buildings and facilities. To deliver tiered incentive measures the NH Utilities will collaborate with energy service companies and other turnkey service providers who have staff or sub-contractors capable of installing multiple energy efficiency measures.

Custom measures will include but are not limited to: energy management systems and controls, insulation and air sealing, integrated air compressors, specialized equipment (e.g., polymer bead washing machines), and industrial process equipment.

Multiple Program Pathways

The Small Business Energy Solutions program is designed to provide hard-working small business owners with multiple pathways to engage in energy efficiency. These options allow the NH Utilities to broaden program reach to the different market segments, business sizes, and customer types that fall under the "small business" umbrella. Whether a small business is replacing failed or end-of-life equipment, has aging, inefficient equipment and systems, or is planning for a major renovation or new construction project, there is a program option allowing customers to choose an energy-efficient solution designed for them.

The program's pathways include turnkey direct-installations, customer-directed installations, and midstream incentives.

Turnkey Direct Installations

Turnkey direct installation is the program's simple, easy-to-use pathway that removes the initial barriers to energy efficiency (e.g., time, shortage of capital resources, and expertise or awareness of energy efficiency opportunities) and delivers solutions to small business customers. Professional trade ally contractors perform an initial assessment of the small business and its existing equipment at no cost to the customers. Then, the contractors recommend energy-efficient improvements, and directly install customer-approved measures, including, but not limited to: hot water-saving measures, LED lighting and controls, programmable Wi-Fi thermostats, commercial refrigeration measures, spray rinse valves, and weatherization measures.

As program administrators, the NH Utilities establish the pricing of energy-efficient measures, approve comprehensive custom projects, review energy savings proposals, and issue incentives. Contractors are paid directly for the incentive portion of approved energy efficiency projects: ensuring upfront costs are not a barrier to small business customer participation. The NH Utilities and energy efficiency contractors work with business owners to guide them through the program's processes, determine which prescriptive and custom measures can be installed, and assess how each business can optimize its facility's energy performance. In addition to routine marketing efforts, the NH Utilities promote the Small Business Energy Solutions program through Main Street efforts and community blitzes.

Customer-Directed Installations

To streamline and increase participation, the NH Utilities also encourage customer-directed installations (measures installed by the customers' vendors of choice) of energy-efficient equipment through prescriptive incentives for common, pre-qualified measures.

Midstream Incentives

Midstream (point-of-sale) incentives encourage distributors to stock and promote energy-efficient equipment and systems, including, but not limited to lighting, HVAC, commercial kitchen, and water heating equipment. The midstream rebate approach is an effective way to impact the broader marketplace and influence what distributors purchase and make available throughout their product inventory. Midstream rebates increase the availability of energy-efficient products in the marketplace, streamline the transaction process for the customer (i.e., no rebate forms), and play a critical role in encouraging program participation and increasing energy savings.

3.2.5 Program Budget and Goals

Table 3-1: Small Business Energy Solutions Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$18,256,109	$23,519,869	$26,472,350	**$68,248,328**
Annual kWh Savings	44,565,529	51,966,852	57,983,341	**154,515,722**
Lifetime kWh Savings	578,904,251	677,515,283	761,818,067	**2,018,237,600**
kW Reduction	5,305	5,725	6,234	**17,264**
No. of Participants	6,106	5,851	5,186	**17,143**
Natural Gas Programs				
Program Budget	$2,170,666	$2,490,353	$3,149,503	**$7,810,522**
Annual MMBtu Savings	34,139	38,422	43,814	**116,374**
Lifetime MMBtu Savings	574,867	647,631	738,300	**1,960,797**
No. of Participants	1,211	1,287	1,383	**3,881**
Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.				

3.3 Municipal Program

3.3.1 Program Objective

The Municipal program was established by legislation to focus RGGI energy efficiency revenues on New Hampshire's towns and cities and is administered by the NH Electric Utilities.[21] The objective is to help local communities to better identify, plan, and implement energy efficiency projects to help reduce the energy intensity and operating costs of municipal and school buildings. This turnkey retrofit and new construction program provides incentives and technical assistance to municipalities and school districts replacing existing equipment with high-efficiency alternatives, installing new equipment or systems, or planning major renovation or new construction projects. In addition, the program provides fuel-neutral weatherization services for existing municipal buildings to help reduce energy costs and promote comprehensive energy-saving projects.

The municipal sector (municipal and school buildings) is a large and important customer segment of the NH Utilities. Energy-efficient projects allow New Hampshire's towns and cities to reduce their operational costs and shift energy bill-related funds toward other priorities. The Municipal program is a close collaboration among the NH Electric Utilities, municipal representatives, and citizen stakeholders, including community energy committees.

The program's effective design allows the NH Electric Utilities to help municipal representatives and staff eliminate unique market segment barriers to planning and implementing energy efficiency projects. These barriers include a shortage of time, expertise or awareness of energy efficiency programs and opportunities, and the number of dedicated staff for facilities and operations. In addition, municipalities face other barriers that limit participation in energy efficiency programs, including the short operating hours of municipal buildings (resulting in reduced cost-benefit savings),

[21] RSA 125-O:23. Available at: http://www.gencourt.state.nh.us/rsa/html/X/125-O/125-O-23.htm. NH Senate Bill 123 ("SB 123") requires that the NH Electric Utilities ensure municipal customers have priority access to these funds. If after four months however, program funding is not fully allocated, the dollars will be offered to other business customers who contribute to the Systems Benefit Charge. This legislatively-directed funding for the Municipal program goes specifically to the NHSaves Electric programs and not the NHSaves Natural Gas programs.

the long-term budgeting and approval process of towns and cities for capital improvements, and the cyclic electoral turnover of municipal representatives.

3.3.2 Target Market

Municipalities and school buildings are the target market for the Municipal program, including both large and small energy users. The Municipal program covers a diverse array of energy-efficient projects, ranging from large comprehensive school district upgrades to small wastewater facility renovations. The program provides technical assistance and incentives to encourage comprehensive and fuel-neutral energy savings from electric, oil, and propane municipal customers. All municipal and local government energy efficiency projects are eligible to participate in the program, including local governments with municipal utilities, such as Ashland, Littleton, New Hampton, Wolfeboro, and Woodsville.

While the Municipal program is administered by the NH Electric Utilities, the NH Natural Gas Utilities provide the same C&I rebates, technical assistance, and financing to municipalities; however, these are offered through other NHSaves C&I Programs. The NH Utilities work closely together to ensure that the process for municipalities to participate in energy efficiency projects, regardless of electric, natural gas, or other fuel measures, is uniformly accessible.

3.3.3 2021-2023 Plans

For the 2021-2023 term, the NH Electric Utilities are considering a number of innovative approaches to expand the Municipal program’s reach and energy savings. These include:

Increasing the Comprehensiveness of Municipal Projects

For the 2021-2023 term, the Municipal program will continue to pursue more comprehensive projects in municipal and school buildings, including potentially offering a new tiered incentive design to encourage the installation of multiple, non-lighting energy-efficient measures. If implemented, this proposed incentive design change would increase energy savings for municipal customers and drive comprehensiveness in school and town building renovation and new construction projects.

The NH Utilities will explore splitting comprehensive energy audit costs with municipal customers. Currently, these costs are seen as an upfront barrier to municipalities and school districts that prefer funds to be directed toward short-term energy fixes rather than long-term energy planning and solutions. Municipal capital projects involve long-term planning and goals which do not always align with the current annual savings goals for the NHSaves C&I Programs. For the 2021-2023 term, the NH Utilities will encourage long-term projects that consider comprehensive, multi-measure and multi-year energy solutions rather than short-term, energy-efficient fixes. This effort will involve the NH Utilities encouraging program contractors to shift toward multi-year strategies and energy savings goals, rather than annual goals, and encouraging process improvements.

In addition, the NH Utilities will increase the number of contractor trainings on non-lighting energy-efficient measures, such as commercial kitchen equipment, HVAC systems and controls, commercial refrigeration measures, programmable Wi-Fi thermostats, and VFDs. This will increase contractor awareness and education regarding new and emerging technologies that can help them customize energy solutions for a municipality's needs.

Engaging Municipalities and New Hampshire Communities in Energy Efficiency

Continuing for the 2021-2023 term, the NH Utilities remain committed to increasing collaboration with municipalities and building a community network of energy champions that includes sustainability groups, community energy committees, and economic development commissions from across the state. Municipalities with energy-efficient town and school buildings serve as sustainable role models, educating and empowering citizens and businesses to participate in NHSaves Residential and C&I Programs.

The NH Utilities will continue to work with the Community Relations and Account Executive departments to engage municipal leaders to help identify appropriate energy champions within that community. Outreach will also be conducted by leveraging existing relationships already developed through the local energy committees.

Main Street Efforts

In 2020, the NH Utilities initiated the Main Street efforts. This unique initiative allows the NH Utilities to focus outreach efforts on specific neighborhoods and to provide personal attention to the small businesses and smaller town and city accounts in that community. Initially, the NH Utility that serves the community will partner with a municipality to lead an “energy blitz” campaign to educate local businesses about the NHSaves C&I Programs, energy-saving measures, incentives, and financing tools that can help reduce energy consumption and save money. The applicable NH Utility will send out communications to the targeted community letting it know about the Main Street campaign in the community, including specifics regarding its duration, objectives, program partners, and how a small business can engage in energy efficiency.

Then, an NH Utility-authorized contractor will perform a no-cost energy assessment of businesses to identify energy-saving opportunities, such as high-efficiency lighting and controls, Wi-Fi thermostats, occupancy sensors, and commercial refrigeration measures and controls. During the assessment some of these measures are immediately installed, while larger energy-saving projects, such as new HVAC systems and controls, are scheduled for direct installation at a later date.

During the 2021-2023 term, the NH Utilities plan to continue Main Street efforts and offer increased incentives for micro-businesses, small town and city accounts, such as libraries and town halls. These efforts will be supported by direct outreach through NH Utilities’ employees who work closely with municipalities and energy committees to leverage partnerships with chambers of commerce, Main Street groups, and affinity groups (e.g., NH Lodging & Restaurant Association, NH Grocers Association, NH Manufacturing Extension Partnership, etc.) to conduct more aggregated campaigns rather than single-customer marketing activities. Main Street efforts will also utilize the new standard offer materials to provide targeted marketing collateral to market segments and microbusinesses typically not targeted by the C&I Programs’ turnkey vendors.

To ensure that the NH Utilities are strategically focusing Main Street efforts, the NH Utilities will look to establish a steering committee comprised of municipalities, energy committees, stakeholders, and community partners during the 2021-2023 term. This steering committee will help the NH Utilities establish a clear set of guidelines for selecting (i.e., qualifying) a community for Main Street efforts to ensure its efficacy and cost-effectiveness.

Additional Municipal Engagement

In addition, the NH Utilities will explore ways to enhance municipal engagement by providing technical assistance and project management support for towns and cities with limited or no facility operations staff. Efforts will be made to help guide small and rural towns and cities through the energy efficiency process and provide education on the programs and incentives. The NH Utilities will provide additional technical assistance to help municipal customers review proposals, implement long-term planning, develop sustainable procurement policies, and how to discuss projects with the community at town and school board meetings. This increased technical assistance, combined with additional workforce development and the new Granite State benefit-cost test will allow less cost-effective projects (small municipal buildings with lower operating hours) to be implemented in rural and small towns across the state.

Increasing Number of Comprehensive Fuel Neutral Projects

The Municipal program is funded by RGGI to deliver fuel-neutral measures to New Hampshire's town and city buildings, facilities, and schools. During the 2021-2023 term, the NH Utilities stand ready to adjust programs if RGGI funding changes to help the state's municipalities save energy and money. Therefore, the NH Utilities will plan accordingly to increase the number of fuel-neutral projects in school districts through enhanced incentives for comprehensive energy efficiency solutions, including air sealing, insulation, and HVAC equipment and control measures. If RGGI funding is exhausted, the NH Utilities will work with the municipality to offer solutions through the other C&I Programs.

3.3.4 Program Design

The Municipal program covers a diverse array of building types, such as school buildings, town offices, public works facilities, police and fire stations, and libraries. For the 2021-2023 term, the NH Utilities will offer an array of C&I solutions, incentives, technical assistance, and financing options to support the state's municipalities in implementing energy-efficient projects. Similar to the other NHSaves C&I Programs, the Municipal program focuses on providing seamless pathways for customers to participate in energy efficiency projects. Though programs, measures, and incentives are detailed in the 2021-2023 Plan, the NH Utilities work with municipalities to present efficiency solutions tailored to them.

The NH Utilities are consistently looking for new ways to simplify the process for municipal customers and contractors to engage in energy efficiency. Municipal customers have several pathways to install high-efficiency lighting, including direct install, downstream rebates for prescriptive and custom projects, and upstream rebates. In addition to the direct-install option, the NH Utilities envision a new mid-size comprehensive model for municipal customers. The NH Utilities have also moved certain existing downstream offerings upstream, such as commercial kitchen equipment to make a municipality's participation seamless. Throughout the 2021-2023 term, the NH Utilities will continue to develop new pathways to better align with contractor distribution models and customer engagement within the municipal market segment.

Incentives

Similar to Small Business Energy Solutions, the Municipal program offers prescriptive and custom incentives to encourage towns and cities to implement energy efficiency projects.

Prescriptive Incentives

Prescriptive incentives allow customers to select measures from a pre-qualified energy-efficient measure list and receive a set rebate amount to cover the incremental cost of installing a high-efficiency measure rather than a standard product. Municipal customers can receive prescriptive incentives through turnkey contractors (see Program Pathways section) if they are installing standard energy-efficient measures.

Custom Incentives

The Municipal program also offers custom incentives that are determined based on engineering calculations and analyses. By offering custom incentives, the NH Utilities encourage customers to consider tailored solutions to reduce the energy intensity of their town's or school district's buildings and facilities. Custom incentives encourage long-term comprehensive projects that drive energy savings, reduce capital and operational budgets, and increase the rate of return on a municipality's energy-efficient investment. The NH Utilities review and evaluate each project's technical studies and analyses on a case-by-case basis to determine the custom incentive amount.

Targeted Incentives

In addition to prescriptive and custom measures, the Municipal program provides targeted incentives to encourage New Hampshire's towns and cities to commit to energy efficiency projects. For public school buildings, NHSaves Programs offer energy-efficient school incentives of up to 100 percent of the incremental cost of new equipment and new construction projects to assist buildings to improve indoor air quality.[22] As referenced earlier in this section, the Municipal program offers fuel-neutral incentives for the installation of energy-efficient measures, such as boilers, HVAC systems and equipment, and weatherization measures.[23] This is in addition to the custom, prescriptive, or energy-efficient school incentives given for the installation of electric and natural gas-saving measures.

Financing Products and Incentive Structure

In addition to incentives, the NH Utilities provide on-bill financing and other financing products which allows municipalities to pay for a project out of O&M budgets (i.e., monthly utility bill): not requiring the towns and cities to secure additional approvals, bonding, or ballot measures.

For the 2021-2023 term, the NH Utilities are exploring a more flexible incentive structure that can calibrate incentive levels to meet the customer's benefit-cost decision making based on the customer's business needs. This portfolio-level view of cost effectiveness will allow for program review of municipal projects that historically may not have qualified due to cost-effectiveness barriers, such as low operating hours or other extenuating circumstances.

[22] RSA 374-F.4 VIII(a): Electric Utility Restructuring Act, 1996. VIII-a. Any electric utility that collects funds for energy efficiency programs that are subject to the Commission's approval, shall include in its plans to be submitted to the Commission program design, and/or enhancements, and estimated participation that maximize energy efficiency benefits to public schools, including measures that help enhance the energy efficiency of public school construction or renovation projects that are designed to improve indoor air quality. The report required under RSA 374-F:4, VIII(f) shall include the results and effectiveness of the energy efficiency programs for schools and, in addition to other requirements, be submitted to the commissioner of the department of education.

[23] Note: Very few fuel-neutral incentives for boilers and furnaces are issued on an annual basis. As natural gas is not available in many areas of the state, the NH Utilities see oil and propane as the only option for older municipal buildings without incurring extensive weatherization upgrades to cost-effectively support electric heating technologies, such as heat pumps.

To encourage comprehensiveness in the program, the NH Utilities may implement a pay-for-performance approach. This would include the creation of a tiered incentive system that packages rebates based on delivered energy savings of an entire project, rather than the current prescriptive approach of incentivizing specific energy-efficient measures. In addition, the NH Utilities may increase incentive levels for remote towns and allow non-turnkey vendors to implement Municipal program services in hard-to-serve areas. To complement these incentive approaches, the NH Utilities will increase the number of municipal contractor trainings on non-lighting measures, such as HVAC equipment and controls, programmable Wi-Fi thermostats, and air compressors.

Measures

During the 2021-2023 term, the Municipal program will provide incentives for both high-efficiency prescriptive and custom measures. Over the next three-year period, the NH Utilities will pursue more comprehensive projects that consider energy efficiency from a long-term perspective. The program's new comprehensive incentive design will incentivize turnkey, performance contracting, and direct-install contractors (see Multiple Program Pathways section below) to install non-lighting measures in municipal buildings and facilities.

Prescriptive Measures

The program will provide incentives for the following prescriptive measures: high-efficiency equipment including but not limited to: aerators, air compressors, electric commercial kitchen equipment (e.g., dishwashers and ice machines), electric HVAC equipment (e.g., heat pumps and unitary air conditioners), HVAC controls, HPWHs, LED lighting and controls, motors, spray rinse valves, VSDs, water heater pipe wrap, water-heating equipment, and Wi-Fi thermostats.

Custom Measures

Custom measures will include, but are not limited to: energy management systems, HPWHs, insulation and air sealing, commercial refrigeration equipment, water heating equipment, and weatherization measures.

Multiple Program Pathways

The NH Utilities have designed the Municipal program to provide New Hampshire's towns and cities with multiple pathways to participate in energy efficiency projects. They have developed a robust trade ally network of equipment distributors and installers, energy assessors, engineering and commissioning firms, and energy service companies to drive energy efficiency projects across New Hampshire's towns and cities. The NH Utilities rely on the technical and project management expertise of contractors to work effectively with municipalities to aggregate energy-saving projects, determine the best energy efficiency solution for the town or city, and analyze how incentives and financing mechanisms can help make the project feasible and affordable.

Turnkey Vendor Installations

The program's turnkey vendor installation pathway connects municipalities with experienced trade allies who can help design, develop, and install prescriptive measures for town buildings or facilities. This pathway is an effective streamlined mechanism that provides municipalities with professional trade allies who perform initial assessments of municipal or school district buildings and make energy-efficient recommendations. The NH Utilities work with the contractors to determine pricing, approve energy savings proposals, and help municipalities prioritize the projects with the best payback. Contractors are paid directly for the incentive portion of approved energy efficiency projects: ensuring that upfront costs are not a barrier to municipalities participating in the program. During the 2021-2023 term, the NH Utilities will continue to increase the availability of turnkey vendors' schedules and expand Main Street efforts and community blitzes.

Customer-Directed Installations

To streamline and increase participation in the Municipal program, the NH Utilities encourage customer-directed installations of energy-efficient equipment through prescriptive incentives for common, pre-qualified measures. This includes midstream rebates, incentives that encourage distributors to stock and promote energy-efficient equipment and systems, including, but not limited to HVAC, commercial kitchen, and water heating equipment. Midstream rebates allow distributors to offer incentives directly to customers and offers flexibility to non-turnkey vendors to participate in

NHSaves C&I Programs. This also streamlines the program for the NH Utilities, as many distributors operate in multiple states, allowing for coordination and common points of contact.

The NH Utilities provide technical assistance to municipal customers with limited energy efficiency expertise or resources to guide them through the project process. This assistance includes showing municipalities how to understand an energy audit's findings, determining which energy-efficient solutions are right for the town's needs, and how to leverage incentive and loan options to finance projects. For the 2021-2023 term, the NH Utilities will continue to provide technical assistance for specialized assessments of historical buildings, such as building shell or HVAC system audits.

Over the past few years, the NH Utilities have observed an increased interest in performance contracting by school districts and municipalities. For the 2021-2023 term, the Municipal program will continue to support performance contracting as it spurs comprehensiveness in projects and is a streamlined guided energy efficiency pathway for municipalities and school districts. The NH Utilities will also continue to service wastewater treatment facilities through a partnership with the New Hampshire Department of Environmental Services to implement audit findings and recommendations identified as part of a prior three-year US Department of Energy ("US DOE") grant. This grant funded comprehensive energy audits and benchmarking (analysis of energy performance of a building).

Contractor and Customer Education

To encourage participation in the program and comprehensiveness, the NH Utilities will continue to offer contractor and customer education opportunities, including Builder Operator Certification ("BOC") training, energy code training, and workshops. BOC training helps municipal facility managers learn to efficiently manage town and school building operations and helps connect NH Utility employees with municipal points of contact. The NH Utilities will also participate in affinity group conferences during the 2021-2023 term.

3.3.5 Program Budget and Goals

Table 3-2: Municipal Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$1,955,558	$1,955,089	$1,961,055	**$5,871,702**
Annual kWh Savings	3,769,585	3,520,545	3,409,955	**10,700,086**
Lifetime kWh Savings	52,433,933	50,268,690	48,703,610	**151,406,233**
kW Reduction	504	448	451	**1,404**
No. of Participants	227	224	220	**672**
Note: kWh = kilowatt hours, kW = kilowatts.				

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3.4 Large Business Energy Solutions Program (Retrofit and New Equipment & Construction)

3.4.1 Program Objective

New Hampshire's energy efficiency solution for large C&I customers is the Large Business Energy Solutions program. The program provides custom and prescriptive incentives to large C&I customers who are retrofitting existing facilities or equipment (Retrofit Pathway) or constructing new facilities, installing new equipment, or replacing equipment that is at the end of its useful life (New Equipment & Construction Pathway). The NH Utilities' energy efficiency staff, key account representatives, and energy service contractors work collaboratively with customers to design, build, and retrofit large C&I facilities to optimize energy performance. Energy-efficient projects can provide numerous benefits for large C&I customers, including reduced operating costs, increased productivity, improved comfort of employees and customers, and enhanced building air quality.

3.4.2 Target Market

Large C&I energy users are defined as customers who have an average annual demand of 200 kW or greater for electric customers and 40,000 Therms or greater for natural gas customers. The program serves large C&I customers who are replacing failed equipment, addressing aging, inefficient equipment and systems, or who are planning new construction or major renovation projects.

The target market segments for the Large Business Energy Solutions program include commercial real estate, healthcare facilities, higher education, hotels, manufacturers, national retail chains, private schools, ski resort areas (snowmaking), and large retail facilities. These large C&I customers typically have in-house sustainability and energy efficiency expertise and are primarily interested in reducing operating costs and eliminating waste.

In addition to focusing on large C&I energy users, the NH Utilities also target building developers, architects, and design teams through the New Equipment & Construction pathway. Working with design and building firms early in the process allows the NH Utilities to work with architects to promote and incorporate energy efficiency at the drawing board.

To optimize large C&I customer participation during the 2021-2023 term, the NH Utilities will continue to consider these customers' unique seasonal, organizational decision-making constraints. A recent New Hampshire Energy Efficiency Market Assessment ("Market Assessment") determined the decision-making constraints of four large C&I market segments and identified recommendations for the NHSaves Programs.[24] The NH Utilities will employ this research to create standard offer marketing packages to these large C&I customer segments:

- **Large National Retail Chains.** Decisions regarding energy efficiency are made at the national and regional level for large national retail chain stores. The Market Assessment noted that it was essential for the NH Utilities to maintain strong key account representative relationships and to coordinate efforts with other regional utility partners to promote energy efficiency.
- **Large Manufacturers.** The large manufacturing segment is a highly-competitive space focused on cost-cutting measures that increase productivity and output and give businesses an advantage over competitors. The decision-making process for large manufacturers is often decentralized and all levels of the business offer energy efficiency opportunities. The NH Utilities will maintain strong account representative relationships and highlight cost-saving measures to this market segment.
- **Municipal and Higher Education.** The decision-making process for these organizations is highly structured, long term, and time consuming. Large-scale projects are often considered with this market segment, increasing the potential for comprehensive energy-saving measures.
- **Seasonal Operations.** This market segment includes resorts, hotels, and manufacturing firms with cyclic down periods and limited operations. It is important to market these types of businesses during their respective off-seasons, so that energy efficiency investments will not interfere with business operations.

[24] Navigant Consulting. *New Hampshire Energy Efficiency Market Assessment*. Apr. 19, 2019 presentation. Available at: https://www.puc.nh.gov/EESE%20Board/Meetings/2019/0419Mtg/20190419-EESE-Board-NHSaves-Market-Assessment-Presentation.pdf.

The NH Utilities are exploring segment- and facility-specific energy efficiency guides and standard offer marketing packages that advise large C&I customers and contractors to plan for more comprehensive energy-saving projects. In the 2021-2023 term, the NH Utilities will work with contractors to develop these types of resources.

3.4.3 2021-2023 Retrofit Pathway

The Retrofit pathway incentivizes large C&I customers to replace existing, functioning equipment or systems with high-efficiency measures. The incentives cover a portion of the installed cost to purchase the energy-efficient measure, thus deeming it an acceptable return on investment for large companies and facilities. The NH Utilities are considering introducing several initiatives and design approaches to the 2021-2023 Large Business Energy Solutions program's Retrofit pathway. These changes include increasing contractor education and training, strengthening trade ally relationships, focusing on retro-commissioning equipment and systems performance, and delivering tailored solutions to targeted C&I market segments.

Promoting Retro-commissioning and Systems Performance Optimization

For the Retrofit pathway, the NH Utilities will introduce multiple channels to retro-commissioning during the 2021-2023 term. This includes offering low-cost prescriptive tuning measures, such as resetting water and air temperature for cooling systems and adjusting pump and fan schedules. The Retrofit pathway will also introduce financial assistance to help defray the cost of technical assistance to facilitate targeted systems tuning and process tuning to help meter and monitor energy savings for targeted system optimization. In addition, the NH Utilities will introduce a Whole Buildings and Process Tuning channel to the Retrofit pathway that will target facilities with existing functioning control systems.

Develop Tailored Services and Delivery Models for Market Segments

For the 2021-2023 term, the NH Utilities will continue to develop segment-specific services and delivery models to target large C&I market sectors. For the Manufacturing sector, the NH Utilities will focus on promoting and incentivizing air compressors and chiller optimization as an entry point to work with new manufacturing customers. Air compressors and chillers provide highly cost-effective savings and the NH Utilities have found that the existing marketplace for these technologies is focused on selling high-efficiency components to large C&I customers. Once air compressors and chillers are installed, large C&I customers are encouraged by the cost-effective energy savings to participate in deeper energy efficiency projects, such as boiler optimization, process optimization, refrigeration measures, and VFDs. For the 2021-2023 term, another critical focus of the Large Business Energy Solutions program is retro-commissioning: encouraging contractors to look holistically at entire building systems rather than individual system components.

For the Healthcare sector, the program will focus on promoting the adoption of high-efficiency HVAC technologies and controls, water heating equipment, and commercial kitchen equipment. For the Retail sector, the NH Utilities will direct customers to advanced lighting and controls, commercial refrigeration equipment, and HVAC equipment and controls.

The NH Utilities have identified that tenant fit-outs and HVAC equipment are customized solutions for the Real Estate Management sector. For franchise businesses, the NH Utilities will continue to market high-efficiency commercial kitchen equipment, hot water equipment, HVAC equipment and controls, interior and exterior lighting and controls, and commercial refrigeration equipment to this customer segment.

3.4.4 New Equipment & Construction Pathway

The New Equipment & Construction pathway incentivizes major renovation and new construction projects, as well as the replacement of failed existing equipment or equipment at the end of its life with high-efficiency units. The NH Utilities created this pathway to encourage design teams, facility managers, and building owners to move beyond minimum building code compliance and integrate high-efficiency technologies and optimized building systems early in the design stage.

The program's New Equipment & Construction pathway allows the NH Utilities and contractors to reinforce the value that energy-efficient measures and design create for large C&I customers, including reduced energy costs, improved comfort of the building space, and increased worker productivity. It is vital that the NH Utilities and efficiency stakeholders play a role with new construction and renovation projects to ensure that incentives and the benefits of energy-efficient methods are considered at each of the design stages. Including the NH Utilities and efficiency contractors in cost-and-design deliberations with building owners and design firms will ensure that the Large Business Energy Solutions program's incentives and technical assistance are fully considered and not removed in an effort to reduce project costs.

For the 2021-2023 term, the NH Utilities are considering introducing several initiatives and design approaches to the New Equipment & Construction pathway, including revamping pathway offerings, expanding midstream rebate offerings, increasing trade ally education and trainings, and exploring opportunities to integrate Combined Heat and Power ("CHP") systems with energy-efficient projects.

Introduce New Equipment & Construction Pathway Offerings

The NH Utilities will revamp the New Equipment & Construction pathway during the 2021-2023 term through the creation of four new paths:

1. Deep Energy Savings and Lower Energy Use Intensity;
2. Whole Building with Modeled Savings;
3. Simplified Whole Buildings Worksheet Model; and
4. Systems and Measures.

Deep Energy Savings and Lower Energy Use Intensity Pathway

The NH Utilities will introduce a Deep Energy Savings and Lower Energy Use Intensity ("EUI") path over the next three-year period. The EUI path is designed to encourage new construction projects with a target of zero net energy or zero net emissions. For the 2021-2023 term, the NH Utilities are exploring offering a building commissioning incentive.

Whole Building with Modeled Savings Pathway

The second path is the Whole Building with Modeled Savings path that is designed to provide intensive technical assistance and support for large C&I new construction and equipment projects. Customers will be guided through the decision-making process in determining the correct energy-efficient measures or designs that are right for their business' needs and priorities. Large C&I projects require a collaborative planning process that utilizes the expertise of architects, design teams, and contractors—often via a design charette. The Whole Building with Modeled Savings path will provide charette support, mid-design feedback, and guidance regarding setting EUI targets.

Simplified Whole Buildings Worksheet Model Pathway

The Simplified Whole Buildings Worksheet Model is the third path introduced for the 2021-2023 term. This path is being introduced for fast-paced design and build projects and will require simplified spreadsheets versus detailed energy models.

Systems and Measures Pathway

The fourth and final new path being introduced in 2021-2023 is the Systems and Measures path that will focus on capture projects in the late design stages. This path will integrate existing prescriptive and custom incentives, and the NH Utilities will provide technical assistance services typically not available for these fast-paced projects.

Expand Program Offerings

The NH Utilities are consistently looking for new ways to simplify the process for C&I customers to engage in energy efficiency including offering different incentive models and pathways. For example, large C&I customers who install high-efficiency lighting can participate through downstream incentives for prescriptive and custom projects, and the NH Utilities can shift downstream offerings upstream, such as commercial kitchen equipment. Throughout the 2021-2023 term, the NH Utilities will continue to develop new pathways and incentives to better align with contractor distribution models and customer engagement to better serve the large C&I customer market segment.

Similar to other C&I solutions, the Large Business Energy Solutions program is focused on expanding the availability of midstream offerings to increase the availability of, and stocking of, high-efficiency technologies. For the 2021-2023 term, the NH Utilities will expand beyond the lighting market to support new midstream incentives for commercial kitchen equipment and HVAC equipment, including HPWHs and high-efficiency condensing units. The NH Utilities will use the results of the Energy Efficiency Baseline and Potential study (see Chapters 10 and 11) as a guide to determine which technologies still have significant opportunities. The NH Utilities will continue to collaborate across the New England region to influence distributors to stock high-efficiency equipment.

In 2020, the NH Utilities added commercial kitchen and HVAC equipment to midstream offerings. During the 2021-2023 term, the NH Utilities will continue to actively evolve midstream initiatives to capitalize on multiple measures.

Support CHP System Installations

In 2021-2023, the NH Utilities will continue to explore opportunities to incentivize CHP projects to target market segments with high-energy requirements for heat and power. CHP equipment uses waste heat from a building's generator for thermal needs, such as space heating or hot water. These types of projects have long lead times, typically one to three years, requiring a long-term commitment from participating customers.

Though any input fuel can be used with CHP projects, generally natural gas is the preferred choice due to the reliability of the equipment, less GHG emissions emitted, and the low cost of fuel. Other fuels could include liquid natural gas, propane, diesel, or biomass. CHP can also be used as a demand reduction resource and as a back-up generator. Typically, the market segments that are viable candidates for CHP include: hospitals, hotels, manufacturers with a significant thermal process load, and nursing homes.

For the 2021-2023 term, both the NH Electric Utilities and NH Natural Gas Utilities will include and support CHP projects across the state. In addition, the NH Utilities will also develop a network of vendors to assist with screening CHP projects to determine qualifications and system performance, as well as establish partnerships with universities and other groups to assess CHP opportunities. Starting in 2021, the NH Utilities will begin to incorporate custom incentives for CHP installations.

Building Codes and Standards

The NH Utilities plan to pursue a codes and standards initiative as part of the C&I New Construction program. Please see the full description in the Residential New Construction section, Section 4.2.4.

3.4.5 Program Design

Design

There are three program delivery channels for customers to participate in the Large Business Energy Solutions program's Retrofit or New Equipment & Construction pathways.

One-on-One Technical Assistance

First, the NH Utilities offer one-on-one technical assistance, through account representatives and energy efficiency staff, to help large C&I customers identify energy-saving opportunities, complete applications, and generally guide them through the process.

Energy Service Companies

Energy service companies are firms that offer compressed air, electrical, HVAC, lighting certification, and other comprehensive energy efficiency services to large C&I customers such as state and local government, higher education institutions, hospitals, hotels, manufacturers, and ski resorts. This second program delivery channel allows energy service companies to provide holistic building services and comprehensive technical assistance to large C&I customers.

Engineering Firms

Engineering firms are the third alternative channel for customers to participate in the Large Business Energy Solutions program. These firms provide whole building audits and individual building system performance checks and work directly with a customer's facility team and energy committee to identify energy behavioral changes, new equipment, renovations, retro-commissioning opportunities, and process improvements that could result in energy efficiency savings.

Incentives

Similar to other C&I programs, the Large Business Energy Solutions program provides prescriptive, custom, and performance-based incentives to encourage the implementation of cost-effective, energy efficiency projects. The addition of a tiered incentive design in 2021-2023 will encourage advanced lighting and comprehensive energy efficiency projects for the Retrofit and New Equipment & Construction pathways. The NH Utilities will provide third-party review of savings for customers participating in performance contracting.

The NH Utilities note that flexibility is key for serving large C&I customers. Different market segments and energy-efficient measures have unique payback requirements and there are varying barriers to implementation. Flexibility in the incentive model encourages large C&I customers to invest in comprehensive energy efficiency projects and not focus on individual measure savings or payback thresholds. A dynamic incentive model allows the NH Utilities to increase incentives for some measures while not overpaying for others; thus, allowing for the implementation of cost-effective projects.

Prescriptive Incentives

Prescriptive incentives allow customers to select equipment from a pre-qualified list of measures and receive an incentive designed to cover the incremental installed cost for New Equipment & Construction pathway projects and a percentage of the installed costs for Retrofit pathway projects. Incentives for prescriptive measures offer a standardized process for customers to integrate energy efficiency in their renovation or construction projects. Program trade allies can manage the prescriptive incentive process for large C&I customers, allowing them a streamlined pathway to energy efficiency. Prescriptive incentives create a supply chain that includes distributors, manufacturers, key trade ally contractors, and the NH Utilities.

Custom Incentives

The Large Business Energy Solutions program offers custom incentives for energy-efficient measures that are non-standard and not on the prescriptive list of approved products. This approach encourages comprehensive, long-term projects that the prescriptive incentive process cannot fully address. Project engineering calculations and analyses are reviewed on a case-by-case basis by the NH Utilities to determine project eligibility and incentive amounts.

Performance-Based Incentives

In addition, performance-based incentives are also offered to customers to encourage comprehensive energy savings from multiple measures. These incentives are based on energy calculations, including watts saved per square foot, dollars per kWh saved, and energy savings achieved above code. Performance-based incentives encourage customers to move beyond installing just one piece of energy-efficient equipment to consider long-term, holistic building design and measures that optimize the energy performance of systems or buildings. For the 2021-2023 term, the NH Utilities will offer performance-based incentives for performance lighting, lighting controls, and whole building projects implemented through the New Equipment & Construction pathway.

Tiered Incentives

For lighting projects beyond fixture replacements only, incentives may be increased to account for greater savings derived by the addition of one or more control strategies. For projects that have a minimum of one or more non-lighting end uses with each end-use defined as a natural gas or electric measure impacting heating, cooling, lighting, process, domestic water heating, refrigeration, motors and drives, etc., the incentives would be enhanced for each additional measure that increases savings beyond that single measure. Savings from each additional measure must be significant enough to warrant the additional incentives. To deliver tiered incentive measures, the NH Utilities will collaborate with energy service companies and other turnkey service providers who have staff or sub-contractors capable of installing multiple energy efficiency measures.

Performance Contracting

As noted in the Municipal program section, the NH Utilities have observed an increased interest in performance contracting over the last few years. During the 2021-2023 term, the Large Business Energy Solutions program will continue to support large C&I customers who choose to follow the performance contracting path. The NH Utilities will collaborate with key performance contractor partners in the state on the development of energy efficiency projects. The NH Utilities provide a third-party review of calculated energy savings and help determine the right level of incentives to encourage the installation of highly cost-effective measures with lower savings to create a balanced, comprehensive suite of energy-efficient measures.

Measures

The NH Utilities will incentivize prescriptive, custom, and performance-based measures for the Large Business Energy Solutions program during the 2021-2023 term. The NH Utilities will search for opportunities to achieve more energy savings through controls for building systems, such as energy management systems (“EMS”), lighting, HVAC equipment, and Wi-Fi thermostats.

Prescriptive Measures

Incentivized prescriptive measures will include, but are not limited to: air compressors, chillers, commercial kitchen equipment, HPWHs, high-efficiency condensing equipment, hot water-saving equipment, HVAC equipment (e.g., heat pumps and unitary air conditioners) and controls, insulation and air sealing, LED lighting and lighting controls, motors, commercial refrigeration equipment, process equipment, and VFDs.

Custom Measures

Many large C&I customers have complex technologies and specialty equipment and systems that require tailored solutions and custom measures. These custom measures will include, but are not limited to: chiller pump upgrades, CHP systems, EMS, injection molding machines, insulation and air sealing, integrated air compressors, large chillers and boilers, retro-commissioning, snowmaking equipment (e.g., low-energy snow guns and lift heater terminal controls), specialized equipment (e.g., polymer bead washing machines), and weatherization measures.

Commissioning Assistance

The NH Utilities provide commissioning assistance for existing equipment and facilities. Energy savings are either prescriptive or custom calculations based upon metering and monitoring. Currently, the NH Utilities do not envision offering incentives for the commissioning of new building systems as builders and owners are expected to ensure optimal equipment performance as part of the cost to deliver a new construction or new equipment project.

3.4.6 Program Budget and Goals

Table 3-3: Large Business Energy Solutions Program—Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$24,938,645	$34,018,730	$46,779,278	**$105,736,654**
Annual kWh Savings	65,122,196	83,591,154	109,036,322	**257,749,671**
Lifetime kWh Savings	876,554,611	1,124,260,353	1,461,425,507	**3,462,240,471**
kW Reduction	8,203	10,464	13,572	**32,239**
No. of Participants	1,811	1,957	2,091	**5,859**
Natural Gas Programs				
Program Budget	$2,685,689	$3,334,466	$4,140,552	**$10,160,707**
Annual MMBtu Savings	95,778	112,738	133,548	**342,064**
Lifetime MMBtu Savings	1,195,081	1,443,530	1,707,340	**4,345,950**
No. of Participants	291	385	435	**1,110**
Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.				

3.5 Energy Rewards Program (Eversource Only)

3.5.1 Program Objectives

The Energy Rewards program encourages customers to propose energy efficiency retrofit projects as part of a competitive solicitation process and is designed to promote competitive market development in the energy efficiency industry by encouraging third parties to bid for energy-saving projects on a competitive basis. The program's objective is to generate market-driven demand for cost-effective electric savings by encouraging customers to bid in retrofit projects that meet their internal business objectives, rate-of-return requirements, and approval processes. The program was designed for industrial and other large customers who need several years to design, plan, approve, and implement large, comprehensive electric-saving projects.

3.5.2 Target Market

The target market for the 2021-2023 Energy Rewards program is C&I customers with electric demand greater than 200 kW, individually or in aggregate. Eversource has established a minimum estimated energy savings for all projects of 100,000 kWh per year (single site or aggregate) and project costs of $150,000 or greater. C&I customers of Eversource, energy service companies, and other third-party service providers representing an Eversource C&I customer are eligible to participate in the program.

3.5.3 Program Design

The Energy Rewards program offers customers and engineering consultants an opportunity to design and bid in cost-effective comprehensive projects with electric savings. The program allows customers to bundle less cost-effective and more cost-effective efficient measures together. This increases the chances for comprehensive energy-saving projects that are multi-year and implement multiple measures. Having a multi-year program structure gives large C&I customers the time to develop projects, obtain approval, and submit well-developed proposals for their internal planning process.

The design of the Energy Rewards program allows Eversource to engage large C&I customers, giving them the opportunity to tailor their own energy-efficient solutions. Over the years, the program has allowed Eversource to provide a better customer experience and to develop project plans, such as Memorandums of Understanding ("MOUs"), with large C&I energy users across New Hampshire.

2021-2023 Changes

During the 2021-2023 term, Eversource will issue an open-bidding cycle held year-round with bids awarded two times a year. This program design change is in response to customer demand to align the issuance of an RFP with multiple accounting calendars, such as the fiscal year and a customer's annual accounting year (e.g., some state and local government calendar years end on June 30th, while some businesses' fiscal years end on October 31st). This program modification creates time for C&I customers to receive internal approvals, secure financing, and gain company support for efficiency projects. Eversource expects that this change will increase participation in the Energy Rewards program and create a continuous pipeline of electric-saving projects. In addition, this should help increase the number of submitted bids from large national companies and franchises that have counterparts in other states competing for the same funding sources to complete renovation projects.

During the 2021-2023 term, the NH Utilities will encourage Energy Rewards program participants to develop sustainable procurement policies and implement comprehensive energy efficiency projects.

Incentives and Measures

The Energy Rewards program's incentive levels are market driven through a competitive bidding process. Customers submit their requests for incentives to implement energy efficiency projects through their bid submissions. Customers determine their requested incentive levels based upon internal calculations regarding rate of return and if management will approve the projects, project costs, and design plans. The program reviews all energy-efficient measures that cost effectively deliver electric savings.

Eligible measures include but are not limited to: high-efficiency lighting systems and controls, motor VSDs, process or air conditioning system improvements, and other measures that reduce annual electrical consumption. Non-eligible measures include new construction projects, any power-producing projects such as cogeneration, fuel switching, and any repair or maintenance projects, and any technology with a measure lifetime of less than three years.

Program Process

For each RFP issued, Eversource hosts an Energy Rewards bidders' conference to provide customers and contractors information regarding submission requirements and the criteria used to select projects. Potential bidders are invited to the bidders' conference to learn how to participate in the program. Eversource also promotes the Energy Rewards program to Eversource customers with greater than 200 kW peak demand who might qualify either individually or on an aggregated demand basis. Potential energy service companies and third-party service providers are notified, and the Energy Rewards program and bidders' conferences are promoted on the NHSaves and Eversource websites.[25]

In response to an RFP, customers must submit a request for the incentive amount needed to implement an individual project or a series of energy efficiency projects. Funds are awarded through the competitive RFP process to customers or third parties acting on behalf of a customer. Projects are screened through a preliminary evaluation and a final, more-detailed analysis by Eversource staff. The bids are evaluated on the projected electric savings, incentive levels (pricing determined by customer or third party), and other non-price variables. Non-price variables include such factors as whether the project includes measures other than lighting (e.g., HVAC and process measures) and whether the environmental impacts reduce on-site emissions or waste stream impacts. All projects are evaluated on the basis of established cost-effectiveness criteria.

[25] Energy Rewards Program. Available at: https://nhsaves.com/energy-rewards-rfp-program/.

3.5.4 Program Budget and Goals

Table 3-4: Energy Rewards Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$2,997,161	$5,611,934	$9,172,068	**$17,781,164**
Annual kWh Savings	4,540,000	7,300,000	10,560,000	**22,400,000**
Lifetime kWh Savings	59,250,000	96,600,000	141,300,000	**297,150,000**
kW Reduction	424	657	924	**2,005**
No. of Participants	10	16	23	**49**
Note: kWh = kilowatt hours and kW = kilowatts.				

Chapter Four: NHSaves Residential Energy Efficiency Programs

Since 2002, the NH Utilities have implemented residential programs to help improve the efficiency of single-family and multifamily homes across the state. The NHSaves Residential Programs are designed to help New Hampshire residents reduce their energy costs, engage in energy efficiency behaviors, purchase high-efficiency equipment and technologies, defer the need for additional generation on the electrical grid, and help protect the environment through reduced electricity, natural gas, and delivered fossil fuel consumption.

4.1 Residential Programs Overview

In addition to serving customers, the NHSaves Residential Programs support a mature and robust network of stakeholders, including but not limited to: energy efficiency contractors, community action agencies, distributors, manufacturers, retailers, and other stakeholders that are the backbone of completing audits and installations of equipment and materials. The NH Utilities provide education, incentives, design and technical assistance, and contractor education to promote investment in energy-efficiency advancement and increase program participation.

For the 2021-2023 term, the NH Utilities are focused on scaling up participation and energy savings for the NHSaves Residential Programs. The NH Utilities will support these objectives by designing flexible and innovative programs, incentivizing emerging energy-efficient technologies, ensuring convenient customer access to capital, increasing workforce development efforts, and providing new “on-ramps” that allow customers varied pathways to participate in NHSaves Residential Programs. The flexibility built into NHSaves Residential Programs is imperative to allowing the NH Utilities to adapt quickly to new federal and state laws, changing codes and standards, market transformation, emerging technologies, and customer demand.

4.1.1 2021-2023 Residential Program Priorities

For almost 20 years, the NH Utilities have designed and delivered valuable energy efficiency services to New Hampshire's residential customers. Historical efforts have prioritized energy efficiency projects that maximize cost effectiveness over serving the greatest number of customers. Due to increased 2021-2023 Plan program budgets and goals, the NH Utilities will shift the focus to providing market-friendly offerings that encourage greater customer participation and increased engagement. To realize these evolving goals in residential energy-efficient technologies and building design, the 2021-2023 Plan emphasizes the following NHSaves Residential Programs' priorities:

1. **Increasing Participation through New and Expanded Program Pathways.** The NH Utilities will continue to effectively scale up the NHSaves Residential Programs to drive deeper and broader energy savings by creating or reinforcing multiple market pathways or "on ramps" with varied levels of participation offered for different customer types. These may include but are not limited to: access to single-measure rebates, online platforms, visual audits, and code-plus initiatives for residential new construction projects. These on-ramps will provide residential home owners, home buyers, and tenants with easily accessible avenues to realize initial energy savings.

   The NH Utilities will use various marketing methods to attract and retain these customers, as they may be more inclined to further engage in energy efficiency with future home improvement projects. The NH Utilities will employ data analysis to determine how these new or reinforced pathways are utilized and will also track repeat program participation by contractors, home builders, homeowners, or landlords throughout the 2021-2023 term.

2. **Offering Effectively-Packaged Solutions to Engage Customers.** The NH Utilities will effectively market and package energy efficiency solutions to New Hampshire residents. These solutions will include expanded midstream and point-of-purchase rebates (ENERGY STAR® Products

program) and additional tiers and bonus incentives to encourage the design-and-build community to move beyond the current building code in residential new construction projects (ENERGY STAR Homes program).

3. **Increase Customer Education and Workforce Development Trainings.** To scale up participation and drive deeper energy savings for the 2021-2023 NHSaves Residential Programs, the NH Utilities must facilitate a thorough and targeted workforce development plan to educate contractors, distributors, manufacturers, community action agencies, home builders, and retailers regarding the benefits and availability of energy-efficient technologies and program offerings.

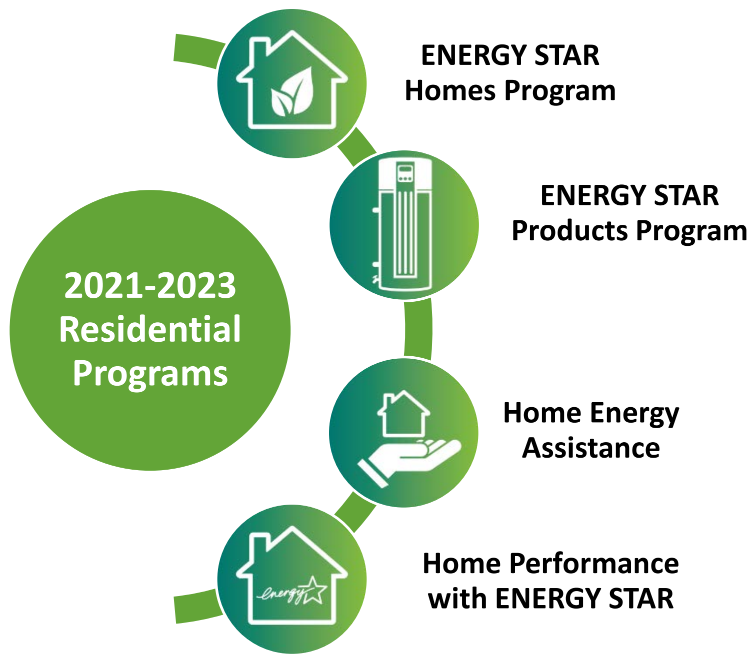
   Throughout the 2021-2023 term, the NH Utilities will expand the trainings offered for going beyond minimum code compliance, emerging technologies, and energy-efficient building techniques. These trainings will be delivered through several short-term and long-term workforce development channels, including but not limited to: interactive online training videos, in-field home builder trainings, hands-on equipment training, and lunch & learn sessions.

4.1.2 Residential Programs

For the 2021-2023 term, the NH Utilities will continue to deliver comprehensive NHSaves Residential Programs to help all New Hampshire residents regardless of income or home type, to reduce their energy consumption, save money, and protect the environment through reduced GHG emissions.

The 2021-2023 NHSaves Residential Programs will offer multiple pathways to engage residential customers with entrées to energy efficiency. In order to reach the ambitious EERS goals, the NH Utilities must offer multiple and varied pathways in order to scale up program participation and drive energy savings. By offering multiple new and reinforced pathways, the NH Utilities will engage a broad range of customers in energy efficiency programs at various levels of savings, while raising interest across the market overall regardless the degree of participation. Figure 4-1 illustrates the multi-entry point approach of the 2021-2023 NHSaves Residential Programs.

Figure 4-1: 2021-2023 Residential Programs



- **ENERGY STAR Homes Program.** This is the NHSaves energy efficiency solution for residential single-family and multifamily new construction homes. The program provides incentives and contractor support through two pathways: (1) Drive to ENERGY STAR and (2) ENERGY STAR 3.1. During the 2021-2023 term, the NH Utilities will for the first time explore providing incentives for new construction homes that are certified passive solar, solar photovoltaic ("PV") ready, EV ready, demand management ready, and for all-electric homes.

- **ENERGY STAR Products Program.** This high-volume program with broad reach is designed to help residential customers overcome the extra expense of purchasing and installing ENERGY STAR-certified appliances, electronics, HVAC equipment and systems, hot water-saving equipment, and lighting. This is accomplished through consumer education, point-of-sale marketing, active training, engagement of retailers and distributors, and a variety of incentives both at point of sale and through automatic markdowns.

- **Home Energy Assistance Program.** This fuel-neutral weatherization program is designed to reduce energy use from both electric and fossil fuel-consuming appliances, lighting, and HVAC systems. The program serves New Hampshire's income-eligible homeowners and renters to help reduce their energy costs, optimize their home's energy performance, and make their homes safer, healthier, and more comfortable.

- **Home Performance with ENERGY STAR.** This energy efficiency solution provides comprehensive energy-saving services at significantly reduced cost to customers' existing homes, and covers lighting improvements, space heating and hot water equipment upgrades, weatherization measures, and appliance replacements.

4.1.3 Changes in the National Lighting Marketplace

Over the past two years, there has been great uncertainty regarding the implementation and enforcement of the Energy Independence & Security Act of 2007 ("EISA").[26] Phase 2 and Phase 3 of EISA's light bulb standards were slated to begin on January 1, 2020 ("EISA 2020 standard") and January 1, 2025 ("EISA 2025 standard"), respectively, to go into effect on those dates. Finally, on February 11, 2019, the US DOE published a Notice of Proposed Rulemaking ("NOPR") that proposed withdrawing the revised definitions of general service lamp ("GSL"), general service incandescent lamp ("GSIL"), and other supplemental definitions, that were originally set to go into effect on January 1, 2020. In a final ruling issued on September 5, 2019, the US DOE reversed its 2017 decision to expand the types of GSLs to be subject to the stricter standards, rescinded the expanded definition, and allowed exemptions for specialty lamps such as globes, candelabras, and reflectors, as well as other bulbs such as three-way and rough service lamps.[27]

With this ruling, the US DOE withdrew the prior final rules regarding the EISA 2020 standard published on January 19, 2017 (82 FR 7276 and 82 FR 7322) that were to become effective on October 7, 2019.

[26] Public Law 110-40. Energy Independence and Security Act of 2007. Dec. 19, 2007.

[27] 84 FR 46661. Office of Energy Efficiency and Renewable Energy. Energy Conservation Program: Definition for General Service Lamps, Published Sep. 5, 2019, pp. 46661-46676. Available at: https://www.federalregister.gov/documents/2019/09/05/2019-18940/energyconservation-program-definition-for-general-service-lamps.

The September 2019 final rule eliminated energy efficiency standards for about 50 percent of the six billion light bulbs used in the United States.[28] The standards would have covered a variety of light bulb shapes and sizes used in homes, including candelabra-based bulbs, candle- and globe-shaped bulbs, and reflector bulbs. These original standards were intended to phase out the incandescent bulb in favor of high-efficiency LEDs and fluorescent bulbs and fixtures. In a further rollback of earlier proposed lighting efficiency standards, the US DOE also issued a proposed determination on September 5, 2019, which if finalized, would eliminate the EISA 2020 standards for "A-lamps," the pear-shaped bulbs that make up the other 50 percent of light bulbs used in the United States.[29]

At the same time, lighting manufacturers, expecting the original rules to go into effect in 2020 and 2025, have largely already transitioned to designing and manufacturing long-lasting, energy-efficient LEDs, both ENERGY STAR-certified and otherwise. As a result, the lighting market continued to drive the transition to LEDs in the marketplace, a process that is expected to continue in spite of the federal roll-back of minimum-efficiency standards.

In order to help maintain and accelerate the strong demand for high-efficiency ENERGY STAR LED technologies, the NH Utilities will continue to aggressively support and incentivize energy-efficient bulbs and fixtures for the NHSaves Residential Programs through the end of 2021. Beginning in 2022

[28] ACEEE. DOE's Light Bulb Standards Rollback Will Cost Americans $14 Billion Each Year. Sep. 4, 2019. Available at: https://aceee.org/press/2019/09/doe-s-light-bulb-standards-rollback. 25 84 FR 46830. Office of Energy Efficiency and Renewable Energy. Energy.

[29] 84 FR 46830. Office of Energy Efficiency and Renewable Energy. Energy Conservation Program: Energy Conservation Standards for General Service Incandescent Lamps, Published Sep. 5, 2019, pp. 46830-46862. Available at: https://www.federalregister.gov/documents/2019/09/05/2019-18941/energy-conservation-program-energy-conservation-standards-forgeneral-service-incandescent-lamps.

and depending on how the marketplace responds to the relaxed federal standards, the NH Utilities will begin to transition program support to discount retailers focused on reaching the last-to-adopt and underserved customers.

4.1.4 Residential Building Codes

New Hampshire's current building energy code went into effect on September 15, 2019 when the State Building Code Review Board approved the adoption of the 2015 editions of the International Building Code, including the 2015 International Energy Conservation Code ("IECC 2015").[30] There were several legislative amendments to the code that will sunset in March 2022. As of January 1, 2019, the NH Utilities updated the ENERGY STAR Homes program's User Defined Reference Home ("UDRH") to reflect the current minimum standard from the IECC 2015. The UDRH will be updated again in March 2022 to reflect the end of the sunsetted amendments to the IECC 2015.

The NH Utilities are extensively researching current approaches for building code savings attribution in New England, specifically in Connecticut and Massachusetts. Based on the NH Utilities' analysis, the creation of a code savings attribution model for New Hampshire may be proposed during the 2021-2023 term.

4.1.5 Workforce Development

To scale up participation and drive deeper energy savings for the 2021-2023 NHSaves Programs, the NH Utilities and a consultant will develop a cohesive statewide Workforce Development Strategy for understanding workforce development needs and what training is needed for vendors, community action agencies, distribution contractors, building operators, and other energy efficiency stakeholders. For more information regarding the NH Utilities' Workforce Development Strategy, see Chapter Nine of the 2021-2023 Plan.

[30] New Hampshire Department of Safety—State Building Code Review Board. *New Hampshire Building Code.* Sep. 15, 2019. Available at: https://www.nh.gov/safety/boardsandcommissions/bldgcode/.

4.1.6 Financing

The NH Utilities recognize that technical assistance, incentives, and innovative financing tools are all important mechanisms to effectively encourage residential customers to invest in comprehensive energy efficiency. Effective financing mechanisms have supported the success of the NHSaves Residential Programs and can be leveraged further in the next term. During the 2021-2023 term, the NH Utilities will continue to offer on-bill and third-party financing options to encourage residential customers to pursue comprehensive and cost-effective energy efficiency projects in their homes. These include zero percent on-bill offerings for electric and natural gas customers, two percent loans offered in partnership with local lenders, and zero-percent moderate-income loans, also in partnership with local lenders.

On-Bill Financing

All NH Utilities have on-bill financing available for Home Performance with ENERGY STAR program customers to help cover their portion of a weatherization project. Customers with a qualifying project apply to their NH Utility for the loan. Lending criteria includes bill payment history (all NH Utilities) and credit score (Eversource only). For customers receiving an on-bill loan, the NH Utility will pay the customer's co-pay to the contractor directly and the customer will pay off the loan at zero percent interest on their utility bill[31].

The NH Utilities will continue to monitor customer interest in residential on-bill financing as well as capital available for loans and may make adjustments to maximum loan amounts if needed. On-bill loan offerings are governed by each NH Utility's tariff and changes are made by updating the tariff with the Commission.

[31] Liberty Electric and Gas, Unitil Electric and Gas, and NHEC all have a maximum on-bill loan amount of $4,000. Eversource has a maximum on-bill loan amount of $2,000. Unitil has a maximum on-bill loan amount of $7,500 for market-rate customers and $15,000 for moderate-income customers. Customers needing loans up to $15,000 can access the Residential Energy Efficiency Loan Program with third-party lenders.

Residential Energy Efficiency Loan Program

Through the Residential Energy Efficiency Loan program, the NH Utilities partner with local lending institutions, banks, and credit unions to ensure capital and lending expertise is available to customers who want or need it to move forward with efficiency projects. The Residential Energy Efficiency Loan program allows qualified electric and natural gas customers to finance all or a portion of their share of approved energy efficiency upgrades through a low-interest loan in cooperation with local banks and credit unions. Loans cover a residential customer's co-pay portion of the work performed through the Home Performance with ENERGY STAR program (e.g., insulation, appliances, and health and safety measures) and some other approved energy efficiency measures.[32]

Customers can finance up to $15,000 for qualifying energy efficiency upgrades and the customer's lending institution will determine if a customer is eligible for a loan based on lending criteria. The NHSaves Programs subsidize a two percent APR home energy efficiency improvement loan to qualified customers. See Table 4-1 for loan amounts and repayment terms.

Table 4-1: Residential Energy Efficiency Loan

Amount	Max Loan Repayment Term
$1,000 up to $2,000	2 Years
$2,001 up to $4,000	3 Years
$4,001 up to $6,000	4 Years
$6,001 up to $9,000	5 Years
$9,001 up to $12,000	6 Years
$12,001 up to $15,000	7 Years

This third-party financing program is not designed to support a specific number of loans, but rather to ensure that customers have financing options available to cover the co-pay portion of their projects if

[32] Unitil Electric and Gas will give loans to Gas Networks customers.

needed. These financing dollars help drive more comprehensive projects. Throughout the 2021-2023 term, the NH Utilities will continue to offer the Residential Energy Efficiency Loan through the current lending partners for the 2018-2020 program cycle, and additional lenders will be introduced based on customer need and lender interest.[33]

Moderate-Income Customer Financing

During the 2019 program year, the NH Utilities established a zero-percent moderate-income financial offering with local lenders. 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. During the 2021-2023 term, this financing offering will continue.

Funding—NH Saves Partnership Initiative

During 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 co-pay of moderate-income customers, coordination with efforts that provide interactive benefits with energy efficiency, such as public health, or other identified opportunities. The NH Saves Partnership Initiative serves all of the NH Utilities' customers, however, this very much depends on the types of grants that are awarded.

[33] The current lending partners include: Merrimack County Saving Bank, Meredith Village Savings Bank, Northeast Credit Union, Woodsville Guaranty County Bank (Eversource and NHEC customers only), Claremont Savings Bank (Eversource customers only), Mills 42 Federal Credit Union (Eversource customers only), and the Savings Bank of Walpole (Eversource customers only).

Specific to income-eligible customers, in May of 2020, a grant was written and submitted on behalf of a CAA for a US Department of Agriculture Housing Preservation Grant. If awarded, this grant will be used for repairs and health and safety measures for single-family homes that the HEA program could not pay for and, therefore, the house would be classified as a “walk away.”[34] Additionally, in May of 2020, a grant was written on behalf of a CAA and submitted to the Northern Borders Regional Commission, which provides economic and community development grants in Maine, New Hampshire, New York, and Vermont. This grant, if awarded, would pay for two trucks for a crew-based CAA that is expanding due to more HEA funds being available.[35]

Throughout the 2021-2023 term, the NH Utilities will continue to look for additional opportunities to apply for grants and leverage funding resources to promote energy efficiency.

4.1.6 Marketing and Outreach

The NH Utilities will market the NHSaves Residential Programs through a variety of channels, both as individual companies as well as through a statewide marketing approach. These channels will include but are not limited to: the website (NHSaves.com), program promotional materials (“collateral”), direct mail and e-mail, bill inserts, point-of-sale marketing, retailer engagement, social media campaigns, paid digital advertising, billboards, radio/TV/music streaming advertisements, trade shows, public relations efforts (statewide and utility-driven), hosting or providing speakers for trainings, forums, and events, and providing content for partners’ blogs, newsletters, and websites.

The NH Utilities take advantage of market segmentation to effectively target customers and engage them in energy efficiency programs. Understanding what motivates a customer to participate in energy efficiency programs gives the NH Utilities insight into what marketing strategies will work when trying to increase NHSaves Residential Program participation. During the 2021-2023 term, the NH Utilities plan to scale up data analysis of customers’ billing and demographic information to effectively market

[34] The grant request is for $100k.
[35] This grant request is for $70k.

new and existing program pathways and offerings to those customers who are most likely to respond to and benefit from the NHSaves Residential Programs.

In addition, the NH Utilities conduct significant community outreach through training such as the Button Up Workshops. This is a popular energy-saving workshop series sponsored by NHSaves and coordinated by the Plymouth Area Renewable Energy Initiative ("PAREI"). Participants attend a 90 minute presentation on how to optimize the energy performance of their homes and the workshop includes information about basic building science principles and how whole-house energy measures can help customers "button up" their homes for the heating and cooling seasons. Each workshop is presented by a knowledgeable Building Performance Institute ("BPI")-certified Building Analyst and a representative from the NH Utilities.

4.2 ENERGY STAR Homes Program

4.2.1 Program Objective

The ENERGY STAR Homes (“ES Homes”) program is New Hampshire’s energy efficiency solution for residential single-family and multifamily new construction homes. Residential new construction homes must meet strict building guidelines to earn the US Environmental Protection Agency’s (“EPA”) ENERGY STAR certification and are typically 15 to 30 percent more efficient than standard, built-to-code homes. The EPA’s ENERGY STAR Home certification uses the Home Energy Rating System (“HERS”) as a scoring mechanism, analogous to a miles-per-gallon sticker for new homes, giving current or future home owners insight into the home’s energy performance. The lower the HERS Index Score the more energy efficient the home is compared to one built to standard building code.

The goal of ES Homes is to encourage homeowners, home builders, and contractors to build high-performance single-family and multifamily homes. This encouragement is provided through incentives and connecting home builders with third-party HERS Raters who provide support and verification services throughout the construction process. Over the past decade, ES Homes has seen 15 to 35 percent of New Hampshire’s newly built homes achieve ENERGY STAR certification. ES Homes, the NH Utilities, participating home builders, HERS Raters, and contractors have also received numerous national ENERGY STAR awards and recognition for driving the New Hampshire residential construction market toward high-efficiency building designs, techniques, and technologies.

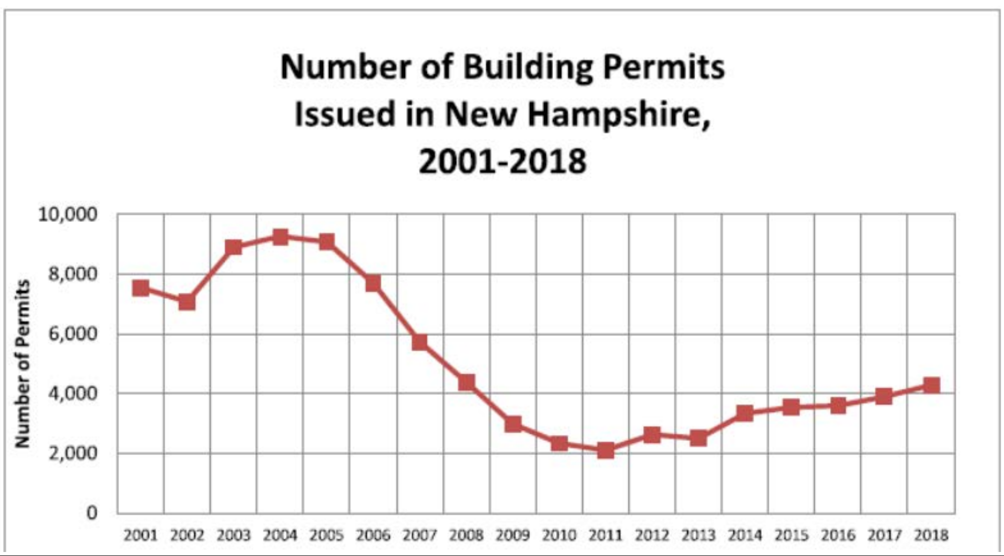
4.2.2 Target Market

The target market for ES Homes is the entire residential new construction community across the state of New Hampshire. This includes architects, developers, home builders, homeowners, and HVAC contractors. All residential single-family and multifamily new construction projects are eligible to participate in ES Homes, regardless of the fuel or system used in the home for space heating. ES Homes eligibility applies to manufactured, pre-fabricated, and site-built homes.

A secondary target market is homes with major additions or large portions of a home's structure undergoing a renovation. The goal of this offering is to encourage high-efficiency building practices and equipment for remodeled homes that are not eligible for the ENERGY STAR Homes Version 3.1 or Drive to ENERGY STAR pathways. For the 2021-2023 term, the NH Utilities will look to expand this strategy through greater marketing and by offering more robust incentives (based on the scale of the opportunity and cost-effectiveness) and increasing home contractor and homeowner awareness.

In 2018, the number of new construction permits filed statewide reached 4,285, an increase of approximately 18.5 percent from 2017 (3,625 permits pulled).[36] This is the fifth year in a row in which there was an increase in the total number of permits issued. The NH Utilities estimate that 4,500 permits will be filed in 2020, with 33 percent participating in the ES Homes program.

Figure 4-2: Building Permits Issued in New Hampshire (2001-2018)



[36] New Hampshire Office of Strategic Initiatives. *Current Estimates and Trends in New Hampshire's Housing Supply: Update 2010-2018.* Dec. 2019. Available at: https://www.nh.gov/osi/data-center/documents/housing-estimates-trends.pdf.

Over the next decade, the NH Utilities plan to foster an increase in the percentage of ENERGY STAR-certified homes built in New Hampshire through enhanced contractor outreach, in-person and online home builder trainings, and the creation of a flexible program design that encourages multiple points of entry and incentive levels for the home builder community.

4.2.3 2021-2023 Plans

For the 2021-2023 term, the NH Utilities will implement a number of new strategies to increase electricity, natural gas, and fossil fuel savings for residential customers. These include:

Increase Reach of Existing Program and Serve More Customers

Beginning with the 2021-2023 term, the NH Utilities plan to significantly ramp-up energy savings and participation in ES Homes. By 2030, an aspirational objective of the NH Utilities is to have 80 percent of new construction homes permitted in the state participating in ES Homes each program year.[37] During the 2021-2023 term, the NH Utilities will deploy a combination of training, technical support, and incentives to encourage home builders, renovation firms, and HVAC contractors to utilize the ES Homes' two performance-based pathways to integrate energy-efficient design and equipment into new construction or major rehab and renovation projects. For the 2021-2023 term, ES Homes will continue to offer performance-based incentives and high targets for energy efficiency savings for the residential new construction marketplace.

The Drive to ENERGY STAR Homes pathway provides an introduction to ES Homes by offering smaller incentives for home builders who construct homes above code but fall short of being eligible for ENERGY STAR certification. By slowly easing non-participating builders into ES Homes, the NH Utilities can encourage home builders to begin to practice more comprehensive design with the idea of moving them toward the higher efficiency ENERGY STAR Homes Version 3.1 pathway. In 2021-2023, the NH

[37] For the 2021-2023 term, the NH Utilities expect the number of residential permits pulled in New Hampshire that are enrolled in ES Homes to be between 15 and 30 percent. The 80 percent goal by 2030 is aspirational only and is not a PI metric.

Utilities will make the online enrollment form more accessible to builders and allow builders to submit the enrollment form and associated ES Homes paperwork online.

Increase Workforce Development, Education and Outreach

To meet increased energy savings goals and to encourage greater participation in ES Homes, the NH Utilities will expand contractor education and outreach efforts during the 2021-2023 term. This includes providing more code and beyond code trainings for home builders, and lunch & learn sessions for architects, home builders, and HVAC contractors.

The NH Utilities will continue to deploy more in-the-field home builder trainings in which high-performance building specialists will provide on-site technical support during the installation of air sealing, high-efficiency insulation, and HVAC equipment and systems. These hands-on, interactive trainings will be supplemented with an enhanced NHSaves.com video library to serve as an online classroom for home builders, HVAC contractors, and home owners, as well as web links to the EPA's ENERGY STAR-certified home project checklists. In addition, the NH Utilities will create and post their own ES Homes checklists and guidelines for home builders, home owners, and contractors detailing the different aspects of designing and building an ENERGY STAR-certified home. These utility-generated checklists will feature "Top 10" tips and tricks of the trade (e.g., "Top 10 ways to ensure HVAC equipment is properly installed," etc.).

Throughout the 2021-2023 term, the NH Utilities will continue to engage with local building departments regarding current residential building codes, IECC 2015, and ES Homes. This includes ongoing meetings with building departments and delivering program literature to town halls and building code enforcement offices. The NH Utilities are researching current approaches for building code savings attribution in New England. This may include attribution of energy savings for increasing compliance with codes and standards, as well as conducting code trainings. Based on the NH Utilities' analysis, the creation of a code savings attribution model for New Hampshire may be proposed during the 2021-2023 term.

Design Program Tiers and Bonus Incentives to Encourage Sustainability

During the 2021-2023 term, the NH Utilities will include multifamily new construction projects in the Drive to ENERGY STAR pathway. The NH Utilities will also offer additional program tiers and bonus incentives to encourage the design-and-build community to build to standards well beyond the current IECC 2015. In addition, the NH Utilities may offer bonus incentives for residential new construction projects that meet additional efficiency criteria or other sustainable guidelines, such as:

1. **US DOE Zero Energy Ready Home ("ZERH") Program.** This US DOE program is based on the building science requirements of ENERGY STAR for Homes Version 3.1 and promotes a comprehensive home performance-principled approach to residential new construction projects. ZERHs are high-performance homes that are so energy efficient that a renewable energy system can offset all or most of the home's annual energy consumption.

   The ZERH program has two pathways: Prescriptive and Performance. This allows the NH Utilities to offer more opportunities for home builders and homeowners looking for varied options to construct efficiently. The Performance pathway requires energy modeling (HERS) and qualifying measures include: thermal enclosures, domestic hot water equipment and distribution systems, high-quality HVAC installations, water management, certification by the EPA's Indoor airPLUS program, ENERGY STAR-certified appliances, lighting, and windows, and compliance with the US DOE's PV-ready checklist.

   A ZERH offering may also include incentives for "renewable energy-ready" homes. The NH Utilities will explore whether there is a need for separate or additional incentives to ensure that future homeowners can easily install renewable energy systems, such as PVs, without needing to alter their home's building envelope or electrical service.

2. **Passive House Certification.** The NH Utilities are closely watching the passive house ("Passive House") movement in Massachusetts and Connecticut and will apply any lessons learned in the development of a New Hampshire offering during the 2021-2023 term. The NH Utilities will

actively support Passive House trainings conducted by PHIUS in the region to the state's building community.

3. **EV-Ready Homes.** The NH Utilities may also add a bonus incentive for newly-constructed homes that are built as "EV ready". An EV-ready home ensures that customers have safe access to a dedicated 240 volt power supply for fast-charging Level 2 EV chargers. If a homeowner prewires their new home for EV charging during construction (even if it is not used immediately upon occupancy), they can save hundreds of dollars later. There are two paths to make a home EV-ready, both of which include a pre-installed conduit and wiring for a Level 2 EV charger.

   To design the EV-ready bonus incentive, the NH Utilities will benchmark other states' program designs, including Rhode Island's stretch code which includes requirements for upgraded service panels and a conduit for electricity to a garage or driveway from the home's service breaker.

4. **All-Electric Home Package.** For the 2021-2023 term, the NH Utilities will offer an all-electric home offering to encourage home builders and contractors to build all-electric residential homes outfitted with heat pump technologies to mitigate the environmental impact of fossil fuels and eliminate fuel combustion within the home. The Companies may provide incentives for the following measures: building envelope measures, thermal energy-efficiency measures, air-source or heat pumps, increased use of biofuels, biomass heating systems, EV readiness, and on-site renewable energy production and storage, including PV readiness.

5. **Above-and-Beyond Code Measures.** During the 2021-2023 term, the NH Utilities will explore offering incentives for energy-efficient measures that meet the next iteration of building codes for residential new construction, such as duct blaster thresholds and infiltration measures. In addition, the NH Utilities will explore implementing a pay-for-performance incentive for occupants of new homes to keep their home's energy consumption down.

4.2.4 Program Design

ES Homes is designed to serve all residential single-family and multifamily new construction homes, including site-built, manufactured, and pre-fabricated homes. The NH Utilities' Residential Program implementation staff will work closely with home builders, contractors, and certified HERS Raters across New Hampshire to encourage participation in the program's two primary pathways—ENERGY STAR Version 3.1 and Drive to ENERGY STAR.

ENERGY STAR Version 3.1 Pathway

The ENERGY STAR Homes Version 3.1 pathway ("ES 3.1") establishes a high-efficiency target for new construction homes to be built above code in the state. On average, ES 3.1 homes are designed to save 15 percent or more energy relative to homes built to the IECC 2015 standards. The NH Utilities use a robust HERS Rater contractor network to provide independent third-party inspection, verification, and diagnostic testing to help maximize the energy efficiency of single-family and multifamily homes. Once enrolled in ES Homes, a home builder submits design plans to a HERS Rater for review. The HERS Rater analyzes the submitted designs using HERS to determine and share with builders the energy-efficient features needed to ensure the home earns the ENERGY STAR certification. During the construction process, the HERS Rater is responsible for performing site visits and inspections.

To be eligible for incentives, a home must be enrolled in ES Homes and inspected prior to the installation of any sheet rock or other type of wall covering, to ensure that an insulation inspection can occur. Once a home is fully built, the HERS Rater will perform a final inspection and calculate the home's energy performance. For the 2021-2023 term, the NH Utilities will encourage the continued adoption of ES 3.1 through additional incentives and increased HERS Rater support and training.

Drive to ENERGY STAR Pathway

During the 2018-2020 Plan, the NH Utilities introduced the Drive to ENERGY STAR ("Drive to ES") pathway to recruit new builders, HVAC contractors, and single-family homeowners to ES Homes. The pathway was originally designed as an entry point into energy-efficient building design and practices to encourage home builders to go beyond code (code plus) in their new construction projects. Once a home builder participates in the Drive to ES pathway, the NH Utilities have found that it eliminates an identified program barrier: the perception that committing to building an ENERGY STAR-certified home is a complex undertaking that requires multiple steps and interactions with other firms or contractors.

For the 2021-2023 term, the NH Utilities will continue to offer the Drive to ES pathway to builders of single-family homes and will expand the pathway offering to include builders of multifamily homes. The pathway will continue to provide smaller incentives (less than the ES 3.1's pathway incentives) to builders who have constructed new single-family and multifamily homes that are above code but do not meet ENERGY STAR certification requirements.

HVAC Contractor Training

Through ES Homes, the NH Utilities will expand the workforce training opportunities and certification assistance for HVAC contractors during the 2021-2023 term. Currently, a third-party vendor trains HVAC contractors to understand the ES 3.1 requirements and checklists, how to conduct duct blaster tests, and how to properly seal duct work. The EPA requires builders to utilize a credentialed HVAC contractor trained in best practice HVAC design and installation services to qualify a home for ENERGY STAR certification. These trainings and technical assistance will allow the NH Utilities to build a robust network of HVAC contractors to support increased energy savings goals.

Measures

An ENERGY STAR-certified home is designed and built so that all energy efficiency systems and features work together to create a high-performance home. This level of building performance is achieved through the installation of energy-saving measures and energy-efficient design, including high-efficiency HVAC systems, complete thermal enclosure (i.e., high-performance windows, properly installed insulation, and air sealing), ENERGY STAR-certified lighting and appliances, water protection systems (i.e., water management system checklist) to improve indoor air quality and durability, and well-insulated and sealed heating and cooling ducts.

Drive to Net Zero Home Competition

The Drive to Net Zero Home Competition was designed to challenge homebuilders, architects, and home owners to build high-efficiency, net zero energy homes that generate more on-site energy than is used. Typically, net zero homes are 40 to 50 percent more energy efficient than standard homes and score a 10 or below on the HERS Index Score. The NH Utilities started the competition in 2017 and have seen considerable success in promoting beyond ENERGY STAR construction techniques to the New Hampshire residential home builder community.

The annual competition recognizes the top three homes across five categories, including: lowest overall HERS Index, lowest overall HERS Index prior to renewables, home's estimated annual operating costs, construction cost per square foot, and technological innovation. The competition is marketed to the state's home builder community and publicized through press releases, videos on the NHSaves website, and at an annual awards presentation. For program years 2020, 2021, and 2022, the NH Utilities have partnered with the New Hampshire Home Builders Association ("NHHBA") to recognize the Drive to Net Zero Home Competition winners at the NHHBA's annual Cornerstone Awards.[38] These awards are presented yearly to recognize excellence in the building industry.

Throughout the 2021-2023 term, the NH Utilities will continue to meet with the EPA to collaborate on how to continue integrating advancements in net zero homes in New Hampshire. The ES Homes program is performance based and uses HERS as a scoring mechanism to determine incentives on a dollar-per-point below the target HERS Index Score. Net zero homes have a low HERS Index Score (i.e., energy efficient); therefore, homeowners and builders who build a net zero home will earn a higher

[38] NHHBA. Website: https://nhhba.com/nhhbaevents/cornerstone-awards/.

performance-based incentive for building above code. During the 2021-2023 term, the NH Utilities may move toward offering a net zero homes option or pathway.

Building Codes and Standards

New Hampshire's current building energy code went into effect on September 15, 2019 when the State Building Code Review Board approved the adoption of the 2015 editions of the International Building Code[29], including the 2015 International Energy Conservation Code ("IECC 2015"). There were several legislative amendments to the code that will sunset in March 2022. As of January 1, 2019, the NH Utilities updated the ENERGY STAR Homes program's User Defined Reference Home ("UDRH") to reflect the current minimum standard from the IECC 2015. The UDRH will be updated again in March 2022 to reflect the end of the sun-set amendments to the IECC 2015.

Compliance Support for Base and Stretch Code

The NH Utilities can provide support to improve compliance with building energy codes and appliance standards. As codes change and become more stringent, the building community (owners, developers, designers, contractors) must understand how to interpret requirements in order to comply with building codes. The NHSaves Programs have a successful history of promoting, educating, and delivering energy-efficient measures and programs. For these reasons, the NH Utilities are in an advantageous position to support code compliance and code enhancement through energy codes training and education as they work closely with stakeholders and trade allies.

The NH Utilities would work with local builders, contractors and building enforcement officials to increase the number of homes and commercial buildings complying with the locally applicable energy code, generally either the International Conservation Code ("ICC") model code version adopted statewide, or New Hampshire's stretch code. Activities may include targeted trainings, outreach and technical support in the form of code ambassadors and circuit riders, compliance documentation tool development, and review support. Looking ahead to the 2021-2023 term, additional infrastructure will need to be developed to support the next iteration of requirements for residential and commercial new construction. For example, the IECC 2015 building code requires blower door testing for all residential buildings. Starting in 2021, the NH Utilities plan to begin the strategic identification of jurisdictions that would benefit from code compliance support.

The NH Utilities' efforts can supplement the efforts of code enforcement officials who may be challenged to fully enforce the energy use provisions, as their focus is more on health and safety-related aspects of the code. Through their relationship with contractors and builders, the NH Utilities will be able to support the implementation of those improvements going forward. The NH Utilities could expand upon existing incentive-based new construction program outreach efforts to target various stakeholders.

Stretch Code Development Support

The NH Utilities can support the development of a stretch code that exceeds statewide minimum requirements and is adopted by local governments. A coordinated approach by the NH Utilities will provide technical support for the development of stretch code.

While the NH Utilities will focus their efforts in 2021-2023 on support for energy code compliance, another aspect of codes and standards includes supporting the adoption of updated versions as knowledge and technical capabilities related to building science applications improves. Codes and standards adoption work in other jurisdictions includes efforts on both appliance standards and on base energy codes. Energy efficiency programs can provide technical expertise and resources as state boards and legislative bodies review codes and standards updates.

Evaluation Savings and Attribution

Support for Energy Code Compliance should result in the realization of the energy savings that are lost when newly-constructed homes are not 100 percent compliant with the locally applicable building code. The NH Utilities will collaborate with stakeholders on the development of an evaluation plan that will enable the measurement and attribution of savings from these efforts to the NH Utilities for the 2021-2023 term. A detailed evaluation plan, along with an appropriate attribution methodology, will be developed in 2021. Qualitative as well as quantitative research would be planned for in 2021 and 2022 to evaluate ongoing initiative efforts and will be used for savings projections that can potentially be claimed within this three-year cycle (2021-2023 term) and future cycles.

4.2.5 Marketing

ES Homes will be promoted through a variety of marketing channels including social media updates (Facebook and Twitter), home shows, paid Internet searches, and circuit riders at Lowe's, Home Depot, and local hardware and lumber stores. The NHSaves.com website will continue to drive participation in the program through interactive online trainings regarding ENERGY STAR-certified homes, fillable online enrollment forms, customer testimonials, and Drive to Net Zero Home Competition case studies.

Throughout the 2012-2023 term, the NH Utilities will focus their marketing efforts on direct outreach to the program's existing network of builders, HERS Raters, and HVAC contractors, as well as reaching out to recruit new participants from the home builder community through the Drive to ES pathway. In addition, the NH Utilities have ongoing meetings with building departments and deliver ES Homes literature to town halls and building code enforcement offices.

The NH Utilities will continue to diversify marketing strategies to reach potential new construction home buyers. This may include utilizing data collected from consumer social media searches to target customers looking for property and residential developments, as well as promoting ES Homes at home improvement stores (brick-and-mortar and online) and lumberyards. In addition, the NH Utilities may extend educational opportunities beyond the new construction marketplace to the real estate, home inspection, and appraisal communities.

4.2.6 Program Budget and Goals

Table 4-2: ES Homes Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$3,370,729	$3,605,389	$3,878,304	**$10,854,423**
Annual kWh Savings	1,614,972	1,753,735	1,944,116	**5,312,824**
Lifetime kWh Savings	38,239,860	41,507,492	45,841,807	**125,589,158**
kW Reduction	20	20	33	**73**
No. of Participants	797	764	837	**2,398**
Natural Gas Programs				
Program Budget	$1,346,744	$1,592,055	$1,823,272	**$4,762,071**
Annual MMBtu Savings	7,214	9,313	13,419	**29,947**
Lifetime MMBtu Savings	178,569	230,377	320,050	**728,997**
No. of Participants	198	256	306	**760**
Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.				

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4.3 ENERGY STAR Products Program

4.3.1 Program Objective

The ENERGY STAR Products ("ES Products") program's objective is to increase the purchase and installation of high-efficiency appliances, lighting, heating and cooling systems, and water heating equipment. ES Products is focused on targeted consumer education and a robust network of distributors, manufacturers, installation contractors, and retailers to promote the purchase of energy-efficient products over standard-efficiency equipment. The NH Utilities also provide appliance recycling rebates that give customers an incentive to recycle certain old, inefficient appliances, such as refrigerators and freezers, and dispose of them in an environmentally-friendly manner.

4.3.2 Target Market

The target market for ES Products is New Hampshire's 520,000 households which utilize a multitude of energy-consuming devices. The program's incentives are designed to encourage customers to replace old, inefficient products with high-efficiency ENERGY STAR-certified technologies.

4.3.3 2021-2023 Plan Priorities

The NH Utilities have established several priorities for ES Products to increase energy savings and customer participation during the 2021-2023 term. These priorities include:

Introducing New Products to the Energy Efficiency Marketplace

The NH Utilities will expand ES Products during the 2021-2023 term by offering incentives for additional high-efficiency products, such as advanced power strips, freezers, electric-heated water-saving devices, and Wi-Fi thermostats (for oil and propane-heated homes). In addition, the NH Utilities will expand appliance recycling rebates to include room air conditioners and will investigate adding dehumidifiers during the 2021-2023 term. This expansion may be integrated into the current appliance recycling pick-up offering (see Section 4.3.4: Program Design) for freezers and refrigerators. Alternatively, some of the NH Utilities may host local and regional recycling events in collaboration with municipalities or waste managers.

In addition to the above-referenced new measures, the NH Utilities will evaluate the cost effectiveness of smart home energy management systems and connected products for inclusion in the 2021-2023 ES Products program. The NH Utilities work with organizations and vendors such as the Massachusetts and Connecticut Technical Assessment Centers, EPA, Northeast Energy Efficiency Partnerships ("NEEP"), E-Source, and contracted vendors who are experts in the appliance field (i.e., retailer circuit riders and product fulfilment vendors) to identify new and emerging technologies for ES Products.

Residential Lighting

During the 2021-2023 term, the NH Utilities will continue to incentivize general service LED bulbs and fixtures in order to prevent backsliding that may otherwise result from recent reversals in federal standards for general service bulbs (see Section 4.1.3). The NH Utilities have been implemented retailer point-of-purchase markdowns for energy-efficient lighting beginning in 2016. Since that time, the number of participating retailers has increased each year, while some smaller retailers have continued to offer mail-in rebates.

During the 2021-2023 term, the NH Utilities will conduct strategic marketing promotions and incentives to ensure that hard-to-reach and income-eligible customers, who are the most up-front value conscious consumers, have high-efficiency choices in the lighting marketplace.

ENERGY STAR Retail Products Platform

During the 2021-2023 term, the NH Utilities will look into introducing the ENERGY STAR Retail Products Platform ("ESRPP"), a collaborative marketing and upstream initiative facilitated by the EPA, ENERGY STAR, energy efficiency program sponsors (i.e., utilities), retailer partners, and other stakeholders to the New Hampshire marketplace. The ESRPP gives program sponsors a national-level structure to offer minimal direct retailer incentives to big-box retail stores, such as Best Buy, Home Depot, Lowe's, Wal-Mart, Target, and small independent stores (as part of the Nationwide Marketing Group) to increase the sale, promotion, and stocking of high-efficiency appliances.

Incentivized measures may include, but are not limited to: clothes dryers, clothes washers, freezers, refrigerators, and room air conditioners. This new product channel will be designed to generate increased energy savings as more energy-efficient products are stocked and sold at big-box and small independent retail stores. In preparation, the NH Utilities will research other state's ESRPP programs, and evaluations of those offerings to help determine best practices regarding a possible deployment of a New Hampshire ESRPP.

Expand Midstream Rebate Offerings

The NH Utilities will expand the list of measures offered by the existing midstream distributor network to include HPWHs and Electronically Commutated Motor ("ECM") circulating pumps. The NH Utilities will continue to investigate if and when to include heat pumps for heating and cooling in midstream offerings.

4.3.4 Program Design

The NH Utilities have designed ES Products for 2021-2023 to promote the purchase of ENERGY STAR-certified appliances, lighting, heating and cooling systems, and water-heating equipment. The NH Utilities will continue to utilize varied incentives and delivery mechanisms to reach New Hampshire's households at multiple retail entry points.

Lighting Products

The primary mechanisms to promote ENERGY STAR-certified LED products are point-of-purchase product markdowns and online rebates. The NH Utilities partner with numerous retailers, distributors, and manufacturers ("Retail Partnerships") to promote LED light bulbs and fixtures. Recently, five new Retail Partnerships with discount stores have been established to better serve the limited-income and hard-to-serve markets. Over the next three-year period, the NH Utilities will continue to negotiate the special placement of products and promotions at various retail partners' locations throughout the state to help fully transform the market toward high-efficiency LED lighting.

Appliances

Rebates

ES Products provides rebates for the purchase of ENERGY STAR-certified electric appliances, including: clothes dryers, clothes washers, dehumidifiers, pool pumps, refrigerators, room air conditioners, and room air purifiers. These rebate forms are available online and at retail partner locations. For online rebates, customers must first purchase the energy-efficient item, then complete an online rebate form, and provide supporting documentation (i.e., receipts) through the ES Product online system. The NH Utilities' rebate fulfillment vendor then processes and verifies online rebate submissions. Once an online rebate submission has been approved, the vendor sends the NHSaves incentive check to the customer. The rebate fulfillment vendor sends detailed rebate fulfillment data to each NH Utility along with an invoice for the cost of all customer rebates fulfilled during the period.

Point-of-sale rebates result from collaborations between the NH Utilities, a retailer, and a manufacturer. These partners agree to offer special promotions combined with program incentives for targeted high-efficiency products. The on-sale products are displayed at end-caps and retail shelves with prominent NHSaves and ENERGY STAR signage promoting the discounted prices. Upon checkout, the product is automatically marked down without the need for the customer to fill out a mail-in rebate: thus, removing a participation barrier for customers and retailers. Point-of-sale rebates and instant discount e-rebates are available for measures such as dehumidifiers, room air conditioners, and room air purifiers. The NH Utilities will monitor new and emerging technologies that could be introduced during the 2021-2023 term.

Appliance Recycling Program

The NH Utilities offer appliance recycling rebates to encourage customers to dispose of their under-utilized freezers and refrigerators wasting energy that are typically located in the basement or garage.

These old, inefficient appliances are then disposed of in an environmentally-friendly manner. The appliance recycling process begins when a customer schedules a pick-up time for the appliances through an online request form or via telephone. The third-party vendor will pick up the old refrigerator or freezer at the customer's home and will then issue an incentive payment.

During the 2021-2023 term, the NH Utilities will expand ES Products recycling to include room air conditioners and will evaluate the cost effectiveness of offering dehumidifier recycling rebates. This expansion may include integration into the current program design (third-party pickup) or recycling events at central locations.

HVAC Systems

The NH Utilities offer mail-in and online submission rebates for high-efficiency heating and cooling equipment, including central air conditioning systems, air-source heat pumps, ductless heat pump mini-splits ("DHPMS"), natural gas boilers and furnaces, and Wi-Fi thermostats. The HVAC offerings are heavily promoted through periodic e-mail blasts to over 500 contractors across the state and New England area, as well as through bill inserts, newsletters, and social media.

Contractor response has been extremely positive to these rebates, especially for air-source heat pumps, as the incentives significantly help them to sell high-efficiency heating and cooling equipment to customers. To complement these rebates, the NH Utilities will continue to support contractor education and training on high-efficiency HVAC equipment.

To receive an incentive, midstream or upstream, the NH Utilities require that central air conditioning ("A/C") systems and heat pump systems meet nationally-recognized energy efficiency specifications, including:

- **Energy Efficiency Ratio ("EER").** An EER rating measures how efficient a central A/C or heat pump system will operate when the outdoor temperature is at a specific level (95°F). The higher the EER, the more efficient the system.
- **Heating Seasonal Performance Factor ("HSPF").** The HSPF measures the efficiency of a heat pump and shows the total heating output of the heat pump during a normal heating season, in

BTUs, as compared to the total electricity consumed (in kWh) during the same period. The higher the HSPF, the more efficient the heat pump.

- **Seasonal Energy Efficiency Ratio ("SEER").** A SEER rating measures the efficiency of a central A/C or heat pump system over an entire cooling season. The SEER rating indicates the cooling output of a central A/C or heat pump system in BTUs during the normal cooling season as compared to the total electricity consumed (in kWh) during the same period. The higher the SEER rating, the more efficient the central A/C or heat pump system.

Domestic Water Heating Equipment

ES Products provides rebates for the purchase of ENERGY STAR-certified water heating equipment, including natural gas water heaters, combination units (providing both heat and hot water), and HPWHs. Natural gas water heater incentives are available through mail-in and online rebate submissions.

HPWHs are considerably more efficient than traditional electric water heaters. HPWHs concentrate the warmth of ambient air around them to heat water for domestic hot water consumption. For the 2021-2023 term, HPWH technology rebates will be offered through three channels: (1) mail-in rebates, (2) instant discount e-rebates offered through participating Retail Partners, and (3) a midstream offering.

In 2020, the NH Utilities introduced a midstream rebate to encourage retailers and distributors to stock their shelves with ECM circulating pumps and high-efficiency HPWHs and market the technologies to contactors. To support the newly-introduced midstream rebates, the NH Utilities will continue to partner with big-box retail stores and distributors to conduct contractor trainings regarding the benefits of high-efficiency water heating equipment.

4.3.5 Marketing

For the 2021-2023 Plan, the NH Utilities plan to market ES Products through a variety of marketing channels, including retail and equipment distributor partner promotions, bill inserts, e-mail communications, social media updates (Facebook and Twitter), and paid internet searches. The NH Utilities will also continue to work closely with Retail Partners to market high-efficiency appliances, HVAC systems, water heating equipment, and lighting products to the residential marketplace. This may include special promotions, end-cap displays, distribution of marketing collateral, and in-store educational presentations.

4.3.6 Program Budget and Goals

Table 4-3: ES Products Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$11,931,356	$10,230,869	$9,465,526	**$31,627,751**
Annual kWh Savings	22,405,241	14,574,410	11,770,086	**48,749,738**
Lifetime kWh Savings	141,057,761	133,362,831	141,898,573	**416,319,165**
kW Reduction	3,421	2,226	1,854	**7,500**
No. of Participants	442,076	250,791	102,196	**795,062**
Natural Gas Programs				
Program Budget	$1,463,811	$1,634,490	$1,808,383	**$4,906,684**
Annual MMBtu Savings	17,493	19,791	21,456	**58,740**
Lifetime MMBtu Savings	296,615	334,790	362,488	**993,893**
No. of Participants	11,216	12,930	13,231	**37,377**
Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.				

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4.4 Home Energy Assistance Program ("HEA")

4.4.1 Program Objective

HEA is a fuel-neutral weatherization program designed to reduce energy use from both electric and fossil fuel-consuming appliances and HVAC systems. The program serves New Hampshire's income-eligible homeowners and renters to help reduce their energy costs, optimize their home's energy performance, and make their homes more comfortable. The primary objective of HEA is to reduce the energy burden of limited-income households, which often incur a significantly higher share of household income from energy costs.

High energy burdens, often called *energy poverty*, are when a household spends 10 percent or more of its income on energy-related expenses. Often, these households are older homes where maintenance improvements have been deferred and there is insufficient insulation to keep the home comfortable, safe, and efficient. HEA measures, such as air sealing, insulation, heating system upgrades, and LED lighting provide long-term solutions that help these households reduce energy consumption, lower their bills, and provide significant non-energy-related benefits.

HEA covers the cost to improve the efficiency of customers' homes and provides practical solutions about how to modify how they use their homes and equipment without sacrificing their comfort or quality of life. In addition to energy-efficient measures, the HEA program may provide services to address health and safety barriers in the home, such as inadequate ventilation, old wiring, and damaged insulation, if the energy efficiency project is deemed as cost effective.

4.4.2 Target Market

A baseline potential study currently being undertaken estimates that approximately 22 percent of New Hampshire's households meet the income-eligible criteria for HEA, some of which have been served over the past two decades through the NH Utilities' collaboration with the CAAs.[39] The HEA program targets income-eligible residential customers who live in single-family buildings (1 to 4 units) and multifamily buildings (greater than 4 units).

To receive HEA services, a household's income must meet the eligibility criteria for participation in the New Hampshire Fuel Assistance Program ("FAP"), the New Hampshire Electric Assistance Program ("EAP"), or anyone residing in subsidized housing or municipal or nonprofit organizations serving those in need. The current guidelines include:

- **FAP Guidelines.** Participants must have an income that is at or below 60 percent of the state median income for their household size; or
- **Electric Assistance Guidelines.** This statewide utility assistance program has general guidelines for discounts on bills based on household income, household size, and electricity or natural gas usage. Applications are processed by the CAAs.

The NH Utilities also coordinate closely with the US DOE's Weatherization Assistance Program ("WAP") to identify HEA participants and to leverage funding for energy efficiency projects. WAP participants must have an income that is at or below 200 percent of the federal poverty guidelines for their household size.

HEA applications are reviewed, and income eligibility is verified before customers can receive services. HEA effectively leverages multiple funding sources, like WAP and FAP, to fund additional energy efficiency measures, such as heating system replacements. WAP provides federal funding to income-qualified homeowners who want to optimize the energy performance of their home. The New Hampshire FAP is funded by the federal Low Income Home Energy Assistance Program's ("LIHEAP") funds and assists the state's low-income customers in paying for heating costs. The New Hampshire Office of Strategic Initiatives ("NH OSI") and New Hampshire's CAAs distribute FAP benefits.

[39] Itron, Inc. *New Hampshire Residential Energy Efficiency Baseline Study*. Jun. 11, 2020.

4.4.3 2021-2023 Plans

For the 2021-2023 Plan, the NH Utilities will implement a number of new initiatives to increase participation in HEA, including supporting workforce development, addressing program design constraints, developing new “on ramps” to program participation, introducing new energy-efficient measures, and improving the program’s data sharing and data tracking systems.

Improving Weatherization Tracking Systems

Currently, the NH Utilities are working to upgrade weatherization tracking and referral systems to streamline information sharing between the NH Utilities, CAAs, NH OSI, and other contractors. The new software will allow the NH Utilities to perform energy modeling more easily; allowing them to review more projects for cost effectiveness and provide better energy savings information to customers. By 2021, the NH Utilities’ data tracking system should be upgraded and operational.

Modifications to HEA

During the 2021-2023 term, the NH Utilities will make several modifications to HEA, including:

1. **Increasing or Eliminating Current Incentive Cap.** The NH Utilities have increased the previous incentive cap of $8,000 to $20,000, including heating systems, and will allow exceptions to exceed that cap when there is not enough other funding available to complete all cost-effective measures. Due to the limited amount of WAP funds available, once the incentive threshold is reached, HEA contractors cannot install additional energy-efficient measures or address further health and safety barriers. The previous threshold did not always support the installation of all energy efficiency measures that could optimize each home’s energy performance. The increased incentive cap of $20,000 will ensure that more homes are addressed comprehensively, consequently driving energy savings in HEA. If the project cap is reached ($20,000), the NH Utilities will review each home on a case-by-case basis to determine the cost-effectiveness of the project.
2. **Implement New Screening Methodologies.** By 2021, the structure of the new Granite State Test for cost-benefit analysis of the portfolio of programs, as well as a PI structure that places

the benefit-cost threshold at the portfolio level, will allow the NH Utilities more flexibility in applying the benefit-cost test requirements for HEA which in turn will allow more projects to qualify, including those that need health and safety repairs. For the 2021-2023 term, the NH Utilities will also continue to allocate HEA incentive dollars toward fixing health and safety barriers, such as roof repair, removal of knob and tube wiring, and vermiculite remediation, as part of the energy improvements.

3. **HEA Implementation Manual.** During the 2021-2023 term, the NH Utilities will revise and update the HEA implementation manual to record the standard processes and guidelines the NH Utilities follow to administer the program. This will eliminate some inconsistencies in HEA design, procedures (e.g., invoice processing, which measures are funded, etc.), and operations across the NH Utilities.
4. **Introduce New Pathways and Measures.** To scale up energy savings and serve more customers through HEA, the NH Utilities will offer additional “on ramps” for income-eligible customers to participate in the program during the 2021-2023 term. These additional pathways will include, but are not limited to: visual audits, standalone appliance vouchers, and the distribution of energy efficiency kits.

In addition to the new HEA pathways, the NH Utilities will introduce new energy-efficient measures during the 2021-2023 term, including, but not limited to: clothes dryers, clothes washers, dehumidifiers, HPWHs, and air conditioning equipment. Some of these measures may be included with the standalone appliance vouchers referenced above.

Increase Education, Training, and Trade Ally Relationships

In order to ramp-up HEA activity, the NH Utilities recognize the need to increase workforce capacity in parallel through CAA and qualified contractor training. This will ensure the CAAs can train and retain contractors who have the expertise to specify, install, and optimize energy-efficient technologies. In addition, the NH Utilities plan to allocate a portion of NHSaves funds to allow CAAs to support capacity building, such as hiring and training new CAA staff due to attrition in the workforce and purchasing weatherization equipment.[40] The NH Utilities will focus efforts on conducting CAA and qualified contractor education and training to increase the knowledge-level and expertise regarding high-efficiency technologies and comprehensive energy savings. Building an educated workforce will allow the program to serve more customers and drive increased energy savings.

4.4.4 Program Design

The HEA program provides fuel-neutral weatherization services to income-eligible homeowners and renters across the state. These energy-efficient measures reduce customers' energy costs, improves their homes' energy performance, and ensures their homes are comfortable. For the 2021-2023 term, the NH Utilities have established four pathways for HEA: (1) direct-install weatherization services, (2) visual audits with limited weatherization measures, (3) appliance vouchers offered to visual audit participants or as standalone rebates, and (4) the distribution of energy kits. The NH Utilities have created these pathways to scale up energy savings and make it easier for income-eligible customers to participate in NHSaves Programs.

Customer Intake

The NH Utilities partner with the CAAs, NH OSI, housing authorities, and other nonprofits across the state to identify and verify eligible customers and projects for the HEA program. This collaboration is important to ensure that the HEA program fully qualifies, prioritizes, and serves income-eligible customers who have a variety of complex needs. The HEA program's partners are consistent and reliable presences within the low-income community and have established relationships with multiple service providers that help promote trust and social acceptance, and have access to a variety of local, state and federal funding sources that improve services and outcomes for the same income-eligible customers.

[40] RSA 374-F. http://www.gencourt.state.nh.us/rsa/html/XXXIV/374-F/374-F-mrg.htm. Energy efficiency programs should include the development of relationships with third-party lending institutions to provide opportunities for low-cost financing of energy efficiency measures to leverage available funds to the maximum extent and shall also include funding for workforce development to minimize waiting periods for low-income energy audits and weatherization.

Energy Efficiency Audit and Direct-Install Pathway

Verification screenings determine if customers are eligible for HEA based on their income. HEA contractors will perform an energy assessment of the eligible home to identify the most cost-effective improvements needed to optimize the energy performance of each customer's home. Then, a team of energy technicians installs the recommended improvements. Once a home has received HEA direct-install services, an energy auditor will perform a post-work inspection and explain the energy savings to the customer. Services are fully paid for by the NHSaves HEA budget or collaborating partner funding (e.g., WAP), and there are no costs incurred directly by the customer.

For the 2021-2023 term, the NH Utilities will continue to offer the CAAs the right of first refusal to deliver HEA direct-install program services, provided they meet a set of statewide standards for bidding, pricing, and timely program delivery. In 2020, the HEA measure incentives were increased based on updated pricing. Should a CAA not be able to provide HEA program services in accordance with the approved weatherization plan or declines to deliver the services, the work will be assigned to other qualified contractors who meet the NH Utilities' standards for pricing, customer service, and work quality.

Direct-Install Measures

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

- Air sealing;
- Building shell insulation;
- Duct sealing;
- Freezer replacements;
- High-efficiency lighting;
- Hot water-saving devices (hot water temperature setback, faucet aerators, low-flow showerheads, and water pipe insulation);
- HVAC system cleaning;

- Refrigerator replacements;
- Window and door replacements; and
- Health and safety measures that are required for weatherization services to be performed.[41]

HEA also replaces HVAC equipment with high-efficiency technologies if the current model is at the end of its useful life, deemed potentially unsafe, or is otherwise in need of replacement. The NH Utilities may install ductless heat pumps for customers currently using electric resistance heat or electric cooling when it is deemed cost-effective. In addition, the NH Utilities will continue to offer HPWHs to encourage homeowners to replace old, inefficient oil and propane water heaters with these high-efficiency technologies.

For the 2021-2023 term, the NH Utilities will continuously evaluate the cost effectiveness of adding new measures to the program.

Visual Audit Pathway

A visual audit offering has been deployed through the Home Performance with ENERGY STAR ("HPwES") program (see Section 4.5) and is being reviewed for its efficacy and cost effectiveness within the 2020 HEA framework. The Visual Audit pathway in HPwES is utilized for electric and natural gas customers who applied for energy efficiency services through the Home Heating Index ("HHI") tool but did not meet the heating fuel threshold for participation in the full HPwES program. If a visual audit customer is identified by their NH Utility as income-qualified, that customer is eligible to receive a visual audit through HEA.

In the Visual Audit pathway, the contractor will perform an on-site assessment of the home to determine energy-saving opportunities and the customer will receive basic measures, such as Wi-Fi or programmable thermostats, flow-control showerheads and faucet aerators, up to six feet of domestic

[41] For the 2021-2023 term, the basic health and safety measures will include basic ventilation requirements, as well as smoke and carbon monoxide detectors needed to safely conduct weatherization services. Additional health and safety measures that are typically high-cost barriers to weatherization will continue to be included in HEA, including but not limited to: roof repair, knob and tube wiring replacement, and wet basement mitigation.

hot water pipe insulation, and LED bulbs without the need for a full on-site energy audit. The contractor will also determine if there are other opportunities that can be implemented through the full HEA pathway (direct-install). If sufficient opportunity exists, then the contractor will notify the customer's NH Utility to enroll the customer in the full HEA offering.

Appliance Vouchers

During the 2021-2023 term, the NH Utilities plan to offer appliance vouchers (rebates) to income-qualified customers, including those with high electric usage. These vouchers will be offered through the Visual Audit or may be standalone appliance rebates to encourage customers to replace their old, inefficient appliances with high-efficiency models.

Prior to implementation, the NH Utilities will finalize the pre-qualification conditions for appliance vouchers, which may include requiring the customer to receive a Visual Audit or processing qualified customers that have been on a wait list for an extended period of time for HEA direct-install weatherization services. The appliance voucher offering will allow the NH Utilities to reach more income-eligible customers and drive energy savings for HEA.

Distribution of Energy Kits

For the 2021-2023 term, the NH Utilities will expand the distribution of energy kits to targeted groups of income-eligible customers across the state to broaden access to low cost measures for eligible customers. The distributed energy kits will include items such as LED bulbs, power strips, and program literature. Energy kits may be distributed to targeted customers (i.e., EAP customers) through direct marketing, after they have participated in the Visual Audit pathway, or at Button Up Workshops (see Section 4.4.5 for more details).

Energy kits are an effective tool to offer quick and easy energy savings to customers, particularly if they are on a wait list for an extended period of time for HEA direct-install weatherization services.

Coordination with Other Fuel Assistance Programs

HEA is closely coordinated with the EAP and FAP (which as noted previously is funded by LIHEAP). The NH Utilities work with EAP and FAP participants to help make their homes more energy efficient and help them save on their energy bills. This stretches EAP and FAP funding to include other New Hampshire residents in need of assistance, while improving the comfort and efficiency of their homes.

Coordination with WAP

The CAAs and the NH OSI administer WAP. The NH Utilities collaborate closely with these HEA partners to maximize the number of projects that are jointly funded by HEA and WAP. Leveraging other energy efficiency funding allows the NH Utilities to serve more income-qualified customers and help decrease these customers' energy burdens.

Coordination with Other NHSaves Programs

When a customer qualifies for the HPwES program (see Section 4.5), the NH Utility checks to see if the customer is receiving EAP benefits to determine if they qualify for HEA. In addition, the NH Utilities work closely with building owners and developers building new homes or multifamily buildings for low-income communities (e.g., Habitat for Humanity, affordable housing projects, etc.) to ensure that these homes are built efficiently to decrease the energy burden on the new tenants or occupants. Residential new construction projects are budgeted for and energy savings goals are tracked through ES Homes (see Section 4.2).

4.4.5 Marketing

Program participants are primarily recruited through referrals from the CAAs, social service agencies, housing authorities, nonprofit groups, the EAP and FAP programs, and the NH Utilities' customer care and energy efficiency departments. These groups are well-trusted and serve the target market year round. By partnering with these entities, the NH Utilities have direct access to communicate HEA benefits to the right market segment. For the 2021-2023 term, the NH Utilities may market HEA through a variety of marketing channels, including bill inserts, periodic e-mail updates and newsletters, events, social media updates (Facebook and Twitter), targeted direct mail, and paid Internet searches.

4.4.6 Program Budget and Goals

Table 4-4: HEA Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$18,555,949	$23,025,028	$28,273,056	**$69,854,034**
Annual kWh Savings	2,631,229	3,336,262	4,030,680	**9,998,172**
Lifetime kWh Savings	36,575,964	45,155,878	54,156,758	**135,888,600**
kW Reduction	365	458	549	**1,372**
No. of Participants	1,974	2,531	2,982	**7,487**
Natural Gas Programs				
Program Budget	$2,066,275	$2,356,050	$2,713,815	**$7,136,139**
Annual MMBtu Savings	9,550	10,606	12,028	**32,184**
Lifetime MMBtu Savings	207,193	230,583	262,398	**700,173**
No. of Participants	453	490	540	**1,483**
Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.				

4.5 Home Performance with ENERGY STAR Program

4.5.1 Program Objective

The HPwES program is a comprehensive, fuel-neutral whole house approach to improving energy efficiency and comfort in existing residential single-family and multifamily homes. The objective of HPwES is to help customers who live in existing homes reduce their energy costs, reduce their dependence on fossil fuels, and improve their home's energy performance through the implementation of weatherization and energy-efficient measures. HPwES provides lighting upgrades, heating and hot water equipment upgrades, weatherization measures, and appliance replacements.

4.5.2 Target Market

The target market for HPwES is existing residential single-family homes where the homeowners or landlords want to reduce energy bills, improve a home's energy performance, and increase the comfort of the home.

Program Eligibility

There are a number of eligibility guidelines for participation in HPwES. Single-family homes (1 to 4 units) are eligible to participate regardless of how a home is heated. If a home is primarily served by its natural gas utility (residentially-metered home heated by natural gas), it participates in HPwES through its natural gas utility and if it is a non-natural gas home, it participates through its electric utility.[42]

HPwES reviews multifamily homes and evaluates them for cost effectiveness using the standard benefit-cost test to determine the home's eligibility.

[42] For single-family and multifamily homes that are natural gas-heated, the customer's NH Gas Utility pays for weatherization and health and safety measures and the customer's NH Electric Utility pays for the electric savings measures.

- **Natural Gas-Heated Homes.** Individually-metered residential units are serviced through HPwES. If a project reaches the customer's cap $(8,000), the customer's electric utility will incent the customer up to $8,000 more. Centrally-heated residential units that are on a commercial or master-meter account are primarily served by the NH Natural Gas Utilities through the NHSaves C&I programs (see Chapter Three).
- **Other Fuel-Heated Homes.** These homes are eligible for all services, which are provided by the respective NH Electric Utility.

Regardless of heating fuel, utility territory, or which program the project falls into, customers undertaking a multifamily project will have a streamlined single point of contact, through their Home Performance Contractor, Community Action Agency, or other vendor working with the NH Utilities.

4.5.3 2021-2023 Plans

For the 2021-2023 term, the NH Utilities will implement a number of new initiatives to continue the success of HPwES while making program design modifications to serve more customers and help drive more energy savings.

Improving Weatherization Tracking Systems

As noted in the HEA section (Section 4.4), the NH Utilities are working to upgrade weatherization tracking and referral systems to streamline information sharing between the NH Utilities, CAAs, NH OSI, and other contractors. The new software will allow the NH Utilities to perform energy modeling more easily; allowing them to review more projects for cost effectiveness and provide better energy savings information to customers. By 2021, the NH Utilities will have upgraded the program's data tracking systems.

Increase Program Participation and Savings

The NH Utilities will increase HPwES participation levels and energy savings by expanding the entry points to the program for customers and contractors. This drive toward increased energy savings and participation will include the following initiatives:

- **Prioritize Workforce Trainings.** The NH Utilities will focus efforts on conducting contractor education and training workshops to increase the knowledge level and expertise regarding high-efficiency technologies and comprehensive energy savings. Building an educated workforce will allow the program to serve more customers and drive increased energy savings.

- **Implement New Screening Methodologies.** The structure of the new Granite State Test for cost-benefit analysis of the portfolio of NHSaves Programs, as well as a PI structure that places the benefit-cost threshold at the portfolio level, will allow the NH Utilities more flexibility in applying the benefit-cost test requirements for HPwES. The upgraded tracking software will allow more timely and accurate energy modeling that is expected to allow the NH Utilities to expand HPwES offerings to more customers.

- **Expand Visual Audit Pathway.** To ensure that HPwES energy efficiency services reach more customers, the NH Utilities will expand the program to offer more HPwES Visual Audits. This ensures that all customers have a pathway to participate in the program, even if they do not qualify through the HHI screening models.

- **Add New Pathways.** The NH Utilities are exploring adding more pathways for customers who do not meet the HHI screening tool to participate in HPwES. This may include appliance vouchers for prescriptive measures, such as high-efficiency appliances or self-installed insulation. For the 2021-203 term, the NH Utilities will continue the Virtual Assessment pathway to HPwES that was introduced in 2020.

Addressing Program Design Constraints

For the 2021-2023 term, the NH Utilities have resolved to refine several HPwES design constraints, including:

- **Increasing Current Incentive Cap.** For the 2021-2023 term, the NH Utilities have increased the previous HPwES incentive cap from $4,000 to $8,000, including heating system incentives. Increasing project costs restrict, HPwES contractors’ ability to drive deeper energy savings through the installation of holistic energy-efficient measures under the previous incentive cap. The previous threshold did not always support the installation of all energy efficiency measures that could optimize each home's energy performance. The increased incentive cap of $8,000 will ensure that more homes are addressed comprehensively, consequently driving energy savings in HPwES. If the project cap is reached ($8,000), the NH Utilities will review each home on a case-by-case basis to determine the cost effectiveness of the project.

- **Addressing More Health and Safety Barriers.** In 2021, the NH Utilities will begin to make financing options available to those homes with health and safety barriers, such as knob tube wiring and vermiculite for projects requiring this remediation to move forward.

Introduce Additional Measures to HPwES

To increase energy savings and better serve customers, the NH Utilities will introduce new energy-efficient measures during the 2021-2023 term, such as additional appliances and HPWHs (that are already part of the ES Products program). In addition, the NH Gas Utilities will work to identify and evaluate new natural gas space and water heating measures throughout the 2021-2023 term.

4.5.4 Program Design

Contractor Eligibility

HPwES supports a robust network of local energy efficiency professionals who provide a number of implementation services including: raising customer awareness of the program, recruiting participants, conducting the home energy audits, recommending energy-saving improvements, installing energy-efficient measures, and tracking the energy savings and project progress. The NH Utilities provide a contractor vetting process to ensure all HPwES contractors meet the following qualifications: (1) be a registered business in New Hampshire, (2) have weatherization experience, (3) have BPI Building Analyst certification and lead training, (4) pass an enhanced quality assurance ("QA") review of their initial three jobs performed within HPwES, and (5) agree to the HPwES program's pricing and the NH

Utilities' terms and conditions.[43] A third-party QA contractor reviews a percentage of homes serviced and provides feedback to the NH Utilities and HPwES contractor.

Program Qualifications

Customers can determine if their home qualifies to participate in HPwES through the NHSaves.com website. Here, customers can self-qualify via the HHI Tool. Customers are asked for the following information: (1) zip code, (2) conditioned square footage of the home, and (3) annual heating fuel use (one year of fuel history; system accepts up to two different types of heating fuel).[44] Interested residential customers can also work directly with their respective NH Utility to enroll in the HPwES program.

Home Heating Index

The HHI is used as a customer intake system for the program and includes a behavioral component of raising customer awareness regarding their energy consumption. The HHI Tool determines if a customer is considered a low, moderate or higher energy usage per square foot customer (normalized for size of house) and if the customer is eligible for full HPwES services. Eligibility for full HPwES services is based on a high proportion of heating fuel usage per square feet of the home to help identify if there is potential for cost-effective measures or actual energy savings. In limited cases, a NH Utilities program administrator may waive the HHI qualification if it can be determined that the project potentially has significant energy-saving opportunities.

The HHI qualification was put in place several years ago to identify the homes with the most opportunity for energy savings. In an effort to better serve residential customers who wish to engage in energy efficiency but who have low to moderate energy consumption in the home. The NH Utilities

[43] Customers can choose their own contractor provided the contractor meets meet the HPwES program's minimum qualifications. If the contractor is not already approved for work in the program, they can be brought in, provided they agree to all the program rules that participating contractors must follow.

[44] The NH Utilities do allow customers with less than 12 months of fuel data to participate in the program, as long as their usage still meets the HHI threshold for HPwES.

introduced the Visual Audit during the 2018-2020 term. For the 2021-2023 term, the NH Utilities will expand the Visual Audit offering and Virtual Assessment to more customers.

Full Program Services

The NH Utilities use a streamlined whole-home approach from the energy audit through installation to inspection and allows customers to choose their HPwES contractor from a qualified list, or to ask their respective utility to assign them a contractor based on location and workload. Once a customer qualifies for HPwES, a qualified contractor will perform an energy audit of the customer's home to identify energy efficiency opportunities, calculate potential savings, and provide QA for any services performed. A nominal fee is paid upfront for the energy audit, which includes diagnostic testing (blower door test) for air leakage. If a customer decides to move forward with any of the HPwES contractor's recommendations, this fee is applied toward the customer's cost share of the project costs.

The energy audit report provides the project cost, rebate availability, and payback or Return-on-Investment ("ROI") estimations. When presented with the recommendations and energy audit report, customers must decide within 45 days if they want to proceed further with the energy-efficient improvements.[45] For customers who decide not to proceed further with energy-efficient improvements, the contractor will provide some no cost, direct-install measures.

If a customer decides to proceed with the home improvements, energy efficient measures are installed by the qualified HPwES contractor. Incentive payments are typically paid directly to contactors by the NH Utilities once the project is complete. Customers are responsible for paying their share of the project costs ("Co-pay") either directly to the contractor or via the loan program. Qualifying energy-efficient measures allow for comprehensive, fuel neutral weatherization, and typically include:

- Air sealing;

[45] All pricing of recommendations is good for 45 days and can be extended by the contractor if necessary. The HPwES contract gives customers an initial 45 days to commit and the NH Utilities note that contracts are often extended to give customers as much time as they need to make a decision regarding what energy-efficient measures (if any) they will install.

- Building shell insulation;
- Duct sealing;
- High-efficiency lighting;
- Hot water pipe insulation and hot water temperature setback;
- Refrigerator replacements;
- Water-saving devices (low-flow showerheads and faucet aerators);
- Wi-Fi thermostats; and
- Health and safety measures[46] that serve as barriers to energy efficiency projects.

During the energy audit, the HPwES contractor will also evaluate the efficiency of the home's appliances to determine if they are cost effective to replace. These appliances include: clothes dryers, clothes washers, dehumidifiers, refrigerators, room air purifiers, and other measures.

For homes that need more energy-efficient improvements than those listed above, HPwES also offers incentives for custom measures. Custom measures are proposed and evaluated as individual projects, separate from the customer's HPwES energy-efficient improvements. These custom measures can include but are not limited to:

- Air source or ductless heat pumps;
- HVAC optimization; and
- Smart home energy management systems.

In addition, if an oil or propane heating system is at the end of its life, the HPwES contractor can recommend that the customer bring in an HVAC contractor to replace the unit with a new ENERGY

[46] For the 2021-2023 term, the basic health and safety measures will continue to be limited to basic ventilation requirements, as well as smoke and carbon monoxide detectors needed to safely conduct weatherization services and will be limited to ensure the project is cost effective.

STAR-certified model. HPwES provides an additional rebate to lower the incremental cost between the standard equipment and high-efficiency model. Customers that receive a recommendation from the contractor to install a new natural gas heating system or electric heat pump system will be served via ES Products.

Visual Audit Approach

For the 2021-2023 term, the NH Utilities will continue to offer the Visual Audit pathway to electric and natural gas customers who do not meet the current HHI threshold (typically high to moderate usage customers) and therefore are not eligible to participate in HPwES. The contractor performs a visual audit of the home and the customer will receive measures, including Wi-Fi thermostats, flow-control showerheads or faucet aerators, up to six feet of domestic hot water pipe insulation, and LED light bulbs. Additional appliance vouchers may also be considered. The contractor will also determine if there are opportunities for weatherization measures that can be implemented through the full HPwES offering. If sufficient opportunity exists, then the contractor will notify the customer's NH Utility to evaluate the customer for full HPwES.

Virtual Assessments

The NH Utilities are continuously exploring new offerings for customers to participate in HPwES. In 2020, the NH Utilities designed and implemented a temporary virtual HPwES audit offering ("Virtual Assessment") to provide an opportunity for contractors to engage with customers who have already expressed an interest in an audit while on-site services were suspended due to the COVID-19 pandemic.

Pre-Screening Tool

The NH Utilities believe that the Virtual Assessment is a useful pre-screening tool for a home, allowing contractors to better prepare for a more efficient on-site visit. Virtual Assessments could potentially identify weatherization barriers (e.g., improper ventilation, etc.) in advance of an on-site Visual Audit, thus reducing the need for a second visit which should reduce costs. In addition, a Virtual Assessment can help contractors better ascertain the opportunity and scope of work so the optimum contractor crew compliment and the length of scheduled on-site visit time (through the direct-install or visual audit pathways) is more precise. This could result in more efficient scheduling and perhaps more effective utilization of existing contractor resources. During the 2021-2023 term, the NH Utilities will integrate Virtual Assessments into the HPwES program as appropriate.

Customers who elect to receive a Virtual Assessment will have a convenient way to understand the likely energy-saving opportunities in their homes. Together, the customer and an experienced contractor will identify energy efficiency opportunities in the home, get the customer access to immediate energy-saving measures, and define additional savings opportunities and appropriate follow-up actions.

Through a combination of reviewing information about the customer's home from publicly-available online resources, pictures submitted by the customer, and through virtual interactions with the customer, a contractor will identify the energy efficiency savings opportunities and recommend solutions. The contractor will educate the customer about the opportunities and the value proposition for moving forward to implement certain measures.

Customers participating in the Virtual Assessment may be eligible to receive the following:

- **Energy Kits.** Customers may receive Energy Kits (similar to those offered through HEA) containing energy-saving measures, such as LED lighting, power strips, and NHSaves Residential Programs information. The customer will be asked if they are comfortable with installing any of these measures on their own. For measures where the customer affirms their ability to self-install, the customers will be required to attest that they will install the identified applicable products upon receipt. Once an attestation is signed, the products will be shipped directly to the customer for self-installation within an agreed-upon timeframe.

- **Appliance Rebates.** During the Virtual Assessment, the contractor will identify potential opportunities, within reason, for upgrades to mechanical equipment (e.g., heating, air conditioning, hot water, etc.) and appliances. For the 2021-2023 term, the NH Utilities will consider allowing the contractor to offer appliance rebates through the Virtual Assessment pathway. This would encourage customers to replace their old, inefficient appliances with high-efficiency models. Prior to implementation of appliance rebates, the NH Utilities will finalize the pre-qualifications, which may include requiring the customer to still receive a Visual Audit (on-site service). The appliance rebate offering would allow the NH Utilities to reach more customers and drive energy savings for HPwES.

Participating customers will be emailed a report that discusses the energy-saving opportunities identified by the HPwES contractor during the Visual Assessment. This report will direct customers to the appropriate informational resources for all applicable rebates, incentives, and financing options.

Appliance Rebates

For the 2021-2023 term, HPwES may offer standalone rebates for the following appliances: clothes dryers, clothes washers, dehumidifiers, room air purifiers, and other measures. This offering would encourage customers to replace their old, inefficient appliances with high-efficiency models. Prior to implementation of these rebates, the NH Utilities will finalize the pre-qualifications for appliance vouchers, which may include requiring the customer to receive a Visual Audit (on-site service). The Appliance Rebate offering would allow the NH Utilities to reach more customers and drive energy savings for HPwES.

4.5.5 Marketing

For the 2021-2023 term, the NH Utilities plan to market HPwES through a variety of marketing channels, including bill inserts, direct mail, e-mail blasts, events, newspaper and magazine advertisements, NH Utilities call center referrals, paid Internet searches, and social media updates (e.g., Facebook and Twitter). The NH Utilities will continue to work to increase the number of natural gas customers enrolled in HPwES over the next three years especially since low natural gas prices have historically limited participation.

The NH Utilities will continue to explore avenues to partner with and support community-based initiatives to encourage weatherization projects during the 2021-2023 term. This includes partnering with local energy committees, community organizations, and environmental groups to promote the benefits of HPwES through workshops and outreach events. The NH Utilities will work with community partners to deliver online trainings to create grassroots “boots-on-the-ground” outreach.

4.5.6 Program Budget and Goals

Table 4-5: HPwES Program—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Programs				
Program Budget	$8,607,418	$9,696,828	$10,758,305	**$29,062,551**
Annual kWh Savings	1,610,469	1,695,769	1,786,000	**5,092,237**
Lifetime kWh Savings	19,877,078	21,260,740	22,657,112	**63,794,930**
kW Reduction	245	259	274	**778**
No. of Participants	3,094	3,132	3,171	**9,397**
Natural Gas Programs				
Program Budget	$1,448,128	$1,600,824	$1,791,511	**$4,840,463**
Annual MMBtu Savings	12,472	13,584	15,013	**41,069**
Lifetime MMBtu Savings	229,868	249,787	276,564	**756,219**
No. of Participants	843	887	947	**2,676**

Note: kWh = kilowatt hours, kW = kilowatts, and MMBtu = million British thermal units.

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Chapter Five: Active Demand Reduction Programs

5.1 Program Objective

For the 2021-2023 term, the NH Utilities have designed several ADR offerings to reduce customer costs and provide benefits to the ISO-NE electric grid. Through the new Residential and C&I ADR programs, the NH Electric Utilities seek to reduce peak demand and capture benefits as quantified in the regional Annual Energy Supply Components ("AESC") study. The goals of the Residential and C&I ADR programs are to flatten peak loads, improve system load factors, and reduce long-term system costs for all grid-tied New Hampshire customers. Active Demand savings (kW) are realized by dispatching resources during the ISO-NE peak demand period. Reducing load during ISO-NE peak hours also has the effect of reducing New Hampshire's share of the installed capacity ("ICAP") cost allocation.

5.2 Target Market

The target market for the 2021-2023 ADR programs includes residential and C&I customers with controllable equipment that can be called upon to reduce electricity demand when an "event" is called during peak times. C&I program participants typically include customers with interval meters and demand charges, summer average annual peak demands of 250 kW or higher, and the ability to curtail at least 50 kW during an event. Residential ADR program participants typically include customers with controllable behind-the-meter ("BTM") equipment such as batteries, Wi-Fi thermostats controlling central air conditioning, or EV chargers.

5.3 2021-2023 Plans

For the 2021-2023 term, Eversource, Unitil Electric, and Liberty Electric will build upon the ADR demonstrations offered by Eversource and Unitil in 2019 and 2020 and in other jurisdictions and transition the ADR pilots to full programs in 2021. Liberty Electric will also offer a C&I ADR program for the first time.

Table 5-1: ADR Program Offerings for 2021-2023

Offering	Participating Utilities	Targeted Peaks	Event Window
Wi-Fi Thermostat DLC Residential)	Eversource, Unitil Electric	ISO-NE annual system peak. Benefits based on ISO-NE top 62 days (Max. 15 events, 3 hour duration each).	June – Sept. (2-7 p.m., non-holiday weekdays)
Battery Storage (Residential)	Eversource	ISO-NE annual system peak. Benefits based on ISO-NE top 62 days (Max. 60 events per season, 2 or 3 hour events).	Daily dispatch program. June – Sept. (2-7 p.m., non-holiday weekdays)
Load Curtailment (C&I)	Eversource, Unitil Electric, Liberty Electric	ISO-NE annual system peak. Benefits based on ISO-NE top 62 days (Max. 8 events per season, 3 hour events).	Targeted curtailment/shedding. June – Sept. (2-7 p.m. non-holiday weekdays)
Storage Performance (C&I)	Eversource, Unitil Electric	ISO-NE annual system peak. Benefits based on ISO-NE top 62 days (Max. 60 events per season, 2 or 3 hour events).	Daily dispatch program. June – Sept. (2-7 p.m., non-holiday weekdays)

5.3.1 Program Design – Commercial ADR Offerings

The Commercial ADR program has two main offerings: Load Curtailment (i.e., Interruptible Load) and Storage Performance.

Load Curtailment

The Load Curtailment offering provides an incentive for verifiable shedding of load by participants in response to communication from the NH Utilities or utility-vendors, curtailment service providers (“CSPs”). This offering is based upon the design of the Eversource and Unitil Electric pilots implemented during the 2018-2020 term. The Load Curtailment offering is technology agnostic, which means that customers are able to use any technology or strategy and earn an incentive based on their summer seasonal average curtailment performance.

With a technology agnostic approach, customers with on-site generation are allowed to participate in the Load Curtailment offering. However, the NH Utilities have established certain criterion in order to not increase emissions, including prohibiting participation by “emergency only” back-up generators.

Allowed generators in the program must pass local, state, and federal guidelines for participation in demand response programs. These permitting procedures mean this class of generator (typically EPA Tier 4) can operate a higher number of hours per year and produce little emissions, especially when compared to electrical grid emissions during peak hours.

The Load Curtailment offering provides an incentive to C&I customers to temporarily reduce facility load upon a signal from their NH Electric Utility or CSP during times of peak electric demand (referred to as "events"). Generally, curtailment events will last three hours and occur during July and August. Typically, there will be between one to eight events per summer season depending upon ISO-NE load conditions.

The NH Utilities (with assistance from CSPs) identify customers with curtailable load, assess curtailment opportunities, process and approve customer enrollment applications, manage the relationship with participants, call and manage curtailment events, oversee customer performance, and calculate payments. Unitil Electric, Eversource, and Liberty Electric plan to offer curtailment incentives to customers beginning in 2021 and throughout the 2021-2023 term.

Storage Performance

Storage Performance is a BYOD pay-for-performance ADR offering, which provides an incentive to customers with BTM storage at their facilities, based on the measured kW discharge from a storage device when responding to an NH Utility event signal. The performance-based incentive only rewards the actual performance of storage systems during events and does not provide compensation for other project costs such as the installation or maintenance of such systems. The technologies chosen by customers tend to be battery storage and thermal storage. Unitil Electric and Eversource plan to offer this to customers beginning in 2021 and throughout the 2021-2023 term.

Customer Outreach and Integration with Other Efficiency Offerings

Eversource, Liberty Electric, and Unitil Electric will utilize a variety of methods to conduct customer outreach for the Commercial ADR offerings, including leveraging touchpoints and relationships from the other NHSaves Program offerings. Many of the NH Utility staff focused on managing the standard efficiency programs, including account executives and NHSaves C&I Program staff, will also help deliver the ADR offerings to C&I customers. Customers can speak with their account executive or NH Utility contact about all of the offerings that may apply to their business and develop an implementation plan that works best for them. The direct expertise and relationships developed by CSPs and storage system vendors will also serve as an entryway to the program for customers.

5.3.2 Program Design – Residential ADR Offerings

The residential ADR program consists of two main BYOD offerings: Battery Storage and Wi-Fi Thermostat DLC. For the 2021-2023 term, the NH Utilities will also explore EV load management as a potential third offering for residential customers.

Battery Storage

The residential Battery Storage offering encourages the utilization of energy storage systems during peak events through a pay-for-performance approach. Under this offering, participating customers are incentivized to decrease their demand on the electric grid and rely instead on stored energy from their residential batteries in response to a signal or communication from their NH Utility's intermediary partner(s). Lowering daily summer peak demand may lower the distribution company's associated capacity costs. Eversource intends to provide this offering to its customers beginning in 2021 and throughout the 2021-2023 term, while Unitil Electric continues to explore this offering.

Wi-Fi Thermostat Direct Load Control

The Wi-Fi Thermostat DLC offering will target customers who own a qualified, wirelessly communicating thermostat that controls a central A/C system (including heat pump technology). As is the case with the current pilot being offered by Eversource and Unitil Electric, participants agree to allow their NH Utility to make brief, limited adjustments to their Wi-Fi thermostats during periods of peak electric demand (referred to as "events").

There will be a minimum of one event per summer season, and a maximum of 15 events. Customers who enroll in the program may opt out of any or all events depending on their needs. Customers receive an incentive at the time of enrollment and an annual participation incentive. There is no minimum number of events for customers to receive a participation incentive, however, customers with low participation may be removed from the program.

Eversource and Unitil have offered a similar Wi-Fi Thermostat DLC program for several years in neighboring jurisdictions and will draw upon third-party evaluations as well as in-market experience to optimize customer recruitment, retention, as well as performance for New Hampshire residential customers. Having established relationships with partnering vendors, both Eversource and Unitil Electric intend to begin the full program in 2021 and continue throughout the 2021-2023 term. Multiple evaluations of Wi-Fi Thermostat DLC programs across Massachusetts and Connecticut have repeatedly verified programs' performance in reducing peak utility system demand, as detailed in Section 5.3.4 below.

EV Load Management

The NH Electric Utilities will explore possible EV Load Management offerings throughout the various service territories and may implement this offering if deemed feasible and cost effective. If implemented, the EV Load Management measure would focus on events that limit or stop EVs from charging during ISO-NE peak hours. The NH Electric Utilities expect that best practices involving EV load management will evolve concurrently with the EV marketplace as other jurisdictions and energy regulatory proceedings begin to offer EV Load Management solutions. In particular, Eversource MA and CT are currently piloting EV load management offerings, and evaluation results from those pilots are expected in early 2021, which will inform the potential development of such an offering in New Hampshire. The NH Electric Utilities will collaborate with colleagues and vendors in other states that are considering or offering EV Load Management solutions in conjunction with other ADR programs.

Customer Outreach and Integration with Other Efficiency Offerings

For the Residential ADR program, Eversource and Unitil Electric can leverage marketing efforts from the other energy efficiency programs to introduce the ADR offerings. For example, when a customer receives an incentive for a Wi-Fi thermostat purchase, they can also sign up for a Residential ADR program offering at the same time. Eversource and Unitil Electric Residential program staff, customer services representatives and others who provide customers information on efficiency offerings will be provided information on the residential ADR offerings as well. Eversource and Unitil Electric will partner with technology manufacturers and battery integrators as another means to inform and enroll potential customers in the Residential ADR program.

5.3.3 Cybersecurity

Eversource and Unitil Electric have undertaken a thorough cybersecurity risk review for ADR offerings as described in depth in the 2020 Demand Reduction Initiatives Supplemental Information compliance filing submitted as part of the 2020 Plan Update in DE 17-136.[47] Liberty Electric plans to undertake the same level of cybersecurity risk review.

5.3.4 Evaluation

In 2019, Eversource's and Unitil Electric's NHSaves C&I ADR pilots were evaluated as part of a multi-state evaluation, and the NH Utilities are applying the impact results from the study to the ADR programs for 2021, as described in the 2020 Demand Reduction Initiatives Supplemental Information filing, and as reflected in the TRM.[48] This study also included a process evaluation, which is informing the NH Utilities on how to improve program processes as the initiative expands and matures. Recent ADR program evaluations have been conducted in Massachusetts and Connecticut on residential offerings, including a cross-state evaluation of the Wi-Fi Thermostat DLC offered by Eversource and Unitil Electric, which produced impact results that are being applied in estimating load reductions for the New Hampshire offering, as detailed in the TRM.[49] These and other evaluations shown in Table 5-2 below have validated the load reductions of ADR programs and provided insight into program processes in other states that have helped the NH Utilities fine-tune the proposed programs. The NH

[47] DE 17-136. 2020 Demand Reduction Initiatives Supplemental Information. Feb. 28, 2020. Unitil and Eversource's cybersecurity review process is described in Section 4, pp. 10-14. https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2020-02-28_EVERSOURCE_UES_SUPP_INFORMATION.PDF.

[48] Cross-State C&I Active Demand Reduction Initiative Summer 2019 Evaluation Report. Prepared for Eversource, National Grid and Unitil https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Cross-State-CI-DR-S19-Evaluation-Report_04-15-2020.pdf

[49] Navigant Consulting. 2019 Residential Wi-Fi Thermostat DLC Offering Evaluation. Prepared for Eversource, National Grid, and Unitil, Apr. 1, 2020. http://ma-eeac.org/wordpress/wp-content/uploads/2019-Residential-Wi-Fi-Thermostat-DLC-Evaluation-Report-2020-04-01-with-Infographic.pdf.

Utilities have included with this filing New Hampshire-specific ADR benefit-cost models detailing the planning assumptions and program goals for all offerings described in this section.

Table 5-2: Evaluations of ADR Programs

Evaluation Focus	State and Year	Evaluator	Title	Link
C&I Load Curtailment and Targeted Battery Storage, Impact and Process Evaluation	MA, CT, NH, 2019	ERS	Cross-State C&I Active Demand Reduction Initiative Summer 2019 Evaluation Report. Prepared for Eversource, National Grid and Unitil	https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Cross-State-CI-DR-S19-Evaluation-Report_04-15-2020.pdf
C&I Manual Curtailment, Controls, Thermal and Battery storage, Impact and Process Evaluation	MA, 2019	ERS	2019 Consolidated Demand Demonstration Project Evaluation Report (Eversource)	http://ma-eeac.org/wordpress/wp-content/uploads/2019-Consolidated-Demand-Demonstration-Project-Evaluation-Report_04-15-2020_clean.pdf
C&I Battery Storage, Impact and Process Evaluation	MA, 2019	ERS	C&I Daily Dispatch Battery Project Evaluation Report (Eversource)	http://ma-eeac.org/wordpress/wp-content/uploads/Daily-Dispatch-Battery-Post-Summer-2019-Report_2-3-2020.pdf
Residential Wi-Fi Thermostat DLC, Impact and Process Evaluation	MA, CT, 2019	Navigant Consulting	2019 Residential Wi-Fi Thermostat Direct Load Control Offering Evaluation. Prepared for Eversource, National Grid, and Unitil. MA and CT	http://ma-eeac.org/wordpress/wp-content/uploads/2019-Residential-Wi-Fi-Thermostat-DLC-Evaluation-Report-2020-04-01-with-Infographic.pdf
Residential Energy Storage, Impact and Process Evaluation	MA, 2019	Navigant Consulting	2019 Residential Energy Storage Demand Response Demonstration Evaluation	http://ma-eeac.org/wordpress/wp-content/uploads/MA19DR02-E-Storage_Res-Storage-Summer-Eval_wInfographic_2020-02-10-final.pdf
Residential Wi-Fi Thermostat, Impact and Process Evaluation	MA, 2018	Navigant Consulting	2018 Residential Wi-Fi Thermostat Demand Response Evaluation. Prepared for National Grid. MA.	http://ma-eeac.org/wordpress/wp-content/uploads/2018-NGrid-DR-Eval-Report-2019-03-28-Final.pdf
Residential Wi-Fi Thermostat, A/C Smart Plugs and HPWH Controls, Impact and Process Evaluation	CT, 2018	GDS Associates, Inc.	Eversource CT Residential Demand Response Pilot - Second Year Evaluation	http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/8525797c00471adb8525840b005c200c/$FILE/GDS,%20Eversource%20Connecticut%20Residential%20Demand%20Response%20Pilot,%20February%2020,%202019.pdf

5.3.5 Program Budget and Goals

Table 5-3: ADR Programs—Energy Savings and Budgets

	2021	2022	2023	2021-2023
Electric Residential Programs				
Program Budget	$139,875	$199,665	$286,832	**$626,372**
Active kW Reduction	1,025	1,538	2,275	**4,838**
No. of Participants	1,655	2,483	3,693	**7,830**
Electric C&I Programs				
Program Budget	$1,059,735	$1,524,233	$2,191,526	**$4,775,494**
Active kW Reduction	13,655	19,983	29,175	**62,813**
No. of Participants	139	202	296	**636**
Note: kW = kilowatts.				

Chapter Six: Behavioral-Based Strategies

Utilities and energy efficiency program administrators are increasingly exploring new innovative ways to utilize data-driven and behavioral-based strategies to engage customers in energy efficiency. During the 2021-2023 term, the NH Utilities plan to diversify and expand their behavioral-based strategies to determine optimal engagement channels.

The NH Utilities' Behavioral-Based Strategies are designed to make customers aware of how much energy they consume and empower them to adopt energy-efficient technologies and behaviors. The concept behind behavioral-based strategies is that most customers are neither engaged, nor knowledgeable, regarding their energy consumption and habits. However, when a customer is made aware of how much energy they consume via digital, print, or visual communications, they are more empowered and motivated to adopt energy-efficient behaviors or technologies. Since 2014, one or more of the NH Utilities have utilized a behavioral-based strategy in the form of Home Energy Reports ("HER") as a component of the NHSaves Programs.

For the 2021-2023 term, the NH Utilities will diversify program offerings in order to test new behavioral-based strategies to determine if varied approaches work better for certain customer segments, utility service territories, and even fuel types. Though these approaches vary, the NH Utilities are all working toward a common goal of maintaining behavioral-based strategies as an integral part of the NHSaves Programs and to drive customer engagement in energy efficiency.

6.1 Home Energy Reports (Unitil and Liberty)

For the past several years, the primary behavioral-based solution for the NH Utilities has been HERs. HERs are communications (e-mails and printed reports) that provide energy consumption information and energy-saving tips to residential customers in an effort to raise awareness and change behavior. These reports provide customer-specific information in easy-to-understand language and with easy-to-read graphics. The primary objective of HER is to induce customers to conserve energy by providing easy-to-understand paper and e-mail communications comparing their household energy consumption with that of their neighbors or other customers. The 2021-2023 program will continue to be implemented by Liberty (Electric and Natural Gas) and Unitil (Electric and Natural Gas). HER 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.

6.1.1 Liberty Electric and Gas HERs

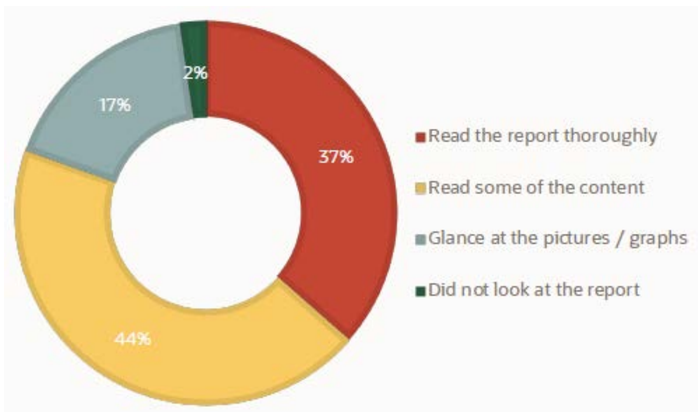
The initial launch of the Liberty Gas HER program was in the fall of 2014 and currently includes approximately 30,000 customers. Paper-based HERs are sent out approximately four times a year and six e-mail-based HERs are distributed during the heating months (November-March) when natural gas consumption is higher for space heating.

The Liberty Electric HER program was launched in January 2018 and currently includes approximately 12,000 electric customers. The program components and structure are identical to that of the Liberty Gas HER program, with the exception of communication frequencies. Liberty Electric customers receive year-round HER via print and e-mail alternating every other month in frequency for a total of six of each medium per year.

Customers receiving either the paper or email-based reports have the ability to view their reports and profiles online via a web-based platform. The online platform allows customers to view their reports and energy consumption data, as well as provide additional data about their residences and energy consumption patterns that then enables Liberty to benchmark a customer more accurately against an appropriate peer comparison group.

Liberty Electric and Gas completed an online customer engagement survey of the program in June of 2020 which showed that the overall response to HER has been favorable, with over 80 percent of program recipients actively reading their reports and 82 percent stating positive (60 percent) or neutral (22 percent) opinions of the program.[50]

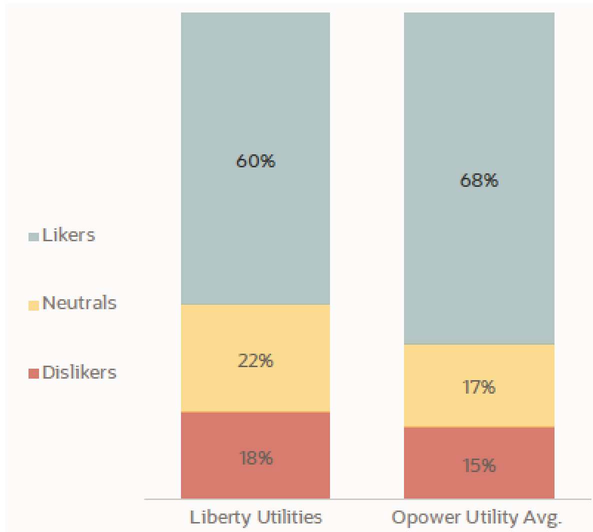
Image 6-1: Home Energy Report Reading[51]



50 Online survey of 479 Liberty customers in Home Energy Report program: 286 recipients of the HER communications; 193 “control” customers (non-recipients to be used as baseline); ~4.5% margin of error; Random sample of customers from across overall program population, gas and electric; survey fielded between June 5 and June 26, 2020 by California-based provider Interviewing Service of America. ~4% overall response rate (email invitations sent to ~13k customers).

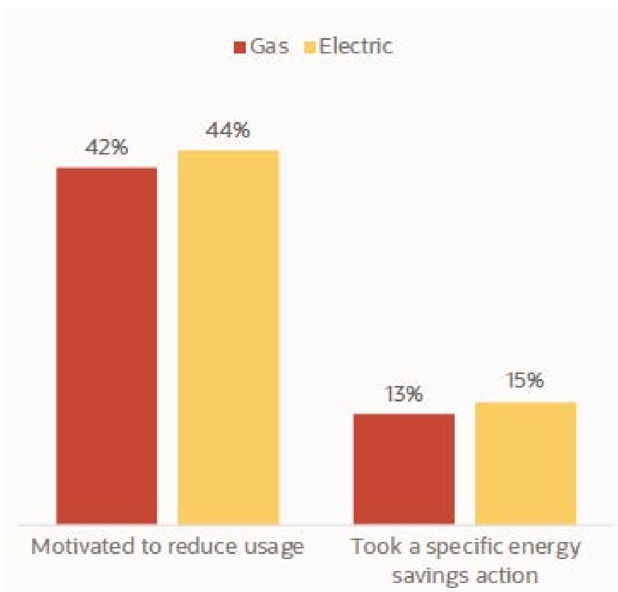
51 Survey question: “In the past six months, do you remember receiving a Home Energy Report from Liberty Utilities about your in-home energy use? Thinking of all the reports you have received, in general, what have you done with them?”

Image 6-2: Home Energy Report Liking (all customers who have read reports) [52]



Nearly half of report recipients (42 percent – Liberty Gas; 44 percent- Liberty Electric) also cite being motivated to save energy from the program.

Image 6-3: Energy Savings Action (all customers who have read reports) [53]



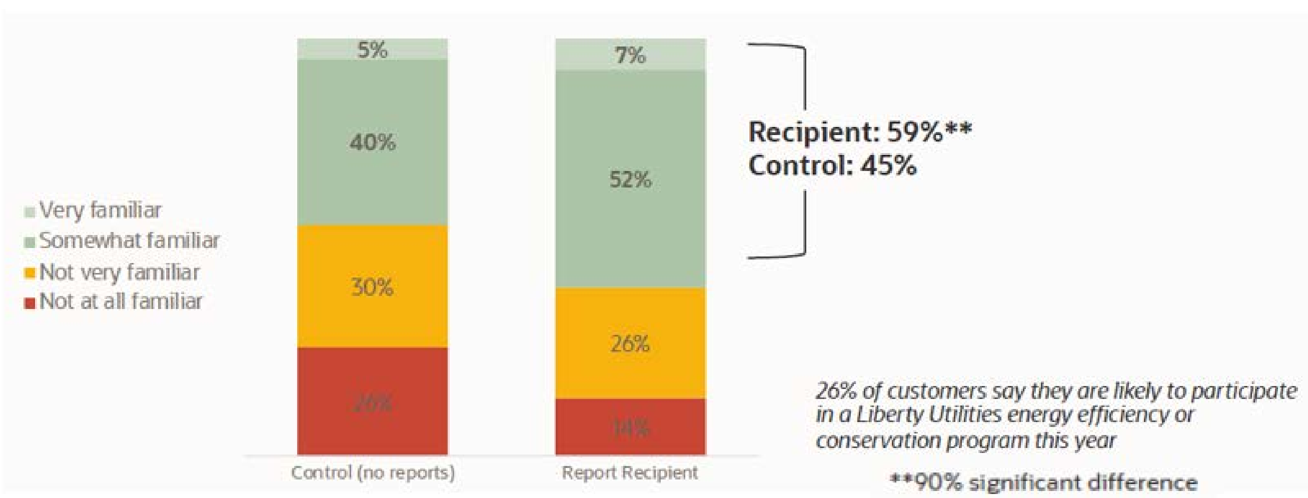
[52] Survey question: "Thinking about the Home Energy Reports you've received; how much do you agree or disagree with each of the following statements: I like the Home Energy Reports."
[53] Survey question: "After reviewing your reports, do you… Take a specific energy-savings action. Did the Home Energy Report motivate you to reduce your energy usage?

Image 6-4: What Actions Did You Take? (sample of open-ended customer responses)[53]

- *"Lowered temp on water heater."*
- *"Turn down water heater. Bought hi-tech thermostat."*
- *"More careful about using televisions and lights in the house."*
- *"Started using the timer feature on my dehumidifier."*
- *"Storm window. Keeping heat at 62."*
- *"Made people aware of the amount our bill had gone up, shutting off lights, to keep bill down."*
- *"I bought an Ecobee. I talked to my daughters about their energy use and its costs."*
- *"Adjusting thermostat, consideration of purchasing better windows to be more efficient, be more diligent about turning off lights when not in use/unplug things when not in use and consider purchasing more energy efficient light bulbs."*

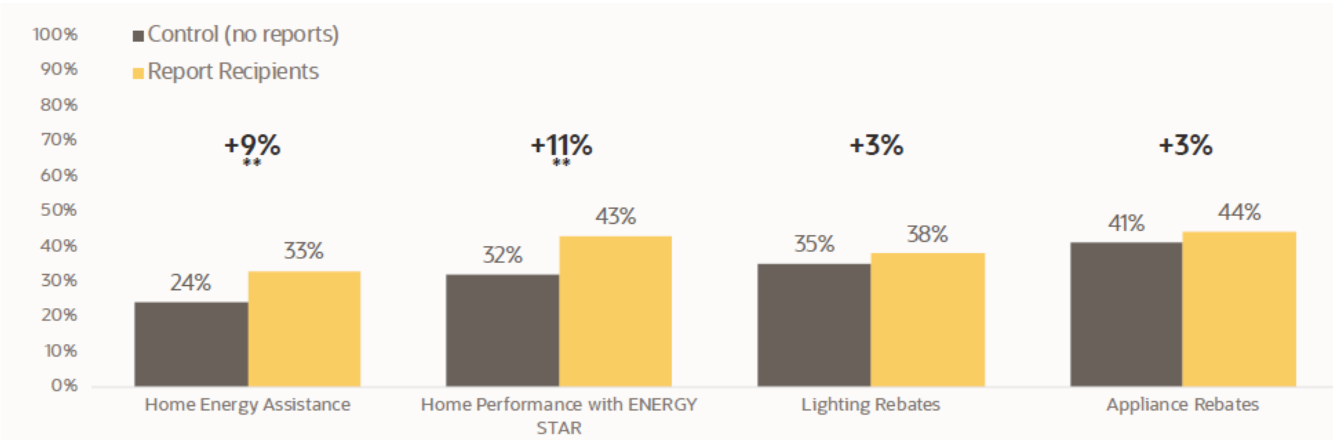
Liberty extensively uses the HER program to cross promote its other NHSaves Program offerings and finds a number of customers who sign up for HPwES or HEA referencing their HER when asked about how they found out about the programs. The recent engagement survey results support this where report recipients were shown to be more familiar with energy efficiency programs.

Image 6-5: Energy Efficiency Program Familiarity[54]



[54] Survey question: "How familiar are you with energy efficiency or conservation programs from Liberty Utilities that help you use less energy?"

Image 6-6: Energy Efficiency Program Familiarity by Offering[55]



Savings

As the program continues to mature, for the 2021-2023 Plan, Liberty Electric and Gas will attempt to capture more relative savings out of the program by cycling its recipient pool, adjusting the frequency of reports distributed, and continuing to tailor report and tip messaging via the printed and web-based reports.

Liberty Electric and Gas have decided to change the accounting methodology for computing energy savings for the program. The current methodology uses a three-year measure life and accounts for persisting savings year to year. Liberty Electric and Gas intend to switch to a single-year measure life, which is recommended by the implementation vendor to simplify accounting, improve forecasting, and remove the savings variability that occurs with a multi-year measure life scheme.

Ultimately in a single-year methodology, annual savings will be equal to measured savings in a given year. With the shift from multi-year measure life comes a transition period where Liberty Electric and Gas must take into account persisting savings that have already been claimed, which will not count toward annual savings in the new methodology. This will affect cost effectiveness in the first year of the new triennial, bringing the program benefit-cost ratios under the Granite State Test below 1.0 in

55 Survey question: "Which of the following Liberty Utilities energy efficiency initiatives are you familiar with?"

2021. Because the program will stop counting new persistence in the new methodology, this already-claimed persistence will phase out over time, and cost effectiveness will be above 1.0 under the Granite State Test in 2022 and 2023, and will also be above 1.0 under the Granite State Test when looking across the cumulative three-year period.

Given the benefits of moving to a single-year measure life and the focus on a true three-year planning process for the next triennial, Liberty Electric and Gas believe a single transition year with a benefit-cost ratio below 1.0 under the Granite State Test is reasonable and appropriate.

6.1.2 Unitil Electric and Gas HERs

Launched in October 2018, the Unitil Electric and Gas HER programs are run concurrently with Unitil's Massachusetts territory to take advantage of economies of scale. The Unitil Electric and Gas HERs are sent to approximately 25,800 electric customers and 11,000 natural gas customers. Unitil Gas HER program participants receive e-mail HERs year round (12 per year) and four paper HERs are distributed during the heating months (November-March). Unitil Electric HER participants receive year-round e-mail HERs and six print HERs a year with higher frequency during the summer months.

For the 2021-2023 Term, the Unitil Electric and Gas HER programs are projected to save 25 percent and 9 percent of the residential sector annual savings, respectively. Unitil Electric and Gas will continue to offer the HER program through at least the end of its current contract with its vendor for both its natural gas and electric customers and will assess appropriate next steps for behavioral-based strategies for 2022-2023 and beyond.

6.2 Customer Engagement Initiative (Eversource)

For the 2021-2023 term, Eversource will undertake behavioral-based marketing strategies to engage its electric customers in understanding how they consume energy in their homes and move them toward adoption of energy efficiency measures through the Residential program offerings. Additional description of the marketing approach can be found in Section 8.4.

The Customer Engagement Initiative marketing approach will not generate behavior-based energy savings. However, Eversource will continue to investigate additional opportunities for behavior-based savings. Such communication efforts will involve statewide evaluation contractors early in the design process to ensure that the methodologies used meet requirements for future savings evaluations. If Eversource develops an offering for behavior savings it will be proposed through a Midterm Modification.

6.3 Aerial Infrared Mapping Program (Liberty Gas)

6.3.1 Objective

For the 2021-2023 term, Liberty Gas will implement an innovative behavior-based initiative called the Aerial Infrared Mapping ("AIM") program. The objective of the AIM program is to efficiently capture detailed building weatherization information about Liberty's residential natural gas customer base at scale in order to:

- Drive customer behavior change savings through promoting literacy on the specific opportunities for improved building efficiency;
- Engage and motivate customers to participate in the HEA and HPwES programs by providing a more detailed, visual profile of their heat loss; and
- Better identify, rank and prioritize, and qualify weatherization projects without having the need to go onsite.

6.3.2 Market Challenge

Heat loss arguably suffers from an invisibility problem, in that it is inconspicuous in everyday activities. Further, few customers have easy access to view, let alone understand, the weatherization conditioning of their home or how it compares to others. From a psychology perspective, having the opportunity to see something that is typically invisible can attract attention and create more of an emotional connection, as well as make things easier to understand. In fact, consumer research shows that homeowners are five times more likely to implement energy efficiency measures after seeing a thermal image of their home.[56]

6.3.3 How It Works

Liberty will deliver the AIM program in partnership with MyHEAT Inc., a technology company that generates aerial thermal images to produce unique and proprietary building HEAT Maps.[57] The MyHEAT Maps provide customers a resource to help identify and target building weatherization improvement areas. MyHEAT also provides customers personalized and proprietary HEAT Ratings that enable customers to compare a home's heat loss to others in their town or city.

MyHEAT is able to collect aerial Thermal Infrared ("TIR") imagery of buildings via a super high-resolution TIR camera with a plane flying over a geographical area at night, under strict environmental conditions at approximately 4,000 feet. MyHEAT's process uses Geographic Object-Based Image Analysis and machine learning to detect, map, and create powerful visualizations of the heat waste escaping from buildings. The TIR sensors do not detect temperature, rather they detect emitted long-wave thermal radiation (i.e., relative temperature), which when 'corrected' to kinetic temperature is used to present heat loss data.

MyHEAT's process has the ability to automatically correct for local changes in temperature, microclimate, and elevation, meaning all buildings can be compared as if they were collected at a single instance in time. Data for each building is extracted and standardized so that different buildings can be compared and rated using a scale of 1 (least heat loss measured) to 10 (most heat loss measured). The information collected can determine the inefficiency of poorly insulated attics and walls, energy loss from windows, and air leaks around mechanical vents.

MyHEAT's solution has been deployed across numerous cities and utility territories in the United States and Canada and is based on six years of award-winning, peer reviewed research in Urban Thermal

[56] Goodhew, J. et al. (2014). Making Heat Visible: Promoting Energy Conservation Behaviors Through Thermal Imaging. Sage Journals, 1059–1088. Retrieved from: https://doi.org/10.1177%2F0013916514546218.

[57] MyHEAT Inc. website: http://myheat.ca.

Remote Sensing from the University of Calgary. MyHEAT's information is typically presented to end-users via a private online platform and utilized in a variety of marketing communications such as direct mail and email.

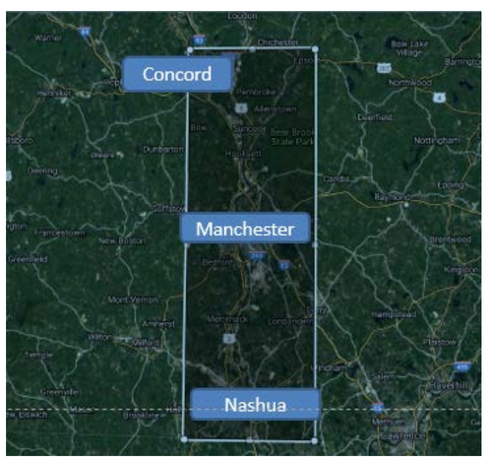
6.3.4 Thermal and Ancillary Data Collection

At a high-level, several data elements are required and will be captured in order to deploy the AIM program:

- **MyHEAT Data.** Aerial thermal capture data, building polygons generated from thermal data, proprietary HEAT Ratings and HEAT Maps; and
- **Third-Party Data.** Open data, such as land parcel details, and purchased data such as market demographics.

MyHEAT will perform two flyovers of Liberty's territory, in the Spring of 2021 and Spring of 2023. The flyovers will cover the specified geography as shown in Image 6-7 to collect the aerial thermal data in order to generate HEAT Maps and HEAT Ratings.

Image 6-7: Depiction of AIM Program Fly-Over Geography



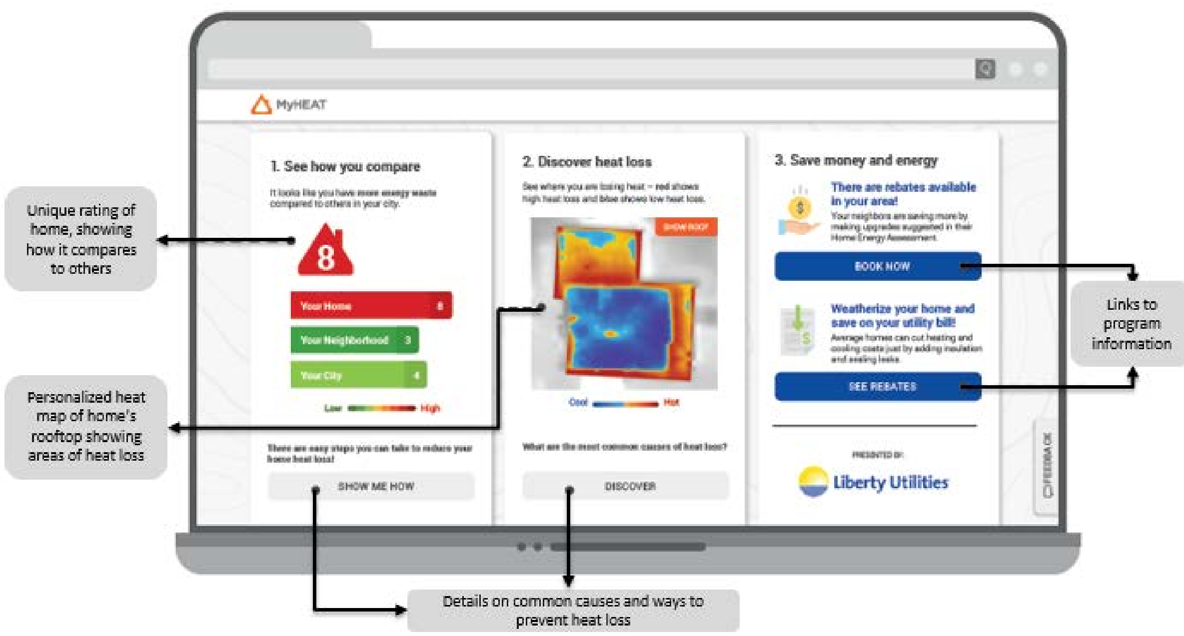
Additional geospatial datasets, such as building shapes and customer address details, will also be generated and/or compiled at this time. MyHEAT estimates that it will take approximately three nights to capture the majority of Liberty's natural gas service territory for each flyover cycle. After capturing the relevant data from Liberty, third-party data sources, and with the collected aerial thermal data, MyHEAT will process the combined data to generate personalized customer HEAT Maps and HEAT Ratings. Simultaneously, a unique customer-facing platform will be designed.

6.3.5 Customer Experience

As part of the AIM program, Liberty will provide residential customers a visual HEAT Map depiction and HEAT Rating of their home via a private access code protected web-based platform, where customers can view the heat loss details for only their own home. The HEAT Map and HEAT rating information will be provided alongside calls-to-action that direct customers toward ways they can save energy, including participating in NHSaves Programs.

Image 6-8 provides a visual example of the information that a customer would see when viewing the online platform:

Image 6-8: AIM Program Customer Home Profile



The online platform will also allow customers to compare their home's HEAT Map visual depiction to what is publicly available via Google Maps, as shown in Image 6-9.

Image 6-9: Comparison of Heat Map View to Google Maps View

Liberty and MyHEAT consider user privacy to be of utmost importance and we recognize the growing societal concerns about privacy in general. The MyHEAT thermal images are very benign; nothing about the HEAT Maps, as depicted in the image above, suggests or show anything with regards to occupants. In fact, there is more that someone could glean about occupants from the publicly available Google Maps images of a home. That said, similar to the protocol that has been implemented for the HER program, any customers who prefer to opt-out of the program will have the ability to do so.

6.3.6 Eligibility and Enrollment

Liberty will offer the AIM program to customers free of charge, via an opt-out basis, meaning customers will not have the ability to opt-in if they so choose in order to maintain the proper participant control group for evaluation and measurement purposes. Rather, customers will have the ability to opt-out if they do not want their home mapped and rated.

6.3.7 Marketing and Promotion

The AIM program will be promoted via personalized direct mail and e-mail, which will encourage customers to visit the customized Liberty/MyHEAT private online platform, where customers can view their unique, personalized profile. Communications will be distributed periodically, with an anticipated four direct mailings per year, and eight e-mail distributions per year, primarily during the heating season months. The first customer communications of the AIM program will be in September of 2021, following the initial data capture, analysis and final configuration of implementation details.

6.3.8 Target Market & Evaluation

The AIM program will be implemented under a randomized control trial ("RCT") to measure the impact on energy consumption and program participation from customers. The AIM program will also be deployed alongside Liberty Gas' HER program, where both programs will be in the market at the same time, but each will be distributed to separate treatment groups. For reference, the current Liberty Gas HER program includes:

Table 6-1: Liberty Gas HER Program

Group	No. of Homes
Treatment Group	33,000 homes[1]
Control Group	14,000 homes[1]
Remaining Customers	37,000 homes[1]
[1]Approximate quantities. Exact counts can vary slightly from month-to-month based on report deliverability and periodic opt-outs.	

The AIM program will use the existing Liberty Gas HER program control group and will have a separate treatment group of approximately 33,000 customers. The AIM program treatment group will be sourced from both the available balance of customers who would not be part of the treatment group of the HER program. As the creation of balanced treatment groups depends on the inclusion of MyHEAT's HEAT Loss dataset, the exact details around the overlap between the AIM Initiative and the HER program won't be confirmed until the thermal data is collected by MyHEAT and the HEAT Ratings are created. Also, this approach factors in that an adequate group of customers that are statistically similar to those in the existing control group can be identified. Liberty Gas will work with its HER vendor to ensure that no conflicts exist between the two programs for the purposes of evaluation and implementation integrity.

MyHEAT will assess annual natural gas energy consumption reduction based on a statistical analysis of the targeted homes change in billing consumption data. The evaluation will consider pre-and-post treatment consumption details, measuring the impact versus the control group. Additionally, Liberty Gas' other program participation details will be incorporated to measure uplift attributed from the treatment group efforts.

6.3.9 Expected Results

The expected results for the AIM program are extrapolated from another recent MyHEAT pilot project, which found that customers achieved greater energy savings as their HEAT Ratings and potential dollar savings increased. For every $100 in potential annual savings, customers in the MyHEAT treatment reduced their natural gas consumption by 2.9 percent. At the mean savings of $150 per year, participants reduced natural gas consumption by 4.4 percent. Based on previous implementations by MyHEAT, the AIM program is also expected to lead to nearly a 30 percent increase in applications submitted to relevant incentive programs. For the 2021-2023 program term, Liberty is projecting the potential impact range of the AIM program to be an average 2.2 percent reduction in natural gas for targeted homes.

6.3.10 Initial Customer Feedback

Liberty Gas performed an online survey of its residential customers to gauge their initial reaction and feedback on the AIM program concept to inform its consideration and planning of the program. The survey was fielded between March 30 and April 13, 2020 and 1,133 unique customer responses were captured with a margin of error of plus or minus three percentage points. In summary, the survey results found:

- The AIM program would be popular with customers:
    - Three out of four customers think the AIM program would be useful to them and 79 percent say they would access the information if they received a link to the site where they could see their HEAT Map and HEAT Rating.
    - Curiosity and desire to save money are the top reasons for customer interest. Many of those who don’t think the program would be useful to them are renters and/or customer living in multifamily dwellings.
    - Very few (only 1 percent of the entire sample) say they would not be likely to access the information via a private platform due to privacy concerns.
- Customers have a clear preference for a private platform:
    - By a 2-to-1 margin, customers prefer that the AIM program is offered via a private platform.
    - Concerns about privacy are the dominant reason customers prefer the private platform. Among those who gave specifics, there are worries that they could be vulnerable to sales and marketing based on their rating, as well as potential shaming from neighbors; some are even worried that their HEAT Rating could negatively affect their home’s value if the information were publicly available.

- Most who prefer the public platform think it would help facilitate comparisons, or better legitimize, their home's rating with other homes.

Image 6-10: Residential Customer Survey—Likelihood to Access AIM Data[58]

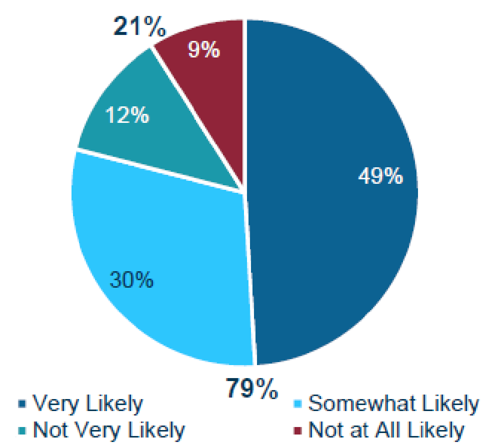
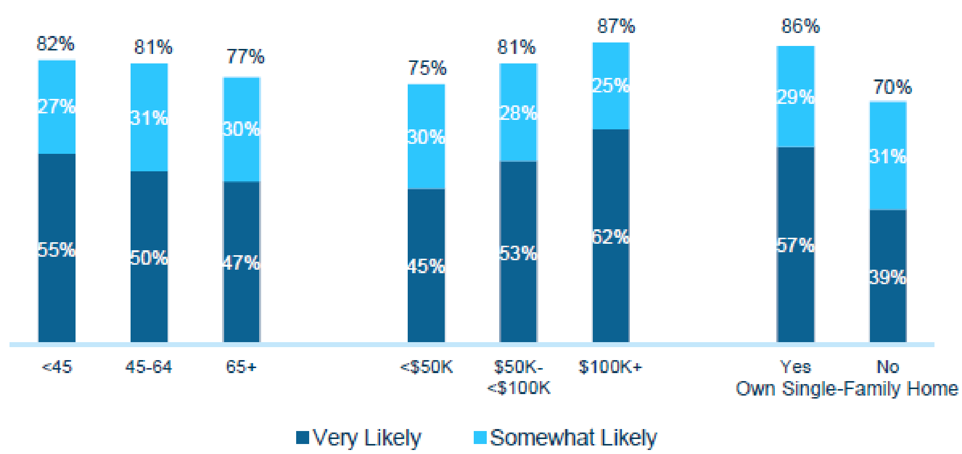


Image 6-11: Residential Customer Survey—Likelihood to Access AIM by Demographics[58]



[58] Survey Question: "If you received a link to the site where you could see the HEAT Map and HEAT Rating for your home, how likely would you be to access the information?" Base: Total (n=1,133), <45 years old (n=192), 45-64 years old (n=449), 65+ years old (n=492), <$50,000 household income (n=260), $50,000-<$100,000 household income (n=352), $100,000+ household income (n=227), Own single-family dwelling (n=639), Do not own single-family dwelling (n=494.)

Image 6-12: Residential Customer Survey—Why Likely to Access AIM?[59]

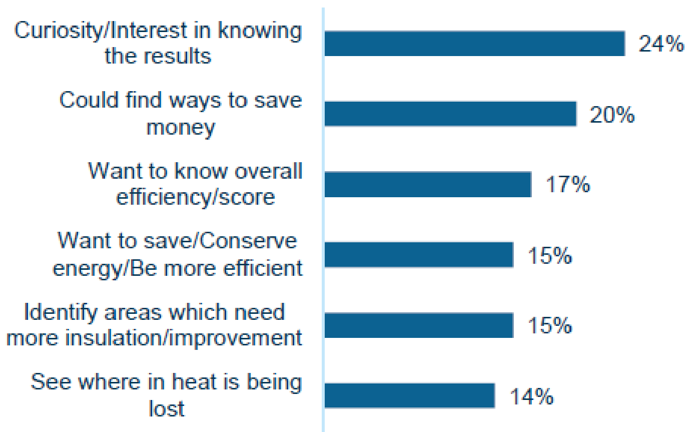


Image 6-13: Residential Customer Survey—Why Likely to Access AIM? Customer Quotes[59]

[59] Survey Question: Q:"Why would you be likely to access the HEAT Map and HEAT Rating for your home?" Base: Likely to access HEAT Map and HEAT Rating for home (n=893).

Image 6-14: Residential Customer Survey—Why Prefer Private Platform?[60]

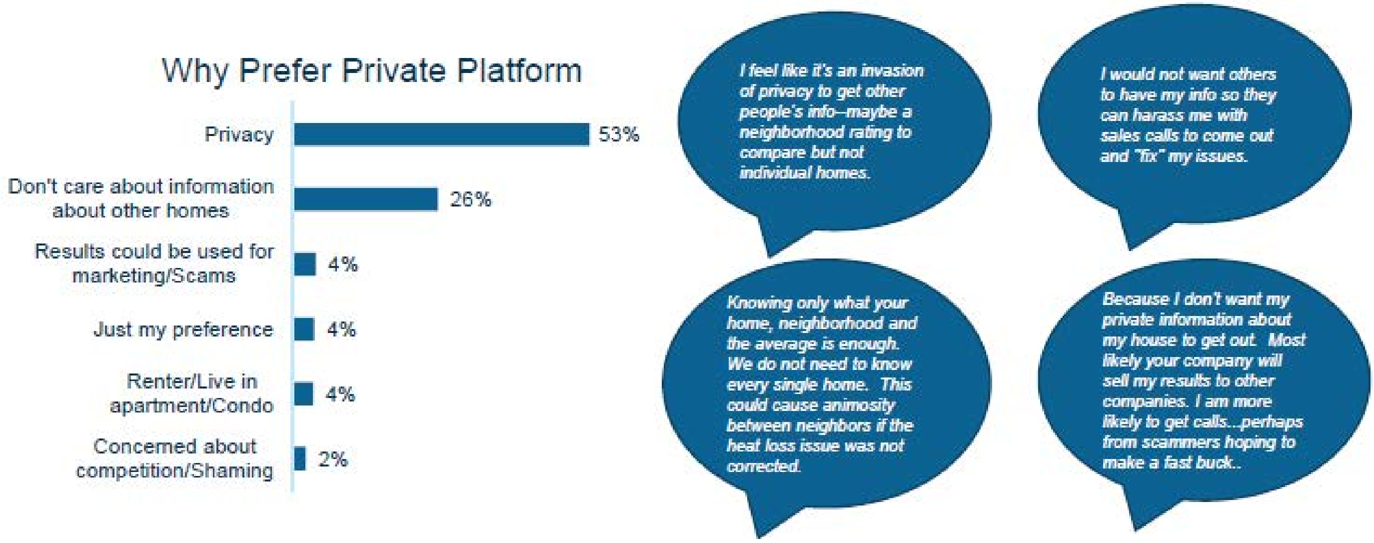
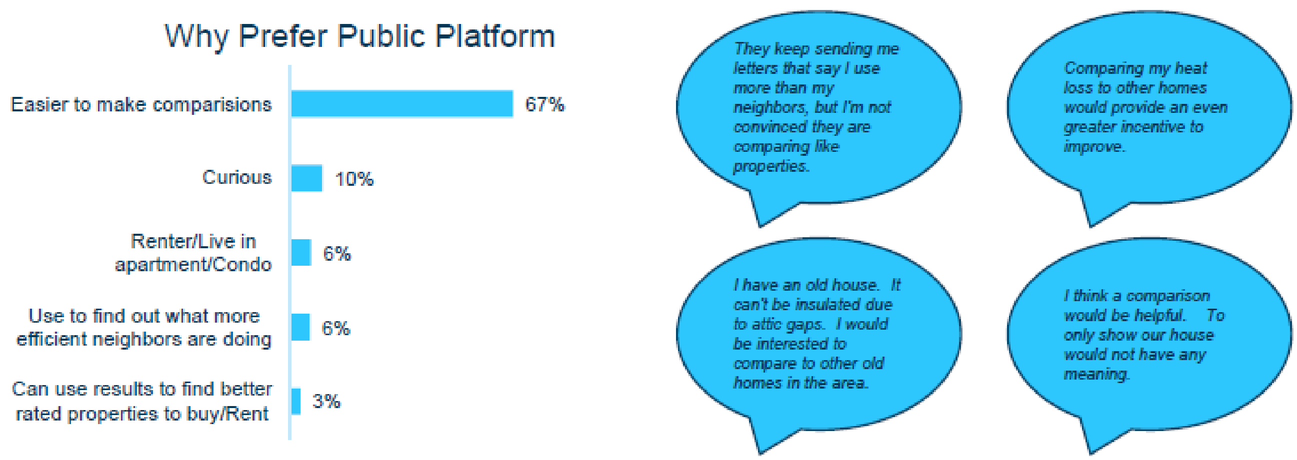


Image 6-15: Residential Customer Survey–Why Prefer Public Platform?[61]



60 Survey Question: "Why would you prefer a private platform, where you could only view heat loss details for your home using unique access information." Base: Prefer private platform (n=603).
61 Survey Question: "Why would you prefer a public platform, where you could view heat loss details for any residence across your city to help you compare your home's heat loss to others?" Base: Prefer public platform (n=268).

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Chapter Seven: Energy Optimization

Energy Optimization ("EO") is an energy resource framework that seeks to minimize customers' total energy usage across all energy sources while maximizing customers' benefits. In particular, EO often focuses on conversions from delivered fossil-fuel heating systems to higher efficiency electric systems. EO strategies account for both equipment efficiency, as well as the mix of fuels used, which distinguishes it from fuel switching and beneficial electrification, which focus primarily on fuel type but do not necessarily prioritize overall energy efficiency.

For the 2021-2023 term, the NH Utilities are proposing an EO pilot based on the NHEC Social Responsibility Heat Pump program as well as offerings in other New England states. The NHSaves EO pilot will focus on displacing residential delivered fossil fuel through the adoption of cold climate air source heat pumps ("ASHPs"), including central and mini-split systems. The pilot will provide the NH Utilities with a more comprehensive understanding and experience of the benefits of heat pumps to the electric system, as well as the impact on emissions from GHGs and nitrogen and sulfur oxides. The NH Utilities will also investigate customer experience and optimal program delivery standards related to this offering.

To be eligible for the EO pilot, customers must be willing and able to displace their existing heat source for at least one heating zone(s) of their home for a substantial portion of the heating season (see requirements below regarding switchover set points). For the EO pilot, the NH Utilities will recommend, but not require, that the home be weatherized in advance of participation to ensure optimal sizing of the ASHP. The NH Utilities will also recommend that customers maintain a backup automatic feed heating system. In these cases, customers must allow for the installation of integrated controls that will automatically assign the most efficient heating system to operate during the heating season, based on the outdoor temperature. Homes in which a backup heating system is deemed unnecessary will not be required to have integrated controls. Since the vast majority of the installations in the pilot are projected to have a backup system, the narrative focuses on these installations.

7.1 Existing Heat Pump Program

For more than a decade, the NH Utilities have provided incentives for the installation of high-efficiency ASHPs and have adopted best practices when cold climate heat pumps became commercially available. To date, heat pump units have typically been treated as a "lost opportunity" in which it was assumed that the customer was making a choice between the program-incented high-efficiency unit and a less expensive, standard-efficiency unit. The kWh and kW savings were therefore calculated based on a comparison between the high-efficiency and standard-efficiency unit and assumed both heating and cooling savings.

7.2 Purpose

The EO pilot is designed to gather information on both program design elements and key regulatory questions, including how the NH Utilities should account for fossil fuel and electricity savings (positive and negative). The EO pilot will be accompanied by an impact and process evaluation to guide future program design should the NH Utilities elect to expand the pilot to a full-scale program. The evaluation will also assess issues raised by the Commission in Order No. 26,322, as described in Section 7.6.

7.3 Target Population

The pilot has a goal of 100 participants per year over the 2021-2023 term. The pilot will target homes with existing HVAC configurations that are well-suited for ASHP conversions, but where the homeowners are not already planning to install ASHPs for heating (which are already incented by the existing ES Products program). The pilot will target customers heating with oil and propane furnaces and boilers. The target population will include:

- Customers who are not actively considering heat pumps but who have central A/C systems, that are failing or old;

- Customers who are not actively considering heat pumps but who use window A/C units;
- Customers who are actively considering the installation of a central A/C system and who currently have window A/C units or no cooling system; and
- Customers who are currently interested in heat pumps only for cooling, but not heating.

While not part of the target population, those heating with auto-fed wood pellet stoves and boilers will also be eligible on a limited basis provided they meet other pilot requirements for integrated controls and provision of fuel data.

7.4 Customer and Contractor Outreach

The EO pilot will leverage existing pathways for incentivizing high-efficiency heat pump technologies, as well as design new outreach efforts for the target population and technologies. The NH Electric Utilities will engage customers through online and in-person education, targeted incentives, marketing, and financing solutions (e.g., on-bill financing and third-party loan programs). Customer education will focus on how to optimize their heating system's efficiency and proper maintenance and upkeep.

A cornerstone of the NH Utilities' EO pilot will be a broad promotional outreach effort, including training for HVAC and energy efficiency contractors on the benefits of ASHP technologies, and the need for integrated HVAC controls to optimally operate the ASHP with the building's existing heating system. Customers' existing heating systems will generally be expected to provide backup heating during the heating season's coldest temperatures while the ASHP will meet customers' full heating needs for the rest of the season.

The NH Utilities will market the program to the following customers through personal outreach, direct marketing, collaboration with interested stakeholders, and other methods:

- HPwES program customers (past, present, and future);
- Existing customers of HVAC contractors;
- NH Electric Utility net metering Solar PV customers; and

- Customers who have installed battery storage

7.5 Customer Eligibility

Customers may participate in the EO pilot if they meet the following eligibility guidelines:

- Are willing to allow for the installation of integrated controls (not required if a customer removes the existing heat source for a whole zone(s) within the home);
- Are willing to provide data on their delivered fuel consumption, including data from no less than one year prior to the installation of the heat pump. This data will enable evaluation of fossil fuel and electricity usage, both before and after the installation of the heat pump technology. The customer can provide the fossil fuel records directly, or sign a release form that allows evaluators to obtain the data directly from the customer's fuel company;
- Agree to meet a maximum outdoor temperature set point (determined by the Utilities) for the switch over from the backup heating system to ASHPs; and
- Agree to implement a full heating zone(s) displacement. Partial heating zone installations are not eligible.
- Backup heating systems must be automatic feed systems. These include boilers, certain types of stoves, and furnaces.

7.6 Incentive Structure

Incentives for EO are designed to move a customer away from their current primary fossil fuel heat source to use high-efficiency ASHPs as their primary heat source instead. This proposition differs from a standard ASHP program offering, which incentivizes a customer who is already purchasing an ASHP to buy a more efficient unit, rather than a typical unit. In the EO framework, the customer cost barrier is higher and the overall MMBtu savings are greater than a standard ASHP program offering. The incentive levels for the EO pilot are designed to help overcome the customer barriers and achieve the displacement of the fossil fuel heating source. The initial incentive level for the EO pilot will be $1,250/ton, which aligns with a similar offering in Massachusetts. This level may be adjusted as the NH Utilities gain experience and customer feedback during the pilot.

7.7 Post Inspections and Survey

Post-installation inspections will be conducted for all EO pilot participants. An EM&V survey will be provided during each inspection. The inspectors will collect the following information:

- If the number of installed HP tons (1 ton = 12,000 Btuh) meets the customer's heating needs;
- If the existing heating system and heat pump set points are within the pilot parameters;
- If there are working integrated controls (if required as listed above); and
- If the heat pump technologies installed were designed to provide heat to a whole heating zone(s).

7.8 Evaluation Plan

The NH Utilities' pilot will be accompanied by an evaluation to measure the impacts on total energy consumption (for both heating and cooling, and across all fuels) and to assess program processes, customer behavior, and workforce capacity. Results of the evaluation will guide future decisions on expanding the pilot to a full-scale program. Design of the evaluation can leverage experience gained through similar evaluations happening in other states, such as the EO Impact and Process evaluation currently underway in Massachusetts. The NH EO evaluation will include both impact and process components:

- **Pilot Impacts.** The evaluation will measure impacts and refine methods for accounting for unregulated fuel savings and electric load increases for fuel-to-electric measures, to support modelling net MMBtu savings that could be claimed under a holistic accounting framework. The evaluation may include analysis of heat pump usage data from integrated control systems, delivered fuels billing data, where available, and whole home electric usage data from the NH Utilities. Requirements for integrated controls and customer releases to obtain delivered fuel records will support these efforts. This analysis will also help determine the extent to which EO could, at scale, lead to load factor improvements by increasing load during times when the transmission and distribution systems are not operating at peak capacity. As noted by the Commission in Order No. 26,322, such load factor improvements may present an opportunity for ratepayers, as non-participants may stand to benefit from increased electricity sales that do not significantly increase transmission and distribution system costs.

- **Pilot Processes.** The evaluation will assess the pilot design and offerings for tailored ASHP measure bundles, including weatherization and integrated controls, to understand customer behavior and satisfaction, contractor technical capacity and training needs, and equipment configurations and baselines. Post-inspections will be utilized to confirm installation configurations and setpoints, and to survey customers on their plans for using the heat pumps and modifying set points, alternative equipment baselines they considered, and their satisfaction with contractors, the installation processes, and the rebate fulfillment process. The evaluation is also expected to include surveys or interviews with contractors to obtain feedback on issues such as training or capacity needs.

Although the pilot is not subject to cost-effectiveness requirements and the NH Utilities have not modelled planned savings, average project savings are expected to be in line with those from the EO study done under the oversight of the NH Benefit Cost Working Group.[62] This study and its associated planning model were based on a Massachusetts EO model and adapted to include New Hampshire specific inputs such as fuel cost data, weather data, saturation of various air conditioning technologies, and the regional electric generation mix. Table 7-1 provides estimated fossil fuel and electric impacts for the four scenarios expected to comprise the majority of pilot projects: oil and propane furnaces displaced by a central ASHP and oil and propane boilers displaced by ductless heat pumps.

[62] Navigant, Energy Optimization. Sep. 12, 2019. See https://puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_ENERGY_OPTIMIZATION_STUDY.PDF and https://puc.nh.gov/Electric/Reports/20190805-PUC-Electric-NH-Energy-Optimization-Model.xlsx.

Table 7-1: EO Estimated Energy Impacts

Baseline Equipment	Replacement Equipment	Annual Energy Savings on MMBtu Basis (MMBtu/yr)	Propane Annual Savings (MMBtu/yr)	Oil Annual Savings (MMBtu/yr)	Electric Annual Savings (kWh/yr)	Electric Heating Savings (kWh/yr)	Electric Cooling Savings (kWh/yr)	Electric Heating Peak Demand Savings (kW)	Electric Cooling Peak Demand Savings (kW)
Oil Furnace + Baseline A/C Blend	Central HP + Oil Furnace	37.81	0.00	49.02	-3285	-3963	678	-1.630	0.610
Propane Furnace + Baseline A/C Blend	Central HP + Propane Furnace	51.67	68.83	0.00	-5027	-5705	678	-1.630	0.610
Oil Boiler + Room A/C/No A/C Blend	Ductless HP + Oil Boiler	46.11	0.00	57.82	-3433	-4231	799	-1.090	0.970
Propane Boiler + Room A/C/No A/C Blend	Ductless HP + Propane Boiler	63.53	81.19	0.00	-5176	-5975	799	-1.095	0.970

Note: Negative savings values reflect increased consumption. Cooling baselines are based on a statewide blend of A/C penetration for central and room A/C systems.

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Chapter Eight: Marketing and Education

Marketing and education strategies are administered to increase awareness of the benefits of energy efficiency. They are also used to drive increased participation in NHSaves Programs. The NH Utilities will promote and implement marketing strategies that motivate residential, municipal, and C&I customers to participate in program offerings made available by NHSaves.

During the implementation of the 2021-2023 Plan, the NH Utilities will continue to increase customer awareness and participation in energy efficiency programs and to encourage behavior changes that save energy and reduce GHG emissions. Successful marketing and education strategies move customers through a long-term transitional process beginning with awareness that develops attitudinal changes and action. Over the past three years, the NH Utilities have focused marketing communications efforts toward making customers aware of the benefits of energy efficiency, as well as working through a strategic brand redesign of NHSaves and realigning marketing messages specific to target audiences. The primary objective during the 2021-2023 term is to take customers' heightened awareness of energy efficiency and turn it into tangible results by engaging customers' participation in NHSaves Programs in order to save energy, save money and realize non-energy benefits.

8.1 Background

8.1.1 2018-2020 Market Assessment

During the 2018-2020 Term, the NH Utilities launched a significant redesign of the NHSaves approach to marketing in order support the increased program budgets and goals under the EERS. Prior to the EERS framework implementation, NHSaves Programs budgets and goals had remained relatively flat since beginning in 2002 and NHSaves brand marketing was primarily focused on the mass market ES Products program at retail store locations and for jointly branding commercial forms.

In 2018, the NH Utilities established a statewide marketing team and issued an RFP to engage a marketing partner to develop and execute NHSaves marketing and outreach campaigns. Once selected, the marketing partner collaborated with the NH Utilities to establish three broad objectives for a strategic 2018-2020 Marketing Plan:

- **One:** Build awareness and demonstrate the value of energy efficiency;
- **Two:** Drive deeper customer participation in the programs; and
- **Three:** Increase trade and channel participation in the programs.

In 2018, the NH Utilities initiated a soft launch of an umbrella marketing campaign with a refresh of the NHSaves logo and brand, a brand descriptor, digital platform activation, and enhancements to the NHSaves.com website. Included in this scope of work was a deep dive into the brand essence and definition of NHSaves to balance key messages of practical savings while inspiring energy conservation and efficiency.

The NH Utilities' statewide marketing team worked with the EM&V Working Group during 2018 to undertake a New Hampshire Energy Efficiency Market Assessment ("Market Assessment") to determine the general awareness of energy efficiency across the state, establish a benchmark awareness level of the NHSaves brand, and to identify effective marketing channels to communicate with customers and market segments.[63] This research deepened the understanding of the drivers and barriers related to energy efficiency participation, and helped identify general attitudes, perceptions, and behaviors concerning energy efficiency, and more specifically the NHSaves Programs, in New Hampshire.

The Market Assessment gathered primary data through population surveys of residential and small and mid-size business customers, residential customer focus groups, and non-residential customer interviews.[64] Completed in 2019, the Market Assessment found that one-third of residential customers

[63] Navigant Consulting. *New Hampshire Energy Efficiency Market Assessment*. Apr. 19, 2019 Presentation. Available at: https://www.puc.nh.gov/EESE%20Board/Meetings/2019/0419Mtg/20190419-EESE-Board-NHSaves-Market-Assessment-Presentation.pdf.

[64] *New Hampshire Energy Efficiency Market Assessment*. The Study received feedback from 1,072 residential customers (response rate of 11%) and 304 C&I customers (response rate of 4%).Two residential customer focus groups and 30 large C&I customer interviews were held.

and one-half of non-residential customers had seen or heard the term "NHSaves". Additionally, of those aware of the brand, 60 percent and 30 percent of residential and non-residential customers, respectively, were aware that NHSaves was associated with their electric or natural gas utility. Among those who were aware of NHSaves, program participation levels were only around 30 percent for both residential and non-residential customers.

8.1.2 2018-2020 Marketing Activities

In 2019, the NH Utilities launched phase one of a fully-integrated marketing campaign guided by insights from the Market Assessment's findings and recommendations. The theme of the marketing campaign that resulted was: "Live Free, Live Smart." The NH Utilities focused on several key strategies to increase awareness of the NHSaves brand and the benefits of participating in the programs, including:

- Expanded use of social media to build and engage a larger audience with targeted messaging across all the NH Utilities service areas. A variety of social platforms were added to the existing mix, including Facebook, Instagram, Twitter, and LinkedIn;
- Enhanced User Experience Design ("UX") on NHSaves.com with application of UX best practices including: ongoing support and maintenance, beta testing, Search Engine Optimization ("SEO"), navigational improvements, refreshed content and feature updates, and streamlined calls-to-action and consumer access points;
- Deployed consistent customer communication materials (e.g., collateral, display materials, etc.) and resources across the NH Utilities leveraging the NHSaves brand;
- Expanded use of paid media for the purpose of building brand awareness and driving traffic to the NHSaves website for program participation. The NH Utilities developed and implemented a full media plan including: digital, social media, and traditional marketing platforms.
- Expanded, increased, and improved the library of customer case studies and testimonials that can be promoted via social media platforms and on the website to educate customers on the benefits of energy efficiency;

- Created specific brand guidelines to ensure appropriate use and placement of the NHSaves logo by contractor trade allies; and
- Continued leverage of national and regional energy efficiency partnership campaigns, such as ENERGY STAR, to promote programs and services.

Throughout 2019 and 2020, the NH Utilities received monthly data reports with detailed information on website traffic and conversions. These reports, along with data that will be collected during the next Market Assessment will help the NH Utilities to gauge the effectiveness of the marketing efforts to date and guide new strategies for increasing awareness and participation in the NHSaves Programs over the coming term.

8.2 Customer Attributes and Market Research

8.2.1 Understanding What Influences Customers in their Energy Decisions

The overarching marketing strategy for the NH Utilities is to leverage what we know about how our customers use energy and how they make decisions about purchasing energy using equipment to design simple “on ramps” for them to engage with the NHSaves Programs. Understanding what motivates a customer to engage or not engage in energy efficiency programs helps the NH Utilities craft the appropriate messages, determine the right marketing tactics, and design effective communications that focus on solving a customer’s needs or problems. As referenced throughout the 2021-2023 Plan, the NHSaves Programs have many benefits; however, the key to successful marketing is to understand what influences or drives a customer’s energy decisions the most. Cost savings may be the most important thing for one customer to participate in an energy efficiency program, while improving the comfort of the home may be another person’s primary motivator.

Customer Segmentation

To reach target audiences more effectively, the NH Utilities have utilized the Market Assessment research and subsequent data to categorize residential and C&I customers into groups or market segments. For the 2021-2023 term, the NH Utilities will build on this work and leverage a number of psychographic and behavioral segmentation strategies to refine the marketing tactics used to engage customers. This segmentation combined with demographic-based data (e.g., customer characteristics, housing type and age, business type, number of employees, etc.) provides the NH Utilities with insight into customers' decision making process, world views, what motivates them to purchase high efficiency products or engage in efficient practices, and what they perceive as barriers.

The Market Assessment categorized customers into market segments using target metrics, such as awareness of NHSaves Programs and attitudes toward energy and the environment. The following four key factors were used to segment the marketplace: (1) concern for the environment, (2) environmentalism, (3) responsibility, and (4) behaviors. These factors helped to sort customers into the following four categories.

- **Engaged Greens.** This market segment (24 percent) has high levels of familiarity with energy efficiency programs and have participated in NHSaves Programs. Engaged greens have the highest level of concern with environmental issues, perceive a high-level of responsibility to take energy-saving actions, and frequently engage in energy conservation behaviors.
- **Aspiring Greens.** This market segment (27 percent) has moderate levels of awareness of NHSaves Programs, energy-efficient technologies, and has participated in energy efficiency programs. Aspiring Greens have a high level of concern for environmental issues, frequently engage in energy efficiency, and perceive a higher level of personal responsibility to take action.
- **Peripherally Aware.** Customers in this market segment (25 percent) are less likely to be concerned about environmental issues and to take responsibility to act and then in engage in energy-efficiency behaviors. Peripherally Awares are generally aware of NHSaves Programs; however, they do not understand their program options and have never participated in an energy efficiency program.
- **Disconnected.** This market segment (24 percent) shows the lowest levels of awareness of energy efficiency and participation in NHSaves Programs. Disconnected customers have a lower level of concern with environmental issues, perceive a lower level of responsibility to take energy-efficient actions, and do not frequently engage in energy-saving behaviors.

Recommendations

The Market Assessment identified two key customer segments that presented immediate opportunity for the NHSaves brand and program engagement—the Engaged Greens and Aspiring Greens. These customer segments were identified as already having moderate levels of awareness of the NHSaves brand and more likely to have already participated in NHSaves Programs.

These customers are more likely to respond positively to the NH Utilities' communications, given that they are already interested in taking action to save energy and perceive it as their responsibility to do so. A key recommendation from the study was to increase utility-generated communications, including but not limited to: bill inserts, e-mails, or a separate postcard mailing to these customers.

C&I Customers

The NH Utilities utilize market segmentation to effectively target C&I customers and engage them in the NHSaves Programs as well. Understanding what motivates a business customer to adopt energy efficiency equipment and practices gives the NH Utilities insight into what communications strategies are most effective to increase C&I customer participation in the NHSaves Programs.

The Market Assessment determined that the largest energy consuming C&I customers have a higher level of concern for environmental issues than small to mid-size businesses. This is due to the need for many large businesses to meet and uphold environmental sustainability commitments in order to satisfy customer and shareholder priorities. This extrinsic motivation provides the NH Utilities an opportunity to effectively target large C&I customers for high efficiency equipment and behaviors, and to encourage their participation in the NHSaves program offerings. The Market Assessment also shed light on the decision-making constraints of four large C&I market segments and identified viable solutions the NH Utilities should implement. These market segments and strategies were discussed in Section 3.4 of this document.

8.3 2021-2023 Marketing Strategies

While looking toward the 2021-2023 Plan's implementation, the NH Utilities recognize that this is a great opportunity to build on the lessons learned and Market Assessment recommendations implemented in the 2018-2020 term. The primary focus of the NH Utilities' marketing efforts is to take customers' heightened awareness of energy efficiency and turn it into participation in the NHSaves Programs. Increased participation and energy savings will be achieved through increased and targeted customer engagement and by implementing comprehensive, multi-measure projects that save energy and money. Marketing strategies harness the strong association between the NH Utilities and the NHSaves brand, which builds credibility given that the NH Utilities are already viewed as trusted energy advisors for customers across the state.

8.3.1 Marketing Communication Efforts

The NH Utilities will focus on motivating customers to engage in energy efficiency through a diverse mix of push-and-pull tactics that connect them back to relevant conversion points. A "conversion point" is the point at which the recipient of a marketing message performs a desired action. "Pull tactics" are designed to effectively draw customers into the programs and will include television and print and brand advertising, as well as utility communications (e.g., bill inserts, direct mail and e-mail, etc.) to leverage customers' trust with their utility.

The NH Utilities will also continue to place an emphasis on engagement through public relations and social media. These channels will help to expand the "brand story" in authentic, relatable ways. This will include balancing brand, program and product offerings, lifestyle, and education-based content on social media advertising to attract customers' attention indirectly, and then work to motivate customers to find out more about the NHSaves Programs and how they can make their home or business more energy efficient. Positive stories about how local businesses, municipalities, and customers are saving energy and money will serve as a conversion point to engage a customer, turning a potential actor into one who actually engages with the programs and energy efficiency behaviors.

Brand Awareness

Presentation of both the NHSaves logo and the NH Utility logos in marketing and promotional materials is a key approach in the effort to increase both awareness and uptake of energy efficiency offerings. Co-branding allows customers to recognize the statewide nature of energy efficiency offerings, provides assurance that the offerings are connected to trusted, regulated entities that they already have a relationship with, and makes the connection between interest in energy efficiency and contacting their NH Utility to take action.

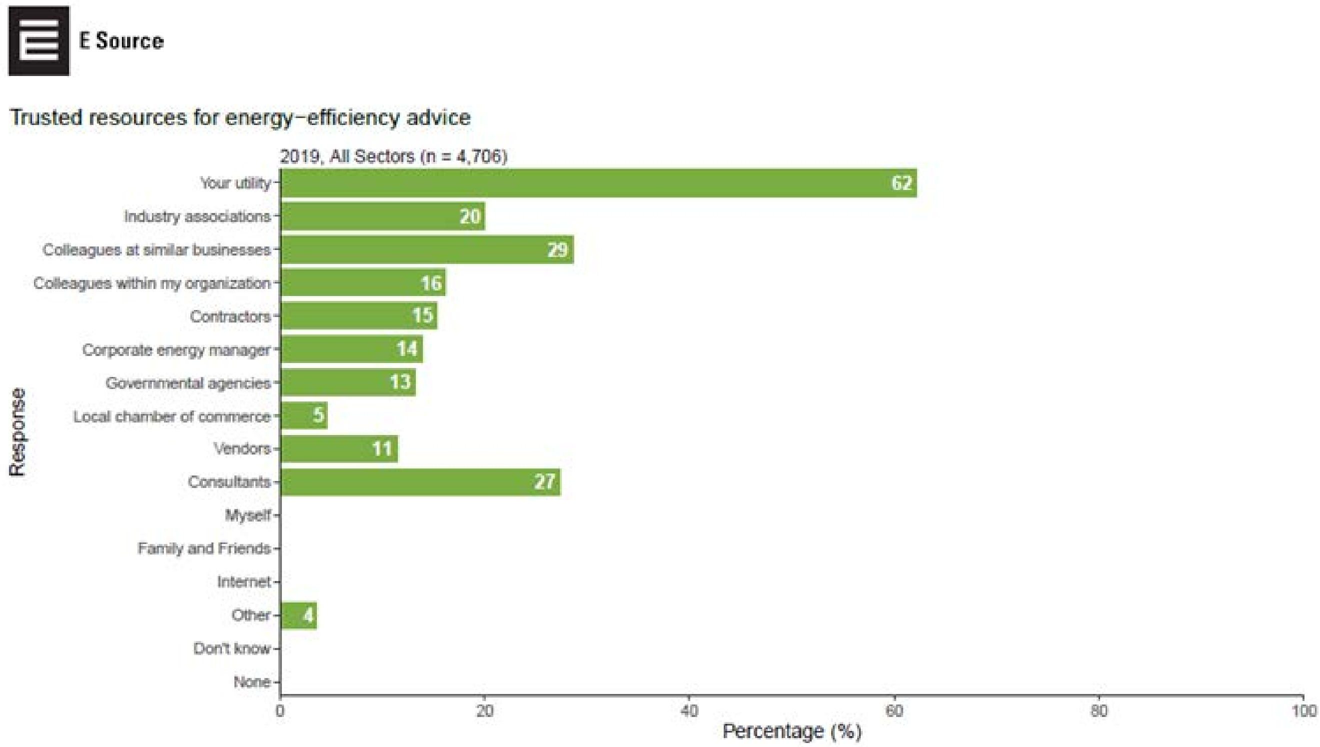
The NH Utilities began utilizing “NHSaves” in 2002, starting with program brochures and the website, and expanded over time as joint utility coordination on NHSaves Program offerings solidified and became the primary approach to energy efficiency in New Hampshire. As an umbrella brand, NHSaves became a way to connect the energy efficiency programs offered by each individual NH Utility to the joint planning and approval process. With NHSaves, customers can recognize that energy efficiency is available to all NH Utility customers across the state.

While the NHSaves logo and brand helps to reinforce the statewide nature of efficiency program offerings, NH Utility brands are featured in conjunction with the NHSaves logo in order to leverage the awareness and trust that customers have in the NH Utilities. Consumers today take in a constant flow of marketing and messaging across every aspect of their lives and activities. Consumers consistently have to analyze those messages to determine whether they are valid and from a trusted source. The initial impression of an advertisement or offer as something legitimate and trustworthy helps to determine whether the customer is willing to engage further in the information that the message contains.

Studies have shown that customers overwhelmingly view their utility as the trusted resource for energy efficiency advice. In fact, a recent study by E-Source surveyed respondents on trusted resources for energy efficiency advice and found that out of 4,706 respondents in all sectors in 2019, 62 percent of respondents selected “Your Utility” as the most trusted resource. See Figure 8-1 for the results from the E-Source study.[65]

[65] E Source (2020). E Source Small and Midsize Gap and Priority Study & Large Business Gap & Priority Study (Business Customer Insights Center).

Image 8-1: Trusted Resources for Energy Efficiency Advice (E-Source)[66]



Additionally, a survey of New Hampshire customers by Eversource found that 62 percent of residential customer respondents preferred a residential advertisement with both the utility and NHSaves logos, noting the advertisement emphasizes collaboration and comes from a business they trust. 21 percent preferred the advertisement with just the utility logo, and 17 percent preferred just the NHSaves logo. Similarly, 68 percent of commercial customer respondents preferred a commercial advertisement with both the utility and NHSaves logos, 24 percent preferred the advertisement with just the utility logo, and 8 percent preferred just the NHSaves logo. Based on research, and the overall desire to leverage customers' existing awareness of the NH Utilities as legitimate regulated entities and trusted energy advisors, co-branding strategies are a critical element of supporting and enhancing the NHSaves brand.

66 E Source (2020). E Source Small and Midsize Gap and Priority Study & Large Business Gap & Priority Study (Business Customer Insights Center).

In addition to trust and awareness of energy efficiency programs, co-branded marketing serves to encourage the customer to take action toward implementing energy efficiency by providing a direct link to the service provider. In order to move from awareness to action the customer must have a clear understanding of what steps they can take and who they can contact. The utility is integrally connected to implementing energy efficiency projects, so it is vital that customers understand the linkage in order to move forward with energy efficiency. Call centers, energy efficiency employees, and business account executives all provide critical pathways for customers to gather information, begin a project, or resolve questions. Understanding the connection between statewide energy efficiency offerings and a customer's utility provides the full circle of information that the customer needs in order to take action and implement energy efficiency improvements. Additionally, linking the utility logo with NHSaves enables customers to see that programs are administered by the NH Utilities, thereby ensuring transparency of funding by ratepayers.

The NH Utilities recognize the benefits of the statewide NHSaves brand in promoting energy efficiency programs to customers. In order to protect the brand and ensure that it represents high standards of delivery and customer service, the NH Utilities will monitor and control the word and logo service marks in order to maintain their value and to prevent inferior services from diminishing them. The NH Utilities have stepped up these efforts, including initiating the federal service mark registration and monitoring efforts, in order to identify unauthorized uses of the service mark and protect the integrity of NHSaves.

In addition to utility-led marketing efforts, the NH utilities are also working to provide enhanced opportunities for contractors to market and support the programs through a trade ally logo. During the third quarter of 2020, this logo will be created specifically to incorporate the NHSaves logo, while differentiating it in order to signify the trade ally relationship. Contractors will be able to receive the benefit of NHSaves brand awareness and visually demonstrate that they have met the requirements to participate in the NHSaves Programs. The use of a trade ally logo will increase the visibility of NHSaves across the state and leverage marketing campaigns funded by contractors to reach more customers. The trade ally logo will be licensed to qualified contractors through an agreement that provides for review of materials by the NH Utilities and detailed brand guidelines in order to ensure proper use of the mark and protect its integrity.

Throughout the 2021-2023 Plan, the NH Utilities will continue to use branding strategies designed to leverage customer trust and awareness and promote energy efficiency in New Hampshire.

Residential Customers

Residential marketing communications will target residents of single-family and multifamily homes, especially limited-income customers, as well as home builders and buyers, contractors, distributors, property managers, realtors, and retailers to inform these stakeholders about NHSaves' high-efficiency products and technologies. The NH Utilities will also increase outreach to rural and hard-to-serve customers to engage them in energy efficiency through Button Up Workshops, community forums and partnerships.

During the 2021-2023 term, the NH Utilities will include more midstream and point-of-purchase rebate offerings for the NHSaves Residential Programs, as well as include additional tiers and bonus incentives for the residential new construction marketplace. These new offerings are designed to both expand and simplify the opportunities for participation in NHSaves programs by residential customers. Through program-specific marketing communications efforts, the NH Utilities will make more customers aware of these easy-to-access on-ramps to energy efficiency.

Throughout the 2021-2023 term, the NH Utilities will market the NHSaves Residential Programs through a variety of channels, including the website (NHSaves.com), bill inserts, program materials, direct mail and e-mail, active social media campaigns, paid digital advertising, billboards, radio/TV/music streaming advertisements, trade shows, public relations efforts (statewide and utility-driven), hosting or providing speakers for trainings and events, and providing content for partners' blogs, newsletters, and websites.

C&I and Municipal Customers

For non-residential customers, the NH Utilities will focus marketing efforts on a variety of industry segments and facility types and will leverage utility account representatives' and customer service personnel's relationships with these customers. The Market Assessment found that C&I customers, especially large C&I customers, attributed their engagement with energy efficiency to their strong relationships with their utility representatives. The NH Utilities will continue to foster these relationships to encourage long-term, multi-measure efficiency projects with their C&I customers. In addition, the NH Utilities will work closely with various trade ally and channel partners, including but not limited to: architects, builders, contractors, developers, electricians, engineers, equipment manufacturers and suppliers, facility managers, and trade associations. For municipalities, the NH Utilities will continue to work closely with town, school, and local community officials and leverage the NH Utilities' internal resources to market the NHSaves Programs.

For the 2021-2023 term, the NH Utilities will focus on making it easier for customers to participate in NHSaves C&I Programs. The NH Utilities will create standard offer marketing pieces, such as sell sheets and presentations, specifically developed for target C&I market segments and end-use equipment. These tailored marketing collateral packages will make it easier for customers to understand the potential incentives and estimated energy savings associated with installing the types of energy-efficient equipment common to businesses like theirs. Through case studies and customer testimonials, the NH Utilities will enhance efforts to use the success stories of other local businesses to recruit newcomers to the NHSaves Programs.

The NH Utilities will work to spread the energy efficiency message further to local communities, municipalities, and small businesses through outreach efforts, such as the main street initiative described in the C&I Programs section of this document (see Chapter 3).

8.3.2 Marketing Strategy Components

The primary focus of the NH Utilities marketing efforts over the coming three-year term is to convert customers' heightened awareness of energy efficiency resulting from NHSaves marketing efforts over the 2018-2020 term and motivate them to take action. For the 2021-2023 term, the NH Utilities have designed programs to allow for multiple, easy-access program pathways to serve as on ramps to engage customers in energy efficiency. The NH Utilities' marketing strategies also focus on delivering communications through multiple and diverse marketing channels to increase customer touch points and to increase conversion rates. The NH Utilities will focus on three broad marketing objectives for the 2021-2023 NHSaves Programs:

1. Continue to build awareness and demonstrate the value of energy efficiency;
2. Convince customers to take action and participate in NHSaves energy efficiency offerings; and
3. Increase education and outreach efforts to both customers and trade allies.

These marketing strategies, along with a comprehensive set of program solutions, are designed to overcome specific barriers to energy efficiency program participation.

Continue to Build Awareness and Demonstrate the Value of Energy Efficiency

The brand awareness research and marketing efforts conducted during the 2018-2020 Plan have helped the NH Utilities to better understand New Hampshire customer behaviors and to assess the overall knowledge of energy efficiency, NHSaves Programs, and the motivators and barriers to participation. During the 2021-2023 term, the NH Utilities will continue to leverage this knowledge to inform marketing campaign strategies and to focus on program-specific marketing campaigns.

The NH Utilities will continue to keep the NHSaves website up to date and engaging throughout the 2021-2023 term to increase awareness of programs, and to provide an online platform for customers to engage with energy efficiency. The website is currently an information source for customers and energy service providers wanting to learn about energy efficiency programs and technologies. The next step is for the NH Utilities to expand the website into a digital marketing platform that directly engages customers with energy efficiency offerings. This will include the creation of multiple digital conversion points where customers may redeem appliance vouchers, sign up for a program, learn about energy-efficient equipment and building design through a digital video library, or even purchase an energy-efficient product through a digital rebate redemption platform.

Convince Customers to Take Action and Participate in NHSaves Programs

The NH Utilities will continue to use established social media platforms to build a larger audience and to target messaging to select customer groups, using a social media content calendar of planned campaigns and promotions to be implemented through the 2021-2023 term. The NH Utilities will continue to track social media metrics to measure change over time and gauge progress toward meeting key performance indicators.

Increase Contractor and Public Education Efforts

For the 2021-2023 term, the NH Utilities will increase the number of contractor and customer education trainings and events across the state. These activities are described in more detail in the NHSaves Residential Programs section (Chapter Four) and the NHSaves C&I Programs section (Chapter Three). Contractor and customer education is an important component of the NH Utilities' marketing efforts to inform the public about the benefits of energy efficiency and the NHSaves Programs.

The NH Utilities recognize that educating K-12 students on energy efficiency has the double benefit of empowering students to help their schools set and achieve energy efficiency goals, while also arming them with information to improve efficiency and performance where they live. During the 2021-2023 term, the NH Utilities will continue to partner with schools to instill an energy-efficient ethic in school-aged children across the state. All K-12 schools in the NH Utilities' service areas are eligible to participate in New Hampshire Energy Education Project ("NHEEP") presentations and workshops to learn about energy efficiency. The NH Utilities have worked with NHEEP to support additional flexible options for teachers and students who may be participating in virtual education. Recognizing the challenges schools are facing related to COVID-19 and health risks, offerings include virtual workshops with hands-on components, home learning lessons and additional custom curriculum support, as well as virtual professional development workshops. The student education and professional development workshop curriculum is aligned with Next Generation Science Standards ("NGSS").

8.3.3 Key Performance Indicators

Throughout the 2021-2023 term, the NH Utilities will build upon the successful 2018-2020 marketing research and strategies developed to increase awareness of and participation in NHSaves Programs. To track the success of these efforts, the NH Utilities have developed several key performance indicators for the 2021-2023 term, including:

- **Awareness.** In 2021, the NH Utilities anticipate having the results of a new Market Assessment, which will show the change over time in NHSaves brand awareness. The new Market Assessment will also provide better understanding of which customer segments have been reached through marketing efforts over the last three years.
- **Interest.** The NH Utilities will track the engagement of visitors to the NHSaves.com website, including the time spent on-site, pages viewed, and bounce rates. In addition, the NH Utilities will track social media account metrics, including social follows, reactions, and general engagement.
- **Intent.** This metric will track the intent of customers to engage in NHSaves Programs, including gathering the following information: visits to key NHSaves.com pages, sponsor and contractor click-throughs, and event engagement (e.g., Button Up Workshops and contractor trainings).
- **Conversion.** This key metric will measure if customers are taking action and participating in NHSaves Programs. The NH Utilities will track the following conversion metrics: rebate submissions, HHI Tool submissions, online store purchases, and e-news sign-ups. Throughout the 2021-2023 term, the NH Utilities will look to add new conversion tools to track the success of all marketing communications efforts.
- **Word-of-Mouth.** Another key metric for marketing communications efforts is advocacy for the NHSaves Programs. Word-of-mouth recommendations and customer-driven testimonials are positive marketing tools to promote the NHSaves Programs. The NH Utilities will track the customer referrals, social shares, and positive reviews of the NHSaves Programs to determine if they can attribute increased program engagement and awareness with advocacy.

8.4 Customer Engagement Initiative (Eversource)

For the 2021-2023 term, Eversource will undertake behavioral-based marketing strategies to engage its electric customers in understanding how they consume energy in their homes and subsequently move them toward adoption of energy efficiency measures through the Residential program offerings

8.4.1 CEI Marketing Objective

Eversource's customer engagement initiative ("CEI") is a streamlined approach to providing customers with data-driven insights and targeted recommendations to motivate behavior change and participation in energy efficiency programs. The initiative will leverage expertise gained through previous experience with traditional behavioral programs and digital customer engagement in the areas of data analytics, informational design, behavioral science, and communication delivery.

In July 2020, Eversource released an RFP to determine what types of customer engagement services and solutions are offered in the marketplace for consideration across its three-state service territory (Connecticut, Massachusetts, and New Hampshire). The tools selected will enable Eversource to integrate customized usage insights and recommendations for applicable NHSaves Programs more seamlessly into the overall customer experience and marketing efforts. Once finalized, the chosen tools will replace the previous Customer Engagement Platform.

8.4.2 CEI Marketing Design

The CEI will drive energy efficiency awareness and customer action by meeting customers where they are with the right message at the right time. Eversource's approach involves identifying good candidates for a specific offer (such as a particular product or measure) based on what Eversource knows about them, their homes, and how they use energy, then designing a series of personalized communications and interactions over time to move customers along the desired path to energy efficiency.

The communications will include customized usage insights and recommendations delivered through traditional one-on-one outbound marketing channels (e-mail and possibly direct mail) that allow for personalization at scale. To maximize impact and reinforce the message, Eversource will integrate this information with natural touchpoints that customers have with their utility (for example, the process of viewing and paying a bill online) and trigger the presentation of information at times when its most relevant (e.g., seasonal changes in temperature or after a customer receives a high bill).

In 2021, Eversource's CEI will focus primarily on residential customers with learnings from that work applied to relevant C&I subsegments in the following years.

In the 2021-2023 term, Eversource has designed the CEI as a marketing approach to drive adoption of program measures and does not expect to generate behavioral-based energy savings. The focus of the CEI in the near term is develop customized communication journeys that utilize behavior-based principles.

To fund the marketing approach, Eversource has moved $600,000 from the former Customer Engagement Platform line of the budget into Marketing and utilized the remainder of the funds previously anticipated for the Platform in the ES Products program, anticipating that the CEI communications will drive customers to participation in that program.

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Chapter Nine: Workforce Development

The NH Utilities recognize that increasing the adoption of energy efficiency improvements in homes, businesses, and municipal facilities across New Hampshire requires a skilled and qualified workforce. The state has a pool of dedicated trade allies who already provide quality services for the NHSaves Programs. However, as savings and participation goals increase over the 2021-2023 term, the NH Utilities must ensure this labor pool can expand to meet the demand for highly-skilled energy efficiency and demand reduction workers across the state.

Beginning in 2020 and continuing during the implementation of the 2021-2023 Plan, the NH Utilities will focus on recruiting and retaining a demographically and geographically diverse workforce to expand the existing local energy efficiency industry with personnel who are highly-skilled and equipped to meet the NHSaves Programs' current and future needs. Energy efficiency is a growing field in New Hampshire, and many firms and organizations working within it have noted difficulties in finding new recruits to help fulfill the demand for services.

In addition to workforce needs related to increasing NHSaves Program activity and demand for services, energy efficiency contractors and vendors are significantly impacted by the recent onset of the COVID-19 pandemic. Many energy service firms had to furlough, or lay-off workers, as on-premises activities were suspended and demand for energy efficiency services slowed. Workforce recovery from this unexpected turn of events remains uncertain and may require new avenues for recruiting and replacing workforce capacity.

Potential entrants into the industry would benefit from a comprehensive source of information and resources including career paths within the energy efficiency field, what education and certifications are required to acquire a job and advance within the industry, whether tuition assistance is available, and where to find career opportunities. The NH Utilities believe that improving access to and awareness of available workforce development resources will help develop the pool of well-trained contractors who will offer high-quality services to customers. In addition, these contractors will be trained regarding building science and emerging energy-efficient technologies, which will inform them of solutions, incentives, and services available to customers through the suite of NHSaves Programs; thus, resulting in comprehensive energy-saving projects and higher levels of participation within the programs.

The NH Utilities currently support various workforce development efforts throughout New Hampshire and will continue to do so during the 2021-2023 term. These efforts are implemented through the NHSaves Programs, with resources and training offered to contractors, distributors, builders, building owners and customers who support or are interested in energy efficiency programs or initiatives. At the same time, the NH Utilities will pursue a cohesive statewide strategy for understanding workforce development needs, and training vendors, community action agencies, building operators, distribution and contractor partners, and others to meet the goals for the 2021-2023 Plan.

9.1 New Hampshire Workforce Development Strategy

In 2020, the NH Utilities will issue a competitive RFP for a Workforce Development lead vendor responsible for designing and implementing a Workforce Development Strategy that supports the NH Utilities' workforce development goals:

1. **Identification of Workforce Development Needs.** The NH Utilities and lead vendor will work to develop a three-year Workforce Development Strategy, including timelines and budget allocations, to address current and future workforce development needs, as informed by existing studies and supplemented by additional benchmarking and research. The lead vendor will propose pathways and opportunities to allow contractors and trade allies to further develop their staff in three ways: technical capacity, sales acumen, and other extraneous benefits like managerial proficiency. In addition, the NH Utilities will ask the lead vendor to identify pathways for job seekers in communities with high unemployment to join the energy efficiency workforce.

2. **Coordinate Implementation of New and Existing Training and Workforce Development Activities.** The Workforce Development lead vendor will be responsible for identifying and

coordinating the implementation of new and existing training and workforce development activities needed to fulfill the Workforce Development Strategy. Trainings will focus on the skills required to sell and install high-efficiency technologies across all fuel types (i.e., electricity, natural gas, oil, and propane), as well as the building sciences and other skills identified during the development of the strategy by the NH Utilities and lead vendor.

3. **Coordinate Activities to Retain Existing Energy Efficiency Workers.** The Workforce Development lead vendor will identify and recommend strategies for retaining trained and qualified energy efficiency workers. The NH Utilities and lead vendor will coordinate with contractors, vendors, engineering firms and other businesses implementing energy efficiency projects to understand issues related to retaining trained workers and develop strategies to keep them working in New Hampshire.

4. **Coordinate Activities to Recruit Entrants to the Energy Efficiency Workforce.** The Workforce Development lead vendor will help identify, develop, and implement activities to engage potential workers who are new to the workforce, or considering career changes, to seek careers within the energy efficiency field in New Hampshire. The NH Utilities and lead vendor will collaborate with existing career and educational organizations, as well as engage with other key stakeholders to define recruitment paths for job seekers. This will also include engagement with high schools and technical schools regarding energy efficiency as a career path.

9.2 2021-2023 Workforce Development Efforts

During the development of the Workforce Development Strategy, the NH Utilities will continue to develop and implement trainings and workforce development activities for the current energy efficiency workforce. As the strategy is developed, the NH Utilities will introduce and/or modify contractor trainings to align with research and best practices design.

The NH Utilities will continue to monitor and support existing trainings and training pathways in order to contribute to building and maintaining a qualified workforce that will meet the demand for energy efficiency. During the 2021-2023 term, the NH Utilities will continue to train the state's current workforce, including contractors, distributors, manufacturers, CAAs, home builders, municipal facility managers, and retailers on high-efficiency equipment and design. To support many of the 2021-2023 Plan's priorities and programs, key workforce trainings will include but are not limited to these topics: high-efficiency HVAC technologies and controls, refrigeration equipment and controls, advanced LED lighting and controls, whole-building design (C&I sector), code-plus initiatives, ADR strategies, and emerging technologies.

Residential Programs

For the 2021-2023 term, the NH Utilities will look to expand existing trainings and include additional content on: building code compliance, emerging technologies, and energy-efficient building techniques. Residential workforce development will include in-field home builder trainings, lunch and learns, hands-on equipment training, and interactive online training videos. In order to scale up energy savings and program participation, the NH Utilities will increase workforce capacity through more contractor training, particularly regarding HVAC equipment and systems.

The NH Utilities also plan to continue to collaborate with HVAC contractors and to increase training opportunities regarding HVAC system design, operations, and performance. In addition, the NH Utilities will expand the refrigeration contractor trade ally network during the 2021-2023 term. This effort will help increase the number of refrigeration contractors who understand high-efficiency technologies and controls and the comprehensiveness of large C&I projects.

C&I Programs

During the 2021-2023 term, the NH Utilities plan to increase the C&I contractor network statewide: enabling the program to serve more customers in remote, hard-to-reach areas where access to energy efficiency contractors and solutions is sometimes limited. The NH Utilities will continue to offer C&I trainings on advanced technologies and controls to municipal representatives, including building operators and facility managers. The NH Utilities will conduct workforce trainings regarding energy-efficient technologies, building codes and standards, and building above code (code plus). The number of specialized contractor trainings will be increased to promote the C&I Programs' push for more comprehensive energy projects and to increase the adoption of new and emerging energy-efficient technologies. Workforce trainings will include but are not limited to: advanced lighting design and controls, HVAC systems and controls, and refrigeration tuning and controls.

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Chapter Ten: Planning Elements

10.1 Benefit-Cost Testing

Since the inception of energy efficiency programs in New Hampshire, and in accordance with Commission Order No. 23,850, in DE 01-057, dated November 29, 2001, the NH Utilities have used the Total Resource Cost ("TRC") test, which compares the value of the avoided cost of energy and other resources over the life of installed measures against the cost of those measures to both the NH Utilities and the participating customers. Over the years, amendments to the TRC test have been made, which include adding the costs and benefits of avoided fossil fuels as the residential weatherization programs became fully fuel-blind (saving oil, propane, and other fossil fuels), and also include a non-energy impact adder to the benefits as a proxy for the participant benefits the programs delivered beyond those deriving from reduced energy use. The NH Utilities use a common set of avoided costs to ensure that program benefits are calculated consistently across utilities, which are based on values from the periodically updated, regional AESC Study (see additional details below).

As part of the settlement to the 2018-2020 Plan, stakeholders agreed to revisit the energy efficiency program's long-standing benefit cost test and assess whether adjustments should be made based on the evolution of policy priorities in New Hampshire. To undertake this assessment, the EM&V Working Group, in conjunction with the Benefit-Cost Working Group, issued a competitive bid and selected Synapse Energy Economics to facilitate the stakeholder effort. Following the guidance of the National Standards Practice Manual, the NH Utilities and energy efficiency stakeholders over many months undertook a comprehensive review of state energy policy and Commission precedent. The resulting Cost Effectiveness Review Final Report was completed in October 2019.[67] On October 31, 2019, the

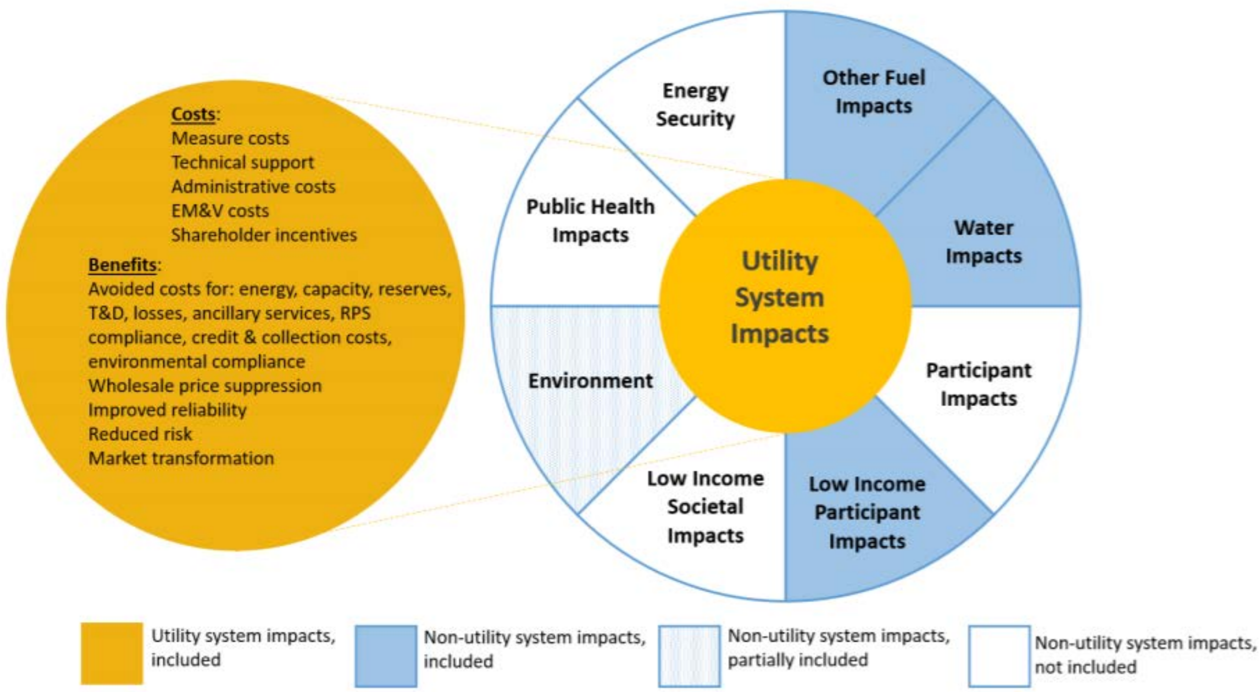
[67] Synapse Energy Economics, Inc. *New Hampshire Cost-Effectiveness Review*. Oct. 4, 2019. Available at: https://puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_COST_EFFECTIVENESS_REVIEW.PDF.

Benefit-Cost Working Group filed a report and a set of recommendations to the Commission regarding the adoption of the proposed primary cost-effectiveness test (the Granite State Test), and two secondary tests to be applied to the 2021-2023 Plan.[68] On December 30, 2019, the Commission issued Order 26,322, approving the Benefit-Cost Working Group's recommendations to take effect for the 2021-2023 term.

10.1.1 Granite State Test

The Granite State Test, the primary cost-effectiveness test, measures the utility costs of delivering energy efficiency programs against the benefits that accrue to the utility system, as well as those benefits associated with improving outcomes for limited-income participants, reducing participants' use of unregulated fuels and water, and a RGGI/carbon emissions proxy.

Figure 10-1: Granite State Test



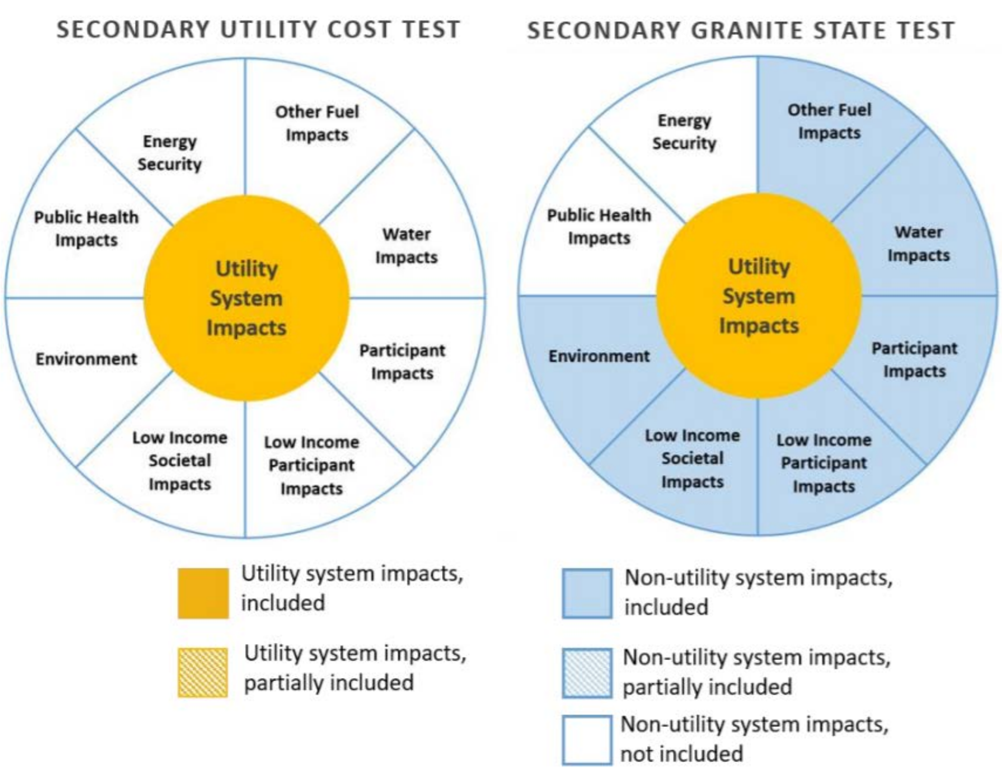
68 DE 17-136, *Electric and Gas Utilities 2018-20 New Hampshire Statewide Energy Efficiency Plan Benefit-Cost Working Group Recommendations Regarding New Hampshire Cost-Effectiveness Review and Energy Optimization through Fuel Switching Study*. Oct. 31, 2019. Available at: https://puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_FILING_WORKING_GROUP_REC.PDF.

10.1.2 Secondary Tests

In addition to the Granite State Test, the Commission approved two secondary cost-effectiveness tests recommended by the Benefit-Cost Working Group: the Utility Cost Test ("UCT") and Secondary Granite State Cost Test ("GST-2"). These two tests measure the two extremes of the cost-effectiveness spectrum: one test includes impacts to the utility system only, the other test includes a much larger list of impacts that the Benefit-Cost Working Group considered relevant to New Hampshire.

- The UCT takes into account the utility's costs of delivering energy efficiency programs against the direct benefits to the utility system (i.e., ignoring the significant non-system benefits realized by participants).
- The GST-2 considers the utility and participant costs of delivering energy efficiency programs against both the direct and indirect benefits to the utility system, participants, and the environment.

Figure 10-2: UCT and GST-2



The Granite State Test is applied to each proposed energy-saving program in the portfolio at the time of filing. If the Net Present Value ("NPV") of benefits realized by the energy efficiency programs (benefits) is greater than the NPV of costs to deliver those programs (costs), it is assumed the investment is sound and can proceed. Certain exceptions to cost-effectiveness requirements can be made for offerings including education, approved pilots, programs in early stages, and the low-income HEA program.

The Granite State Test will also be applied by each NH Utility to each approved program at the time of annual and term reporting. If, under that test, a NH Utility's portfolio of programs delivered during the term is cost-effective (with a benefit-cost ratio greater than 1.0), the NH Utility will be eligible to earn a performance incentive.

Because the Granite State Test requires that the NH Utilities plan for each program to be cost effective, measures and projects that make up the program must also be cost effective. Not every individual measure or project has to be cost effective, but on average, they must have a benefit-cost ratio greater than 1.0 to ensure their benefits exceed the costs of both rebates and services provided to customers, as well as all program-related marketing, evaluation, administration, and other costs not invested directly in energy-saving measures. In accordance with recommendations from the benefit-cost working group, the NH Utilities will not apply values for reliability benefits as quantified in the 2018 AESC Study but will work toward developing more rigorous values under the 2021 AESC Study that will be applied during the 2022-2023 term.

The secondary tests (UCT and GST-2) will also be applied by each NH Utility to each of the NHSaves Programs at the time of filing and reporting. These tests will help inform resource allocation decisions, as well as treatment of marginally cost-effective programs, but will not be used to judge the viability of a program that has been determined cost-effective under the Granite State Test and will not have an impact on the NH Utilities' PI.

10.1.3 Benefits

Benefits are derived from the AESC Study undertaken every three years for the entire New England region. The AESC Study is overseen by and receives input from the AESC Study Group, comprised of regulators, utility staff, and energy efficiency consultants throughout New England, and serves as the source of most avoided costs for calculation of benefits for New England states.

The most recent study, *Avoided Energy Supply Components in New England: 2018 Report* ("2018 AESC") was completed in March 2018 and amended in June 2018. The results of the 2018 AESC Study have been used to calculate the benefits associated with programs to be delivered as a result of the 2021-2023 Plan. Updated benefits from the 2021 AESC Study will be provided to the Commission as outlined in Chapter Two.

The AESC Study generates state-specific models of the value of avoided energy and capacity (kWh in each of four seasonal periods, kW at summer and winter peak, and natural gas, oil, propane, kerosene, cord wood, and wood pellets), as well as Demand Reduction Induced Price Effect ("DRIPE") and avoided costs of certain transmission infrastructure. These avoided energy values are projected out over a 25-year time horizon. Individual state policy specifies the time period that should be used in determining the inflation and discount rates to be applied to the NH Utilities' benefit-cost model to arrive at a calculation of NPV benefits. The NPV benefits of a given project depend on various project-specific factors, including measure life, load-shape, the coincidence of its use with summer electric system peak, and the fuel(s) whose use is avoided. As a result, the value (or benefit) of an avoided annual kWh varies by measure and by project.

In accordance with the Final Energy Efficiency Group Report, dated July 6, 1999 in DR 96-150, the nominal discount rate from June of the prior year is applied to the benefit-cost analysis, while the inflation rate is based on the seasonally adjusted rate of inflation between January of the preceding year and January of the current year, as determined by the US Bureau of Economic Analysis. For the 2021-2023 Plan, the NH Utilities have applied a nominal discount rate of 3.25 percent (June 2020 value) and an inflation rate of 1.81 percent (rate of inflation between January 2019 and January 2020), resulting in a real discount rate of 1.41 percent used for NPV cost and benefit calculations.

10.1.4 Non-Energy Impacts

As discussed with the NH Benefit-Cost Working Group, and per Commission Order,[69] the NH Utilities are applying non-energy impacts ("NEIs") in cost-effectiveness screenings as follows:

- The **Primary Granite State Test** reflects low-income participant NEIs, based on New Hampshire-specific primary research on the HEA program. Specifically, based on the HEA evaluation, a per-project value 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, as reflected in the TRM.[70]
- 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 comprehensive, secondary research survey and analysis of NEIs by an independent third party, adjusted for New Hampshire-specific economic and other factors and matched to New Hampshire's programs and measures.[71] Per the BC Working Group's final report, the test also reflects environmental externalities, including the $100/ton global reduction marginal abatement scenario from the AESC Study.

Both the Primary and Secondary Granite State Tests reflect other resource impacts for water and delivered fuels.

[69] Docket No. DE 17-136, Order Approving Benefit Cost Working Group Recommendations, No. 26,322, Dec. 30, 2019; Order Approving 2020 Update Plan, No. 26,323, Dec. 31, 2019.
[70] Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, Jul. 29, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf.
[71] DNV-GL. New Hampshire Non-Energy Impacts Database Methodology Memo, Apr. 9, 2020. https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/Final-NH-NEI-Methodology-Memo-20200409.pdf.

10.2 Performance Incentive

As part of the DE 17-136 Performance Incentive Working Group, which commenced in January 2018 and concluded with a final report in July 2019, changes to the PI structure were proposed and implemented for Plan Year 2020. For the 2021-2023 Plan, the NH Utilities will continue to utilize the revised PI framework, with minor changes to the weightings proposed below. The PI framework categorizes and weights six separate performance indicators: (1) Lifetime kWh Savings, (2) Annual kWh Savings, (3) Summer Peak Demand Savings, (4) Winter Peak Demand Savings, (5) Value, and new this term, (6) Active Demand Savings (components) at the portfolio level for each NH Electric Utility, each involving minimum savings thresholds (as well as other minimum thresholds summarized below) that must be met in order for any PI to be earned for that component.

The PI Working Group report recommended changing minimum thresholds for savings and benefits components from the prior 65 percent to 75 percent. Due the significant economic and societal impacts of COVID-19, the 2021-2023 Plan moves those thresholds back to 65 percent. This shift reflects the dichotomy between the high energy savings goals in the 2021-2023 Plan and the significant uncertainty that exists in the marketplace due to current and future impacts of the global pandemic and its ripple effects.

In 2021-2023, the ADR offerings will transition from demonstration projects to full-fledged programs; those NH Utilities that offer an ADR program will include a distinct PI component for achievement of ADR goals, as was anticipated by the PI Working Group. This element will be based on the actual spending for the ADR programs, as well as actual kW reduced. The target PI for the ADR portion will match the rest of the PI at 5.5 percent of actual expenditures, with a threshold of 65 percent and a cap of 125 percent. Compared to 2020, the demand components continue to represent a combined 20 percent of the incentive weight, however the percentages for Summer Peak and Winter Peak Demand Savings components have been lowered slightly to allow for a weight of 5 percent for the Active Demand component.

Eversource, Liberty Electric, and Unitil Electric have added an Active Demand component to the PI calculations for 2021-2023, which follows the same framework as the other components, as shown in Table 10-1.

Table 10-1: Performance Incentive Components (Electric)

PI No.	Component Title	Description	Incentive Weight	Minimum Threshold	Maximum PI Level	Verification
1	Lifetime kWh Savings	Actual/Planned Lifetime kWh Savings	35%	65%	125%	Term PI Filing w/Commission
2	Annual kWh Savings	Actual/Planned Annual kWh Savings	10%	65%	125%	Term PI Filing w/Commission
3	Summer Peak Demand Savings	Actual/Planned ISO-NE System-wide Summer Peak Passive kW Savings	9%	65%	125%	Term PI Filing w/Commission
4	Winter Peak Demand Savings	Actual/Planned ISO-NE System-wide Summer Peak Passive kW Savings	6%	65%	125%	Term PI Filing w/Commission
5	Active Demand Savings	Actual/Planned Active kW Savings	5%	65%	125%	Term PI Filing w/Commission
6	Value	Actual/Planned Net Benefits	35%	65%	125%	Term PI Filing w/Commission
Total			**100%**			

For the NH Natural Gas Utilities, the kW components are omitted from the framework.

Table 10-2: Performance Incentive Components (Natural Gas)

PI No.	Component Title	Description	Incentive Weight	Minimum Threshold	Maximum PI Level	Verification
1	Lifetime MMBtu Savings	Actual/Planned Lifetime MMBtu Savings	45%	65%	125%	Term PI Filing w/Commission
2	Annual MMBtu Savings	Actual/Planned Annual MMBtu Savings	20%	65%	125%	Term PI Filing w/Commission
3	Value	Actual/Planned Net Benefits[2]	35%	65%	125%	Term PI Filing w/Commission
Total			**100%**			

- **PI Calculation.** PI = [(1.925% x ACTUAL) x (kWhL-ACT/kWhL-PLN)] + [(0.55% x ACTUAL) x (kWhA-ACT/kWhA-PLN)] + [(0.495% x ACTUAL) x (kWSUM-ACT/kWSUM-PLN)] + [(0.33% x ACTUAL) x (kWWIN-ACT/kWWIN-PLN)] + [(0.275% x ACTUAL) x (kWADR-ACT/kWADR-PLN)] + [(1.925% x ACTUAL) x (NET-BENACT/NET-BENPLN)]
- Where:
  - **PI** = Performance Incentive in dollars;
  - **ACTUAL** = Total dollars spent (less PI);
  - **kWhL-ACT** = Actual lifetime kWh;
  - **kWhL-PLN** = Planned lifetime kWh;
  - **kWhA-ACT** = Actual annual kWh;
  - **kWhA-PLN** = Planned annual kWh;
  - **kWSUM-ACT** = Actual passive summer peak kW;
  - **kWSUM-PLN**= Planned passive summer peak kW;
  - **kWWIN-ACT** = Actual passive winter peak kW;
  - **kWWIN-PLN** = Planned passive winter peak kW;
  - **kWADR-ACT** = Actual active demand summer peak kW;
  - **kWADR-PLN** = Planned active demand summer peak kW;
  - **NET-BENACT** = Actual net benefits (in NPV dollars) (i.e., total benefits less utility costs and NEI's)[72]; and
  - **NET-BENPLN** = Planned net benefits (in NPV dollars).

[72] Refer to Appendix D in the Final Performance Incentive Working Group Report in Docket No. DE 17-136.

Additional requirements are as follows:

- The NH Utilities' portfolio of programs must be cost effective over the term before any PI can be earned, meaning the BCR must be at least 1.0 under the Granite State Test;
- If the Electric Program portfolio does not meet a minimum threshold of 55 percent of total energy savings from electricity, the PI coefficient will be reduced to 80 percent of the design value, that is, the total incentive level decreases to a maximum of 4.4 percent (e.g., for lifetime electric savings the PI would change from a target of 1.925 percent to a maximum of 1.54 percent, etc.);
- Lifetime savings must be at least 65 percent of planned lifetime savings in order for any PI to be earned on the Lifetime Savings kWh component;
- Annual savings must be at least 65 percent of planned annual savings in order for any PI to be earned on the Annual Savings kWh component;
- Passive summer peak kW savings must be at least 65 percent of planned passive summer peak kW in order for any PI to be earned on the Summer Peak Demand Savings component;
- Passive winter peak kW savings must be at least 65 percent of planned passive winter peak kW in order for any PI to be earned on the Winter Peak Demand Savings component;
- Active summer peak kW savings must be at least 65 percent of planned active summer peak kW in order for any PI to be earned on the Active Demand component;
- The portfolio Net Benefits must be at least 65 percent of the planned Net Benefits in order for any PI to be earned on the net benefits component;
- Earned PI on each component is capped at 125 percent of that component's coefficient, that is, the maximum total PI is 6.875 percent; and
- PI will be calculated on actual portfolio spending up to 110 percent of approved portfolio term budget, excluding PI, without prior Commission authorization. That is, the actual spending may exceed the planned term budgets, including all sources of funding and excluding the PI, by up to

10 percent. A NH Utility may request approval from the Commission to spend in excess of 110 percent of proposed budget over the term, however, the utility will be expected to demonstrate good reasons why it should be exceeded. PI would then be calculated against actual program spending at the portfolio level, up to the revised Commission-approved budget, or as otherwise ordered.

For the EO pilot, costs are included in the PI calculation but neither planned nor will savings or benefits resulting from the pilot be reported or used in PI calculations. This approach ensures that the portfolio is cost effective with all costs, including those for the pilot, while avoiding inaccurate projections of savings and benefits, which the pilot is designed to test.

As discussed in Chapter 2, each NH Utility will complete a preliminary PI calculation in annual reports, based on actual costs, savings, and benefits for the program year. At the end of the third year of the three-year term, each NH Utility will perform a final calculation of earned PI, based on actual achievement over the term compared to the three-year term goals.

10.3 Technical Reference Manual

In advance of every program plan or update filing, the NH Utilities work together to review savings assumptions, incorporate results from New Hampshire evaluations, identify changes in federal equipment standards, reference neighboring states' evaluations, and update relevant savings algorithms, as necessary. Historically, these changes have been made by the NH Utilities and are reflected in the benefit-cost models filed with each plan. Beginning with the 2021-2023 Plan, these savings assumptions will also be documented in the New Hampshire TRM, which will contain the set of standard methodologies and inputs for calculating the savings impacts and cost effectiveness of the NHSaves Program measures.

The revised draft of the TRM is included with this filing. Although the draft is substantially complete, some measure chapters are still under review by members of the EM&V Working Group and the independent evaluation contractor supporting this effort. This ongoing review will help ensure accuracy and allow for incorporation of the most up-to-date results from New Hampshire evaluations, including from the nearly-finalized Energy Efficiency Baseline and Potential Study. In developing the TRM, the EM&V Working Group prioritized measures with the greatest impacts on portfolio savings, and remaining adjustments will not have a material impact on portfolio savings of any individual utility or the statewide EERS goals. The NH Utilities, in coordination with the EM&V Working Group, will work expeditiously to finalize and publish the complete TRM as soon as possible after this filing, in accordance with the 2018-2020 settlement agreement which requires the TRM to be published by the end of 2020. Once complete, the TRM will be made publicly accessible on an electronic platform to provide a user-friendly interface. Any compliance filing resulting from settlement discussions and/or a final order on the 2021-2023 Plan will incorporate in the NH Utilities' benefit-cost models all adjustments to the TRM made after the date of this filing.

The 2021-2023 Plan TRM will take effect as of January 1, 2021, and an annual update to the TRM will be submitted to the Commission by December 1 of 2021 and 2022. These updates to the TRM will reflect changes in assumptions and will take effect as of the beginning of the subsequent program year. The NH Utilities will update the TRM in coordination with the EM&V Working Group, and annual updates will incorporate all relevant evaluation results that are finalized by November 1. The EM&V Working Group will strive to include consensus-based assumptions for all measures and offerings included in the NHSaves Programs. Should consensus not be reached, members of the EM&V Working Group may petition the Commission for resolution on the matter.

The primary source of methodologies and inputs for the TRM is New Hampshire-specific evaluations, where available. New Hampshire jurisdiction-specific results will be favored 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. When considering whether to apply results from a study originating in another jurisdiction to New Hampshire programs, the EM&V Working Group will make the determination based on (1) the similarity of evaluated program/measures to those offered in New Hampshire; (2) the similarity of relevant markets and customers base; (3) the recency of the study relative to the recency of any applicable New Hampshire 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 US DOE or EPA, or credible and realistic factors developed using engineering judgment. Savings from energy efficiency measures and projects will be calculated using the TRM that is in effect during the program year in which the application or project savings are approved by the respective NH Utility.

10.4 Bill and Rate Impact Analysis

As part of the settlement agreement filed on December 13, 2018 and approved via Order No. 26,207 on December 31, 2018 in Docket No. DE 17-136, Eversource, Liberty Electric and Gas, and Unitil Electric and Gas (the "Regulated Utilities") agreed to undertake a bill impact analysis, including rate impacts, bill impacts, and participant impacts ("Rate & Bill Impact Analysis").[73] As agreed to in the settlement, the Regulated Utilities performed a Rate & Bill Impact Analysis utilizing the model developed by Synapse Energy Economics ("Synapse"), under the guidance of the EM&V Working Group.

For the 2021-2023 Plan, the Regulated Utilities utilized the modeling tool developed by Synapse, using model inputs including rates, sales, and customer data, as well as planned savings for the 2021-2023 NHSaves Programs.[74] Based on these inputs, the modeling tool estimates the annual and long-term electric and gas rate and bill impacts of the proposed energy efficiency programs, relative to a scenario with no programs. These impacts are estimated for both non-participating customers and for program participants, including an illustrative high savings participant and an illustrative low-savings participant, across each of the four customer segments: residential, low-income, small C&I, and large C&I. In addition, the modeling tool estimates bill impacts for an average customer in each segment, which represents a hypothetical blend between non-participants and participants and is calculated based on the segment's program savings divided by the segment's total customers.

The rate and bill impact analysis does not consider two key impacts to customers' energy bills. First, the analysis focuses on electric and natural gas utility rates and bills, while the NH Utilities implement

[73] 2018 Settlement Agreement, Docket No. DE 17-136, pp. 18-19, Available at: https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136.html.
[74] Draft 2021-2023 Plan, Filed Jul. 1, 2020.

the energy efficiency programs in a fuel-neutral manner, providing additional benefits to customers that consume oil, propane, or other unregulated fuels. Second, the estimates of long-term bill and rate impacts do not reflect the potential costs of compliance with any future federal or state GHG or other environmental requirements, which would increase the cost to ratepayers of energy resources other than energy efficiency.

Based on the NH Utilities' 2021-2023 Plan, the energy efficiency programs will change the Regulated Utilities' revenue requirements by -1.3 percent on average, or -$419.9 million in total, over the life of the measures installed during the term and across all programs. The Regulated Utilities' natural gas revenue requirements change by -3.2 percent on average, or -$9 million in total. These changes in revenue requirements are driven by long-term avoided costs and account for SBC and LDAC revenues. The reductions in revenue requirements are distributed across each utility and each rate class differently, depending on the rate class' structure. Additional details, including graphs showing bill and rate impacts for non-participants, high and low savings participants, and average customers for each customer segment and each Regulated Utility, is included in Attachment K.

10.5 Lighting Market Trends

The NH Utilities carefully considered and accounted for the significant ongoing changes in lighting markets in the development of the 2021-2023 Plan. There are two primary factors impacting the claimable lighting savings reflected in the 2021-2023 Plan:

1. The quantity of the various lighting measures that the NH Utilities anticipate being able to deliver; and
2. The net savings per lighting measure, given market changes and evaluation paradigms.

For the first factor, the NH Utilities used historical quantities as well as recent study results to determine the remaining potential from lighting. Specifically, the results from the residential baseline survey revealed that the majority (over 50 percent) of sockets in New Hampshire homes are already filled with LEDs.[75] At the same time, retail lighting sales data evaluation results found that although there are strong signs of LED market transformation in New England, the depth of transformation has varied among states and retail channels, and that the timing of market exit strategies should account for these differences.[76] For instance, Massachusetts and Rhode Island have the highest LED market shares, while Connecticut and New Hampshire lag slightly behind these states. Given these findings, the NH Utilities planned for residential retail lighting quantities to aggressively promote continued transition to LEDs in 2021, followed by a substantial decline over the remainder of the term.

For C&I customers, based on results from surveys of NH lighting suppliers as well as survey and on-site results from Massachusetts and Rhode Island, the NH Utilities have planned for continued aggressive increased levels of C&I lighting in 2021, focusing primarily on capturing the remaining market potential for retrofit lighting. Final results from the Energy Efficiency Baseline and Potential Study show continued savings potential from lighting in both the commercial and residential sectors, though with decreasing opportunity as the 2021-2023 term progresses.

Additionally, for midstream offerings, including lighting, the NH Utilities accounted for the fact that some consumers participating in the programs would have purchased LED lighting with or without the NHSaves Program incentives. To adjust for this “free ridership,” the NH Utilities have included a Net to Gross (“NTG”) rate for these measures in benefit cost modeling, effectively reducing the amount of savings attributable to the NHSaves Programs. Utilizing guidance from vendors and efficiency program administrators operating similar programs in other states, and accounting for possible differences in the New Hampshire market, the NH Utilities applied declining NTG rates (i.e., greater free-ridership and less net savings attributable to the efficiency programs) over the term for both residential retail and C&I midstream lighting.

[75] Itron, Inc. *New Hampshire Residential Energy Efficiency Baseline Study*. Jun. 11, 2020.
[76] NMR, *2019 Regional Lighting Sales Data Analysis (MA20R22-E)*, Draft, Aug. 17, 2020.

10.6 2021-2023 Quarterly Meetings and Stakeholder Engagement

During the course of the 2021-2023 Plan, Quarterly Meetings will be held no more than one month after submission of each quarterly report. Program progress and updates year-to-date savings results, marketing updates, EM&V Working Group report, potential MTMs, pilot updates, financing updates, and other related information will be provided during the quarterly meeting to all parties who participate, including those from the EESE Board. The Quarterly Meeting will serve as a venue for discussion of cross-cutting topics and may lead to scheduling of topic-specific follow-up meetings on an as needed basis.

The NH Utilities will continue to engage as active members of the EESE Board during the 2021-2023 Term, participating in the energy efficiency and renewable energy discussions taken up by that Board, including topic-specific presentations or program updates as needed.

10.7 2024-2026 Planning Process

Establishment of appropriate EERS goals for the next triennial plan covering the 2024-2026 term will take place in a stakeholder process that will be initiated in October of 2022. The stakeholder process will be conducted through scheduled meetings of the EERS Committee of the EESE Board.

The first task of the EERS Committee will be to establish savings goals for the 2024-2026 triennium. The Committee may review energy efficiency results and lessons learned from the 2021-2023 triennium, including those contained in program evaluations or market studies projecting new trends and opportunities in the energy efficiency market place, as well as energy efficiency program activities from other states, as well as evolving state, regional and federal energy policy, and any other information related to energy efficiency goals.

The second task of the EERS Committee will be to discuss and provide input to the NH Utilities on program design, the appropriate level of funding, and other aspects of the 2024-2026 Plan that will lead to the achievement of the previously determined goals.

In 2022, the Commission will solicit and hire a technical consultant to advise Commission Staff, the OCA, and all other non-utility stakeholders. The proposed 2024-2026 Plan will be filed no later than July 1, 2023. A Draft 2024-2026 Plan will be provided to the EERS Committee during the stakeholder process at a date determined by the Committee based on its workplan.

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Chapter Eleven: Evaluation, Measurement, and Verification

EM&V has been an integral component of the efficiency programs in New Hampshire since inception. EM&V has many objectives, including verifying portfolio energy savings, estimating future energy savings of specific measures and behaviors, and identifying ways to improve program delivery and results. The 2018-2020 Plan established a formalized NH EM&V Working Group, consisting of Commission Staff members, independent EM&V consultants hired and supervised by the Commission, representatives of the NH Utilities, and a representative of the EESE Board.

The EM&V Working Group has successfully managed a dozen studies during the 2018-2020 term to date and will be launching several additional evaluations in the remainder of 2020. Going forward, particularly during times of quickly-evolving markets and program offerings, as well as broader economic disruptions associated with the COVID-19 pandemic, there will be many research questions to be studied, and competition for limited evaluation resources and staff time.

To date, the NH Utility members of the EM&V Working Group have facilitated meetings and served as the primary point(s) of contact with each of the third-party evaluators under contract. This follows from the necessity of the NH Utilities, rather than the Commission or other public entity, contracting directly with the third-party evaluators given constraints on state agencies. However, the NH Utilities are committed to an efficient and collaborative process within the EM&V Working Group and welcome a larger facilitation role for the Commission's EM&V consultants in the next term.

Although members of the EM&V Working Group have successfully resolved evaluation-related disagreements to date, the NH Utilities propose a process be established for resolving potential disputes going forward. Specifically, this new process would allow for questions on which the EM&V Working Group cannot reach consensus to be adjudicated by an appeal to the Commission. In a dispute that is appealed to the Commission, each party would provide a written position summary for Commission review and resolution.

For purposes of this dispute resolution process, 'parties' to the EM&V Working Group would include:

1. The NH Utilities;
2. The Commission Staff and designees; and
3. The EESE Board Representative.

The EM&V Working Group has worked diligently to build upon previous evaluation work and expand the portfolio of New Hampshire evaluation activities to a level commensurate with the size and scope of the NHSaves Programs, and it will continue doing so as the programs continue growing over the 2021-2023 triennium.

- All completed New Hampshire evaluations are posted at: https://puc.nh.gov/Electric/Monitoring_Evaluation_Report_List.htm; and
- EM&V Working Group agendas and other materials are posted at: https://www.puc.nh.gov/EESE%20Board/EERS_Working_Groups.html#em&v.

The NH Utilities, together with the EM&V Working Group, have also sought to make the most effective use of New Hampshire evaluation resources by leveraging the efforts of neighboring jurisdictions—both by collaborating with other states' program administrators to conduct joint evaluations, and by adopting results from other states' evaluations where appropriate. For example, Eversource and Unitil joined with counterparts in Massachusetts and Connecticut on a regional evaluation of C&I ADR programs and pilots, which are implemented on a similar basis across multiple states. This approach allowed for more robust results at a lower cost than would be possible through a study limited to NHSaves Program offerings. Similarly, the Energy Efficiency Baseline and Potential Study leveraged analysis of the regional residential and C&I lighting markets being led by Massachusetts program administrators, by augmenting survey and interview efforts with New Hampshire-specific research questions.

11.1 2020 Evaluations

The EM&V Working Group has continued progress on a number of ongoing research efforts that are concluding in 2020. Table 11-1 lists the evaluations completed or planned for completion in 2020.

Table 11-1: 2020 Evaluations

Evaluation	Vendor	Completion Date	Results
Energy Efficiency Baseline and Potential Study	Dunsky Energy Consulting	Draft report, August 2020; final report, September 2020 (est.)	The study provides a key source of planning assumptions and inputs for the 2021-2023 Plan (see below).
NH Lighting Supplier Insights	NMR Group	June 2020	The NH Utilities used findings from in-depth interviews with manufacturers and retailers regarding the residential lighting market in New Hampshire and the region to guide 2021-2023 planning assumptions.
NH Lighting Sales Data Analysis	NMR Group	Draft report, August 2019; final report, September 2020 (est.)	The analysis of retail lighting sales data trends in New Hampshire and the region have informed the NH Utilities' market exit strategy for different lighting types and channels.
HPwES Impact and Process Evaluation	Opinion Dynamics Corporation	June 2020	Impact results are reflected in the TRM. Process recommendations, including incentive structure changes and software upgrades are being pursued as described in the residential section of the 2021-2023 Plan.
HEA Impact, Process, and Low-Income NEI Evaluation	Opinion Dynamics Corporation	June 2020	Impact results are reflected in the TRM and NEI values are incorporated in the TRM as described in Section 10.1.4 and based on review by the NH Benefit-Cost Working Group. Process recommendations, including incentive structure changes and software upgrades are being pursued as described in the residential section of the 2021-2023 Plan.

Table 11-1: 2020 Evaluations (continued)

Evaluation	Vendor	Completion Date	Results
Crosscutting Non-Energy Impacts Study	DNV-GL	NEI database for 2021-2023 Plan, August 2020; Methodology Memo, April 2020; Sensitivity Analysis Memo, June 2020	As described in Section 10.1.4, NEI values from this study have been used to develop sector-level percentage adders for the Secondary Granite State Test, as discussed with the NH Benefit-Cost Working Group.
Bill and Rate Impact Analysis	Synapse Energy Economics, Inc.	August 2020	The analysis developed estimates of the bill and rate impacts of the 2021-2023 Plan programs based on utility-specific inputs, as described in Section 10.4 and detailed in an attachment to the 2021-2023 Plan.
Cross-State C&I Active Demand Reduction Evaluation *(joint with Massachusetts and Connecticut)*	Energy & Resource Solutions	April 2020	The study evaluated load reduction values for the 2019 ADR offerings and recommended an approach to estimate planned load reductions for the 2020 program, which the NH Utilities are applying as described in the Supplemental Information filing to the Commission[77] and reflected in the TRM.

In addition to the ongoing evaluations listed above, the NH Utilities, in coordination with the EM&V Working Group, are working with ERS, an evaluation firm, to compile New Hampshire's first comprehensive TRM, which will extensively document savings calculations and assumptions for measures offered by the NHSaves Programs. This work will result in a public-facing, electronic TRM for program year 2021, to be updated annually, as described above in the Planning Elements chapter.

11.2 Strategic Evaluation Plan

In early 2020, the Commission's EM&V consultants led the EM&V Working Group in updating the NH Strategic Evaluation Plan ("SEP"). The updated SEP provides a prioritized and annotated list of

[77] DE 17-136, 2020 Demand Reduction Initiatives, Supplemental Information, Feb. 28, 2020.

evaluation activities to guide the EM&V Working Group over the next several years. These activities will include impact and process evaluations—including a Large Business Solutions impact and process evaluation, as well as a Baseline Practice Study, both of which are being competitively procured as of the date of this filing. In late 2020, the NH Utilities expect to initiate another RFP for a follow-up to the initial NHSaves Market Awareness Assessment.

In addition to addressing these near-term evaluation priorities, the EM&V Working Group has identified other evaluation activities that will be needed to ensure the NHSaves Programs continue to produce verified, accurate savings, and achieve the highest levels of performance during the 2021-2023 term. In particular, a subsequent round of evaluation projects will be planned based on insights gained from the results of the Energy Efficiency Baseline and Potential study as well as gaps identified during the development of the TRM.

11.3 Energy Efficiency Baseline and Potential Study

One of the critical inputs informing the 2021-2023 Plan is the New Hampshire Energy Efficiency Baseline and Potential Study, conducted by Dunsky Energy Consulting and overseen by the EM&V Working Group. Dunsky has conducted similar research for Eversource in Massachusetts, as well as for other utilities throughout North America. This study provides insights into the available energy and demand reduction opportunities in New Hampshire and helped to inform the development of savings forecasts for a wide set of energy efficiency and ADR measures across all fuels and segments. The research, report, and supporting data resulting from this year-long effort will remain a valuable source of information for program evaluation and design for years to come, and serve as a starting point for additional research to be undertaken as part of the SEP framework in the coming term.

The study utilized primary and secondary research to provide detailed data and analysis on residential market baselines, and to estimate saturation and efficiency of energy-using equipment in New Hampshire homes. In addition, the study conducted primary research into high savings lighting and HVAC measure saturation and penetration in non-residential markets, and leveraged building archetypes from the US DOE as well as Dunsky's own database of building baselines, adjusted for New Hampshire's climate and economy. Dunsky also performed a sensitivity analysis based on the new barriers posed by the COVID-19 pandemic, which has confirmed that the wide scale impacts to the economy and ways people work will be challenging and expensive to overcome. The final report, which is expected to be delivered in mid-September, will examine the impact of customer barriers on achievable energy efficiency savings and model the impact of different incentive levels. As with all evaluations, the study will be posted to the Commission's website upon completion.

The draft results of the study present three levels of potential energy savings: (1) technical potential, which includes all theoretically possible energy savings resulting from measures included in the study, regardless of cost effectiveness, market barriers, or customer economics; (2) economic potential, which is the subset of technical potential that reflects only those measures that pass cost-effectiveness screening; and and(3) achievable potential, which is a subset of economic potential that considers market barriers and customer economics.

Based on adoption curves adapted from the US DOE, the study models cost-effectiveness as well as market barriers to arrive at low, medium, and high scenarios of achievable potential. There is a direct relationship between the level of energy efficiency potential that is achievable, the barriers to adoption that must be overcome to achieve that potential, and the level of investment needed to overcome those barriers. Working closely with the EM&V Working Group, the Dunsky team focused on the low and medium achievement scenarios. The scenarios are modelled using the following assumptions:

- **Low:** modelled using incentives and enabling activities (i.e., strategies to overcome customer and market barriers) at levels from the 2018-2020 Plan, to simulate business as usual.
- **Medium:** modelled with incentives increased to a minimum of 75 percent of the incremental cost of efficient equipment and increased enabling activities.
- **Maximum:** eliminates any customer contribution, while maintaining all other assumptions from the medium scenario.

As with the development of the 2021-2023 Plan, two of the key challenges faced by the EM&V Working Group in guiding Dunsky through the development of the potential study were: a) how to treat the rapidly evolving market for lighting, and b) how to incorporate the economic impacts and resulting barriers resulting from COVID-19 into the assumptions.

The draft report of the potential study explains that: "lighting remains an important measure class under both the low and mid scenarios in 2021. The study assumes declining NTG values for lighting in alignment with the utility benefit cost ratio models. This results in fewer savings from lighting with each subsequent study year and decreased total savings over time because of reduced lighting savings under both scenarios. Between the low and mid scenario, the HVAC, appliance, and other non-lighting measure classes show the greatest relative growth."

The NH Utilities will continue to carefully consider this and related research throughout the region related to lighting, and will adjust the market approach in order to continue to promote market transformation for measures and markets that have additional potential available, while at the same time aggressively pursuing non-lighting savings where the potential for energy efficiency has yet to achieve the same degree of market transformation.

The potential study was well underway when COVID-19 caused on-site research and activity to come to a sudden halt, negatively impacting data collection efforts among medium and large businesses. The EM&V Working Group asked Dunsky to perform a sensitivity analysis relating to the pandemic based on primary data collected by the NH Utilities from customers, as well as by the US Census. This sensitivity analysis considered the impact of the shut down and associated economic impacts on residential customers, as well as different business segments. Draft results indicate that in the low - or business-as-usual scenario, the impact to electric energy efficiency savings in 2021 could be reduced from between 25 percent to 41 percent compared to a world in which the pandemic had not occurred; this is projected to ease to between 21 percent and 30 percent in 2022 and 2023. For natural gas programs, the modeled impact of COVID-19 is even greater, showing a 30 to 48 percent reduction in 2021, which is eased to between 24 and 38 percent in the second and third year of the 2021-2023 Plan.

In the medium scenario, which reflects higher customer incentives and lower costs, the impact of the pandemic is somewhat moderated, impacting between 20 and 37 percent of electricity and natural gas savings in 2021 and between 14 and 25 percent in 2022 and 2023. The aggressive EERS goals the NH Utilities are proposing under this 2021-2023 Plan are roughly equivalent to savings modelled under the medium scenario, after accounting for potential COVID-19 impacts.

The potential significance of these barriers to program achievement is daunting, as is the general uncertainty surrounding the impact of COVID-19 on our economy and our customers. This level of uncertainty poses substantial challenges to the NH Utilities as they propose and work to achieve significantly increased energy savings goals in 2021-2023. A true three-year plan, the ability to file mid-term modifications, and the lowering of the minimum performance threshold are collectively critical to managing these substantial challenges.

11.4 EM&V Budgets

The EM&V budget for the 2021-2023 Plan is proposed to be consistent with past budgeting at approximately 5 percent of the annual program budgets. This includes both internal and external costs of evaluation, measurement and verification activities including but not limited to any studies identified by the EM&V Working Group and the Strategic Evaluation Plan. The EM&V budget also includes costs for several cross-cutting activities such as, the AESC Study, ISO certification of utility demand resources, Commission Staff's third-party evaluation consultants, updating and maintaining the TRM, program research, professional associations, utility tracking system upgrades and maintenance, quarterly and annual reporting, program modeling software, and other program support needs.

Any funds budgeted in the EM&V budget activity category that an NH Utility anticipates will not be spent in a given year can be utilized for other program-related purposes. The total evaluation budget for the 2021-2023 Plan is $16.4 million. Of that figure, approximately one third will be utilized for other EM&V activities.

NEW HAMPSHIRE
TECHNICAL REFERENCE MANUAL
for Estimating Savings from Energy Efficiency Measures, 2021 Program Year

DRAFT

Filed September 1, 2020 by the New Hampshire Utilities

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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.

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 with ENERGY STAR	HPwES

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

<u>In-Service Rates:</u>

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 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. 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

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 loadshape 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 – Residential

Measure Code	[Code]
Market	Residential
Program Type	Custom
Category	Active Demand Response

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:

The baseline case for Residential Direct Load Control is an equivalent piece of residential HVAC equipment or a residential appliance without summer peak demand response.

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:

$$\Delta kW_{Pre-event} = \left(\Delta kW_{Pre-event,vendor}\right) \times \left(F_{pre-event}\right)$$
$$\Delta kW_{Post-even} = \left(\Delta kW_{Post-event,vendor}\right) \times \left(F_{post-even}\right)$$
$$\Delta kW_{Event} = (\Delta kW_{vendor}) \times (F_{event})$$
$$F_{event} = -3.06 + (0.05 \times Temp_{avg})$$

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
$\Delta kW_{pre/post/event,vendo}$	= 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 0.67 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.[4]

BC Measure ID	Measure Name	Program	Measure Life

E21A5a001	Residential Direct Load Control	Residential ADR	1
E21A5a002	Residential Storage Daily Dispatch P4P (savings) Summer	Residential ADR	1
E21A5a003	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}
E21A5a001	Residential Direct Load Control	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00
E21A5a002	Residential Storage Daily Dispatch P4P (savings) Summer	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00
E21A5a003	Residential Storage Daily Dispatch P4P (consumption) Summer	Residential ADR	1.00	1.00	1.00	1.00	1.00	1.00	0.00

<u>In-Service Rates:</u>

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.

<u>Realization Rates:</u>

Savings adjustment factors and deemed energy savings provided in the Algorithms section above represent an evaluation adjustment to vendor-reported reported gross savings.

<u>Coincidence Factors:</u>

Summer coincidence factors are assumed to be 100% reflecting the timing of demand response events. Winter coincidence factors are assumed to be 0%.

Energy Load Shape:

All savings for Active Demand Response take place in the summer on-peak period.

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. http://ma-eeac.org/wordpress/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. http://ma-eeac.org/wordpress/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no-bulk.pdf

1.2 Appliances - Advanced Power Strip

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Appliances

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 refenced study results.[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21A3b001	Advanced Power Strip, Tier I	ES Products	117.0	0.011
E21A3b002	Advanced Power Strip, Tier II	ES Products	174.0	0.018

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}
E21A3b001	Advanced Power Strip, Tier I	ES Products	0.86	0.92	n/a	0.92	0.92	0.58	0.86
E21A3b002	Advanced Power Strip, Tier II	ES Products	0.75	0.92	n/a	0.92	0.92	0.58	0.86

<u>In-Service Rates:</u>

In-service rates are based on consumer surveys, as found in the referenced study.[1]

<u>Realization Rates:</u>

Realization rates account for the savings lost due to improper customer set-up/use of devices, as found in the referenced study.[1]

<u>Coincidence Factors:</u>

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]

<u>Endnotes</u>:

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. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.3 Appliances – Clothes Dryer

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Appliances

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:

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.[6]

$$\Delta kWh = (lbs/YEAR \div CEF_{Base}) - (lbs/YEAR \div CEF_{EFF})$$

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 [3,4,5]

BC Measure Id	Measure Name	Program	ΔkWh	ΔkW	ΔGas MMBtu
E21B1a052	Clothes Dryer (Retrofit)	HEA	Calculated	Calculated	n/a
E21A2a055	Clothes Dryer (Retrofit)	HPwES	Calculated	Calculated	n/a
E21A1a027	Clothes Dryer (New Construction)	ES Homes	160.4	0.047	n/a
G---	Clothes Dryer (New Construction)	ES Homes			
E21A3b010	Clothes Dryer (ENERGY STAR)	ES Products	160.4	0.047	n/a
E21A3b012	Clothes Dryer (ENERGY STAR + Hybrid technology)	ES Products	213.3	0.063	n/a
E21A3b011	Clothes Dryer (ENERGY STAR + Heat Pump technology)	ES Products	421.1	0.124	n/a
G---	Clothes Dryer (Energy Star) - Gas	ES Products			

Measure Life:

The measure life is 16 years for electric dryers and 17 years for gas dryers.[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}
E21B1a052	Clothes Dryer (Retrofit)	HEA	1.00	0.91	n/a	0.87	0.87	0.45	0.58
E21A2a055	Clothes Dryer (Retrofit)	HPwES	0.99	1.00	n/a	1.00	1.00	0.45	0.58
E21A1a027	Clothes Dryer (New Construction)	ES Homes	1.00	1.00	n/a	1.00	1.00	0.45	0.58
G---	Clothes Dryer (ENERGY STAR)	ES Products	1.00	1.00	n/a	1.00	1.00	0.45	0.58
E21A3b010	Clothes Dryer (ENERGY STAR + Hybrid technology)	ES Products	1.00	1.00	n/a	1.00	1.00	0.45	0.58
E21A3b012	Clothes Dryer (ENERGY STAR + Heat Pump technology)	ES Products	1.00	1.00	n/a	1.00	1.00	0.45	0.58

<u>In-Service Rates:</u>

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[8], and 99% for HPwES[7].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[8], and 100% for HPwES[7].

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]

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: Northwest Energy Efficiency Alliance (2019). Dryers - QPL October 2019.
4: Department of Energy (2015). 10 CFR Part 431 March 27, 2015. Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers. Table II.7.
5: 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.
6: Guidehouse (2020). Comprehensive TRM Review, MA19R17-B-TRM.
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: 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

1.4 Appliances – Clothes Washer

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Appliances

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:

Unit 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[5].

Measure ID	**Measure Name**	**Program**	**ΔkWh**	**ΔkW**	**ΔGas MMBtu**	**ΔOil MMBtu**	**ΔPropane MMBtu**
E21B1a051	Clothes Washer (Retrofit)	HEA	Calculated	Calculated	Calculated	Calculated	Calculated
E21A2a054	Clothes Washer (Retrofit)	HPwES	Calculated	Calculated	Calculated	Calculated	Calculated
E21A1a026	Clothes Washer (New Construction)	ES Homes	89.9	0.279	0.02	0.00	0.05
G21A1a009	Clothes Washer (New Construction) – Gas	ES Homes	24.1	0.075	0.29	0.00	0.29

E21A3b017	Clothes Washer (ENERGY STAR)	Products	89.9	0.0.279	0.03	0.00	0.04
G---	Clothes Washer (ENERGY STAR) – Gas	Products					
E21A3b018	Clothes Washer (ENERGY STAR Most Efficient)	Products	138.9	0.431	0.94	0.94	0.94
G---	Clothes Washer (ENERGY STAR Most Efficient) – Gas	Products					

Measure Life:

The measure life is 11 years.[2]

Other Resource Impacts:

Annual water savings are deemed.

Measure Name	Program	Annual Water Savings (gallons)
Clothes Washer (Retrofit)	HEA/HPwES	Calculated
Clothes Washer (New Construction)	ES Homes	2,244
Clothes Washer (ENERGY STAR)	ES Products	2,244
Clothes Washer (ENERGY STAR Most Efficient)	ES Products	3,940

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}
E21B1a051	Clothes Washer (Retrofit)	HEA	1.00	0.91	0.98	0.87	0.87	0.49	0.52
E21A2a054	Clothes Washer (Retrofit)	HPwES	0.99	1.00	1.00	1.00	1.00	0.49	0.52
E21A1a026	Clothes Washer (New Construction)	ES Homes	1.00	1.00	1.00	1.00	1.00	0.49	0.52
G21A1a009	Clothes Washer (New Construction) – Gas	ES Homes	1.00	1.00	1.00	1.00	1.00	1.00	0.94
E21A3b017	Clothes Washer (ENERGY STAR)	ES Products	1.00	1.00	1.00	1.00	1.00	0.49	0.52
G---	Clothes Washer (ENERGY STAR) – Gas	ES Products	1.00	1.00	1.00	1.00	1.00	1.00	0.94
E21A3b018	Clothes Washer (ENERGY STAR Most Efficient)	ES Products	1.00	1.00	1.00	1.00	1.00	0.49	0.52
G---	Clothes Washer (ENERGY STAR Most Efficient) – Gas	ES Products	1.00	1.00	1.00	1.00	1.00	1.00	0.94

<u>In-Service Rates:</u>

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[4], and 99% for HPwES[3].

<u>Realization Rates:</u>

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[4], and 100% for HPwES[3].

<u>Coincidence Factors:</u>

All electric programs use a summer coincidence factor of 49% and a winter coincidence factor of 52%.[5] All gas programs use a summer coincidence factor of 100% and a winter coincidence factor of 94%.

Energy Load Shape:

See Appendix 1 – “Clothes Washer”.[5]

<u>Endnotes</u>:
1: Energy Efficiency Vermont (2018) Technical Reference User Manual. Efficient Clothes Washers.
2: Environmental Protection Agency (2016). Savings Calculator for ENERGY STAR Qualified Appliances. https://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
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

1.5. Appliances – Dehumidifier

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Appliances

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
E21B1a053	Dehumidifier (Retrofit)	HEA	407.1	0.10
E21A2a056	Dehumidifier (Retrofit)	HPwES	407.1	0.10
E21A3b019	Dehumidifier (ENERGY STAR)	Products	82.3	0.02

Measure Life:

The measure life is 17 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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a053	Dehumidifier (Retrofit)	HEA	1.00	0.91	n/a	0.87	0.87	0.28	0.05
E21A2a056	Dehumidifier (Retrofit)	HPwES	0.99	1.00	n/a	1.00	1.00	0.28	0.05
E21A3b019	Dehumidifier (ENERGY STAR)	ES Products	1.00	1.00	n/a	1.00	1.00	0.28	0.05

In-Service Rates:

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[5], and 99% for HPwES[4].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[5], and 100% for HPwES[4].

Coincidence Factors:

All programs use a summer coincidence factor of 28% and a winter coincidence factor of 5%.[1]

Energy Load Shape:

See Appendix 1 – "Dehumidifier".[1]

Endnotes:

1: 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

2: Environmental Protection Agency (2019). Dehumidifier Key Efficiency Criteria. https://www.energystar.gov/products/appliances/dehumidifiers/key_efficiency_criteria
3: Guidehouse (2020). Comprehensive TRM Review MA19R17-B-TRM. Prepared for The Electric and Gas Program Administrators of Massachusetts.
4: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
5: Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.6. Appliances – Dishwasher

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Appliances

Description:

The installation of a high efficiency ENERGY STAR residential dishwasher.

Baseline Efficiency:

The baseline efficiency case is a dishwasher that meets the federal standard effective May 30, 2013. Standard size dishwashers shall not exceed 307 kwh/year and 5.0 gallons per cycle.

High Efficiency:

The high efficiency case is a dishwasher that meets the ENERGY STAR standard as of January 29, 2016. Standard size dishwashers shall not exceed 270 kwh/year and 3.5 gallons per cycle.

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated based on the EPA ENERGY STAR appliance calculator. Demand savings are derived from the Navigant Demand Impact Model.

$\Delta kWh = kWh_{BASE} - kWh_{ES}$

Where:
kWh_{BASE} = Average usage of a baseline dishwasher
kWh_{ES} = Average usage of a new dishwasher meeting ENERGY STAR® standards

Table: Measure Energy Impact[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21A3b020	ES Dishwasher	ES Products	37.0	0.011

Measure Life:

The measure life is 11 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}
E21A3b020	ES Dishwasher	ES Products	1.00	1.00	n/a	1.00	1.00	0.28	0.48

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 28% and a winter coincidence factor of 48%.[2]

Energy Load Shape:

See Appendix 1 – "Dishwasher".[2]

Endnotes:
1: Environmental Protection Agency (2016). Savings Calculator for Energy Star Qualified Appliances.
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

1.7. Appliances – Freezer

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Appliances

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 evaluation study results.[1] Lost-opportunity unit energy and demand savings are based on calculations from the 2018 Vermont TRM[2].

$\Delta kWh = kWh_{BASE} - kWh_{ES}$

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
E21B1a050	Freezer (Retrofit)	HEA	769	0.09
E21A2a053	Freezer (Retrofit)	HPwES	769	0.09
E21A3b021	Freezer (ENERGY STAR®)	Products	31.2	0.004

Measure Life:

The measure life is 12 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}
E21B1a050	Freezer (Retrofit)	HEA	1.00	0.91	n/a	0.87	0.87	0.91	0.68
E21A2a053	Freezer (Retrofit)	HPwES	0.99	1.00	n/a	1.00	1.00	0.91	0.68
E21A3b021	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[4], and 99% for HPwES[3].

Realization Rates:

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[4], and 100% for HPwES[3].

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: NMR Group (2019). MA19R01-E Appliance Recycling Report. Prepared for MA Program Administrators and the Energy Efficiency Advisory Council. http://ma-eeac.org/wordpress/wp-content/uploads/MA19R01-E-ApplianceRecycleReport-Final-2019.03.26.pdf
2: Vermont TRM (2018): ENERGY STAR Retail Products Platform, page 178 of 313.
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
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

1.8. Appliances – Refrigerator

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Appliances

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® standardswith an average energy consumption of 452 kWh for ENERGY STAR refrigerators, or 393 kWh for Most Efficient refrigerator
SLF = Site/Lab adjustment factor, 0.881[3]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21B1a049	Refrigerator (Retrofit)	HEA	Calculated	Calculated
E21A2a049	Refrigerator (Retrofit)	HPwES	Calculated	Calculated
E21A1a025	Refrigerator (New Construction)	ES Homes	44.2	0.01

E21A3b022	Refrigerator (ENERGY STAR®)	ES Products	44.2	0.01
E21A3b023	Refrigerator (Most Efficient)	ES Products	96.4	0.02

Measure Life:

The measure life is 12 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	Program	ISR	RR_{E}	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a049	Refrigerator (Retrofit)	HEA	1.00	0.91	n/a	0.87	0.87	1.00	0.80
E21A2a049	Refrigerator (Retrofit)	HPwES	0.99	1.00	n/a	1.00	1.00	1.00	0.80
E21A1a025	Refrigerator (New Construction)	ES Homes	1.00	1.00	n/a	1.00	1.00	1.00	0.80
E21A3b022	Refrigerator (ENERGY STAR®)	ES Products	1.00	1.00	n/a	1.00	1.00	1.00	0.80
E21A3b023	Refrigerator (Most Efficient)	ES Products	1.00	1.00	n/a	1.00	1.00	1.00	0.80

<u>In-Service Rates:</u>

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA[5], and 99% for HPwES[4].

<u>Realization Rates:</u>

Realization rates are 100% for ES Products unless an evaluation finds otherwise, 91% for HEA[5], and 100% for HPwES[4].

<u>Coincidence Factors:</u>

A summer coincidence factor of 100% and a winter coincidence factor of 80% are based on the Vermont TRM.[6]

Energy Load Shape:

See Appendix 1 – “Primary Refrigerator”.[2]

<u>Endnotes</u>:

1: Opinion Dynamics (2019). Home Energy Assistance 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/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf.
3: Connecticut PSD (2019).
4: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
5: Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
6: Vermont TRM (2018). Refrigerator/Freezer Early Retirement.

1.9. Appliances – Recycling

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit
Category	Appliances

Description:

The retirement of old, inefficient refrigerators, freezers and room air conditioners.

Baseline Efficiency:

The baseline efficiency case is an old, inefficient working refrigerator, freezer 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 research presented in the 2018 Vermont TRM.[1]study results.

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21A3b027	Primary Refrigerator Recycling[1]	ES Products	1,027	0.180
E21A3b028	Secondary Refrigerator Recycling[2]	ES Products	743	0.088
E21A3b029	Secondary Freezer Recycling[1]	ES Products	769	0.014
E21A3b030	Room Air Conditioner Recycling[3]	ES Products	113	0.180

Measure Life:

The measure life is 8 years for refrigerators and freezers and 5 years for room air conditioners.

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}
E21A3b027	Primary Refrigerator Recycling	ES Products	1.00	1.00	n/a	1.00	1.00	1.00	0.80
E21A3b028	Secondary Refrigerator Recycling	ES Products	1.00	1.00	n/a	1.00	1.00	1.00	0.80
E21A3b029	Secondary Freezer Recycling	ES Products	1.00	1.00	n/a	1.00	1.00	1.00	0.80
E21A3b030	Room Air Conditioner Recycling	ES Products	1.00	1.00	n/a	1.00	1.00	0.46	0.00

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 summer coincidence factor of 100% and a winter coincidence factor of 80% for refrigerator and freezer recycling[2], a summer coincidence factor of 46% and a winter coincidence factor of 0% for room air conditioner recycling.[3]

Energy Load Shape:

See Appendix 1 – "Primary Refrigerator" for primary refrigerator recycling, "Secondary Refrigerator" for secondary refrigerator recycling, "Freezer" for secondary freezer recycling, "Room or Window Air Conditioner" for room air conditioner recycling.[3]

Endnotes:

1: NMR Group, Inc. (2019). Appliance Recycling Report. Prepared for MA Joint Utilities. https://etrm.anbetrack.com/#/workarea/trm/MADPU/RES-A-RFR/2019%20Report%20TRM/version/3a?measureName=Appliance%20-%20Refrigerator%2FFreezer%20Recycling

2: Vermont TRM (2018). Refrigerator/Freezer Early Retirement.

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

1.10. Appliances – Room Air Purifier

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Appliances

Description:

Room air purifiers exceeding minimum qualifying efficiency standards established as ENERGY STAR®.

Baseline Efficiency:

The baseline efficiency case is a room air purifier that does not meet ENERGY STAR® efficiency requirements.

High Efficiency:

The high efficiency case is a room air purifier that meets the ENERGY STAR® standard as of July 1, 2004. A new room air purifier must produce a minimum Clean Air Delivery Rate (CADR)[1] of 50, and minimum performance of 3.0 CADR per watt.

Algorithms for Calculating Primary Energy Impact:

Unit energy savings are deemed based on latest information available at the EPA ENERGY STAR appliances website based on each CADR range, as specified in the table below.[2,3]

Table: Measure Energy Impacts

BC Measure ID	Measure Name	Program	CADR Range	ΔkWh
E21A3b025	Room Air Purifier	ES Products	51-100	293
			101-150	488
			151-200	683
			201-250	877
			Over 250	1,169

Demand savings are calculated using the following formula:

$$\Delta kW = \frac{\Delta kWh}{Hours}$$

Where:
$Hours$ = Assumed annual operating hours, 5,840 hours per year

Measure Life:

The measure life is 9 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}
E21A3b025	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.[5]

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".[6]

Endnotes:

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: Environmental Protection Agency ENERGY STAR website (accessed July 2020).
https://www.energystar.gov/products/appliances/air_purifiers_cleaners
https://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx
3: Guidehouse (2020), Comprehensive TRM Review, MA1917-B-TRM. The Electric and Gas Program Administrators of Massachusetts Part of the Residential Evaluation Program Area
4: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division (2007). 2008 Status Report: Savings Estimates for the ENERGY STAR Voluntary Labeling Program.
5: NMR Group, Inc. (2018). Products Impact Evaluation of In-Service and Short Term Retention Rates Study.
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.

1.11. Motors- ECM Circulator Pump

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Motors and Drives

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
E21A3b013	ECM Motor for FWH Circulating Pump	ES Products	68.0	0.024

Measure Life:

The measure life is 10 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}
E21A3b013	ECM Motor for FWH Circulating Pump	ES Products	1.00	1.00	n/a	1.00	1.00	0.00	0.54

<u>In-Service Rates:</u>

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 54%.[2]

Energy Load Shape:

See Appendix 1 – "Boiler Distribution".[2]

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21A3b013	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: 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

1.13. Motors - Pool Pump

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Motors and Drives

Description:

The installation of a variable-speed drive pool pump. 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 a single speed 1.5 horsepower pump that pumps 71 gallons per minute (gpm) and runs 7.7 hours per day for 122 days a year. It has an Energy Factor (EF) = 2.0.

High Efficiency:

The high efficiency case is a variable-speed pump rated at 57 gpm at high speed and 23 gpm at low speed. It has a 2.9 EF at high speed, a 10.5 EF at low speed and runs 2 hr/day at high speed for filter & cleaning and 22 hr/day for filtering alone.

Algorithms for Calculating Primary Energy Impact[1]:

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21A3b024	Pool Pump (Variable Speed)	ES Products	1,360	1.43

Measure Life:

The measure life is 6 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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21A3b024	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.

Realization Rates:

All programs use a 100% realization rate unless an evaluation finds otherwise.

Coincidence Factors:

Programs use a summer coincidence factor of 55% and a winter coincidence factor of 0%.[2]

Energy Load Shape:

See Appendix 1 – "Pool Pump".[2]

Endnotes:

1: Guidehouse, August 2020. Comprehensive TRM Review, MA19R17-B-TRM. Prepared for The Electric and Gas Program Administrators of Massachusetts Part of the Residential Evaluation Program Area.

2: Navigant, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.14. Building Shell – Air Sealing

Measure Code	[To Be Defined in ANB system],
Market	Residential
Program Type	Retrofit, Single Family
Category	Building Shell

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 with ENERGY STAR 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 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.

ΔMMBtu = ΔCFM * (MMBtu/$CFM_{heating}$ + $CFM_{cooling}$)

Where:

ΔCFM = Reduced air loss, in Cubic Feet per Minute (CFM) in a treated home.

MMBtu/CFM = Deemed savings per reduced CFM of 0.012934 MMBtu per CFM. This represents a blended savings value, applicable for all heating fuel types and cooling equipment scenarios in HPwES, based on evaluation results.[1]

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):[5]

Equipment	kWh Savings	Description of Impact
Furnace fan	86.0	Per home value reflecting reduced fan operation based on heating load reduction from weatherization measures
HW boiler circulation pump(s)	9.0	Per circulator pump value reflecting reduced pump operation based on heating load reduction from weatherization measures

Measure Life:

The table below includes below includes the effective useful life (EUL) for air sealing which assumes retrofit installation.

BC Measure ID	Measure Name	Program	Measure Life
E21A2a001 E21A2a002 E21A2a003 E21A2a004 E21A2a005 E21A2a006 E21A2a007 G21A2a001 E21B1a001 E21B1a002 E21B1a003 E21B1a004 E21B1a005 E21B1a006 E21B1a007 G21B1a001	Air Sealing	HPwES/ HEA	15[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:[1 3]

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_{E}	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a001	Air Sealing	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a001	Air Sealing	Cord Wood	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a002	Air Sealing	Electric	HEA	1.00	0.91	n/a	n/a	0.89	0.00	0.43
E21A2a002	Air Sealing	Electric	HPwES	0.99	1.00	n/a	n/a	1.00	0.00	0.43
E21B1a003 G21B1a001	Air Sealing	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a003 G21A2a001	Air Sealing	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a004	Air Sealing	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a004	Air Sealing	Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a005	Air Sealing	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a005	Air Sealing	Oil	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a006	Air Sealing	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a006	Air Sealing	Propane	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a007	Air Sealing	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a007	Air Sealing	Wood Pellets	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

In-service rates for HPwES programs are 99% and are 100% HEA programs based on evaluation results[1,3].

Realization Rates:

Realization rate for HPwES programs are 100% and are 91% for HEA programs based on evaluation results.[1,3]

Coincidence Factors:

A winter coincidence factor of 43% is utilized. [4]

Energy Load Shape:

See Appendix 1.

Non-Energy Impact:

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[3].

Endnotes:

1: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.

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: 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

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: Cadmus, April 5, 2013, New Hampshire HVAC Load and Savings Research, Final Report, table 19.

1.15. Building Shell – Insulation

Measure Code	[To Be Defined in ANB system],
Market	Residential
Program Type	Retrofit
Category	Building Shell

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 with ENERGY STAR 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 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]

$\Delta MMBtu = HSqFt * (MMBtu_{heating} + MMBtu_{cooling})$

Where:
HSqFt = Hundred square feet of installed insulation in a treated home (represented by installed sq ft / 100 sq ft).

MMBtu*heating* = 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.[1]
MMBtu*cooling* = 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]

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):[1]

Equipment	kWh Savings	Description of Impact
Furnace fan	86.0	Per home value reflecting reduced fan operation based on heating load reduction from weatherization measures
HW boiler circulation pump(s)	9.0	Per circulator pump value reflecting reduced pump operation based on heating load reduction from weatherization measures

Measure Life:

The table below includes below includes the effective useful life (EUL) for insulation which assumes retrofit installation.

BC Measure ID	Measure Name	Program	Measure Life
E21A2a022 E21A2a023 E21A2a024 E21A2a025 E21A2a026 E21A2a027 E21A2a028 G21A2a004 E21B1a022 E21B1a023 E21B1a024 E21B1a025 E21B1a026 E21B1a027 E21B1a028 G21B1a004	Insulation	HPwES/ HEA	25[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:[1,3]

BC Measure ID	Measure Name	Fuel	ISR	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a022	Insulation	Cord Wood	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a022	Insulation	Cord Wood	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a023	Insulation	Electric	HEA	1.00	0.91	n/a	n/a	n/a	0.00	0.43
E21A2a023	Insulation	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.00	0.43
E21B1a024 G21B1a004	Insulation	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a024 G21A2a004	Insulation	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a025	Insulation	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a025	Insulation	Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a026	Insulation	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a026	Insulation	Oil	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a027	Insulation	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a027	Insulation	Propane	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a028	Insulation	Wood Pellets	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a028	Insulation	Wood Pellets	HPwES	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 HPwES programs and are 100% HEA programs based on evaluation results.[1,3]

<u>Realization Rates:</u>

Realization rate for HPwES programs are 100% and are 91% for HEA programs based on evaluation results.[1,3]

<u>Coincidence Factors:</u>

A winter coincidence factor of 43% is utilized.[4]

Energy Load Shape:

See Appendix 1.

Non-Energy Impact:

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.

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, "2019 NHSaves HPwES Deemed Savings_2020-02-25_FM adjustments".
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: 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
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: Cadmus, April 5, 2013, New Hampshire HVAC Load and Savings Research, Final Report, table 19.

1.16. Hot Water – Faucet Aerator

Measure Code	
Market	Residential
Program Type	Retrofit
Category	Hot Water

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:

Unit savings are deemed based on study results.[3]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW[4]	ΔMMBtu
E21B1a009	Faucet Aerator	Electric	HEA	46.863	0.010	
E21B1a010 G21B1a002	Faucet Aerator	Gas	HEA			0.156
E21B1a011	Faucet Aerator	Kerosene	HEA			0.156
E21B1a012	Faucet Aerator	Oil	HEA			0.156
E21B1a013	Faucet Aerator	Propane	HEA			0.156
E21A2a009	Faucet Aerator	Electric	HPwES	46.863	0.010	
E21A2a010 G21A2a002	Faucet Aerator	Gas	HPwES			0.156
E21A2a011	Faucet Aerator	Kerosene	HPwES			0.156
E21A2a012	Faucet Aerator	Oil	HPwES			0.156
E21A2a013	Faucet Aerator	Propane	HPwES			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}
E21B1a009	Faucet Aerator	Electric	HEA	1.00	0.91	n/a	n/a	n/a	0.31	0.81
E21B1a010 G21B1a002	Faucet Aerator	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a011	Faucet Aerator	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a012	Faucet Aerator	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a013	Faucet Aerator	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a009	Faucet Aerator	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.31	0.81
E21A2a010 G21A2a002	Faucet Aerator	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a011	Faucet Aerator	Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a012	Faucet Aerator	Oil	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a013	Faucet Aerator	Propane	HPwES	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 HPwES programs and are 100% HEA programs based on evaluation

results.[3, 6]<u>Realization Rates:</u>

All PAs use a realization rate of 100% for HPwES program and a realization rate of 91% for HEA program.[3 6]

<u>Coincidence Factors:</u>

A summer coincidence factor of 31% and a winter coincidence factor of 81% are utilized for faucet aerators with electric fuel type.[4]

Energy Load Shape:

See Appendix 1 "Water Heater – Electric".[4]

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.
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: 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.

1.17. Hot Water – Heat Pump Water Heater

Measure Code	
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Hot Water

Description:

Installation of a heat pump storage water heater instead of an electric resistance storage water heater.

Baseline Efficiency:

The baseline efficiency case is a new standard efficiency electric resistance storage hot water heater.

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.[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔMMBtu
E21B1a043	Heat Pump Water Heater	HEA	1,818	0.296	
E21A2a043	Heat Pump Water Heater	HPwES	1,818	0.296	
E21A3b007	Heat Pump Water Heater, 50-gallon, Energy Star, EF	ES Products	1,818 kWh for retrofit 961 kWh for lost opportunity	0.296 for retrofit 0.175 for lost opportunity	2.149 for lost opportunity
E21A3b008	Heat Pump Water Heater, 80-gallon, Energy Star, EF	ES Products	1,258 kWh for retrofit 565 kWh for lost opportunity	0.113 for retrofit 0.040 for lost opportunity	2.149 for lost opportunity

Measure Life:

The measure life is 13 years.[2]

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:[3,4,5]

BC Measure ID	Measure Name	Program	ISR	RR_{E}	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a043	Heat Pump Water Heater (Retrofit)	HEA	1.00	0.91	n/a	n/a	n/a	0.31	0.81
E21A2a043	Heat Pump Water Heater (Retrofit)	HPwES	0.99	1.00	n/a	n/a	n/a	0.31	0.81
E21A3b007	Heat Pump Water Heater, 50-gallon, Energy Star, EF	ES Products	1.00	1.00	n/a	n/a	n/a	0.41	0.75
E21A3b008	Heat Pump Water Heater, 80-gallon, Energy Star, EF	ES Products	1.00	1.00	n/a	n/a	n/a	0.41	0.75

<u>In-Service Rates:</u>

Installations have 100% in service rate for ES Products unless an evaluation finds otherwise, 100% for HEA, and 99% for HPwES[3,4].
.

<u>Realization Rates:</u>

All PAs use a realization rate of 100% for HPwES program and a realization rate of 91% for HEA program.[3,4] The ES Homes and ES Products programs use a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

A summer coincidence factor of 41% and a winter coincidence factor of 75% are utilized.[5]

Energy Load Shape:

See Appendix 1 – “Water Heater – Heat Pump”.[5]

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):[6]

BC Measure ID	Measure Name	Program	FR	SO_{P}	SO_{NP}	NTG
E21A3b007	Heat Pump Water Heater, 50-gallon, Energy Star, EF	ES Products	0.23	0.00	0.00	0.77
E21A3b008	Heat Pump Water Heater, 80-gallon, Energy Star, EF	ES Products	0.23	0.00	0.00	0.77

<u>Endnotes</u>:

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
2: Navigant Consulting (2018). Water Heating, Boiler, and Furnace Cost Study (RES 19) Add-On Task 7: Residential Water Heater Analysis Memo. http://ma-eeac.org/wordpress/wp-content/uploads/RES19_Assembled_Report_2018-09-27.pdf
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
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
6: 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

1.18. Hot Water – Pipe Insulation

Measure Code	
Market	Residential
Program Type	Retrofit
Category	Hot Water

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:

Unit savings are deemed based on study results.[1 2]

$$\Delta kW_{total} = Linear\ feet \times \Delta kW$$

$$\Delta kWh_{total} = Linear\ feet \times \Delta kWh$$

$$\Delta MMBtu_{total} = Linear\ feet \times \Delta MMBtu$$

Where:
Linear feet = Total length of pipe insulation (in feet)

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
E21B1a037	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Electric	HEA	14.100 20.500	0.010	
E21B1a038 G21B1a011	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Gas	HEA			0.078 0.113
E21B1a039	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Kerosene	HEA			0.075 0.110
E21B1a040	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Oil	HEA			0.087 0.126

E21B1a041	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Propane	HEA			0.075 0.110
E21A2a037	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Electric	HPwES	14.100 20.500	0.010	
E21A2a038 G21A2a011	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Gas	HPwES			0.078 0.113
E21A2a039	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Kerosene	HPwES			0.075 0.110
E21A2a040	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Oil	HPwES			
E21A2a041	Pipe Insulation <3/4” Pipe Pipe Insulation >3/4” Pipe	Propane	HPwES			0.075 0.110

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:[1 4]

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1a037	Pipe Insulation	Electric	HEA	1.00	0.91	n/a	n/a	n/a	0.31	0.81
E21B1a038 G21B1a011	Pipe Insulation	Gas	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a039	Pipe Insulation	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a040	Pipe Insulation	Oil	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21B1a041	Pipe Insulation	Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a037	Pipe Insulation	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.31	0.81
E21A2a038 G21A2a011	Pipe Insulation	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a039	Pipe Insulation	Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a040	Pipe Insulation	Oil	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21A2a041	Pipe Insulation	Propane	HPwES	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 HPwES programs and are 100% HEA programs based on evaluation results.[1,4]
.

<u>Realization Rates:</u>

All PAs use a realization rate of 100% for HPwES program and a realization rate of 91% for HEA program.[1 4]

<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.[2]

Energy Load Shape:

See Appendix 1 – “Water Heater - Electric”

<u>Endnotes</u>:

1: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL

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: 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
4: Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.19. Hot Water – Setback

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit
Category	Hot Water

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:

Unit savings are deemed based on evaluation results.[1]

Measure Name	Program	Fuel Type	ΔMMBtu/unit
Hot Water Setback (both dishwasher and clothes washer configuration)	HPwES	Electricity	0.174
Hot Water Setback (clothes washer only)	HPwES	Electricity	0.268
Hot Water Setback (clothes washer only)	HPwES	Propane	0.411
Hot Water Setback (clothes washer only)	HPwES	Gas	0.411
Hot Water Setback (clothes washer only)	HPwES	Oil	0.411

Measure Life:

The table below includes the measure life for existing units and new equipment.[2]

BC Measure ID	Measure Name	Fuel Type	Program	Measure Life
	Hot Water Setback	All	HPwES	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}
	Hot Water Setback	HPwES	Electricity	0.99	1.00	n/a	n/a	n/a	n/a	n/a
	Hot Water Setback	HPwES	Propane	0.99	1.00	n/a	n/a	n/a	n/a	n/a
	Hot Water Setback	HPwES	Oil	0.99	1.00	n/a	n/a	n/a	n/a	n/a
	Hot Water Setback	HPwES	Gas	0.99	1.00	n/a	n/a	n/a	n/a	n/a

In-Service Rates:

All HPwES measures have a 99% in-service-rate based on evaluation results.[1]

Realization Rates:

All PAs use an average realization rate of 100% for HPwES program.[1]

Coincidence Factors:

CF results are not available.

Energy Load Shape:

See Appendix 1 – "Hot Water – Setback"

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. https://www.ilsag.info/technical-reference-manual/il-trm-version-9/

1.20. Hot Water – Showerhead

Measure Code	
Market	Residential
Program Type	Retrofit
Category	Hot Water

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:

Unit savings are deemed based on study results.[1] kW savings are calculated using the demand impact model.[2]

BC Measure ID	Measure Name	Hot Water Fuel Type	Program	ΔkWh	ΔkW	ΔMMBtu
E21B1a016	Handheld Showerhead	Electric	HEA	145.226	0.050	
E21B1a017 G21B1a003	Handheld Showerhead	Gas	HEA			0.633
E21B1a018	Handheld Showerhead	Kerosene	HEA			0.633
E21B1a019	Handheld Showerhead	Oil	HEA			
E21B1a020	Handheld Showerhead	Propane	HEA			0.633
E21A2a016	Handheld Showerhead	Electric	HPwES	145.226	0.050	
E21A2a017 G21A2a003	Handheld Showerhead	Gas	HPwES			0.633
E21A2a018	Handheld Showerhead	Kerosene	HPwES			0.633
E21A2a019	Handheld Showerhead	Oil	HPwES			
E21A2a020	Handheld Showerhead	Propane	HPwES			0.633
E21B1a030	Low flow Showerhead	Electric	HEA	145.226	0.050	
E21B1a031 G21B1a010	Low flow Showerhead	Gas	HEA			0.633
E21B1a032	Low flow Showerhead	Kerosene	HEA			0.633
E21B1a033	Low flow Showerhead	Oil	HEA			
E21B1a034	Low flow Showerhead	Propane	HEA			0.633
E21A2a030	Low flow Showerhead	Electric	HPwES	145.226	0.050	
E21A2a031 G21A2a010	Low flow Showerhead	Gas	HPwES			0.633
E21A2a032	Low flow Showerhead	Kerosene	HPwES			0.633
E21A2a033	Low flow Showerhead	Oil	HPwES			
E21A2a034	Low flow Showerhead	Propane	HPwES			0.633

Measure Life:

The measure life is 15 years.[3]

Other Resource Impacts:

Annual water savings are 1,164 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}
E21B1a016	Handheld showerhead	Electric	HEA	1.00	0.91	n/a	n/a	n/a	0.31	0.81
E21B1a017 G21B1a003 E21B1a018 E21B1a019 E21B1a020	Handheld showerhead	Gas Kerosene Oil Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a016	Handheld showerhead	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.31	0.81
E21A2a017 G21A2a003 E21A2a018 E21A2a019 E21A2a020	Handheld showerhead	Gas Kerosene Oil Propane	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a
E21B1a030	Low flow Showerhead	Electric	HEA	1.00	0.91	n/a	n/a	n/a	0.31	0.81
E21B1a031 G21B1a010 E21B1a032 E21B1a033 E21B1a034	Low flow Showerhead	Gas Kerosene Oil Propane	HEA	1.00	n/a	0.91	n/a	n/a	n/a	n/a
E21A2a030	Low flow Showerhead	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.31	0.81
E21A2a031 G21A2a010 E21A2a032 E21A2a033 E21A2a034	Low flow Showerhead	Gas Kerosene Oil Propane	HPwES	0.99	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All installations have a 100% in-service-rate since programs include verification of equipment installations.

Realization Rates:

All PAs use a realization rate of 100% for HPwES program and a realization rate of 91% for HEA program.[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”.

Endnotes:
1: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL. kWh and annual water savings 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.

1.21 Hot Water – Water Heater

Measure Code	[Code]
Market	Residential
Program Type	Retrofit/ Lost Opportunity
Category	Hot Water

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 82% 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 ≥ 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
G21A3b012	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82)	Gas	ES Products			4.000
G21A3b013	Water Heater - Integrated with Condensing Boiler >= 90% AFUE	Gas	ES Products			10.300
G21A3b014	Water Heater - Integrated with Condensing Boiler >= 95% AFUE	Gas	ES Products			12.800
G21A3b018	Water Heater - Tankless, On-Demand >=.94	Gas	ES Products	-43.000	-0.010	7.300
G21A3b016	Stand Alone Storage Tank Water Heater (EF 0.67)	Gas	ES Products	-43.000	-0.010	3.000

Measure Life:

The table shows the measure life for each measure.[4 5 6 7]

BC Measure ID	Measure Name	Program	Measure Life
G21A3b012	Water Heater - Indirect (attached to ES FHW Boiler; Combined eff rating >=85% (EF=.82) (Retrofit)	ES Products	20
G21A3b013	Water Heater - Integrated with Condensing Boiler >= 90% AFUE (Retrofit)	ES Products	19
G21A3b014	Water Heater - Integrated with Condensing Boiler >= 95% AFUE (Retrofit)	ES Products	19
G21A3b018	Water Heater - Tankless, On-Demand >=.94 (Lost Opportunity)	ES Products	19
G21A3b016	Stand Alone Storage Tank Water Heater (EF 0.67)	ES Products	10

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}
G21A3b012	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
G21A3b013	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
G21A3b014	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
G21A3b018	Water Heater - Tankless, On-Demand >=.94 (New Construction)	ES Products	1.00	1.00	1.00	n/a	n/a	0.21	0.40
G21A3b016	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

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”.

Endnotes:
1: The Baseline Energy Factor is based on the Federal Minimum Standard for (50-gallon) water heaters sold on or after April 16, 2015. This ruling can be found here: https://www.govinfo.gov/content/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf
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

1.22 HVAC - Boiler

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

Installation of a new, high efficiency forced hot water boiler, replacing an existing lower efficiency boiler.

Baseline Efficiency:

For the retirement savings over the remaining life of existing boiler, the baseline efficiency is the metered efficiency of existing system.

For the high efficiency unit savings over lifetime of the new boiler, the baseline is a 84.4% AFUE boiler.[1]

High Efficiency:

For the retirement savings over the remaining life of existing boiler, the efficient case is a 84.4% AFUE boiler.

For the high efficiency savings over lifetime of the new boiler, the efficient case for gas and propane boilers is a new high efficiency boiler AFUE >= 93%) adjusted by a degradation factor (0.941) to account for its metered efficiency (AFUE >= 87.5%)[1]. For oil, the efficient case is an 86% AFUE boiler.

Algorithms for Calculating Primary Energy Impact:

The algorithms for calculating unit annual fossil fuel savings are:

For retrofit, $\Delta MMBtu_{RETIRE}$= *heating load MMBTUs * (1/AFUE existing – 1/AFUE ee)*
For lost opportunity, $\Delta MMBtu_{EE}$= *heating load MMBTUs * (1/AFUE base – 1/AFUE ee)*

Where:
$\Delta MMBtu_{RETIRE}$ = Annual MMBtu savings of code-compliant boiler compared to existing boiler
$\Delta MMBtu_{EE}$ = Annual MMBtu savings of high efficiency boiler.
heating load MMBtus = Annual residential heating load. 85,200,000 Btu/year for space heating and 9,630,521 Btu/year for water heating.[2]
AFUE existing = Annual fuel utilization efficiency of an existing boiler.
AFUE base = Annual fuel utilization efficiency of a code-compliant boiler. 0.844.
AFUE ee = Annual fuel utilization efficiency of the installed high efficiency boiler.

The annual unit electric savings are deemed based on evaluation results.[3]

BC Measure ID	Measure Name	Fuel Type	Program	ΔkWh/unit[3,4]	ΔMMBtu//unit
G21A3b001	Early Retirement Boiler, Forced Hot Water (EE)	Gas		9.000	Calculated
E21B1b001 E21A2b001 G21B1b001 G21A2b001 G21A3b002	Early Retirement Boiler, Forced Hot Water (Retire)	Gas		9.000	Calculated
	Early Retirement Boiler, Forced Hot Water (EE), Oil	Oil		9.000	Calculated
E21B1b003 E21A2b003	Early Retirement Boiler, Forced Hot Water (Retire), Oil	Oil		9.000	Calculated
	Early Retirement Boiler, Forced Hot Water (EE), Other	Propane/Kerosene		9.000	Calculated
E21B1b004 E21B1b002 E21A2b004 E21A2b002	Early Retirement Boiler, Forced Hot Water (Retire), Other	Propane/Kerosene		9.000	Calculated

Measure Life:

The table below includes the measure life for existing units and new equipment. The measure life of new equipment is 23 years. For early replacement, the measure lifetime savings are calculated as the sum of retirement savings over the remaining life for the existing unit (7.67 years, assumed to be 1/3 of the measure life of a new equipment) and code/industry standard practice savings for 15.33 years.[5]

BC Measure ID	Measure Name	Fuel Type	Program	Measure Life EUL	RUL
	Boiler, Forced Hot Water	All	All	23	7.67

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}
	Boiler, Forced Hot Water	Gas		1.00	n/a	1.00	n/a	n/a	0.00	1.00
	Boiler, Forced Hot Water	Oil		1.00	n/a	1.00	n/a	n/a	0.00	1.00
	Boiler, Forced Hot Water	Propane/ Kerosene		1.00	n/a	1.00	n/a	n/a	0.00	1.00

<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>

A winter coincidence factor of 100% is claimed.[6]

Energy Load Shape:

See Appendix 1. "Boiler Distribution"

Endnotes:
1: Itron, June 2020. New Hampshire Residential Baseline Study. Prepared for New Hampshire Evaluation, Measurement and Verification Working Group.
2: CT HVAC and Water Heating Process and impact Evaluation Report, West Hill Energy and Computing, R1614/R1613 Jul. 19, 2018.
3: Ancillary savings applied when boiler replacement in combines with weatherization measures.
4: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
5: Guidehouse, inc, August 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.
6: New Hampshire common assumptions.

1.23. HVAC – Boiler Reset Control

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit
Category	HVAC

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
G21A3b005	Boiler Reset Control	Gas	ES Appliances	5.100

Measure Life:

The measure life of reset controls installed on a new boiler is 15 years.[2] The remaining useful life of reset controls installed on an existing boiler is 6.67 years (assumed to be 1/3 EUL of boiler). For reset controls installed on an existing boiler, the measure lifetime savings are calculated as the sum of retirement savings for 6.67 years and code savings for 8.33 years (calculated as 15 – 6.67).

BC Measure ID	Measure Name	Fuel	Program	EUL	RUL
	Boiler Reset Control	All	All	15	6.67

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}
	Boiler Reset Control	Gas	ES Appliances	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".

Endnotes:
1: Navigant Consulting, August 2018. Home Energy Services (HES) Impact Evaluation for Massachusetts. http://ma-eeac.org/wordpress/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.

1.24. HVAC – Condensing Boilers

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

Installation of a new, high efficiency combined water heating and boiler unit.

Baseline Efficiency:

The baseline for normal replacement is a boiler with AFUE of 84.4%.[1] The water heating baseline is a 0.6 EF water heater.[1]

The early replacement baseline efficiency is the metered efficiency of the existing system.

High Efficiency:

The efficient case is an integrated water heater/boiler unit with either an AFUE 90 boiler (AFUE = 90%, EF = 0.90) or an AFUE 95 boiler (AFUE = 95%, EF = 0.95).

Algorithms for Calculating Primary Energy Impact:

The algorithms for calculating unit annual fossil fuel savings are:

For early replacement, $\Delta MMBtu_{RETIRE}$= *heating load MMBTUs × (1/AFUE existing – 1/AFUE ee)*
For lost opportunity, $\Delta MMBtu_{EE}$= *heating load MMBTUs × (1/AFUE base – 1/AFUE ee)*

Where:

$\Delta MMBtu_{RETIRE}$ = Annual MMBtu savings of code-compliant boiler compared to existing boiler
$\Delta MMBtu_{EE}$ = Annual MMBtu savings of high efficiency boiler
Heating load MMBtus = Annual residential hot water load. 9,630,521 Btu/year.[2]
AFUE existing = Annual fuel utilization efficiency of an existing boiler. Site-specific metered value.
AFUE base = Annual fuel utilization efficiency of a new boiler. 0.844 for all fuel types.[1]
AFUE ee = Annual fuel utilization efficiency of the installed high efficiency boiler.

The annual unit electric savings are deemed based on evaluation results.[3]

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu/unit	ΔkWh/unit
	Condensing Boilers ≥ 90% AFUE, Lost Opportunity	Gas Oil Propane Kerosene	ES Products	Calculated	9.00
	Condensing Boilers ≥ 95% AFUE, Lost Opportunity	Gas Oil Propane Kerosene	ES Products	Calculated	9.00
	Condensing Boilers ≥ 90% AFUE, Early Retirement	Gas Oil Propane Kerosene	HEA/ HPwES	Calculated	9.00
	Condensing Boilers ≥ 95% AFUE, Early Retirement	Gas Oil Propane Kerosene	HEA/ HPwES	Calculated	9.00

Measure Life:

The table below includes the measure life for existing units and new equipment. The measure life of new equipment is 20 years. For early replacement, the measure lifetime savings are calculated as the sum of retirement savings over the remaining life for the existing unit (6.67 years, assumed to be 1/3 of the measure life of a new equipment) and code/industry standard practice savings for 13.33 years. [4]

BC Measure ID	Measure Name	Program	Measure Life EUL	RUL
	Boiler, Forced Hot Water	All	20	6.67

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings:[3 5]

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
	Condensing Boiler	Gas Oil Kerosene Propane	ES Products	1.00	n/a	1.00	n/a	n/a	0	1.00
	Condensing Boiler	Gas	HEA	1.00	n/a	0.91	n/a	n/a	0	1.00
	Condensing Boiler	Oil	HEA	1.00	n/a	0.91	n/a	n/a	0	1.00
	Condensing Boiler	Propane /Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	0	1.00
	Condensing Boiler	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	0	1.00
	Condensing Boiler	Oil	HPwES	0.99	n/a	1.00	n/a	n/a	0	1.00
	Condensing Boiler	Propane /Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	0	1.00

<u>In-Service Rates:</u>

All installations have a 100% in-service-rates unless an evaluation finds otherwise.

<u>Realization Rates:</u>

The HPwES program uses a realization rate of 100% and the HEA program uses a realization rate of 91%. The ES Products program uses a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

A winter coincidence factor of 100% is claimed.[6]

Energy Load Shape:

See Appendix 1 "Non-Electric Measures".

<u>Endnotes</u>:

1: Itron, June 2020. New Hampshire Residential Baseline Study. Prepared for New Hampshire Evaluation, Measurement and Verification Working Group.
2: CT HVAC and Water Heating Process and impact Evaluation Report, West Hill Energy and Computing, R1614/R1613 Jul. 19, 2018.
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
4: Environmental Protection Agency, 2009. Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler.

5: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
6: New Hampshire common assumptions.

1.25. HVAC – ENERGY STAR Central Air Conditioning

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

The installation of a high efficiency ENERGY STAR central air conditioning (AC) system.

Baseline Efficiency:

For lost opportunity and replace on failure retrofit, the baseline efficiency case is a Seasonal Energy Efficiency Ratio (SEER) 12.4 central air-conditioning unit.[1] For early retirement, if values are known, then baseline is the existing air-conditioning unit SEER over its remaining life, and a SEER 12.4 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 qualified ENERGY STAR central air-conditioning unit, based on the reported capacity and efficiency levels of units rebated in the previous calendar year. The minimum ENERGY STAR Seasonal Energy Efficiency Ratio (SEER) requirement for the program is 15.

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]
SEERBASE = Seasonal Energy Efficiency Ratio (SEER).

- For lost opportunity and replace on failure retrofit installation, baseline AC equipment should be SEER 12.4 equipment.
- For early replacement retrofit, baseline AC equipment is divided into two components:
  - For the remaining useful life of the replaced AC equipment:
    - if known, use the replaced (old) AC SEER value.
    - if unknown, assume previous calendar year average of the replaced (old) AC SEER value (for 2019 was SEER 10).
  - For the remaining useful life of the new AC equipment: baseline AC equipment should be 12.4 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 2019 was 17.1 SEER). [3]
Hours = Equivalent Full Load Hours (EFLH). Assume 385 for New Hampshire based on the ENERGY STAR calculator.[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[6]
E21A3b015	ENERGY STAR Central AC	ENERGY STAR Products	Use actual, if unknown use 2.85	12.4	Use actual, if unknown use 17.1	385	0.001594
	ENERGY STAR Central AC, Early Retirement	HPwES/HEA	Use actual, if unknown use 2.85	Use actual, if unknown use 10 for remaining useful life of replaced AC, 12.4 for remaining useful life of new AC	Use actual, if unknown use 17.1	385	0.001594

Measure Life:[5 6]

The table below includes the effective useful life (EUL) for central air-conditioning units which assumes a lost opportunity installation[4]. Retrofit installations that meet early retirement criteria should receive a remaining useful life of 6 years for a total of 18-year life[5]. 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)
E21A3b015	ENERGY STAR Central AC	ES Products	18	n/a
	ENERGY STAR Central AC, Early Retirement	HPwES/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}
E21A3b015	ENERGY STAR Central AC	ES Products	1.00	1.00	n/a	1.00	1.00	0.50	0.00
	ENERGY STAR Central AC, Early Retirement	HEA	1.00	0.91	n/a	1.00	1.00	0.50	0.00
	ENERGY STAR Central AC, Early Retirement	HPwES	0.99	1.00	n/a	1.00	1.00	0.50	0.00

<u>In-Service Rates:</u>

In-service rates are 100% for ES Products unless an evaluation finds otherwise, 100% for HEA[8], and 99%% for HPwES[7].

<u>Realization Rates:</u>

Realization rates are 100% for ES Products until further evaluation, 91% for HEA[8], and 100% for HPwES[7].

<u>Coincidence Factors:</u>

Summer coincidence factors are estimated using the RES1 Demand Impact Model Update.[9] The winter coincidence factor is assumed to be zero.

Energy Load Shape:

See Appendix 1 – "Central Air Conditioner/Heat Pump (Cooling)".

<u>Endnotes</u>:
1: Itron 2020. New Hampshire Residential Baseline Study. Prepared for New Hampshire Evaluation, Measurement and Verification Working Group.
2: Average tonnage for Eversource 2019 rebated ENERGY STAR central AC according to tracking database summary report. Pulled February 10, 2020.
3: Average SEER for Eversource 2019 rebated ENERGY STAR central AC according to tracking database summary report. Pulled February 10, 2020.
4: ENERGY STAR Central AC calculator. Assumptions worksheet. Usage: Full Load Cooling Hours. Concord NH location. Based on 2002 EPA study.
https://www.energystar.gov/sites/default/uploads/buildings/old/files/CentralAC_Calculator.xls
EFLH Calculator tab in the EVT_CCHP MOP and Retrofit_2018_.xlsx.). Previous VT TRM was 375. Cadmus study showed much lower for heat pumps:
https://publicservice.vermont.gov/sites/dps/files/documents/2017%20Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.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, 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: 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

1.26. HVAC – ENERGY STAR Room Air Conditioning

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity/Retrofit
Category	HVAC

Description:

The installation of high efficiency room air conditioning (AC) unit.

Baseline Efficiency:

The baseline efficiency case is a room AC unit meeting current federal standard.

High Efficiency:

The high efficiency case is a program-qualified ENERGY STAR room AC unit.

Algorithms for Calculating Primary Energy Impact:

Electric energy savings for a program-qualified ENERGY STAR room air-conditioning unit are deemed at 33 kWh per unit. Unit savings are based on the Massachusetts eTRM value (36 kWh) adjusted to account for the cooling load differential between Massachusetts and New Hampshire.

Savings Assumptions for Calculating Residential ENERGY STAR Room Air Conditioners:

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW[3]
E21A3b016	ENERGY STAR Room AC	ES Products	33	0.06
E21B1a054	ENERGY STAR Room AC	HEA	113	0.18
E21A2a057	ENERGY STAR Room AC	HPwES	113	0.18

Measure Life:

The table below includes the effective useful life (EUL) for room air-conditioning units which assumes lost opportunity installation.

BC Measure ID	Measure Name	Program	Measure Life[3]
E21A3b016	ENERGY STAR Room AC	ES Products	12
E21B1a054	ENERGY STAR Room AC	HEA	12
E21A2a057	ENERGY STAR Room AC	HPwES	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}
E21A3b016	ENERGY STAR Room AC	ES Products	0.97	1.00	n/a	1.00	1.00	0.33	0.00
E21B1a054	ENERGY STAR Room AC	HEA	1.00	0.91	n/a	1.00	1.00	0.33	0.00
E21A2a057	ENERGY STAR Room AC	HPwES	0.99	1.00	n/a	1.00	1.00	0.33	0.00

<u>In-Service Rates:</u>

In-service rates are 0.97% for ES Products[4], 100% for HEA[6], and 99%% for HPwES[5]

<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%[6] and for all HPwES programs are 100%[5] per evaluation results.

<u>Coincidence Factors:</u>

Summer coincidence factors is estimated using the RES1 Demand Impact Model Update.[3] The winter coincidence factor is assumed to be zero.

Energy Load Shape:

See Appendix 1 – "Room or Window Air Conditioner".

<u>Endnotes</u>:

1: Connecticut's 2019 Program Savings Document, March 1, 2019. https://www.energizect.com/sites/default/files/2019%20PSD%20%283-1-19%29.pdf
Common cooling savings algorithms used in the Connecticut PSD show a directly proportional relationship between savings and cooling operational hours. We assume a similar directly proportional relationship between cooling operational hours (EFLH), cooling savings, and cooling degree days. The New Hampshire CDD of 518 is based on the HPwES evaluation and the MA CDD is assumed to be the average of New Hampshire and Connecticut (603).
2: Opinion Dynamics, New Hampshire Utilities Home Performance with Energy Star Program Evaluation Report 2016-2017 – DRAFT, December 24, 2019.
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 Group, INC. (2018). RLPNC 17-4 and 17-5: Product Impact Evaluation of In-Service and Short-Term Retention Rates Study. Prepared for MA Electric Program Administrators and EEAC.
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.

1.27. HVAC – Furnace

Measure Code	
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

Installation of a new high efficiency space heating furnace with an electronically commutated motor (ECM) for the fan.

Baseline Efficiency:

The baseline efficiency case is an 83.2% AFUE furnace.[1]

For the retirement savings over the remaining life of existing boiler, the baseline efficiency is the metered efficiency of existing system.

High Efficiency:

The high efficiency case is a new furnace with AFUE ≥ 95%.

Algorithms for Calculating Primary Energy Impact:

The algorithm for calculating lost opportunity annual fossil fuel savings is:

$$\Delta MMBtu = 77.5 \times (\frac{1}{AFUE_b} - \frac{1}{AFUE_I})$$

Where,
$77.5 = Average\ heating\ factor\ based\ on\ home's\ heat\ load.$ [2]
$AFUE_b = Annual\ fuel\ utilization\ efficiency\ of\ the\ baseline\ furnace.\ 0.832$
$AFUE_I = Annual\ fuel\ utilization\ efficiency\ of\ the\ installed\ furnace$

The algorithm for calculating retrofit annual fossil fuel savings is:

$$\Delta MMBtu = 77.5 \times (\frac{1}{AFUE_e} - \frac{1}{AFUE_b})$$

Where,
$AFUE_e = Annual\ fuel\ utilization\ efficiency\ of\ the\ existing\ furnace.$
$AFUE_b = Annual\ fuel\ utilization\ efficiency\ of\ the\ baseline\ furnace.\ 0.832$

Unit savings for Furnace ancillary savings measure are based on the 2020 HPwES study results.[3] Ancillary electric savings for furnace replacement measure are based on the 2018 ES Products evaluation study.[4]

BC Measure ID	Measure Name	Fuel	Program	ΔkWh	ΔkW	ΔMMBtu
E---	Furnace Ancillary Savings	Electric	HPwES			0.0293
E21B1b005 G21B1b002 E21A2b005 G21A2b002	Furnace Replacement	Gas	HEA HPwES	130.600 168	0.064	Calculated
E21B1b006 E21A2b006	Furnace Replacement	Kerosene	HEA HPwES	87.600 168	0.064	Calculated
E21B1b008 E21A2b008	Furnace Replacement	Propane	HEA HPwES	130.600 168	0.064	Calculated
	Furnace Replacement	Oil	HEA HPwES	6.700 168	0.064	Calculated

Measure Life:

Measure life is summarized in the table below.[5]

BC Measure ID	Measure Name	Fuel Type	Program	Years
	Furnace Ancillary Savings	Electric	HPwES	17
E21B1b005 G21B1b002 E21A2b005 G21A2b002	Furnace Replacement	Gas	HEA HPwES	17
E21B1b006 E21A2b006	Furnace Replacement	Kersone	HEA HPwES	17
E21B1b008 E21A2b008	Furnace Replacement	Propane	HEA HPwES	17
	Furnace Replacement	Oil	HEA HPwES	17

Other Resource Impacts:

There are no other resource impacts identified for this measure.

Impact Factors for Calculating Adjusted Gross Savings: [3 6]

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E---	Ancillary Savings	Electric	HPwES	0.99	1.00	n/a	n/a	n/a	0.00	0.45
E21B1b005 G21B1b002	Furnace Replacement	Gas	HEA	1.00	n/a	0.91	n/a	n/a	0.00	0.45
E21A2b005 G21A2b002	Furnace Replacement	Gas	HPwES	0.99	n/a	1.00	n/a	n/a	0.00	0.45
E21B1b006	Furnace Replacement	Kerosene	HEA	1.00	n/a	0.91	n/a	n/a	0.00	0.45
E21A2b006	Furnace Replacement	Kerosene	HPwES	0.99	n/a	1.00	n/a	n/a	0.00	0.45
E21B1b008	Furnace Replacement	Propane	HEA	1.00	n/a	0.91	n/a	n/a	0.00	0.45
E21A2b008	Furnace Replacement	Propane	HPwES	0.99	n/a	1.00	n/a	n/a	0.00	0.45

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 100% for HPwES program and a realization rate of 91% for HEA program.[3 6]

Coincidence Factors:

The summer coincidence factor for ancillary electric savings is 0.00 and winter coincidence factor is 0.45.[7]

Energy Load Shape:

See Appendix 1 "Furnace Fan".

Endnotes:

1: Itron 2020. New Hampshire Residential Baseline Study. Prepared for New Hampshire Evaluation, Measurement and Verification Working Group.
2: CT HVAC and Water Heating Process and impact Evaluation Report, West Hill Energy and Computing, R161/ R 1613 Jul. 19, 2018.
3: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
4: New Hampshire ENERGY STAR® Products Program 2016 Evaluation Report (2018).

5: 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.
6:Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.
7: 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 HVAC – Air-source Heat Pump

Measure Code	[Code]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

This measure includes the installation of a high-efficiency, 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 increase electric consumption will be realized.

The measure covers four baseline scenarios, described below, and two load configurations:

1. Partial heating displacement
2. Full heating displacement (heat pump meets over 90% of annual space heat load)

Baseline Efficiency:

The baseline efficiency varies as a function of replacement scenario.

Scenario	Baseline System Type	
	Cooling	**Heating**
1. Lost opportunity	Code minimum heat pump	Code minimum heat pump
2. Retrofit, replacing a heat pump	Market average heat pump	Market average heat pump
3. Retrofit, replacing central cooling and electric resistance heat	Market average central air conditioner	Electric resistance
4. Retrofit, replacing central cooling and fossil fuel heating* *Fossil fuel displacement scenario is proposed for a limited pilot offering, starting 2021.	Market average central air conditioner	Market average fossil fuel furnace

High Efficiency:

The high efficiency (or energy efficient) case is the site-specific air-source heat pump unit. For full displacement, the heat pump must meet cold-climate heat pump standards, such as those listed by NEEP or other sources for a cold climate air-source heat pump (ccASHP).

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. Based on the end use of the installed heat pump unit, the savings will be:

1. Cooling only, if the energy efficient heat pump will serve only the cooling load of the house

2. Heating only, if the energy efficient heat pump will serve only the heating load of the house (either partial or complete displacement)
3. Combined, if the energy efficient heat pump will serve both the cooling and heating loads of the house.

The algorithm for calculating electric demand savings is:

$$\Delta kW = \max(\Delta kW_{cool} \textit{ or } \Delta kW_{heat})$$

$$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

If cooling is absent in the preexisting case, the term ($1/EER_{BASE}$) = 0

$$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right)$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate air-source heat pump
$Cap_{heat} = Cap_{cool} \times 0.9$ for all other air-source heat pump

Where:
ΔkW_{cool} = Gross annual cooling demand savings for air-source heat pump unit
ΔkW_{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} = 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.
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
$HSPF_{BASE}$ = 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

The algorithm for calculating annual electric energy savings is:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

If cooling is absent in the preexisting case, the term ($1/EER_{BASE}$) = 0

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

If fossil fuel heating baseline, the term ($1/HSPF_{BASE}$) = 0 and the fossil fuel savings are:

$$\Delta MMBtu_{heat} = \frac{Cap_{heat}}{AFUE} \times EFLH_{heat} \times 10^{-3}$$

$$Cap_{heat} = Cap_{cool} \times 1.0 \text{ if unit is a cold climate air-source heat pump}$$
$$Cap_{heat} = Cap_{cool} \times 0.9 \text{ for all other air-source heat pump}$$

Where:
ΔkWh_{cool} = Gross annual cooling savings for air-source heat pump unit
ΔkWh_{heat} = Gross annual heating savings for air-source heat pump unit
$\Delta MMBtu_{hea}$ = 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
$EFLH_{heat}$ = Equivalent Full Load Hours for heating
$AFUE$ = Annual fuel utilization efficiency of replaced fossil fuel heating system
0.9 = Conversion factor[1] 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 - HP	3. Retrofit - Resistance	4. Retrofit – Fossil Fuel	
Air-source Heat Pump	All sizes	EER_{BASE}	12.72[2]	10.90[2]	-	-	Btu/W-h
		$SEER_{BASE}$	14.00[3]	12.00[5]	-	-	Btu/W-h
		$HSPF_{BASE}$	8.20[3]	7.40[5]	3.412[4]	-	Btu/W-h
		AFUE	N/A	N/A	N/A	75%[6]	
		$EFLH_{cool}$	280[7]				Hours
		$EFLH_{heat}$	1020[8]				Hours

Measure Life[9]:

The measure life of a new heat pump unit is 18 years.

BC Measure ID	Measure Name	Program	Measure Life
E21A3b003	Air-source Heat Pump – Lost Opportunity (Cooling)	ES Products	18
E21A3b004	Air-source Heat Pump – Lost Opportunity (Heating)	ES Products	18
E21A3b033	Air-source Heat Pump – Retrofit HP	ES Products	18
E21A3b034	Air-source 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}
E21A3b003	Air-source Heat Pump – Lost Opportunity (Cooling)	ES Products	1.00	1.00	1.00	1.00	1.00	0.346	0.00
E21A3b004	Air-source Heat Pump – Lost Opportunity (Heating)	ES Products	1.00	1.00	1.00	1.00	1.00	0.00	0.595
E21A3b033	Air-source Heat Pump – Retrofit HP	ES Products	1.00	1.00	1.00	1.00	1.00	0.346	0.595
E21A3b034	Air-source Heat Pump – Retrofit Resistance	ES Products	1.00	1.00	1.00	1.00	1.00	0.346	0.595

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[10]:

A coincidence factor of 34.60% during cooling season and a coincidence factor of 59.5% for the heating season should be applied.

Energy Load Shape:

See Appendix 1 – "Air-source Heat Pump"

Endnotes:
1: Conversion factor is based on internal ERS analysis of Mass Save and NEEP ccASHP product data.
2: Since IECC does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER≈SEER/1.1.
3: International Energy Conservation Code 2015, table C403.2.3(2) Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps
4: Electric heating system has COP = 1, which converts to an HSPF value of 3.412 Btu/w-h
5: ASHRAE 90.1 2004 table 6.8.1B Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements.
6: MA TRM DMSHP measure. This value in the MA TRM has been agreed upon by EEAC consultants. We believe that this value accurately 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. We believe the average of cooling hour values for the cities of Albany and Massena are representative of NH, because their lie roughly along the same latitudes as endpoints of NH.
8: Heating hours from NY TRM v7 Appendix G for Single family homes. We believe the average of heating hour values for the cities of Albany and Massena are representative of NH, because their lie roughly along the same latitudes as the endpoints of NH.
9: 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.
10: Values reflect a blend of replace on failure and early replacement. 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)

1.29 HVAC – Heat Pump, Ductless

Measure Code	[Code]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

This measure includes the installation of a 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.

The measure covers four baseline scenarios, described below, and two load configurations:

0. Partial heating displacement
1. Full heating displacement (heat pump meets over 90% of annual space heat load)

Baseline Efficiency:

The baseline efficiency varies as a function of replacement scenario.

	Baseline System Type	
Scenario	**Cooling**	**Heating**
5. Lost opportunity	Code minimum heat pump	Code minimum heat pump
6. Retrofit, replacing a heat pump	Market average heat pump	Market average heat pump
7. Retrofit, replacing central cooling and electric resistance heat	Market average central air conditioner	Electric resistance
8. Retrofit, replacing central cooling and fossil fuel heating *Fossil fuel displacement scenario is proposed for a limited pilot offering, starting 2021.	Market average central air conditioner	Market average fossil fuel furnace

High Efficiency:

The high efficiency (or energy efficient) case is the site-specific ductless, mini-split heat pump unit. For full displacement, the heat pump must meet cold-climate heat pump standards, such as those listed by NEEP or other sources for a a cold climate ductless, mini-split heat pump (ccDMSHP).

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. Based on the end use of the installed heat pump unit, the savings will be:

4. Cooling only, if the energy efficient heat pump will serve only the cooling load of the house
5. Heating only, if the energy efficient heat pump will serve only the heating load of the house (either partial or complete displacement)
6. Combined, if the energy efficient heat pump will serve both the cooling and heating loads of the house.

The algorithm for calculating electric demand savings is:

$$\Delta kW = \max(\Delta kW_{cool} \text{ or } \Delta kW_{heat})$$

$$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

If cooling is absent in the preexisting case, the term ($1/EER_{BASE}$) = 0

$$\Delta kW_{hea} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right)$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate ductless mini split heat pump

$Cap_{heat} = Cap_{cool} \times 0.9$ for all other ductless mini split heat pump

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} = 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.

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

$HSPF_{BASE}$ = 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

The algorithms for calculating annual cooling and heating electric energy savings are as follows:

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

If cooling is absent in the preexisting case, the term ($1/EER_{BASE}$) = 0

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

If fossil fuel heating baseline, the factor ($1/HSPF_{BASE}$) = 0 and the fossil fuel savings are:

$$\Delta MMBtu_{heat} = \frac{Cap_{heat}}{AFUE} \times EFLH_{heat} \times 10^{-3}$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate ductless mini split heat pump

$$Cap_{heat} = Cap_{cool} \times 0.9 \text{ for all other ductless mini split heat pump}$$

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_{hea} = 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
$EFLH_{hea}$ = Equivalent Full Load Hours for heating
AFUE = Annual fuel utilization efficiency of replaced fossil fuel heating system
0.9 = Conversion factor[1] 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

Heat Pump Type	Cooling Capacity Range	Parameter	Value				Units
			1. Lost Opportunity	2. Retrofit - HP	3. Retrofit - Resistance	4. Retrofit – Fossil Fuel	
Ductless Mini Split	All sizes	EER_{BASE}	12.72[2]	10.90[2]	-	-	Btu/W-h
		$SEER_{BASE}$	14.00[3]	12.00[5]	-	-	Btu/W-h
		$HSPF_{BASE}$	8.20[3]	7.40[5]	3.412[4]	-	Btu/W-h
		AFUE	N/A	N/A	N/A	75%[6]	
		$EFLH_{cool}$	218[7]				Hours
		$EFLH_{heat, partial}$	535[8]				Hours
		$EFLH_{heat, full}$	1,117[8]				Hours

Measure Life[9]:

The table below the measure life of the ductless mini-split heat pump equipment.

BC Measure ID	Measure Name	Program	Measure Life
E21A3b005	Ductless Mini-split Heat Pump (cooling) - Lost Opportunity	ES HVAC	18
E21A3b006	Ductless Mini-split Heat Pump (heating) - Lost Opportunity	ES HVAC	18
E21A3b032	Ductless Mini-split Heat Pump - Retrofit HP	ES HVAC	18
E21A3b031	Ductless Mini-split Heat Pump - Retrofit Resistance	ES HVAC	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}
E21A3b005	Ductless Mini-split Heat Pump (cooling) - Lost Opportunity	ES HVAC	1.00	1.00	1.00	1.00	1.00	0.29	0.00
E21A3b006	Ductless Mini-split Heat Pump (heating) - Lost Opportunity	ES HVAC	1.00	1.00	1.00	1.00	1.00	0.00	0.62
E21A3b032	Ductless Mini-split Heat Pump - Retrofit HP	ES HVAC	1.00	1.00	1.00	1.00	1.00	0.29	0.62
E21A3b031	Ductless Mini-split Heat Pump - Retrofit Resistance	ES HVAC	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[10]:

Coincidence factor of 29% during cooling season and a coincidence factor of 62% for the heating season should be applied.

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)

Endnotes:
1: Conversion factor is based on internal ERS analysis of Mass Save and NEEP ccASHP product data.
2: Since IECC does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER≈SEER/1.1.
3: International Energy Conservation Code 2015, table C403.2.3(2) Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps
4: Electric heating system has COP = 1, which converts to an HSPF value of 3.412 Btu/w-h
5: ASHRAE 90.1 2004 table 6.8.1B Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements.
6: MA TRM DMSHP measure. This value in the MA TRM has been agreed upon by EEAC consultants. We believe that this value accurately represents actual fossil fuel heating equipment efficiencies which include efficiency degradation over the age of the equipment. MA TRM DMSHP.
7: Cooling hours from Cadmus Group (2016), Ductless Mini-Split Heat Pump Impact Evaluation, December 30, 2016. Cadmus_2016_DMSHP_Impact_Evaluation
8: Heating hours from Navigant Consulting (2018), Quick Hit Study: Ductless Mini-Split Heat Pump Survey (RES 29), March 30, 2018. Assumes higher heating hours for displacement of electric heat based on top 25% EFLH (heating) reported in Cadmus Group (2016), Ductless Mini-Split Heat Pump Impact Evaluation, December 30, 2016. Navigant_2018_DMSHP_Survey.
9: 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.
10: Coincidence factors come from the Navigant Demand Impact model analysis spreadsheet – MA, Aug 2018.

1.30. HVAC – Heat Recovery Ventilator

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	HVAC

Description:

Heat recovery ventilators (HRVs) and energy recovery ventilators (ERVs) 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
G21A3b010	Heat Recovery Ventilator	ES Products	8.6
	Energy Recovery Ventilator	ES Products	8.8

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
G21A3b010	Heat Recovery Ventilator	Electric	ES Products	-171	-0.020
	Energy Recovery Ventilator	Electric	ES Products	-127	-0.014

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}
G21A3b010	Heat Recovery Ventilator	ES Products	1.00	1.00	1.00	1.00	1.00	0.00	1.00
	Energy Recovery Ventilator	ES Products	1.00	1.00	1.00	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:

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.

Endnotes:

1: Guidehouse, August 2020. Comprehensive TRM Review MA19R17-B-TRM. Prepared for The Electric and Gas Program Administrators of Massachusetts.

1.31. HVAC- Swimming Pool Heater

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Lost Opportunity
Category	Custom

Description:

The installation of a high efficiency heat pump or gas swimming pool heater.

Baseline Efficiency:

The base case is a new, standard efficiency electric resistance hot water heater.

High Efficiency:

The high efficiency case is a heat pump or gas-fired water heater.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.[1]

Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21A3b009	Heat Pump Swimming Pool Heater, <55 gallon, Energy Star	ES Products	1592	0.100
E21A3b009	Heat Pump Swimming Pool Heater, >55 gallon, UEF 2.70	ES Products	197	0.018
G21A3b016	Gas Swimming Pool Heater	ES Products	2550	0.160

Measure Life:

The measure life is 13 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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21A3b009	Heat Pump Swimming Pool Heater	ES Products	1.00	1.00	n/a	1.00	0.00	0.31	0.00
G21A3b016	Gas Swimming Pool Heater	ES Products	1.00	1.00	n/a	1.00	0.00	0.31	0.00

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 31% and a winter coincidence factor of 0% since pool pumps do not operate during winter.

Energy Load Shape:

See Appendix 1.

Endnotes:
1: Navigant Consulting, 2018. Water Heating, Boiler, and Furnace Cost Study (RES 19) Add-On Task 7: Residential Water Heater Analysis Memo. 2018_Navigant_Water_Heater_Analysis_Memo

1.32. Lighting - Fixture

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Lighting

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:

$\Delta kWh = ((Watts\_Ineff - Watts\_EE) \times HOU)))/1000 \times Qty\_Bulbs \times 365$

$\Delta kW = \Delta kWh \times kW/kWh$

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 with ENERGY STAR 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 (HPwES) 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 of use:[1]

- 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 HPwES 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.[2]

BC Measure ID	Measure Name	Program	Delta Watts per Fixture	Daily HOU	Number of Bulbs	ΔkWh	ΔkW
E21A3a009	LED Fixture	ES Products	34.2	2.1	1	26.4	0.03
E21A2a048	LED Fixture	HPwES	34.2	3	1	37.4	0.02
E21B1a048	LED Fixture	HEA	Vendor Calculated				
E21A3a010	LED Fixture (Hard to Reach)	ES Products	34.2	2.1	1	26.4	0.02
E21A1a024	LED Fixture	ES Homes	8.55	1.75	1	5.5	0.01

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]

BC Measure ID	Measure Name	Program	Adjusted Measure Life
E21A3a009	LED Fixture	ES Products	3
E21A2a048 E21B1a048	LED Fixture	HPwES/HEA	2
E21A3a010	LED Fixture (Hard to Reach)	ES Products	3
E21A1a024	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.[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}
E21A3a009	LED Fixture	ES Products	100%	100%	100%	100%	100%	0.55	0.85
E21A2a048	LED Fixture	HPwES	99%	100%	100%	100%	100%	0.55	0.85
E21B1a048	LED Fixture	HEA	100%	91%	100%	100%	100%	0.55	0.85
E21A3a010	LED Fixture (Hard to Reach)	ES Products	100%	100%	100%	100%	100%	0.55	0.85
E21A1a024	LED Fixture	ES Homes	100%	100%	100%	100%	100%	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 HPwES installations use in-service rate of 99% based on evaluation results. [5 9] All other installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Based on evaluation results, all HEA installations use a realization rate of 91% and all HPwES installations use a realization rate of 100% because gross savings assumptions are adjusted to reflect evaluated results. [5 9] 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.[6]

Energy Load Shape:

See Appendix 1 – "Lighting".[6]

Impact Factors for Calculating Net Savings:[7]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21A3a009	LED Fixture	ES Products	67%	n/a	n/a	33%
E21A3a010	LED Fixture (Hard to Reach)	ES Products	47%	n/a	n/a	53%

Endnotes:

1: 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. 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 HPwES and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day.
2: 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).
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/wordpress/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: 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 HPwES 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
5: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
6: Navigant, 2018. RES1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
7: "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).
8: 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.
9: Opinion Dynamics, July 29 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.33. Lighting – LED Lamp

Measure Code	[To Be Defined in ANB system]
Market	Residential
Program Type	Retrofit/Lost Opportunity
Category	Lighting

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:

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:[1]

$\Delta kWh = ((Watts\_Ineff - Watts\_EE) \times HOU)/1000 \times 365$

$\Delta kW = \Delta kWh \times kW/kWh$

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 with ENERGY STAR 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 (HPwES, 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 HPwES LEDs (all installed in residential applications): 3.0 hours/day
- Retrofit HEA LEDs: (all installed in residential applications): 3.0 hours/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).[3, 11]

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.4 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.[5]

BC Measure ID	Measure Name	Program	Delta Watts	Daily HOU	ΔkWh	ΔkW
E21A3a001	General Service Lamps	ES Products	40	2.1	30.7	0.04
E21A3a004	Reflector	ES Products	43	2.1	33.0	0.04
E21A3a003	Other Specialty	ES Products	35	2.1	26.8	0.04
E21A3a002	Linear	ES Products	17.9	1.6	10.5	0.02
E21A2a044	General Service Lamps	HPwES	32.2	3.0	35.3	0.03
E21A2a047	Reflector	HPwES	46.2	3.0	50.6	0.05
E21A2a046	Other Specialty	HPwES	46.2	3.0	50.6	0.05
E21A2a045	Linear	HPwES	17.9	3.0	19.6	0.02
E21B1a044	General Service Lamps	HEA	Vendor Calculated			
E21B1a047	Reflector	HEA	Vendor Calculated			
E21B1a046	Other Specialty	HEA	Vendor Calculated			
E21B1a045	Linear	HEA	Vendor Calculated			
E21A3a005	General Service Lamps (Hard to Reach)	ES Products	40	2.1	30.7	0.04
E21A3a008	Reflector (Hard to Reach)	ES Products	43	2.1	33.0	0.04
E21A3a007	Other Specialty (Hard to Reach)	ES Products	35	2.1	26.8	0.04
E21A3a006	Linear (Hard to Reach)	ES Products	17.9	1.6	10.5	0.02
E21A1a023	ES Homes Lighting	ES Homes	10.2	1.75	6.5	0.01
	General Service Lamps	Drop Ship	40	1.75	25.6	0.04

	Reflector	Drop Ship	43	1.75	27.5	0.04
	Other Specialty	Drop Ship	35	1.75	22.4	0.04

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 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.[6]

BC Measure ID	Measure Name	Program	Adjusted Measure Life
E21A3a001	General Service Lamps	ES Products/Drop Ship	3
E21A3a004	Reflector	ES Products/Drop Ship	2
E21A3a003	Other Specialty	ES Products/Drop Ship	3
E21A3a002	Linear	ES Products	10
E21A2a044 E21B1a044	General Service Lamps	HPwES/HEA	2
E21A2a047 E21B1a047	Reflector	HPwES/HEA	2
E21A2a046 E21B1a046	Other Specialty	HPwES/HEA	2
E21A2a045 E21B1a045	Linear	HPwES/HEA	10
E21A3a005	General Service Lamps (Hard to Reach)	ES Products	3
E21A3a008	Reflector (Hard to Reach)	ES Products	2
E21A3a007	Other Specialty (Hard to Reach)	ES Products	3
E21A3a006	Linear (Hard to Reach)	ES Products	10
E21A1a023	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.[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}
E21A3a001	General Service Lamps	ES Products	0.86	1.00	100%	100%	100%	0.547	0.848
E21A3a004	Reflector	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A3a003	Other Specialty	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A3a002	Linear	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A2a044 E21B1a044	General Service Lamps	HPwES/HEA	0.99 1.00	1.00 0.91	100%	100%	100%	0.547	0.848
E21A2a047 E21B1a047	Reflector	HPwES/HEA	0.99 1.00	1.00 0.91	100%	100%	100%	0.547	0.848
E21A2a046 E21B1a046	Other Specialty	HPwES/HEA	0.99 1.00	1.00 0.91	100%	100%	100%	0.547	0.848
E21A2a045 E21B1a045	Linear	HPwES/HEA	0.99 1.00	1.00 0.91	100%	100%	100%	0.547	0.848

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21A3a005	General Service Lamps (Hard to Reach)	ES Products	0.86	1.00	100%	100%	100%	0.547	0.848
E21A3a008	Reflector (Hard to Reach)	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A3a007	Other Specialty (Hard to Reach)	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A3a006	Linear (Hard to Reach)	ES Products	0.89	1.00	100%	100%	100%	0.547	0.848
E21A1a023	ES Homes Lighting	ES Homes	1.00	1.00	100%	100%	100%	0.547	0.848
	General Service Lamps	Drop Ship	50%	100%	100%	100%	100%	0.547	0.848
	Reflector	Drop Ship	50%	100%	100%	100%	100%	0.547	0.848
	Other Specialty	Drop Ship	50%	100%	100%	100%	100%	0.547	0.848

<u>In-Service Rates:</u>

All HEA installations use an in-service rate of 100% because HEA realization rates account for uninstalled measures[12]. All HPwES installations use an in-service rate of 99%.[4] In-service for all other installations are based on MA evaluations.[7]

<u>Realization Rates:</u>

Based on evaluation results, all HEA installations use a realization rate of 91%.[12] All HPwES installations use a realization rate of 100% because gross savings assumptions are adjusted to reflect evaluated results.[4] All other installations have a 100% realization rate unless an evaluation finds otherwise.

<u>Coincidence Factors:</u>

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
E21A3a001	General Service Lamps	ES Products	67%	n/a	n/a	33%
E21A3a004	Reflector	ES Products	67%	n/a	n/a	33%
E21A3a003	Other Specialty	ES Products	67%	n/a	n/a	33%
E21A3a002	Linear	ES Products	67%	n/a	n/a	33%
E21A3a005	General Service Lamps (Hard to Reach)	ES Products	47%	n/a	n/a	53%
E21A3a008	Reflector (Hard to Reach)	ES Products	47%	n/a	n/a	53%
E21A3a007	Other Specialty (Hard to Reach)	ES Products	47%	n/a	n/a	53%
E21A3a006	Linear (Hard to Reach)	ES Products	47%	n/a	n/a	53%

<u>**Endnotes**</u>:
1: 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.
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. 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 HPwES and HEA are based on program requirements for contractors to only replace fixtures that are used for at least three hours per day.
3: 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). 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://www.energycodes.gov/sites/default/files/becu/2015_IECC_residential_requirements.pdf).
4: Opinion Dynamics, June 11, 2020, Home Performance with Energy Star Program Evaluation Report 2016-2017 – FINAL.
5: RLPNC 18-7: TLED Product Impact Factor Estimation, Memo from NMR Group, Inc. to the Massachusetts Program Administrators, August 3, 2018.
6: 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/wordpress/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.
7: In-service rates for ES Products and HTR channel are based on the MA study "RLPNC 179: 2019—21 Planning Assumptions: Lighting Hours-of-Use and In-Service Rate," 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.
8: 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
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).
10: 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.
11: Delta watts for HPwES 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
12: Opinion Dynamics, July 29, 2020, New Hampshire Utilities, Home Energy Assistance Program Evaluation Report, 2016-2017 – FINAL.

1.34. Thermostat – Wi-Fi Communicating

Measure Code	TBD
Market	Residential
Program Type	Retrofit
Category	HVAC

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. This measure includes thermostats only with communication features and does not extend to Energy Star rated smart thermostats.

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: [4]

Unit savings are deemed based primarily on impact evaluation results.[4] 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.[1]
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.

BC Measure ID	Measure Name	Energy Type	Program	ΔkWh	ΔkW	ΔMMbtu
E21B1b015 E21A2b015	Wi-Fi Thermostat, Electric Heating	Electricity	HEA HPwES	419.0	0	n/a
E21B1b016 G21B1b004 E21A2b016 G21A2b004	Wi-Fi Thermostat, Gas	NG - Res Heating	HEA HPwES	n/a	n/a	5.80
E21B1b017 E21A2b017	Wi-Fi Thermostat, Kerosene	Kerosene	HEA HPwES	n/a	n/a	3.10
E21B1b018 E21A2b018	Wi-Fi Thermostat, Oil	Fuel Oil - Residential Distillate	HEA HPwES	n/a	n/a	5.90

E21B1b019 E21A2b019	Wi-Fi Thermostat, Propane	Propane	HEA HPwES	n/a	n/a	5.80
E21B1b020 E21A2b020	Wi-Fi Thermostat, Wood Pellets	Pellet Wood	HEA HPwES	n/a	n/a	3.10
E21A3b026	Wi-Fi Thermostat (Heating & Cooling)	Fuel Blind	ES Products	66.7	0.1	4.92
G21A3b020	Wi-Fi Thermostat (Heating & Cooling)	NG - Res Heating	ES Products	n/a	n/a	4.92
G21A3b019	WiFi Thermostat (Heating Only)	NG - Res Heating	ES Products	n/a	n/a	4.92
	Wi-Fi Thermostat (Cooling Only)	Electricity	ES Products	46.0	0.1	n/a

Measure Life:

The measure life is 15 years.[2]

Other Resource Impacts:

No other impacts are reported.

Impact Factors for Calculating Adjusted Gross Savings: [1,3,4]

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21B1b015 E21A2b015	Wi-Fi Thermostat, Electric	Electricity	HEA HPwES	1.00 0.99	0.91 1.00	n/a	n/a	n/a	0.00	1.00

E21B1b016 E21A2b016	Wi-Fi Thermostat, Gas	NG - Res Heating	HEA HPwES	1.00 0.99	n/a	0.91 1.00	n/a	n/a	n/a	n/a
E21B1b017 E21A2b017	Wi-Fi Thermostat, Kerosene	Kerosene	HEA HPwES	1.00 0.99	n/a	0.91 1.00	n/a	n/a	n/a	n/a
E21B1b018 E21A2b018	Wi-Fi Thermostat, Oil	Fuel Oil - Residential Distillate	HEA HPwES	1.00 0.99	n/a	0.91 1.00	n/a	n/a	n/a	n/a
E21B1b019 E21A2b019	Wi-Fi Thermostat, Propane	Propane	HEA HPwES	1.00 0.99	n/a	0.91 1.00	n/a	n/a	n/a	n/a
E21B1b020 E21A2b020	Wi-Fi Thermostat, Wood Pellets	Pellet Wood	HEA HPwES	1.00 0.99	n/a	0.91 1.00	n/a	n/a	n/a	n/a
E21A3b026	Wi-Fi Thermostat (Heating & Cooling)	NG- Res Heating	ES Products	1.00	1.00	1.00	n/a	n/a	0.35	0.00
G21A3b020	Wi-Fi Thermostat (Heating & Cooling)	NG - Res Heating	ES Products	1.00	1.00	1.00	n/a	n/a	0.35	0.00
G21A3b019	WiFi Thermostat (Heating Only)	NG - Res Heating	ES Products	1.00	1.00	1.00	n/a	n/a	0.35	0.00

<u>In-Service Rates:</u>

All HEA installations have a 100% in-service-rate and all HPwES 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.

<u>Realization Rates:</u>

All HEA installations have a 91% realization rate and all HPwES 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.

<u>Coincidence Factors:</u>

Summer and winter coincidence factors are estimated using demand allocation methodology described in the Navigant Demand Impact Model prepared for MA Program Administrators.[3]

Energy Load Shape:

See Appendix 1 “Weighted HVAC- All Homes”

Endnotes:
1: 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
2: Environmental Protection Agency, 2010. Life Cycle Cost Estimate for ENERGY STAR Programmable Thermostat. Assumed to have the same lifetime as a regular programmable thermostat
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: Navigant Consulting, August 2018. Home Energy Services (HES) Impact Evaluation. http://ma-eeac.org/wordpress/wp-content/uploads/RES34_HES-Impact-Evaluation-Report-with-ES_FINAL_29AUG2018.pdf
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.

1.35. Thermostat – Programmable

Measure Code	
Market	Residential
Program Type	Retrofit
Category	HVAC

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: either a manual thermostat or no thermostat.

High Efficiency:

The high efficiency case is an HVAC system that has a programmable thermostat installed.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on evaluation results.[1]

BC Measure ID	Measure Name	Energy Type	Program	ΔkWh	ΔkW	ΔMMbtu
E21B1b009	Programmable Thermostat, Electric Heat	Electricity	B1b - HEA (HVAC Systems)	278.0	0	n/a
E21B1b010	Programmable Thermostat, Gas	NG - Res Heating	B1b - HEA (HVAC Systems)	n/a	n/a	3.50
E21B1b011	Programmable Thermostat, Kerosene	Kerosene	B1b - HEA (HVAC Systems)	n/a	n/a	3.50
E21B1b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	B1b - HEA (HVAC Systems)	n/a	n/a	3.50
E21B1b013	Programmable Thermostat, Propane	Propane	B1b - HEA (HVAC Systems)	n/a	n/a	3.50

E21B1b014	Programmable Thermostat, Wood Pellets	Pellet Wood	B1b - HEA (HVAC Systems)	n/a	n/a	3.50
E21A2b009	Programmable Thermostat, Electric	Electricity	A2b - HPwES (HVAC Systems)	251.0	0	n/a
E21A2b010	Programmable Thermostat, Gas	NG - Res Heating	A2b - HPwES (HVAC Systems)	n/a	n/a	3.50
E21A2b011	Programmable Thermostat, Kerosene	Kerosene	A2b - HPwES (HVAC Systems)	n/a	n/a	3.50
E21A2b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	A2b - HPwES (HVAC Systems)	n/a	n/a	3.50
E21A2b013	Programmable Thermostat, Propane	Propane	A2b - HPwES (HVAC Systems)	n/a	n/a	3.50
E21A2b014	Programmable Thermostat, Wood Pellets	Pellet Wood	A2b - HPwES (HVAC Systems)	n/a	n/a	3.50
TBD	Programmable Thermostat, AC only	Electricity	TBD	27.0	0	n/a

Thermostats that control both heating and central cooling may claim savings for both cooling (27.0 kWh/yr) and heating impacts (by fuel).

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}
E21B1b009	Programmable Thermostat, Electric	Electricity	B1b - HEA (HVAC Systems)	1.00	0.91	0.00	n/a	1.00	0.00	1.00
E21B1b010	Programmable Thermostat, Gas	NG - Res Heating	B1b - HEA (HVAC Systems)	1.00	n/a	0.91	n/a	1.00	n/a	n/a
E21B1b011	Programmable Thermostat, Kerosene	Kerosene	B1b - HEA (HVAC Systems)	1.00	n/a	0.91	n/a	1.00	n/a	n/a
E21B1b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	B1b - HEA (HVAC Systems)	1.00	n/a	0.91	n/a	1.00	n/a	n/a
E21B1b013	Programmable Thermostat, Propane	Propane	B1b - HEA (HVAC Systems)	1.00	n/a	0.91	n/a	1.00	n/a	n/a
E21B1b014	Programmable Thermostat, Wood Pellets	Pellet Wood	B1b - HEA (HVAC Systems)	1.00	n/a	0.91	n/a	1.00	n/a	n/a
E21A2b009	Programmable Thermostat, Electric	Electricity	A2b - HPwES (HVAC Systems)	0.99	1.00	n/a	n/a	1.00	0.00	1.00
E21A2b010	Programmable Thermostat, Gas	NG - Res Heating	A2b - HPwES (HVAC Systems)	0.99	n/a	1.00	n/a	1.00	n/a	n/a
E21A2b011	Programmable Thermostat, Kerosene	Kerosene	A2b - HPwES (HVAC Systems)	0.99	n/a	1.00	n/a	1.00	n/a	n/a
E21A2b012	Programmable Thermostat, Oil	Fuel Oil - Residential Distillate	A2b - HPwES (HVAC Systems)	0.99	n/a	1.00	n/a	1.00	n/a	n/a
E21A2b013	Programmable Thermostat, Propane	Propane	A2b - HPwES (HVAC Systems)	0.99	n/a	1.00	n/a	1.00	n/a	n/a
E21A2b014	Programmable Thermostat, Wood Pellets	Pellet Wood	A2b - HPwES (HVAC Systems)	0.99	n/a	1.00	n/a	1.00	n/a	n/a
TBD	Programmable Thermostat, AC only	Electricity	TBD	1.00	1.00	0.00	n/a	0.00	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 HPwES installations have a 99% in-service rate based on evaluation results.[4 5]

Realization Rates:

All HEA installations have a 91% realization rate and all HPwES installations have a 100% realization rate based on evaluation results.[4 5]

Coincidence Factors:

Summer and winter coincidence factors are estimated using demand allocation methodology described the Navigant Demand Impact Model prepared for MA Program Administrators.[3]

Energy Load Shape:

See Appendix 1 "Weighted HVAC- All Homes"

Endnotes:
1: Navigant Consulting, August 2018. Home Energy Services (HES) Impact Evaluation. http://ma-eeac.org/wordpress/wp-content/uploads/RES34_HES-Impact-Evaluation-Report-with-ES_FINAL_29AUG2018.pdf
2: 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/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf
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.

1.36. Whole Home – New Construction

Measure Code	RES-WH-NEW
Market	Residential
Program Type	Lost Opportunity
Category	Whole Home

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 was updated in 2019 to reflect 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
E21A1a001 E21A1a012	Cooling, Electric	ENERGY STAR Homes
E21A1a002 E21A1a013	Heating, Electric	ENERGY STAR Homes
E21A1a003 E21A1a014	Heating, Gas	ENERGY STAR Homes
E21A1a004 E21A1a015	Heating, Oil	ENERGY STAR Homes

E21A1a005 E21A1a016	Heating, Propane	ENERGY STAR Homes
E21A1a006 E21A1a017	Heating, Wood Pellets	ENERGY STAR Homes
E21A1a007 E21A1a018	Hot Water, Electric	ENERGY STAR Homes
E21A1a008 E21A1a019	Hot Water, Gas	ENERGY STAR Homes
E21A1a009 E21A1a020	Hot Water, Oil	ENERGY STAR Homes
E21A1a010 E21A1a021	Hot Water, Propane	ENERGY STAR Homes
E21A1a011 E21A1a022	Hot Water, Wood Pellets	ENERGY STAR Homes

Measure Life:

The measure life is shown below and varies by end use.[5]

BC Measure ID	Measure Name	Program	EUL
E21A1a002 E21A1a013 E21A1a003 E21A1a014 E21A1a004 E21A1a015 E21A1a005 E21A1a016 E21A1a006 E21A1a017	Heating	ENERGY STAR Homes	25
E21A1a001 E21A1a012	Cooling	ENERGY STAR Homes	25
E21A1a007 E21A1a018 E21A1a008 E21A1a019 E21A1a009 E21A1a020 E21A1a010 E21A1a021 E21A1a011 E21A1a022	Water Heating	ENERGY STAR Homes	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}
E21A1a001 E21A1a012	Cooling, Electric	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	0.35	0.00
E21A1a002 E21A1a013	Heating, Electric	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	0.00	0.43
E21A1a003 E21A1a014	Heating, Gas	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a004 E21A1a015	Heating, Oil	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a005 E21A1a016	Heating, Propane	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a006 E21A1a017	Heating, Wood Pellets	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a007 E21A1a018	Hot Water, Electric	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	0.31	0.81
E21A1a008 E21A1a019	Hot Water, Gas	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a009 E21A1a020	Hot Water, Oil	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a010 E21A1a021	Hot Water, Propane	ENERGY STAR Homes	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E21A1a011 E21A1a022	Hot Water, Wood Pellets	ENERGY STAR Homes	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.

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"
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 2019 Plan-Year Report Version, Page 244, "Chapter 1.60: Whole Home New Construction" section, accessed on February 14, 2020, and GDS Associates Inc. Measure Life Report, Residential and Commercial Industrial Lighting and HVAC Measures, Jun. 2007.
6: Navigant Consulting, 2018. RES 1 Demand Impact Model Update. http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

1.37. Whole Home – Energy Report

Measure Code	[Code]
Market	Residential
Program Type	Custom
Category	Behavioral

Description:

Residential home energy report programs are a behavioral feedback program that involves sending energy use reports to participating electric and natural gas customers in order to change customers' energy use behavior. Vendor results are 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 customer who does not receive a whole home energy report. Vendor savings calculations may use randomly sampled controls who do not receive the whole home energy report treatment to calculate savings.

High Efficiency:

The high efficiency case is a customer who receives a home energy report.

Algorithms for Calculating Primary Energy Impact:

Unit savings for Home Energy Reports are based on calculations from vendor results.

$$\Delta kWh = (kWh_{baseline}) \times (\%Savings_{elec})$$
$$\Delta MMBtu = (MMBtu_{baseline}) \times \left(\%Savings_{gas}\right)$$

Where:
Unit = One participant household
$kWh_{baseline}$ = Baseline energy consumption in kWh/year
$MMBtu_{baseline}$ = Baseline energy consumption in MMBtu/year
$\%Savings_{elec}$ = Energy savings percent per program participant, electric
$\%Savings_{gas}$ = Energy savings percent per program participant, gas

Savings are determined each year by the vendor. However, at times when vendor savings values are not available (e.g. during program planning or for estimating savings for new populations receiving whole home energy reports), default program savings values, based on NH evaluations, may be used.

Default program savings values are as follows:

Variable	Value
$\%Savings_{elec}$	1.32%[1]

$\%Savings_{gas}$	1.28%[2]

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
	Residential Whole Home Energy Report	[Abbr]	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}
E21A4a001	Residential Whole Home Energy Report	Residential Behavior	1.00	0.88	0.98	1.00	1.00	0.73	1.00

<u>In-Service Rates:</u>

All installations have 100% in-service-rates since reports are sent out regularly to participants.[1]

<u>Realization Rates:</u>

The electric realization rate is based on Navigant's 2016 evaluation of Eversource New Hampshire Home Energy Report pilot program.[1] The evaluation did not directly report a realization rate; however, the electric realization rate is calculated based on the reported and evaluated savings in that document.

The non-electric realization rate is based on Navigant's 2015 evaluation of the MA gas utility savings for their Home Energy Report program.[2]

<u>Coincidence Factors:</u>

Summer and winter coincidence factors are estimated using the demand allocation methodology described in the Demand Impact Model, based on ISO-NE peak loading periods.[3]

Energy Load Shape:

See Appendix 1.

<u>Endnotes</u>:

1: Navigant Consulting (2016). Home Energy Report Pilot Program Evaluation Final Report, Feb 2014-Feb 2015. Prepared for Eversource New Hampshire.
2: Navigant Consulting and Illume Advising (2015). Behavior Program Evaluation Opower Results. Navigant_Illume_2014_Behavior_Program_Impact_Evaluation.
Natural gas savings estimates for this evaluation is based on the average savings of the 12 gas Home Energy Report programs listed in the document.
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
2018_Navigant_Baseline_Loadshape_Comprehensive_Report

2. Commercial

2.1. C&I Active Demand Response

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Custom
Category	Active Demand Response

Description:

Active Demand Reduction includes C&I Load Curtailment and Storage 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 storage, both daily dispatch and targeted dispatch (summer and winter), 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.

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]

Custom projects will have a custom baseline.

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
E21C5a001	Load Curtailment Targeted Dispatch P4P Summer	C&I Active Demand Response	1
E21C5a002	Storage Daily Dispatch P4P (savings) Summer	C&I Active Demand Response	1
E21C5a003	Storage Daily Dispatch P4P (consumption) Summer	C&I Active Demand Response	1
E21C5a004	Storage Targeted Dispatch P4P (savings) Summer	C&I Active Demand Response	1
E21C5a005	Storage Targeted 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}
E21C5a001	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
E21C5a002	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

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C5a003	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
E21C5a004	Storage Targeted Dispatch P4P (savings) Summer	C&I Active Demand Response	1.00	1.01	1.00	1.01	1.00	1.00	0.00
E21C5a005	Storage Targeted Dispatch P4P (consumption) Summer	C&I Active Demand Response	1.00	1.01	1.00	1.01	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 all summer savings take place during summer peak periods according to program rules; the programs are not claiming winter peak impacts due to the fact that the ISO-NE system is summer peaking.

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=8a34f8598773992325038987ea62e83319d208f835e892092c491823f78722e7a92604e473dc75021eb90f821f219b8cbc0ddafaae207ed1924f97faecb70d5eaf3e5372d04fb6

2.2. Building Envelope – Air Sealing and Insulation

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	**Building Shell**

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.

Baseline Efficiency:

Air Sealing: The baseline efficiency case is the existing building before the air sealing measure is implemented. The baseline building is characterized by the existing air changes per hour (ACHPRE) for multi-family facilities, which is measured prior to the implementation of the air sealing measure. This will typically be a default value of a baseline/pre-retrofit ACH =0.5.

Insulation: The baseline efficiency case is characterized by the total R-value of the existing attic, basement, or sidewall (Rexisit). This is calculated as the R-value of the existing insulation, estimated by the program contractor, plus 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 building is characterized by the new air changes per hour (ACHPOST) for multi-family facilities, which is measured after the air sealing measure is implemented. This will typically be a default value of a baseline/pre-retrofit ACH =0.4.

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:

kWh = (Vol x ACH x 0.018 x HDD x 24/ ηheating) / 3,413
MMBtu = (Vol x ACH x 0.018 x HDD x 24/ ηheating) / 1,000,000

kW = kWh x kW/kWh

Where:
Vol = [ft^3] This is the air volume of the treated space, calculated from the dimensions of the space, which could include the number of floors, the floor area per floor, and the floor-to-ceiling height, or the dwelling floor area and number of dwellings. The treated space can be the entire building including the common areas, or just the individual dwelling units. (Auditor Input)
Δ ACH = [ºF-day] Infiltration reduction in Air Changes per Hour, natural infiltration basis. This will typically be a default value, but the source of the assumption should be transparent and traceable, or it could come from a blower door test. (Stipulated Value or Blower Door Test)
HDD60 = Heating degree-days with temperature base of 60 degrees. [1]
ηheating = [AFUE, COP, thermal efficiency (%)] Efficiency of the heating system, as determined on site (Auditor Input)
24 = Conversion factor: 24 hours per day
0.018 = [Btu / ft^3- ºF] Air heat capacity: The specific heat of air (0.24 Btu / ºF.lb) times the density of air (0.075 lb / ft_3)
1,000,000 = Conversion factor: 1,000,000 Btu per MMBtu
3,413 = Conversion factor: 3,413 Btu / kWh
kW / kWh = Average kW reduction per kWh reduction: 0.00073 kW / kWh [2]

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.[3]

BC Measure ID	Measure Name	Program	Measure Life
E21C3a015 E21C3a016 E21C3a017 E21C3a018 E21C3d017 E21C3d018 E21C3d019 E21C3d020	Air Sealing	Municipal Retrofit Municipal Direct Install	15
E21C3a051 E21C3a052 E21C3a053 E21C3a054 E21C3d051 E21C3d052 E21C3d053 E21C3d054	Insulation	Municipal Retrofit Municipal Direct Install	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}
E21C3a015 E21C3d017	Air Sealing	Electric	Muni Retro Muni DI	1.00	1.00	n/a	n/a	n/a	0.00	0.43
E21C3a016 E21C3d018	Air Sealing	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a017 E21C3d019	Air Sealing	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a018 E21C3d020	Air Sealing	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a051 E21C3d051	Insulation	Electric	Muni Retro Muni DI	1.00	1.00	n/a	n/a	n/a	0.00	0.43
E21C3a052 E21C3d052	Insulation	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C3a053 E21C3d053	Insulation	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a054 E21C3d054	Insulation	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:

A winter coincidence factor of 43% is utilized.[2]

Energy Load Shape:

See Appendix 1.

Endnotes:
1: The HDD should be calculated based on the TMY3 weather data of the nearest weather station. https://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD&countryabbv=&georegionabbv
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: 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

2.3. Compressed Air – Air Compressor

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Compressed Air

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}
E21C1b016 E21C2b016 E21C3b016	Air Compressor	LBES New SBES New Muni New	1.00	1.00	1.00	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.

Coincidence Factors:

CFs from the prospective results of the 2015 study of prescriptive compressed air.[1]

Energy Load Shape:

See Appendix 1.

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. 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

2.4. Compressed Air – Air Nozzle

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity/ Retrofit
Category	Compressed Air

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 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 100 psig
$FLOW_{EE}$ = energy efficient nozzle flow in cfm, at site specific pressure if available, or else at 100 psig
$\frac{kW}{cfm}$ = site specific compressor efficiency, default value of 0.29 if unavailable

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}
E21C1b017 E21C2b017 E21C3b017	Air Nozzle	LBES New 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.

Coincidence Factors:

CFs from the prospective results of the 2015 study of prescriptive compressed air.[1]

Energy Load Shape:

See Appendix 1.

Endnotes:
1: 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/wordpress/wp-content/uploads/MA30-Prescriptive-Chiller-and-CAIR-Report_FINAL_151026.pdf

2.5. Compressed Air – Adding Compressor Capacity and/or Storage

Measure Code	[Code]
Market	Commercial
Program Type	Retrofit
Category	Compressed Air

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, interpolate 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 25 years for non-mechanical infrastructure, similar to that of insulation.[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}
E21C1b020	Compressed air – compressor storage	LBES	1.00	1.00	n/a	1.00	1.00	1.17	0.98
E21C2b020	Compressed air – compressor storage	SBES	1.00	1.00	n/a	1.00	1.00	1.17	0.98
E21C3b032	Compressed air – compressor storage	Muni	1.00	1.00	n/a	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.

Coincidence Factors:

A summer coincidence factor of 117% and a winter coincidence factor of 98% is utilized.[4]

Energy Load Shape:

See Appendix 1.

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..
4: DNV GL (2015). Impact Evaluation of Prescriptive Chiller and Compressed Air Installations. Prepared for The Massachusetts Joint Utilities.

2.6. Compressed Air – Low Pressure Drop Filter

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Compressed Air

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
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

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}
E21C1a032	Low Pressure Drop Filter	LBES Retro	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C1b043	Low Pressure Drop Filter	LBES New	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C1d032	Low Pressure Drop Filter	LBES DI	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C2a032	Low Pressure Drop Filter	SBES Retro	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C2b043	Low Pressure Drop Filter	SBES New	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C2d032	Low Pressure Drop Filter	SBES DI	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C3a055	Low Pressure Drop Filter	Muni Retro	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C3b065	Low Pressure Drop Filter	Muni New	1.00	1.00	n/a	1.00	1.00	0.80	0.54
E21C3d055	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]

Coincidence Factors:

Summer and winter coincidence factors are CFs based on impact evaluation of PY 2004 compressed air installations.[3]

Energy Load Shape:

See Appendix 1.

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.

2.7. Compressed Air – Refrigerated Air Dryer

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Compressed Air

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

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}
E21C1b047	Refrigerated Air Dryer	LBES New	1.00	1.56	n/a	1.00	1.00	1.17	0.98

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C2b047	Refrigerated Air Dryer	SBES New	1.00	1.56	n/a	1.00	1.00	1.17	0.98
E21C3b078	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:

All programs use a 100% realization rate unless an evaluation finds otherwise.

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.

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

2.8. Compressed Air – Zero Loss Condensate Drain

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Compressed Air

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
Save = Average savings per CFM, site specific if available, default value of 0.29 kW/CFM
Hours = Annual operating hours of the zero loss condensate drain.

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}
E21C1a046	Zero Loss Condensate Drains	LBES Retro	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C1b051	Zero Loss Condensate Drains	LBES New	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C1d046	Zero Loss Condensate Drains	LBES DI	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C2a046	Zero Loss Condensate Drains	SBES Retro	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C2b051	Zero Loss Condensate Drains	SBES New	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C2d046	Zero Loss Condensate Drains	SBES DI	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C3a090	Zero Loss Condensate Drains	Muni Retro	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C3b082	Zero Loss Condensate Drains	Muni New	1.00	1.00	1.00	1.00	1.00	0.80	0.54
E21C3d090	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.

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.

Endnotes:
1a: DMI, 2006. Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Prepared for National Grid; results analysed in RLW Analytics, 2006. Sample Design and Impact Evaluation Analysis for Prescriptive Compressed Air Measures in the Energy Initiative and Design 2000 Programs. Prepared for National Grid
1b: RLW Analytics, 2008. Business & Construction Solutions (BS/CS) Programs Measurement & Verification - 2006 Final Report. Prepared for NSTAR Electric and Gas; Table 17
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

2.9. Custom Measures – Large C&I

Measure Code	[Code]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Custom

Description:

The Custom project track is offered for electric 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. Projects offered through the custom approach must pass a cost-effectiveness test based on project-specific costs and savings. Projects offered through the custom approach must pass a cost-effectiveness test based on project-specific costs and benefits.

Baseline Efficiency:

Retrofit projects will use the existing system or performance as the baseline for all single baseline projects. For dual baseline projects, retrofit projects will use the existing system or performance as the baseline for the first period and use the code or Industry Standard Practice (ISP) as the baseline for the second period (remaining useful life). Lost opportunity projects will generally refer to code, if applicable, or Industry Standard Practice (ISP), although there may be exceptions. If code does not apply and an ISP is not available, engineering judgement should be used to determine a project baseline.

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. The project must be proven cost-effective to qualify for energy efficiency incentives.

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.[2] Dual baseline effects should be considered for retrofit projects.[3]

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:[1]

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1b001	Custom Large Compressed Air New	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a001	Custom Large Compressed Air Retro	LBES	1.00	0.976	0.917	n/a	n/a	1.17	0.98
E21C1b002	Custom Large Hot Water New	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a002	Custom Large Hot Water Retro	LBES	1.00	0.99	0.917	n/a	n/a	0.00	0.00
E21C1b003	Custom Large HVAC New	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a003	Custom Large HVAC Retro	LBES	1.00	0.99	0.917	n/a	n/a	0.00	0.00
E21C1b004	Custom Large Lighting New – Interior	LBES	1.00	1.036	0.909	n/a	n/a	0.000	0.00
E21C1b054	Custom Large Lighting New – Exterior	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1b055	Custom Large Lighting New – Controls	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a004	Custom Large Lighting Retro – Interior	LBES	1.00	0.976	0.917	n/a	n/a	0.00	0.00
E21C1a047	Custom Large Lighting Retro – Exterior	LBES	1.00	0.976	0.917	n/a	n/a	0.00	0.00
E21C1a048	Custom Large Lighting Retro – Controls	LBES	1.00	0.976	0.917	n/a	n/a	0.00	0.00
E21C1b005	Custom Large Motors New	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a005	Custom Large Motors Retro	LBES	1.00	0.976	0.917	n/a	n/a	1.00	1.00
E21C1b008	Custom Large Other New	LBES	1.00	1.036	0.909	n/a	n/a	0.00	0.00
E21C1a008	Custom Large Other Retro	LBES	1.00	0.976	0.917	n/a	n/a	0.00	0.00

E21C1b006	Custom Large Process New	LBES	1.00	1.036	0.909	n/a	n/a	0.49	0.06
E21C1a006	Custom Large Process Retro	LBES	1.00	0.976	0.917	n/a	n/a	0.49	0.06
E21C1b007	Custom Large Refrigeration New	LBES	1.00	1.036	0.917	n/a	n/a	0.00	0.00
E21C1a007	Custom Large Refrigeration Retro	LBES	1.00	0.976	0.909	n/a	n/a	0.00	0.00
E21C3b001	Custom Muni Compressed Air New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a001	Custom Muni Compressed Air Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b002	Custom Muni Hot Water New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a002	Custom Muni Hot Water Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b003	Custom Muni HVAC New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a003	Custom Muni HVAC Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.45	0.00
E21C3b004	Custom Muni Lighting New – Interior	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b085	Custom Muni Lighting New – Exterior	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b086	Custom Muni Lighting New – Controls	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a004	Custom Muni Lighting Retro – Interior	Muni	1.00	1.00	1.00	n/a	n/a	0.80	0.61
E21C3a091	Custom Muni Lighting Retro – Exterior	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a092	Custom Muni Lighting Retro – Controls	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b005	Custom Muni Motors New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a005	Custom Muni Motors Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b008	Custom Muni Other New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00

E21C3a008	Custom Muni Other Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.346	0.00
E21C3b006	Custom Muni Process New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a006	Custom Muni Process Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3b007	Custom Muni Refrigeration New	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C3a007	Custom Muni Refrigeration Retro	Muni	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C4a001	Custom RFP Program Compressed Air	RFP	1.00	1.024	0.914	n/a	n/a	0.00	0.00
E21C4a002	Custom RFP Program Hot Water	RFP	1.00	1.024	0.914	n/a	n/a	0.00	0.00
E21C4a003	Custom RFP Program HVAC	RFP	1.00	1.024	0.914	n/a	n/a	0.70	0.85
E21C4a004	Custom RFP Program Lighting - Interior	RFP	1.00	1.024	0.914	n/a	n/a	0.80	0.61
E21C4a015	Custom RFP Program Lighting - Exterior	RFP	1.00	1.024	0.914	n/a	n/a	0.00	1.00
E21C4a016	Custom RFP Program Lighting - Controls	RFP	1.00	1.024	0.914	n/a	n/a	0.15	0.13
E21C4a005	Custom RFP Program Motors	RFP	1.00	1.024	0.914	n/a	n/a	0.00	0.00
E21C4a008	Custom RFP Program Other	RFP	1.00	1.024	0.914	n/a	n/a	0.00	0.00
E21C4a006	Custom RFP Program Process	RFP	1.00	1.024	0.914	n/a	n/a	0.95	0.90
E21C4a007	Custom RFP Program Refrigeration	RFP	1.00	1.024	0.914	n/a	n/a	0.00	0.00
E21C2b001	Custom Small Compressed Air New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a001	Custom Small Compressed Air Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b002	Custom Small Hot Water New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a002	Custom Small Hot Water Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00

E21C2b003	Custom Small HVAC New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a003	Custom Small HVAC Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b004	Custom Small Lighting New - Interior	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b054	Custom Small Lighting New - Exterior	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b055	Custom Small Lighting New - Controls	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a004	Custom Small Lighting Retro - Interior	SBES	1.00	1.066	1.00	n/a	n/a	0.00	0.00
E21C2a047	Custom Small Lighting Retro- Exterior	SBES	1.00	1.027	1.00	n/a	n/a	0.00	1.00
E21C2a048	Custom Small Lighting Retro - Controls	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b005	Custom Small Motors New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a005	Custom Small Motors Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b008	Custom Small Other New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a008	Custom Small Other Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.67	0.88
E21C2b006	Custom Small Process New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a006	Custom Small Process Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2b007	Custom Small Refrigeration New	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00
E21C2a007	Custom Small Refrigeration Retro	SBES	1.00	1.00	1.00	n/a	n/a	0.00	0.00

Energy Load Shape:

See Appendix 1.

Endnotes:
1: 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
2: Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-2. ERS_2005_Measure_Life_Study
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

2.10. Food Service – Dishwasher

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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[2]:

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
Low Temp Pots & Pans Dishwasher	1.00	0.70

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[1] as follows:

Dishwasher Type	**Idle Energy Rate (kW)**	**Water Consumption (gal/rack)**
High Temp Under Counter Dishwasher	0.50	0.86
High Temp Door Type Dishwasher	0.70	0.89
High Temp Single Tank Conveyer Dishwasher	1.50	0.70
High Temp Multi Tank Conveyer Dishwasher	2.25	0.54
High Temp Pots & Pans Dishwasher	1.20	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[1] as follows:

Dishwasher Type	**Idle Energy Rate (kW)**	**Water Consumption (gal/rack)**
Low Temp Under Counter Dishwasher	0.50	1.19
Low Temp Door Type Dishwasher	0.60	1.18
Low Temp Single Tank Conveyor Dishwasher	1.60	0.79
Low Temp Multi Tank Conveyor Dishwasher	2.00	0.54
Low Temp Pots & Pans Dishwasher	1.00	0.58

Algorithms for Calculating Primary Energy Impact:

Dishwasher High Temp: Unit savings are deemed based on the Energy Star Commercial Kitchen Equipment Savings Calculator[2]:
kWh = kWh
kW = kWh / hours
MMBtu = MMBtu

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, see Hours section below.

BC Measure ID	Measure	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1b026 E21C2b026 E21C3b040	High Temp Under Counter Dishwasher	LBES New SBES New Muni New	0.32	1,791	n/a
E21C1b022 E21C2b022 E21C3b036	High Temp Door Type Dishwasher	LBES New SBES New Muni New	0.74	4,151	n/a
E21C1b025 E21C2b025 E21C3b039	High Temp Single Tank Conveyer Dishwasher	LBES New SBES New Muni New	0.75	4,243	n/a
E21C1b023 E21C2b023 E21C3b037	High Temp Multi Tank Conveyer Dishwasher	LBES New SBES New Muni New	1.71	9,630	n/a
E21C1b024 E21C2b024 E21C3b038	High Temp Pots & Pans Dishwasher	LBES New SBES New Muni New	0.18	1,032	n/a
E21C1b030 E21C2b030 E21C3b044	Low Temp Under Counter Dishwasher	LBES New SBES New Muni New	0.39	2,178	n/a
E21C1b027 E21C2b027 E21C3b041	Low Temp Door Type Dishwasher	LBES New SBES New Muni New	2.46	13,851	n/a
E21C1b029 E21C2b029 E21C3b043	Low Temp Single Tank Conveyor Dishwasher	LBES New SBES New Muni New	2.07	11,685	n/a
E21C1b028 E21C2b028 E21C3b042	Low Temp Multi Tank Conveyor Dishwasher	LBES New SBES New Muni New	2.86	16,131	n/a
TBD	Low Temp Pots & Pans Dishwasher	tbd			

Measure Life:

The measure life for a new high temperature dishwasher is given by type below [3]:

BC Measure ID	Measure Name	Program	Measure Life
E21C1b026 E21C2b026 E21C3b040	High Temp Under Counter Dishwasher	LBES New SBES New Muni New	10
E21C1b022 E21C2b022 E21C3b036	High Temp Door Type Dishwasher	LBES New SBES New Muni New	15
E21C1b025 E21C2b025 E21C3b039	High Temp Single Tank Conveyer Dishwasher	LBES New SBES New Muni New	20
E21C1b023 E21C2b023 E21C3b037	High Temp Multi Tank Conveyer Dishwasher	LBES New SBES New Muni New	20
E21C1b024 E21C2b024 E21C3b038	High Temp Pots & Pans Dishwasher	LBES New SBES New Muni New	10
E21C1b030 E21C2b030 E21C3b044	Low Temp Under Counter Dishwasher	LBES New SBES New Muni New	10
E21C1b027 E21C2b027 E21C3b041	Low Temp Door Type Dishwasher	LBES New SBES New Muni New	15
E21C1b029 E21C2b029 E21C3b043	Low Temp Single Tank Conveyor Dishwasher	LBES New SBES New Muni New	20
E21C1b028 E21C2b028 E21C3b042	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. [2]

Dishwasher Type	Annual water savings (gal/unit)
High Temp Under Counter Dishwasher	5,399
High Temp Door Type Dishwasher	35,056
High Temp Single Tank Conveyer Dishwasher	21,284
High Temp Multi Tank Conveyer Dishwasher	80,754

High Temp Pots & Pans Dishwasher	10,517

Dishwasher low temp: There are water savings associated with this measure. [2]

Dishwasher Type	Annual water savings (gal/unit)
Low Temp Under Counter Dishwasher	12,677
Low Temp Door Type Dishwasher	80,629
Low Temp Single Tank Conveyor Dishwasher	65,104
Low Temp Multi Tank Conveyor Dishwasher	93,900
Low Temp Pots & Pans Dishwasher	TBD

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}
E21C1b026 E21C2b026 E21C3b040	High Temp Under Counter Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b022 E21C2b022 E21C3b036	High Temp Door Type Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b025 E21C2b025 E21C3b039	High Temp Single Tank Conveyer Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b023 E21C2b023 E21C3b037	High Temp Multi Tank Conveyer Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b024 E21C2b024 E21C3b038	High Temp Pots & Pans Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b030 E21C2b030 E21C3b044	Low Temp Under Counter Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b027 E21C2b027 E21C3b041	Low Temp Door Type Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b029 E21C2b029 E21C3b043	Low Temp Single Tank Conveyor Dishwasher	LBES New SBES New Muni New	1.00	1.00	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}
E21C1b028 E21C2b028 E21C3b042	Low Temp Multi Tank Conveyor Dishwasher	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90

<u>In-Service Rates:</u>

In-service rates are assumed to be 100% until an evaluation finds otherwise.

<u>Realization Rates:</u>

Realization rates are assumed to be 100% until 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.

Energy Load Shape:

See Appendix 1.

Endnotes:

1. ENERGY STAR Commercial Dishwashers Key Product Criteria, version 2.0. Effective Feb 1, 2013.
   Note: ENERGY STAR Commercial Dishwashers product specification version 3.0 is in its final draft form as of June 15, 2020 but does not yet have a set adoption date.
2. ENERGY STAR Commercial Kitchen Equipment Calculator. Updated October 2016.
   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. ENERGY STAR notes that a new version of the calculator will be available in fall 2020.
3. FSTC Life Cycle Savings Calculators https://fishnick.com/saveenergy/tools/calculators/

2.11. Food Service – Fryer

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 requirements.

Gas Fryer: The high efficiency case is an fryers is a deep-fat gas fryer with a cooking energy efficiency, shortening capacity, and idle energy rate in line with ENERGY STAR requirements.

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

$\Delta MMBtu = \Delta MMBtu$
Where:
$\Delta MMBtu$ = gross annual MMBtu gas savings from the measure per table below

Energy Savings for Commercial Fryer:

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1b033 E21C2b033 E21C3b050	Electric Fryer, Standard Vat	LBES New SBES New Muni	0.50	2,976	n/a
E21C1b032 E21C2b032 E21C3b049	Electric Fryer, Large Vat	LBES New SBES New Muni	0.50	2,841	n/a
G21C1b024 G21C2b024	Gas Fryer	LBES New SBES New	n/a	n/a	78.3

Measure Life:

The measure life for a new commercial fryer is 12 years.[1]

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}
E21C1b033 E21C2b033 E21C3b050	Electric Fryer, Standard Vat	LBES New SBES New Muni	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b032 E21C2b032 E21C3b049	Electric Fryer, Large Vat	LBES New SBES New Muni	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1b024 G21C2b024	Gas Fryer	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:

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

Endnotes:
1: 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/

2.12. Food Service – Griddle

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 requirements.

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 requirements.

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1b034 E21C2b034 E21C3b055	Commercial Electric Griddle	LBES New SBES New Muni	0.90	3,965	n/a
G21C1b025 G21C2b025	Commercial Gas Griddle	LBES New SBES New	n/a	n/a	37.9

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.[1]

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}
E21C1b034 E21C2b034 E21C3b055	Electric Griddle	LBES New SBES New Muni	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1b025 G21C2b025	Gas Griddle	LBES New SBES New	1.00	n/a	1.00	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>

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

Endnotes:
1: 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/

2.13. Food Service – Holding Cabinet

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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
E21C1b037 E21C2b037 E21C3b058	Full Size	LBES New SBES New Muni	0.50	2,737
E21C1b036 E21C2b036 E21C3b057	3/4 Size	LBES New SBES New Muni	0.20	1,095
E21C1b038 E21C2b038 E21C3b059	1/2 Size	LBES New SBES New Muni	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}
E21C1b037 E21C2b037 E21C3b058	Hot Food Holding Cabinet Full Size	LBES New SBES New Muni	1.00	1.00	1.00	1.00	1.00	0.90	0.90
E21C1b036 E21C2b036 E21C3b057	Hot Food Holding Cabinet 3/4 Size	LBES New SBES New Muni	1.00	1.00	1.00	1.00	1.00	0.90	0.90
E21C1b038 E21C2b038 E21C3b059	Hot Food Holding Cabinet Half Size	LBES New SBES New Muni	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 since programs include verification of equipment installations.

Realization Rates:

100% Realization Rates are assumed because savings are based on researched assumptions by ENERGY STAR.

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.

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/

2.14. Food Service – Ice Machine

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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.

kWh = kWh_baseline – kWh_ee
kW = kWh / hours

Where:
kWh = gross annual kWh savings from the measure.
kWh_baseline = annual kWh usage for the base case, based on ice harvest rate H. See table below.
kWh_ee = annual kWh usage for the efficient case, based on ice harvest rate H. See table below.
kW = gross average kW savings from the measure.
Hours = Average annual equipment operating hours, see Hours section below.

Energy Savings Inputs for Commercial Ice Machine [2]

BC Measure ID	Measure Name	Program	Daily Ice Harvest Rate, H (lb ice/24 hr)	Baseline Daily Energy Use (kWh/100 lb ice)[1]	Efficient Daily Energy Use (kWh/100 lb ice)[3]

E21C1b039 E21C2b039 E21C3b060	Ice Making Head	LBES New SBES New Muni New	H < 300	10 – 0.01233 x H	9.20 – 0.01134 x H
			300 ≤ H < 800	7.05 – 0.0025 x H	6.49 – 0.0023 x H
			800 ≤ H < 1500	5.55 – 0.00063 x H	5.11 – 0.00058 x H
			1500 ≤ H < 4000	4.61	4.24
E21C1b040 E21C2b040 E21C3b061	Self Contained Unit	LBES New SBES New Muni New	50 ≤ H < 1000	7.97 – 0.00342 x H	7.17 – 0.00308 x H
			1000 ≤ H < 4000	4.55	4.13
			H < 110	14.79 – 0.0469 x H	12.57 – 0.0399 x H
E21C1b041 E21C2b041 E21C3b062	Remote Condensing Unit (Batch)	LBES New SBES New Muni New	110 ≤ H < 200	12.42 – 0.02533 x H	10.56 – 0.0215 x H
			200 ≤ H < 4000	7.35	6.25
E21C1b042 E21C2b042 E21C3b063	Remote Condensing Unit (Continuous)	LBES New SBES New Muni New	H < 800	9.7 – 0.0058 x H	7.76 – 0.00464 x H
			800 ≤ H < 4000	5.06	4.05

Measure Life:

The measure life for a new ice making machine is 8 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}
E21C1b039 E21C2b039 E21C3b060	Ice Machine - Ice Making Head	LBES New SBES New Muni New	1.00	1.00	1.00	1.00	1.00	0.9	0.9
E21C1b040 E21C2b040 E21C3b061	Ice Machine - Remote Cond./Split Unit - Batch	LBES New SBES New Muni New	1.00	1.00	1.00	1.00	1.00	0.9	0.9

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1b041 E21C2b041 E21C3b062	Ice Machine - Remote Cond./Split Unit - Continuous	LBES New SBES New Muni New	1.00	1.00	1.00	1.00	1.00	0.9	0.9
E21C1b042 E21C2b042 E21C3b063	Ice Machine - Self Contained	LBES New SBES New Muni New	1.00	1.00	1.00	1.00	1.00	0.9	0.9

<u>In-Service Rates:</u>

All installations have 100% in service rate since programs include verification of equipment installations.

<u>Realization Rates:</u>

100% realization rates are assumed because savings are based on researched assumptions.

<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.

<u>**Endnotes**</u>:

1: 10 CFR 431.136. Effective January 28, 2018
2: FOOD SERVICE COMMERCIAL ICE MACHINE. SWFS006-01. (CA) December 2018.
3: ENERGY STAR Program Requirements For Automatic Commercial Ice Makers. V3.0.

2.15. Food Service – Oven

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 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	≥ 71%	≤ 1.60 kW
Electric	Combination Oven	≥ 55% steam mode ≥ 76% convection mode	≤ 0.133P+0.6400 kW steam mode ≤ 0.080P+0.4989 kW convection mode
Gas	Convection Oven	≥ 46%	≤ 12,000 Btu/hr
Gas	Combination Oven	≥ 41% steam mode ≥ 56% convection mode	≤ 200P + 6,511 Btu/hr steam mode ≤ 150P + 5,425 Btu/hr convection mode

Gas	Conveyer Oven		
Gas	Rack Oven	≥ 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.

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 = 4,390 hr/yr at 12 hr/day

Energy Savings for Commercial Ovens

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1b021 E21C2b021 E21C3b035	Electric Full Size Convection Oven	LBES New SBES New Muni New	0.70	2,787	n/a
E21C1b019 E21C2b019 E21C3b031	Electric Combination Oven	LBES New SBES New Muni New	3.50	15,095	n/a
G21C1b022 G21C2b022	Gas Convection Oven	LBES New SBES New	n/a	n/a	35.7
G21C1b021 G21C2b021	Gas Combination Oven	LBES New SBES New	n/a	n/a	110.3
G21C1b023 G21C2b023	Gas Conveyer Oven	LBES New SBES New	n/a	n/a	88.4
G21C1b026 G21C2b026	Gas Rack Oven	LBES New **SBES New**	n/a	n/a	211.3

Measure Life:

The measure life for a new commercial oven 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}
E21C1b021 E21C2b021 E21C3b035	Electric Convection Oven	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1b019 E21C2b019 E21C3b031	Electric Combination Oven	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1b022 G21C2b022	Gas Convection Oven	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b021 G21C2b021	Gas Combination Oven	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b023 G21C2b023	Gas Conveyer Oven	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b026 G21C2b026	Gas Rack Oven	LBES New SBES New	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.

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.

Endnotes:

1: ENERGY STAR Program Requirements for Commercial Ovens. Version 2.2. https://www.energystar.gov/sites/default/files/Commercial%20Ovens%20Final%20Version%202.2%20Specification.pdf
2: FSTC Life Cycle Savings Calculators https://fishnick.com/saveenergy/tools/calculators/

2.16. Food Service – Steam Cooker

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 requirements.

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 requirements.

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW	ΔMMBtu
E21C1b048 E21C2b048 E21C3b079	Electric Steam Cooker	LBES New SBES New Muni New	30,156	6.89	n/a
G21C1b027	Gas Steam Cooker	LBES New	n/a	n/a	370.7

G21C2b027		SBES New			

Quantity = Number of pans
Hours = Average annual equipment operating hours. See Hours section below.

Measure Life:

The measure life for a new steamer is 12 years.[1]

Other Resource Impacts:

Electric Steam Cooker: Deemed annual water savings.

Gas Steam Cooker: Deemed annual water savings.

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}
E21C1b048 E21C2b048 E21C3b079	Electric Steam Cooker	LBES New SBES New Muni New	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1b027 G21C2b027	Gas Steam Cooker	LBES New SBES 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

Endnotes:

1: 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/

2.17. Hot Water – Faucet Aerators

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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
E21C1a028 E21C1b031 E21C1d030 E21C2a028 E21C2b031 E21C2d030 E21C3a044 E21C3b045 E21C3d046	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
E21C3a045 E21C3b046 E21C3d047 G21C1a005 G21C1b017 G21C2a005 G21C2b017	Faucet Aerator	Gas	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro	n/a	n/a	1.7

			Muni New Muni DI			
E21C3a046 E21C3b047 E21C3d048	Faucet Aerator	Oil	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	n/a	n/a	1.7
E21C3a047 E21C3b048 E21C3d049	Faucet Aerator	Propane	**LBES Retro** **SBES Retro** **Muni Retro**	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}
E21C1a028 E21C1b031 E21C1d030 E21C2a028 E21C2b031 E21C2d030 E21C3a044 E21C3b045 E21C3d046	Faucet Aerator	**Electric**	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI	1.00	1.00	1.00	1.00	1.00	0.52	1.00
E21C3a045 E21C3b046 E21C3d047 G21C1a005 G21C1b017 G21C2a005 G21C2b017	Faucet Aerator	Gas	Muni Retro Muni New Muni DI LBES Retro LBES New SBES Retro SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a046 E21C3b047	Faucet Aerator	Oil	LBES Retro	1.00	n/a	1.00	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}
E21C3d048			SBES Retro Muni Retro							
E21C3a047 E21C3b048 E21C3d049	Faucet Aerator	Propane	LBES Retro SBES Retro Muni Retro	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 52% and a winter coincidence factor of 100% is utilized.[4]

Energy Load Shape:

See Appendix 1.

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

2.19. Hot Water – Showerheads

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Hot Water

Description:

Low-Flow Showerhead with Thermostatic Valve: Installation of a stand-alone thermostatic shut-off valve on stand flow showerhead.
Low-Flow Showerhead, Electric: Installation of a low-flow showerhead with thermostatic shut-off valve.
Low-Flow Showerhead, Gas: Installation of a low flow showerhead with a flow rate of 1.5 GPM or less in a commercial setting with service water heated by natural gas.

Baseline Efficiency:

Low-Flow Showerhead with Thermostatic Valve: The baseline efficiency is an existing standard-flow showerhead (2.5 GPM) with no thermostatic shut-off valve.
Low-Flow Showerhead, Electric: The baseline efficiency is an existing standard-flow showerhead (2.5 GPM) with no thermostatic shut-off valve.
Low-Flow Showerhead, Gas: The baseline efficiency case is a 2.5 GPM showerhead.

High Efficiency:

Low-Flow Showerhead with Thermostatic Valve: The high efficiency case is a standard flow showerhead (2.5 GPM) with the addition of a stand-alone thermostatic shut-off valve.
Low-Flow Showerhead, Electric: The high efficiency case is a low-flow showerhead (1.75 GPM) with the addition of a thermostatic shut-off valve.
Low-Flow Showerhead, Gas: The high efficiency case is a 1.5 GPM showerhead.

Algorithms for Calculating Primary Energy Impact:

Low-Flow Showerhead with Thermostatic Valve: Unit savings are deemed.[1] kW savings are calculated using the demand impact model.[2]

Low-Flow Showerhead, Electric and Low-Flow Showerhead, Gas: Unit savings are deemed. [3]

BC Measure ID	Measure Name	Fuel Type	ΔkWh	ΔkW	ΔMMBtu
E21C1a033 E21C1b044 E21C1d033 E21C2a033 E21C2b044 E21C2d033 E21C3a056 E21C3b066	Low-Flow Showerhead with Thermostatic Valve		69	0.01	n/a

E21C3d056 G21C1a006 G21C1b018 G21C2a006 G21C2b018					
E21C3a057 E21C3b067 E21C3d057	Low-Flow Showerhead	Electric	507	0.09	
E21C3a058 E21C3b068 E21C3d058	Low-Flow Showerhead	Gas	n/a	n/a	2.8
E21C3a059 E21C3b069 **E21C3d059**	Low-Flow Showerhead	Oil	n/a	n/a	2.8
E21C1a034 E21C1b045 E21C1d034 E21C2a034 E21C2b045 E21C2d034 E21C3a060 E21C3b070 E21C3d060 G21C1a007 G21C1b019 G21C2a007 G21C2b019	Low-Flow Showerhead	Propane	n/a	n/a	2.8

Measure Life:

The measure life for all Showerheads is 10 years. [4]

Other Resource Impacts:

Low-Flow Showerhead With Thermostatic Valve: Annual water savings of 558 gallons per unit.[1]

Low-Flow Showerhead, Electric and Low-Flow Showerhead, Gas: Annual water savings of 7,300 gallons per unit.[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}
E21C1a033 E21C1b044 E21C1d033 E21C2a033	Low-Flow Showerhead with	LBES Retro LBES New LBES DI SBES Retro	1.00	1.00	n/a	1.00	1.00	0.52	1.00

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C2b044 E21C2d033 E21C3a056 E21C3b066 E21C3d056 G21C1a006 G21C1b018 G21C2a006 G21C2b018	Thermostatic Valve, Electric	SBES New SBES DI Muni Retro Muni New Muni DI LBES Retro LBES New SBES Retro SBES New							
E21C3a057 E21C3b067 E21C3d057	Low-Flow Showerhead with Thermostatic Valve, Gas	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a058 E21C3b068 E21C3d058	Low-Flow Showerhead with Thermostatic Valve, Oil	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a059 E21C3b069 E21C3d059	Low-Flow Showerhead with Thermostatic Valve, Propane	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C1a034 E21C1b045 E21C1d034 E21C2a034 E21C2b045 E21C2d034 E21C3a060 E21C3b070 E21C3d060 G21C1a007 G21C1b019 G21C2a007 G21C2b019	Low-Flow Showerhead, Electric	LBES Retro LBES New LBES DI SBES Retro SBES New SBES DI Muni Retro Muni New Muni DI LBES Retro LBES New SBES Retro SBES New	1.00	1.00	n/a	1.00	1.00	0.52	1.00
E21C3a061 E21C3b071 E21C3d061	Low-Flow Showerhead, Gas	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a062 E21C3b072 E21C3d062	Low-Flow Showerhead, Oil	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a063 E21C3b073 E21C3d063	Low-Flow Showerhead, Propane	Muni Retro Muni New Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a

In-Service Rates:

All programs 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 52% and a winter coincidence factor of 100% is utilized.[2]

Energy Load Shape:

See Appendix 1.

Endnotes:

1: National Grid, 2014. Review of ShowerStart evolve. Calculation document provided in the MA TRM.
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: 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, 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: 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

2.20. HVAC – Boiler Reset Controls

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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 calculated as:

$$\Delta MMBtu/unit = CAP_{input} \times EFLH \times \frac{SF}{1000}$$

Where,
CAP_{input} = Boiler input capacity (MBH = MBtu/h)
EFLH = Equivalent full load heating hours
SF = Savings factor: 8% [1] or custom.

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu/unit
E21C3a019 E21C3d021 G21C1a010 G21C2a010	Boiler Reset Controls	Gas	Muni Retro Muni DI LBES Retro SBES Retro	Calculated
E21C3a020 E21C3d022	Boiler Reset Control	Oil	Muni Retro Muni DI	Calculated
E21C3a021 E21C3d023	Boiler Reset Control	Propane	Muni Retro Muni DI	Calculated

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	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C3a019 E21C3d021 G21C1a010 G21C2a010	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
E21C3a020 E21C3d022	Boiler Reset Control	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a021 E21C3d023	Boiler Reset Control	Propane	Muni Retro Muni DI	1.00	n/a	1.00	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.

<u>Endnotes</u>:
1: Savings factor is the estimate of annual gas consumption that is saved due to adding boiler reset controls. The CLEAResult uses a boiler tune up savings value derived from Xcel Energy "DSM Biennial Plan-Technical Assumptions," Colorado. Focus on Energy uses 8%, citing "Michigan Energy Measures Database". Vermont Energy Investment Corporation's boiler reset savings estimates for custom projects further indicate 8% savings estimate is better reflection of actual expected savings.
2: ACEEE, 2006. Emerging Technologies Report: Advanced Boiler Controls.

2.21. HVAC – Circulator Pump

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

Description:

Circulator Pump: Single-phase circulator pumps up 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	$\Delta kW = 0.245 * HP_{rated} + 0.02$	$\Delta kWh = 1{,}325 * HP_{rated} + 111$
<= 1 HP	Service Hot Water	$\Delta kW = 0.245 * HP_{rated} + 0.02$	$\Delta kWh = 2{,}780 * HP_{rated} + 233$
> 1 HP	Hydronic Heating	$\Delta kW = 0.265$	$\Delta kWh = 1{,}436$
> 1 HP	Service Hot Water	$\Delta kW = 0.265$	$\Delta kWh = 3{,}013$

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:[3]

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1b018 E21C2b018 E21C3b030	Circulator Pump	LBES New SBES New Muni New	1.00	1.00	n/a	n/a	n/a	0.00	0.53

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 82% and a winter coincidence factor of 5% are utilized.[3]

Energy Load Shape:

See Appendix 1.

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-Joint-Utilities_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

2.22. HVAC – Cooler Night Cover

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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

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}
E21C1a017 E21C1d019 E21C2a017 E21C2d019 E21C3a023 E21C3d025	Cooler Night Covers	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	1.00	n/a	0.00	0.00	0.00	0.00

In-Service Rates:

All installation have 100% in-service rate since all programs require verification of equipment installation.

Realization Rates:

Realization rate is 100% for energy savings and 0% for peak demand savings since night cover usage occurs outside of peak demand hours.

Coincidence Factors:

Coincidence factors are 0.00 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-Life-Study_MA-Joint-Utilities_ERS.pdf

2.23. HVAC- Demand Control Ventilation

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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.

Baseline Efficiency:

The baseline efficiency case assumes the relevant HVAC equipment has no ventilation control.

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:

The energy and demand savings are calculated using the following algorithms and inputs:

$$\Delta kWh = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times Save_{kWh}$$

$$\Delta kW = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times Save_{kW}$$

Where:

$kBtuh$ = Capacity of the cooling equipment in kBtu per hour

$Save_{kW}$ = Average annual kWh reduction per ton of cooling capacity: 170 kWh/ton [1]

$Save_{kW}$ = Average kW reduction per ton of cooling capacity: 0.15 kW/ton [2]

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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1a018 E21C1d020 E21C2a018 E21C2d020 E21C3a024 E21C3d026	Demand Control Ventilation	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	1.01	n/a	1.09	1.57	0.82	0.05

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Realization Rates are from an impact evaluation of 2006 HVAC installations and impact evaluation of 2007/2008 installations. [4]

<u>Coincidence Factors:</u>

CFs are based on Massachusetts TRM standard assumptions.

Energy Load Shape:

Appendix 1 – "C&I Heating and Cooling"

<u>Endnotes</u>:

1: Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid.

2: Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid.

3: 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/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf

4: RLW Analytics, 2008. Business & Construction Solutions (BS/CS) Programs Measurement & Verification 2006 Final Report. Prepared for NSTAR; Table 17.

2.24. HVAC- Dual Enthalpy Economizer Controls

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

Description:

The measure is to upgrade the outside-air dry-bulb economizer to a dual enthalpy economizer. 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 with a fixed dry-bulb 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:

$$\Delta kWh = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kWh}$$

$$\Delta kW = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kW}$$

Where:

kBtu/h = Capacity of the cooling equipment in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h)

$SAVE_{kW}$ = Average annual kWh reduction per ton of cooling capacity: 289 kWh/ton [1]

$SAVE_{kW}$ = Average kW reduction per ton of cooling capacity: 0.289 kW/ton [2]

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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1a020 E21C1d022 E21C2a020 E21C2d022 E21C3a026 E21C3d028	Dual Enthalpy Economizer Controls	LBES Retro LBES DI SBES Retro SBES DI MES Retro MES DI	1.00	1.00	n/a	1.00	1.00	0.33	0.00

In-Service Rates:

All installations have a 100% in-service rate unless an evaluation finds otherwise.

Realization Rates:

Realization Rates are the same as for the Unitary AC measure.

Coincidence Factors:

Coincidence factors are based on 2011 NEEP C&I Unitary AC Loadshape Project [4]

Energy Load Shape:

See Appendix 1 – "C&I Heating and Cooling".

Endnotes:

1, 2: Patel, Dinesh, 2001. Energy Analysis: Dual Enthalpy Control. Prepared for Eversource (NSTAR).

3: 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

4: KEMA, August 2011. C&I Unitary HVAC Loadshape Project - Final Report. Prepared for the Regional Evaluation, Measurement & Verification Forum. https://neep.org/sites/default/files/resources/NEEP_HVAC_Load_Shape_Report_Final_August2_0.pdf

2.25. HVAC – Duct Insulation

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

Description:

For existing ductwork in non-conditioned spaces, insulate ductwork. This could include replacing un-insulated 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 insulated ductwork in unconditioned spaces.

Algorithms for Calculating Primary Energy Impact:

Deemed average annual MMBtu savings of 0.13 [1] are assumed per unit.

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}
E21C3a027 E21C3d029	Duct Insulation	Electric	Muni Retro Muni DI	1.00	1.00	1.00	1.00	1.00	0.35	0.00
E21C3a028 E21C3d030	Duct Insulation	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a029 E21C3d031	Duct Insulation	Oil	Muni Retro Muni DI	1.00	n/a	1.00	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}
E21C3a030 E21C3d032	Duct Insulation	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:

A summer coincidence factor of 35% is utilized.[2]

Energy Load Shape:

See Appendix 1.

Endnotes:

1: National Grid Staff Estimate, 2010. MA SBS-DI Duct Sealing and Insulation Scenario and Deemed Savings. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee4885c6996f2b5047df743/view?authToken=fa8e547661bf80dea8750ffa5a1d3608215165882ceaf6ebc0b7193a1ab071622426a78ec0a491b80535c621447604a03ab75d3119793c326860fd96007eec8b851ba43c196fab

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

2.26. HVAC – Duct Sealing

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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).

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:
Δ MMBtu = MMBtu/unit x Units
Where:
Unit = Number of square feet of ductwork treated
MMBtu/unit = Average annual MMBtu savings per unit: 0.13[1]

Measure Life:

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}
E21C1a021 E21C1d023 E21C2a021 E21C2d023 E21C3a031 E21C3d033	Duct Sealing	Electric	LBES Retro LBES DI SBES Retro SBES DI	1.00	1.00	1.00	1.00	1.00	0.35	0.00

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							
E21C3a032 E21C3d034	Duct Sealing	Gas	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a033 E21C3d035	Duct Sealing	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a034 E21C3d036	Duct Sealing	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:

A summer coincidence factor if 35% is utilized.[2]

Energy Load Shape:

See Appendix 1.

Endnotes:

1: National Grid Staff Estimate, 2010. MA SBS-DI Duct Sealing and Insulation Scenario and Deemed Savings. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee4885c6996f2b5047df743/view?authToken=19819e606c75814de7e2d8af2fec676653fdc0f39f9bd79f566ee687c4851bcdb91e2216408550e53766db986dc9c0640b2776bb702f79b7f56a42e07d73a2cebf5c6abfb39bd1

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

2.27. HVAC – Energy Management System

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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 assumes the relevant HVAC equipment has no centralized control.

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
E21C1a025 E21C1d027 E21C2a025 E21C2d027 E21C3a038 E21C3d040	Energy Management System	Gas	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	0.001277
E21C1a025 E21C1d027 E21C2a025 E21C2d027 E21C3a038 E21C3d040	Energy Management System	Oil	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	0.002496

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}
E21C1a025 E21C1d027 E21C2a025 E21C2d027 E21C3a038 E21C3d040	Energy Management System	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	1.00	1.00	1.00	1.00	0.95	1.00

<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>

A summer coincidence factor of 95% and a winter coincidence factor of 100% is utilized.[3]

Energy Load Shape:

See Appendix 1.

Endnotes:
1: Descriptions of the EMS savings calculation tools are included in the MA TRM Library "C&I Spreadsheet Tools" folder.
2: The Fleming Group, 1994. Persistence of Commercial/Industrial Non-Lighting Measures, Volume 3, Energy Management Control Systems. Prepared for New England Power Service Company.
3: New Hampshire common assumptions.

2.28. HVAC – Heat and Hot Water Combo Systems

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

Description:

Combo Condensing Furnace / Water Heater: Installation of a combination furnace.
Combo Condensing Boiler / Water Heater: This measure promotes the installation of a combined high-efficiency 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 standard efficiency 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
G21C1b012 G21C2b012	Combo Condensing Furnace/Water Heater, Gas	15.1
G21C1b011 G21C2b011	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}
G21C1b012 G21C2b012	Combo Condensing Furnace/Water Heater, Gas	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b011 G21C2b011	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% 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.

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-Impact-Evaluation-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-in-MA.pdf

2.29. HVAC – Heating Systems - Boilers

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

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% AFUE boiler.

High Efficiency:

High efficiency is per table of efficiency thresholds below.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results. [1]

BC Measure ID	Measure Name	Program	ΔMMBtu
G21C1b010 G21C2b010	<= 300 MBH (0.95 TE)	LBES New SBES New	17.7
G21C1b009 G21C2b009	<= 300 MBH (0.90 TE)	LBES New SBES New	14.7
G21C1b008 G21C2b008	301-499 MBH (0.90 TE)	LBES New SBES New	28.0
G21C1b007 G21C2b007	500-999 MBH (0.90 TE)	LBES New SBES New	51.4
G21C1b006 G21C2b006	1000-1700 MBH (0.90 TE)	LBES New SBES New	94.5
G21C1b005 G21C2b005	1701+ MBH (0.90 TE)	LBES New SBES New	165.3

Measure Life:

The measure life is 25 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}
G21C1b010 G21C2b010	<= 300 MBH (0.95 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b009 G21C2b009	<= 300 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b008 G21C2b008	301-499 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b007 G21C2b007	500-999 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b006 G21C2b006	1000-1700 MBH (0.90 TE)	LBES New SBES New	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1b005 G21C2b005	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: DNV GL, NMR, March 2017. Gas Boiler Market Characterization Study Phase II. Prepared for Massachusetts Program Administrators and Energy Efficiency Advisory Council. http://ma-eeac.org/wordpress/wp-content/uploads/Gas-Boiler-Market-Characterization-Study-Phase-II-Final-Report.pdf

2: ASHRAE Applications Handbook, 2003; Page 36.3.

2.30. HVAC – Heating Systems – Condensing Unit Heaters

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

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 calculated as:

$$\Delta MMBtu = \frac{CAP}{OF} \times \left(\frac{EFLH}{1000}\right) x \; (\frac{1}{\eta_b} - \frac{1}{AF \times \eta_{ee}})$$

Where,
CAP = Installed capacity of the heater (KBtu/hr)
OF = Oversize factor. 1.15 for single installation and 1.3 for multiple installations.[2]
EFLH = Equivalent heating full load hours.
η_b = Efficiency of the baseline heater. 0.8.[1]
AF = Adjustment factor. 0.97.[2]
η_{ee} = Proposed heater efficiency. As installed with 0.9 minimum.

BC Measure ID	Measure Name	Program	ΔMMBtu
G21C1b013 G21C2b013	Condensing Unit Heater (<= 300 MBH)	MES LBESS	Calculated

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}
G21C1b013 G21C2b013	Condensing Unit Heater	MES New LBES 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: 2012 International Energy Conservation Code
2: Connecticut Program Savings Document, 2020. Measure 2.2.6. Natural Gas Fired Boilers and Furnaces.
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

2.31. HVAC – Heating Systems – Furnaces

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

Description:

The installation of a high efficiency natural gas warm air furnace with an electronically commutated motor (ECM) for the fan. High efficiency furnaces are better at converting fuel into direct heat and better insulated to reduce heat loss. ECM fan motors significantly reduce fan motor electric consumption as compared to both shaped-pole and permanent split capacitor motors.

Baseline Efficiency:

The baseline efficiency in an 85% AFUE furnace.

High Efficiency:

The high efficiency scenario assumes either a gas-fired furnace equal or higher than 95% AFUE or 97% AFUE.

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results. [1]

BC Measure ID	Measure Name	Program	ΔMMBtu	ΔkWh	ΔkW
G21C1b014 G21C2b014	Furnace, 95%	LBES New SBES New	5.7	168	0.124
G21C1b015 G21C2b015	Furnace, 97%	LBES New SBES New	6.7	168	0.124

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}
G21C1b014 G21C2b014	Furnace, 95%	LBES New SBES New	1.00	1.00	1.00	n/a	n/a	0.00	0.16
G21C1b015 G21C2b015	Furnace, 97%	LBES New SBES New	1.00	1.00	1.00	n/a	n/a	0.00	0.16

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 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-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

2.32. HVAC – Heating Systems – Infrared Heater

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

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%.

High Efficiency:

The high efficiency case is a gas-fired low-intensity infrared heating unit.

Algorithms for Calculating Primary Energy Impact:

Unit savings are calculated as:

$$\Delta MMBtu = \frac{kBtu}{hr_{input}} \times \frac{EFLH_{heating}}{1000} \times \left(1 - \frac{HDD_{55}\,(55 - T_{design})}{HDD_{65}\,(55 - T_{design})}\right)$$

Where,

$\frac{kBtu}{hr_{input}}$ = Fuel input rating of the installed equipment

$EFLH_{heati}$ = Heating equivalent full-load hours

HDD_{55} = Heating degree days with 55-degree bases

HDD_{65} = Heating degree days with 65-degree base

T_{design} = Equipment design temperature

Alternatively, unit savings are deemed based on study results. [1]

BC Measure ID	Measure Name	Fuel Type	Program	ΔMMBtu
G21C1b016 G21C2b016	Infrared Heaters	Gas	LBES New SBES New	12.0

Measure Life:

The measure life is 17 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}
G21C1b016 G21C2b016	Infrared Heaters	Gas	LBES New SBES New	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: KEMA, June 2013. Impact Evaluation of 2011 Prescriptive Gas Measures; Page 1-5. http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-of-2011-Prescription-Gas-Measures-6.27.13.pdf

2: Nexant, 2006. DSM Market Characterization Report. Prepared for Questar Gas.

2.33. HVAC – High Efficiency Chiller

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

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 Massachusetts State Building Code. As described in Chapter 13 of the aforementioned document, energy efficiency must be met via compliance with the International Energy Conservation Code (IECC) 2015.

The table below details the specific efficiency requirements by equipment type and capacity.

Chiller - Minimum Efficiency Requirements [1]:

	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
	≥ 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

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.

High Efficiency:

The high efficiency scenario assumes water chilling packages that exceed the efficiency levels required by Massachusetts 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.

Air-Cooled Chillers:
$kWh = Tons * (12/ EER_{BASE} - 12/ EER_{EE}) * Hours$
$kW = Tons * (12/ EER_{BASE} - 12/ EER_{EE})$

Water-Cooled Chillers:
$kWh = Tons * (kW/ ton_{BASE} - kW/ ton_{EE}) * Hours$
$kW = Tons * (kW/ ton_{BASE} - kW/ ton_{EE}) * (LF/100)$

Where:
Tons = Rated capacity of the cooling equipment
EER_{BASE} = Energy Efficiency Ratio of the baseline equipment. See table below for values.
EER_{EE} = Energy Efficiency Ratio of the efficient equipment. Site-specific.
kW/ton_{BASE} = Energy efficiency rating of the baseline equipment. See table below for values.
kW/ton_{EE} = Energy efficiency rating of the efficient equipment. Site-specific.
Hours = Equivalent full load hours for chiller operation

Measure Life:

The measure life is 23 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}
E21C1b052 E21C2b053 E21C3b084	Chillers – IPLV used	LBES New SBES New Muni New	All	1.00	n/a	1.00	1.00	0.49	0.06
E21C1b052 E21C2b052 E21C3b083	Chillers – FL used	LBES New SBES New Muni New	All	1.00	n/a	1.00	1.00	0.86	0.10

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Realization rates are based on Massachusetts prospective results from 2015 prescriptive chiller study.[3] Prospective results are to be used in parallel with updated savings factors, as described above, from the same study

<u>Coincidence Factors:</u>

Coincidence factors are based on prospective statewide results from 2015 prescriptive chiller study. [3]

Energy Load Shape:

See Appendix 1.

Endnotes:
1: Energy Solutions, 2018. Northeast Chillers Market Research.
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: 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

2.34. HVAC – Hotel Occupancy Sensor

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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:
$\Delta kWh = SAVE_{kWh}$
$\Delta kW = SAVE_{kW}$

Where:
Unit = Installed hotel room occupancy sensor
$SAVE_{kWh}$ = Average annual kWh reduction per unit: 438 kWh [1]
$SAVE_{kW}$ = Demand reduction per unit: 0.09 kW [2]

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}
E21C1d031 E21C2a031 E21C2d031 E21C3a050 E21C3d050	Hotel Occupancy Sensor	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	All	1.00	1.00	1.00	1.00	0.82	0.05

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 82% for summer peak and 5% for winter peak.[3]

Energy Load Shape:

See Appendix 1.

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

2.35. HVAC – Pipe Wrap

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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:

Unit savings are deemed based on study results.[1, 2] 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 Name	Program	ΔkWh	ΔkW	ΔMMBtu per linear foot
Pipe Wrap – Heating (Steam), Gas, <= 1.5"	LBES Retro SBES Retro Muni Retro Muni DI			0.229
Pipe Wrap – Heating (Steam), Gas, 3"	LBES Retro SBES Retro Muni Retro Muni DI			0.371
Pipe Wrap – Hot Water, Gas, <= 1.5"	LBES Retro SBES Retro Muni Retro Muni DI			0.206
Pipe Wrap – Hot Water, Gas, 3"	LBES Retro SBES Retro Muni Retro Muni DI			0.361
Pipe Wrap – Heating, Electric (Residential End Use)	LBES Retro SBES Retro SBES DI Muni Retro Muni DI	Calculated	Calculated	
Pipe Wrap – Hot Water, Electric (Residential End Use)	LBES Retro SBES Retro SBES DI Muni Retro Muni DI	129	0.03	

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:[4]

BC Measure ID	Measure Name	Fuel Type	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1a038 E21C1d038 E21C2d038 E21C3a067 E21C3d067	Pipe Wrap – Heating	Electric	LBES Retro SBES Retro SBES DI Muni Retro Muni DI	1.00	1.00	1.00	1.00	1.00	0.00	0.433
G21C1a013 G21C2a013 E21C3a068 E21C3d068	Pipe Wrap – Heating	Gas	LBES Retro SBES Retro Muni Retro Muni DI	1.00	n/a	1.00	n/	n/a	n/a	n/a
E21C3a069 E21C3d069	Pipe Wrap – Heating	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/	n/a	n/a	n/a
E21C3a070 E21C3d070	Pipe Wrap – Heating	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/	n/a	n/a	n/a
E21C1a039 E21C1d039 E21C2a039 E21C2d039 E21C3a071 E21C3d071	Pipe Wrap – Water Heating	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	1.00	1.00	1.00	1.00	0.312	0.808
G21C1a008 G21C2a008 E21C3a072 E21C3d072	Pipe Wrap – Water Heating	Gas	LBES Retro SBES Retro Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a073 E21C3d073	Pipe Wrap – Water Heating	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/	n/a	n/a	n/a
E21C3a074 E21C3d074	Pipe Wrap – Water Heating	Propane	Muni Retro Muni DI	1.00	n/a	1.00	n/	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 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.[4]

Energy Load Shape:

See Appendix 1.

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=962981283a7d38ac721edb179c5b7bf83c006a08da8c2f38866e381295963d8580eab751291c33061971c75a15dc0166f2c592d030d479cbaf9f7aa54c0ecbf2fc61aac2f00300

2: The Cadmus Group, July 2012. Massachusetts Multifamily Program Impact Analysis July 2012 – Revised May 2013. https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/5ee4885a6996f2cca27df73e/view?authToken=c3f41e9663355f5cba1ed024ab30ea4536bb2244f8e59bbbb2456444aad0600f2a7cd274d4a1ed7bdf33fa580f77ea7fb83e6341e0a43e7d5f9b52e5a311a397d19c852102c00d

3: 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

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

2.36. HVAC- Steam Traps

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	HVAC

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	ΔMMBtu
G21C1a014 G21C2a014	Steam Trap	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	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
G21C1a014 G21C2a014	Steam Trap	LBES Retro SBES Retro	1.00	1.00	1.00	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.

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 – "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://ma-eeac.org/wordpress/wp-content/uploads/MA-CIEC-Two-Tier-Steam-Traps-Memo-FINAL.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://ma-eeac.org/wordpress/wp-content/uploads/MA-2013-Prescriptive-Gas-Impact-Evaluation-Steam-Trap-Evaluation-Phase-1.pdf

2.38. HVAC – Thermostat – Wi-Fi Communicating

Measure Code	
Market	Commercial
Program Type	Retrofit
Category	HVAC

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
E21C1a026 E21C1d028 E21C2a026 E21C2d028 E21C3a039 E21C3d041	Wi-Fi Thermostat	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	794	1.26	n/a
E21C3a040 E21C3d042 G21C1a016 G21C2a016	Wi-Fi Thermostat	Gas	Muni Retro Muni DI LBES Retro SBES Retro	n/a	n/a	9.86
E21C3a041 E21C3d043	Wi-Fi Thermostat	Oil	Muni Retro Muni DI	n/a	n/a	9.86
E21C3a042 E21C3d044	Wi-Fi Thermostat	Propane	Muni Retro Muni DI	n/a	n/a	9.86

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}
E21C1a026 E21C1d028 E21C2a026 E21C2d028 E21C3a039 E21C3d041	Wi-Fi Thermostat	Electric	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	1.00	n/a	1.00	1.00	0.346	0.0
E21C3a040 E21C3d042 G21C1a016 G21C2a016	Wi-Fi Thermostat	Gas	Muni Retro Muni DI LBES Retro SBES Retro	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3d043	Wi-Fi Thermostat	Oil	Muni Retro Muni DI	1.00	n/a	1.00	n/a	n/a	n/a	n/a
E21C3a042 E21C3d044	Wi-Fi Thermostat	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 have a 100% 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”

Endnotes:
1: 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
(MA) This study is specifically applicable to residential settings and references New England RECS data. The savings values reported in this document use the same savings percentages as the “Best Fit for

Massachusetts" line (2.0% of whole building electric energy use and 4.5% of whole building gas energy use), applied to the average electric and fuel consumption of a commercial building located in New England that is 5,000 sq ft or less, as is likely to be the applicable building type for this style of thermostat. This is 219 MMBtu/yr fuel use and 39,700 kWh/yr electric use, as calculated using 2012 CBECS data[4]

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/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf

4: US EIA, 2016. 2012 CBECS microdata. Accessible in CSV and SAS format at https://www.eia.gov/consumption/commercial/data/2012/index.php?view=microdata

2.39. HVAC – Unitary Air Conditioner

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

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:
$\Delta kWh = (kBtu/h)\ (1/\ SEER_{BASE} - 1/\ SEER_{EE})\ (EFLH_{Cool})$
$\Delta kW = (kBtu/h)\ (1/\ EER_{BASE} - 1/\ EER_{EE})$

For units with cooling capacities equal to or greater than 65 kBtu/h and EER available:
$\Delta kWh = (kBtu/h)\ (1/\ EER_{BASE} - 1/\ EER_{EE})\ (EFLH_{Cool})$
$\Delta kW = (kBtu/h)\ (1/\ EER_{BASE} - 1/\ EER_{EE})$

For units with cooling capacities equal to or greater than 65 kBtu/h and IEER available:
$\Delta kWh = (kBtu/h)\ (1/\ IEER_{BASE} - 1/\ IEER_{EE})\ (HoursCool)$ $\Delta kWh = (kBtu/h)\ (1/\ IEER_{BASE} - 1/\ IEER_{EE})$

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
EER_{BASE} = Energy Efficiency Ratio of the baseline equipment
EER_{EE} = Energy Efficiency Ratio of the energy efficient equipment
$IEER_{BASE}$ = Integrated Energy Efficiency Ratio of the baseline equipment
$IEER_{EE}$ = Integrated Energy Efficiency Ratio of the energy efficient equipment
HoursCool = Annual Cooling Hours

The baseline efficiency values are based on the IECC 2015.[1]

Size (Btu/h)	**Units with Electric Resistance of No Heating**	**Units with Heating Section Other Than Electric Resistance**
< 65,000	13.0 SEER (Split System) 14.0 SEER (Single Package)	13.0 SEER (Split System) 14.0 SEER (Single Package)
≥65,000 and <135,000	11.2 EER 12.8 IEER	11.0 EER 12.6 IEER
≥135,000 and <240,000	11.0 EER 12.4 IEER	10.8 EER 12.2 IEER
≥240,000 and <760,000	10.0 EER 11.6 IEER	9.8 EER 11.4 IEER
≥760,000	9.7 EER 11.2 IEER	9.5 EER 11.0 IEER

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}
E21C2b049 E21C3b080	Unitary Air Conditioner	All	1.00	1.00	1.00	1.00	1.00	0.33	0.00

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:

A summer coincidence factor of 33% is utilized.[2]

Energy Load Shape:

See Appendix 1.

Endnotes:

1: 2015 IECC (CT Code) Table C403.2.3(1).

2: 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

2.40. Lighting – Controls

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Lighting

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:

<u>For retrofit applications:</u>
ΔkWh = Controlled_kW × Hours_base × (%_sav)
ΔkW = (Controlled_kW)

Where:
Controlled_kW = controlled fixture wattage
Hours_base = total annual hours that the connected kW operated in the pre-retrofit case
%_sav = percentage of kWh that is saved by utilizing this control measure, as shown in the study-informed deemed savings table below.[1]

Control Type	% Savings Factor
Lighting Controls – Daylighting Dimming	0.28
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[4]
0.15 = deemed fraction of time at low power[4]
0.28 = unit conversion between kW and tons of refrigeration
Eff_RS = efficiency of typical refrigeration system, with deemed values 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	1.6	kW/ton	5
	Large business	1.9	kW/ton	

Measure Life:

The table below provides measure life for control measures.[2,4]

BC Measure ID	Measure Name	Program	Measure Life
E21C1a009 E21C1b009 E21C1d011	Daylight Dimming	C1 - Large Business Energy Solutions	9
E21C1a014 E21C1b014 E21C1d016	Lighting Occupancy Sensors	C1 - Large Business Energy Solutions	9
E21C2a009 E21C2b009 E21C2d011	Daylight Dimming	C2 - Small Business Energy Solutions	9
E21C2a014 E21C2b014 E21C2d016	Lighting Occupancy Sensors	C2 - Small Business Energy Solutions	9
E21C3a009 E21C3b009 E21C3d011	Daylight Dimming	C3 - Municipal Energy Solutions	9
E21C3a014 E21C3b014 E21C3d016	Lighting Occupancy Sensors	C3 - Municipal Energy Solutions	9
E21C4a009	Daylight Dimming	C4 - Energy Rewards RFP Program	9
E21C4a014	Lighting Occupancy Sensors	C4 - Energy Rewards RFP Program	9
	Refrigerated Case Occupancy Sensor		8

Other Resource Impacts:

Heating penalties for large C&I occupancy sensors are from a 12-month MA data logging study.[5] Penalties for small business and municipal programs are from the 2018 MA small business lighting impact evaluation.[7]

BC Measure ID	Measure Name	Program	MMBtu/kWh
E21C1a009 E21C1b009 E21C1d011 E21C1a014 E21C1b014 E21C1d016	Lighting controls	Large Business Energy Solutions, Energy Rewards RFP Program	-0.000691

E21C4a009 E21C4a014			
E21C2a009 E21C2b009 E21C2d011 E21C2a014 E21C2b014 E21C2d016 E21C3a009 E21C3b009 E21C3d011 E21C3a014 E21C3b014 E21C3d016	Lighting controls	Small Business Energy Solutions, Municipal Energy Solutions	-0.004080
	Exterior lighting	C1, C2, C3, C4	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}
E21C1a009 E21C1b009 E21C1d011	Daylight Dimming	C1 - Large Business Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.15	0.13
E21C1a014 E21C1b014 E21C1d016	Lighting Occupancy Sensors	C1 - Large Business Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.15	0.13
E21C2a009 E21C2b009 E21C2d011	Daylight Dimming	C2 - Small Business Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.17	0.13
E21C2a014 E21C2b014 E21C2d016	Lighting Occupancy Sensors	C2 - Small Business Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.17	0.13
E21C3a009 E21C3b009 E21C3d011	Daylight Dimming	C3 - Municipal Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.17	0.13
E21C3a014 E21C3b014 E21C3d016	Lighting Occupancy Sensors	C3 - Municipal Energy Solutions	1.00	1.00	1.00	1.00	1.00	0.17	0.13

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C4a009	Daylight Dimming	C4 - Energy Rewards RFP Program	1.00	1.00	1.00	1.00	1.00	0.15	0.13
E21C4a014	Lighting Occupancy Sensors	C4 - Energy Rewards RFP Program	1.00	1.00	1.00	1.00	1.00	0.15	0.13
	Refrigerated Case Occupancy Sensor		1.00	1.00	1.00	1.00	1.00	0.15	0.15

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.[9, 10]
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.[4]

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.[6] For large businesses, coincidence factors are based on a MA impact evaluation of the large C&I prescriptive lighting program.[5] For refrigerated case lighting controls, coincidence factors are based on a CA DEER workpaper.[4]

Energy Load Shape:

Energy load shapes are based on site-level metering of project sites in MA.[8]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	33.7%	30.1%	18.4%	17.7%
Exterior Lighting	19.2%	20.1%	29.0%	31.6%

Endnotes:
1: DNV KEMA, October 27, 2014. Retrofit Lighting Controls Measures Summary of Findings. Final Report. (MA). http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Retrofit-Control-Measures-Final-Report.pdf

2: 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
3: Pacific Northwest National Laboratory, October 2009. Demonstration Assessment of Light-Emitting Diode (LED) Freezer Case Lighting.
https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/gateway_freezer-case.pdf
4: Southern California Edison, January 2016. Refrigerated Case Door Aisle Traffic Sensor. Work paper SCE13CS003, revision 2.. http://www.deeresources.net/workpapers
5: DNV KEMA, June 21, 2013. Impact Evaluation of 2010 Prescriptive Lighting Installations. (MA) http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-of-2010-Prescriptive-Lighting-Installations-Final-Report-6-21-13.pdf
6: Cadmus Group, October 23, 2012. Small Business Direct Install Program: Pre/Post Lighting Occupancy Sensor
Study. (MA) Available as appendix C-1 in http://ma-eeac.org/wordpress/wp-content/uploads/Massachusetts-Small-Business-Direct-Install_2010-2012-Impact-Evaluations-1.29.13.pdf
7: DNV GL, ERS, June 7, 2018. Impact Evaluation of PY2016 Small Business Initiative: Phase I http://ma-eeac.org/wordpress/wp-content/uploads/P69-Impact-Eval-of-MA-Small-Business-Initiative-Phase-I-Lighting_Report_FINAL.pdf
8: DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings.
9: 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%.
10: 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.

2.41. Lighting – Exterior

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Lighting

Description:

This measure provides savings for the installation of efficient exterior lighting, including LED and efficient fluorescent fixtures.

Baseline Efficiency:

For retrofit cases, the baseline efficiency is project-specific and is determined using actual fixture counts from the existing space.

The baseline efficiency case for new construction is code-compliant lighting and controls as mandated by the New Hampshire Building Code, which currently reflects IECC 2015 and ASHRAE Standard 90.1-2013.

High Efficiency:

The high efficiency case for both retrofit and lost opportunity applications is project-specific and is determined using the actual fixture counts and proposed operating wattages for the project.

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = \left(\sum_{i=1}^{n} ((Count\_i * Watts\_i / 1000)_{BASE}) - \sum_{j=1}^{n} (Count\_j * Watts\_j/1000)_{EE} \right) \times (Hours)$

$\Delta kW = \sum_{i=1}^{n} ((Count_i * Wattsi / 1000)BASE) - \sum_{j=1}^{n} (Countj * Wattsj/1000)EE)$

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.

For lost opportunity installations, the annual hours of operation are typically 4,380 hr/yr, unless the fixture is exempt from code requirements for photocell controls.

Measure Life:

The table below includes measure lives for exterior lighting fixtures.[1]

BC Measure ID	Measure Name	Program	Measure Life
E21C1b010 E21C1a010 E21C1d012	Lighting Fixture - Exterior w/ Controls	C1 - Large Business Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C1b011 E21C1a011 E21C1d013	Lighting Fixture - Exterior w/o Controls	C1 - Large Business Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C2b010 E21C2a010 E21C2d012	Lighting Fixture - Exterior w/ Controls	C2 - Small Business Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C2b011 E21C2a011 E21C2d013	Lighting Fixture - Exterior w/o Controls	C2 - Small Business Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C3b010 E21C3a010 E21C3d012	Lighting Fixture - Exterior w/ Controls	C3 - Municipal Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C3b011 E21C3a011 E21C3d013	Lighting Fixture - Exterior w/o Controls	C3 - Municipal Energy Solutions	15 (New Equipment and Construction) 13 (Retrofit) 10 (Direct Install)
E21C4a010	Lighting Fixture - Exterior w/ Controls	C4 - Energy Rewards RFP Program	13
E21C4a011	Lighting Fixture - Exterior w/o Controls	C4 - Energy Rewards RFP Program	13
	Parking Lot Lighting		15
	Street Lights		15

Other Resource Impacts:

Because exterior lighting involves no HVAC interactivity, 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}
E21C1b010 E21C1a010	Lighting Fixture - Exterior w/ Controls	C1 - Large Business Energy Solutions	1.00	0.968	n/a	1.00	1.00	0.00	1.00
E21C1b011 E21C1a011	Lighting Fixture - Exterior w/o Controls	C1 - Large Business Energy Solutions	1.00	0.968	n/a	1.00	1.00	0.00	1.00
E21C2b010 E21C2a010	Lighting Fixture - Exterior w/ Controls	C2 - Small Business Energy Solutions	1.00	102.7	n/a	1.00	1.00	0.00	1.00
E21C2b011 E21C2a011	Lighting Fixture - Exterior w/o Controls	C2 - Small Business Energy Solutions	1.00	102.7	n/a	1.00	1.00	0.00	1.00
E21C3b010 E21C3a010	Lighting Fixture - Exterior w/ Controls	C3 - Municipal Energy Solutions	1.00	102.7	n/a	1.00	1.00	0.00	1.00
E21C3b011 E21C3a011	Lighting Fixture - Exterior w/o Controls	C3 - Municipal Energy Solutions	1.00	102.7	n/a	1.00	1.00	0.00	1.00
E21C4a010	Lighting Fixture - Exterior w/ Controls	C4 - Energy Rewards RFP Program	1.00	0.968	n/a	1.00	1.00	0.00	1.00
E21C4a011	Lighting Fixture - Exterior w/o Controls	C4 - Energy Rewards	1.00	0.968	n/a	1.00	1.00	0.00	1.00

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
		RFP Program							
	Parking Lot Lighting		1.00	0.968	n/a	1.00	1.00	0.00	1.00
	Street Lights		1.00	0.968	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:

Realization rates are based on a 2020 CT Lighting Impact Evaluation and NH evaluation results for municipal and small business facilities, not including adjustments made for HVAC interactivity.[2, 3]

Coincidence Factors:

Summer and winter coincidence factors are set to 0% and 100%, respectively, based on NH evaluation recommendations.[3]

Energy Load Shape:

Energy load shapes are based on site-level metering of project sites in MA.[4]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Exterior Lighting	19.2%	20.1%	29.0%	31.6%

Endnotes:

1: ERS. November 2005. Measure Life Study. November 17, 2005. https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf (MA)

2: DNV GL, Aug 2020. C1635 Impact Evaluation of PY 2016 & 2017 Energy Opportunities Program, Final Report, Aug 3, 2020, Tables 5-2, 5-3, and 5-20. https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports

Note: Large Business and RFP Program kWh realization rates are based on lighting savings analysis, not including interactive adjustments, as exterior lighting equipment does not incur interactive effects.

3: 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

4: DNV GL, March 2018. P72 Prescriptive C&I Loadshapes of Savings.

2.42. Lighting - Retrofit

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Lighting

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).

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.

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:

$\Delta kWh =(\sum_{i=1}^{n} ((Count_{\_i} * Watts_{\_i} /1000)_{BASE})- \sum_{j=1}^{n} (Count_{\_j} * Watts_{\_j}/1000)_{EE})) \times (Hours)$

$\Delta kW = \sum_{i=1}^{n} ((Count_i * Watts_i /1000)_{BASE})- \sum_{j=1}^{n} (Count_j * Watts_j/1000)_{EE})$

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.[1]

Measure Life:

The table below summarizes the adjusted measure lives (AML) for each measure. Note these AML values account for the estimated fraction of program lighting measures that are assumed to be lost opportunity (replace on failure) vs. retrofit (early replacement) based on MA evaluation research, as well as an outyear factor (accounting for future, naturally occurring adoption of LEDs) that calculates the second-period savings of early replacement dual baseline measures.[2]

BC Measure ID	Measure Category	Measure	AML
	Ambient Linear	TLED	10.53
	Ambient Linear	LED Fixture	10.99
	High/Low Bay	TLED	12.81
	High/Low Bay	LED Fixture	12.84
	High/Low Bay	LED Lamp	12.56
	Exterior/Outdoor	TLED	10.12
	Exterior/Outdoor	LED Fixture	10.18
	Exterior/Outdoor	LED Lamp	9.74
	Screw-Based	A-Line	4.69
	Screw-Based	Downlight/Track	5.86
	Screw-Based	Decorative	3.78

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
E21C4a004 E21C1a004 E21C3a004 E21C2a004	Interior lighting	RFP, LBES, MES, SBES	-0.000691
E21C3a004 E21C2a004	Interior lighting (turnkey)	MES, SBES	-0.004080

E21C4a015 E21C1a047 E21C3a091 E21C2a047	Exterior lighting (both non-turnkey and turnkey)	RFP, LBES, MES, SBES	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}
E21C4a004 E21C1a004 E21C3a004 E21C2a004	Lighting Systems - Interior	RFP, LBES, MES, SBES	1.00	1.066	1.135	1.00	0.504	0.389
E21C4a015 E21C1a047 E21C3a091 E21C2a047	Lighting Systems - Exterior	RFP, LBES, MES, SBES	1.00	1.027	1.00	1.00	0.00	1.00
E21C3a004 E21C2a004	Lighting Systems - Interior (Turnkey)	MES, SBES	1.00	1.066	1.135	1.00	0.504	0.389
E21C3a091 E21C2a047	Lighting Systems - Exterior (Turnkey)	MES, SBES	1.00	1.027	1.00	1.00	0.00	1.00

<u>In-Service Rates:</u>

All downstream installations have 100% in service rate since programs include verification of equipment installations.

<u>Realization Rates:</u>

Realization rates are based on NH evaluation results for municipal and small business facilities.[5] 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.

<u>Coincidence Factors:</u>

Summer and winter coincidence factors are based on NH evaluation results.[5, 6]

Energy Load Shape:

Energy load shapes are based on site-level metering of project sites in MA.[7]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	33.7%	30.1%	18.4%	17.7%
Exterior Lighting	19.2%	20.1%	29.0%	31.6%

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 GL, April 6, 2020. MA19C14-E-LGHTMKT: 2019 C&I Lighting Inventory and Market Model Updates. http://ma-eeac.org/wordpress/wp-content/uploads/MA19C14-E-LGHTMKT_2019-CI-Lighting-Inventory-and-Market-Model-Report_Final_2020.04.06.pdf
3: DNV KEMA, June 21, 2013. Impact Evaluation of 2010 Prescriptive Lighting Installations. http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-of-2010-Prescriptive-Lighting-Installations-Final-Report-6-21-13.pdf
4: DNV GL, ERS, June 7, 2018. Impact Evaluation of PY2016 Small Business Initiative: Phase I http://ma-eeac.org/wordpress/wp-content/uploads/P69-Impact-Eval-of-MA-Small-Business-Initiative-Phase-I-Lighting_Report_FINAL.pdf
5: 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
6: 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
7: DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings.

2.66. Lighting – New Construction and Major Renovation

Measure Code	TBD
Market	Commercial
Program Type	Lost opportunity
Category	Lighting

Description:

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 2015 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 × LPD_proposed_i) × Area_i × Hours_i × 1/1000)

$\Delta kWFixture \sum_{i=1}^{n}$ ((LPD_base_i - LPD_proposed_i) × 1/1000 × Area_i × 1/1000)

$\Delta kWControlled = \sum_{i=1}^{n}$ (LPD_proposed_i × Area_i × 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
LPD_proposed_i = Proposed lighting power density for building or space type i (Watts/ft^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.

Measure Life:

Measure lives are deemed based on study results from MA.[1]

BC Measure ID	Measure Name	Program	Measure Life
E21C1b013 E21C2b013 E21C3b013 E21C4a013	Performance Lighting (Interior)	RFP, LBES, MES, SBES	15
E21C1b011 E21C2b011 E21C3b011 E21C4a011	Performance Lighting (Exterior)	RFP, LBES, MES, SBES	15
E21C1b012 E21C2b012 E21C3b012 E21C4a012	Performance Lighting w/ controls (Interior)	RFP, LBES, MES, SBES	12
E21C1b010 E21C2b010 E21C3b010 E21C4a010	Performance Lighting w/ controls (Exterior)	RFP, LBES, MES, SBES	12

Other Resource Impacts:

Heating penalties are from alighting program evaluation performed on lighting systems in Massachusetts.[2]

BC Measure ID	Measure Name	Program	MMBtu/kWh
E21C1b012 E21C2b012 E21C3b012 E21C4a012 E21C1b013 E21C2b013 E21C3b013 E21C4a013	Performance lighting (interior) w/ and w/out controls	RFP, LBES, MES, SBES	-0.000162279

E21C1b010 E21C2b010 E21C3b010 E21C4a010 E21C1b011 E21C2b011 E21C3b011 E21C4a011	Performance lighting (exterior) w/ and w/out controls	RFP, LBES, MES, SBES	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}
E21C1b012 E21C2b012 E21C3b012 E21C4a012 E21C1b013 E21C2b013 E21C3b013 E21C4a013	Performance lighting (interior) w/ and w/out controls	RFP, LBES, MES, SBES	1.0	106.6%	100.0%	1.135	1.00	0.504	0.389
E21C1b010 E21C2b010 E21C3b010 E21C4a010 E21C1b011 E21C2b011 E21C3b011 E21C4a011	Performance lighting (exterior) w/ and w/out controls	RFP, LBES, MES, SBES	1.0	102.7%	100.0%	100.0%	100.0%	0.00%	100.0%

<u>In-Service Rates:</u>

All installations have a 100% in service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Energy and demand realization rates are based on a NH study of municipal and small business customers.[3] Realization rates for summer peak demand savings in interior systems reflect a 113.5% HVAC interactive multiplier.

<u>Coincidence Factors:</u>

All coincidence factors are based on a NH study of municipal and small business customers.[3]

Energy Load Shape:

Energy load shapes are based the MA P72 C&I loadshape study.[4]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	34.3%	30.3%	18.1%	17.4%
Exterior Lighting	19.2%	20.1%	29.0%	31.6%

Endnotes:

1: DNV GL, ERS, July 22, 2019. Lighting Outyear Factor and Equivalent Measure Life. http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Outyear-Factor-and-Equivalent-Measure-Life-Update_Final.pdf
2: DNV GL, ERS, NMR, November 22, 2017. Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative http://ma-eeac.org/wordpress/wp-content/uploads/Upstream-Lighting-Initiative-Impact-Evaluation-PY2015.pdf
3: 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
4: DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings
5: 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

2.44. Motors & Drives - Variable Frequency Drive

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	Motors and Drives

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, air or water volume/temperature is controlled using valves, dampers, and/or reheats.

High Efficiency:

In the high efficiency case, pump flow or fan air volume is directly controlled using downstream information. The pump or fan will automatically adjust its speed based on inputted set points and the downstream feedback it receives.

Algorithms for Calculating Primary Energy Impact:

$$\Delta kWh = HP \times \frac{kWh}{HP} \times \frac{1}{\eta}$$

$$\Delta kW_{SP} = HP \times \frac{kW_{SP}}{HP} \times \frac{1}{\eta}$$

$$\Delta kW_{WP} = HP \times \frac{kW_{WP}}{HP} \times \frac{1}{\eta}$$

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] and kW/HP) [2]

Building Type	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
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
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	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
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:

For lost-opportunity installations, the lifetime is 15 years. For retrofit, the lifetime is 13 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	Program	ISR	RR$_E$	RR$_{NE}$	RR$_{SP}$	RR$_{WP}$	CF$_{SP}$	CF$_{WP}$
E21C1a043 E21C1d043 E21C2a043 E21C2d043 E21C3a087 E21C3d087	Variable Frequency Drive	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	0.86	n/a	0.86	0.86	1.00	1.00
E21C1a044 E21C1d044 E21C2a044 E21C2d044 E21C3a088 E21C3d088	Variable Frequency Drive with Motor	LBES Retro LBES DI SBES Retro SBES DI Muni Retro Muni DI	1.00	0.86	n/a	0.86	0.86	1.00	1.00

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>Realization Rates:</u>

Realization rates are based on study results.[4]

<u>Coincidence Factors:</u>

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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 VFD (Combined)".

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: 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

4: Navigant Consulting, 2018. Multi-Family Program Impact and Net-to-Gross Evaluation estimates based on Chan, Tumin (2010). Formulation of a Prescriptive Incentive for the VFD and Motors & VFD impact tables at NSTAR. Prepared for NSTAR.

2.45. Plug Load – Advanced Power Strip

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Appliances

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' 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 study results.[1]

BC Measure ID	Measure Name	Program	ΔkWh	ΔkW
E21C1b015	Advanced Power Strip	LBES – New Equipment	153	0.017
E21C2b015	Advanced Power Strip	SBES – New Equipment	153	0.017
E21C3b015	Advanced Power Strip	Muni – New Equipment	153	0.017

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}
E21C1b015	Advanced Power Strip	LBES – New Equipment	0.76	0.92	n/a	0.92	0.92	0.58	0.86
E21C2b015	Advanced Power Strip	SBES – New Equipment	0.76	0.92	n/a	0.92	0.92	0.58	0.86
E21C3b015	Advanced Power Strip	Muni – New Equipment	0.76	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:

Summer and winter Coincidence Factors are estimated using demand allocation methodology described in the Navigant Demand Impact Model.[4]

Energy Load Shape:

See Appendix 1 – "Primary TV and Peripherals".

Endnotes:

1: NMR Group, Inc. (2019). Advanced Power Strip Metering Study (RLPNC17-3). Energy savings calculated based on weighted average consumption (449 kWh/yr) and energy reduction factor (34%).
2: New Hampshire Common Assumption
3: NMR Group, Inc. (2018). Products Impact Evaluation of In-service and Short-Term Retention Rates Study (RLPNC 17-4/5).
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

2.46. Refrigeration - Case Motor Replacement

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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}
E21C1a016	Case Motor Replacement	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1d018	Case Motor Replacement	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2a016	Case Motor Replacement	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2d018	Case Motor Replacement	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3a016	Case Motor Replacement	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3d018	Case Motor Replacement	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 a coincidence factor of 100% since demand savings are average and expected to be consistent.

Energy Load Shape:

See Appendix 1 – "C&I Refrigeration".

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.

2.47. Refrigeration – Door Heater Controls

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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:

$$\Delta kW = \frac{\mathrm{V} \times \mathrm{A}}{1{,}000} \times \%Off$$
$$\Delta kWh = \Delta kW \times 8{,}760$$

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}
E21C1a019	Door Heater Controls	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.50	1.00
E21C1d021	Door Heater Controls	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.50	1.00
E21C2a019	Door Heater Controls	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.50	1.00
E21C2d021	Door Heater Controls	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.50	1.00
E21C3a025	Door Heater Controls	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.50	1.00
E21C3d027	Door Heater Controls	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	0.50	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:

The CF values are based on MA TRM[3] until NH-specific evaluations are available.

Energy Load Shape:

See Appendix 1 – "C&I Refrigeration"

Endnotes:

1: Calculated by NRM based on several pre- and post-meter readings of installations.
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

2.48. Refrigeration – Electric Defrost Control

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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 (1.6 kW/ton) [2]
ΔkW = Average demand savings
8,760 = Hours per year

Measure Life:

The measure life is 9 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}
E21C1a024	Electronic Defrost Control	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1d026	Electronic Defrost Control	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2a024	Electronic Defrost Control	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2d026	Electronic Defrost Control	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3a037	Electronic Defrost Control	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3d039	Electronic Defrost 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 set coincident factors to 100% since demand savings are average and expected to be consistent.

Energy Load Shape:

See Appendix 1 – "C&I Refrigeration"

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: Assumed average refrigeration efficiency for typical installations. 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.

3: Energy & Resource Solutions (2005). Measure Life Study – refrigeration controls for large C&I retrofit. Prepared for The Massachusetts Joint Utilities.

2.49. Refrigeration – Evaporator Fan Control

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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, 46%[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 (1.6 kW/ton) [3]

ΔkW = Average demand savings
8,760 = Hours per year

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	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1a027	Evaporator Fan Control	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1d029	Evaporator Fan Control	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2a027	Evaporator Fan Control	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2d029	Evaporator Fan Control	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3a043	Evaporator Fan Control	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3d045	Evaporator Fan Control	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00

<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>

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 Refrigeration"

Endnotes:
1: Conservative value based on 15 years of NRM field observations and experience.

2: The value is an estimate by NRM based on hundreds of downloads of hours of use data. These values are also supported by Select Energy Services, Inc. (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR
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: Energy & Resource Solutions (2005). Measure Life Study – fan control retrofit. Prepared for The Massachusetts Joint Utilities.

2.50. Refrigeration – Novelty Cooler Shutoff

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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:

$$\Delta kWh = kW_{NC} \times \mathrm{DC}_{\mathrm{AVG}} \times (Hours_{UNOCC} - 1) \times 365$$
$$\Delta kW = 0$$

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

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}
E21C1a037	Novelty Cooler Shutoff	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C1d037	Novelty Cooler Shutoff	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C2a037	Novelty Cooler Shutoff	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C2d037	Novelty Cooler Shutoff	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C3a066	Novelty Cooler Shutoff	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C3d066	Novelty Cooler Shutoff	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	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>

Coincidence factors are zero since all energy savings occur during off-peak hours.

Energy Load Shape:

See Appendix 1.

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.

2.51. Refrigeration – Vending Miser

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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:

$$\Delta kWh = kW_{rated} \times Hours \times SAVE$$
$$\Delta kW = \frac{\Delta kWh}{8760}$$

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	25%
Glass Front Refrigerated Coolers	0.46	35%

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}
E21C1a045	Vending Miser	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C1d045	Vending Miser	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C2a045	Vending Miser	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C2d045	Vending Miser	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C3a089	Vending Miser	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	0.00	0.00
E21C3d089	Vending Miser	Electric	Muni – Direct Install	1.00	1.00	n/a	1.00	1.00	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>

Coincidence factors are 0.00 since energy savings occur during off-peak hours (hours of vending machine inactivity).

Energy Load Shape:

See Appendix 1 – “24 hour operation”.

<u>Endnotes</u>:

1: EnergyMisers – Reducing Energy Use for Vending Machines, Coolers and other Electronic Devices (2020). https://www.energymisers.com/#:~:text=VM2iQ,Learn%20More. Accessed 6/8/2020.

2: Energy & Resource Solutions (2005). Measure Life Study – vending control retrofit. Prepared for The Massachusetts Joint Utilities.

2.52. Refrigeration – ECM Evaporator Fan Motors for Walk-in Coolers and Freezers

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Retrofit
Category	Refrigeration

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 65%[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 (1.6 kW/ton) [1]
ΔkW = Average demand savings
8,760 = Hours per year

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:

BC Measure ID	Measure Name	Fuel	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1a023	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	LBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1d025	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	LBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2a023	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	SBES - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C2d025	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	SBES – Direct Install	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3a036	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	Electric	Muni - Retrofit	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C3d038	ECM Evaporator Fan Motors for Walk-in Cooler/Freezer	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 set coincident factors to 100% since demand savings are average and expected to be consistent.

Energy Load Shape:

See Appendix 1 – "C&I Refrigeration"

Endnotes:
1: Conservative value based on 15 years of NRM field observations and experience.
2: Load factor is an estimate by NRM based on several pre- and post-meter readings of installations; the value is supported by RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.
3: Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; 15-year measure life for retrofit motor installations.

2.53. Midstream Hot Water – Water Heaters

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	**Hot Water**

Description:

- Midstream Heat Pump Water Heater 120 gallons
- Midstream Heat Pump Water Heater 80 gallons.
- Midstream Heat Pump Water Heater 50 gallons.
- Midstream Indirect Water Heater, Gas: Indirect water heaters use a storage tank that is heated by the main boiler. The energy stored by the water tank allows the boiler to turn off and on less often, saving considerable energy.
- Midstream On Demand Tankless Water Heater, Gas: Tankless water heaters circulate water through a heat exchanger to be heated for immediate use, eliminating the standby heat loss associated with a storage tank.
- Midstream Volume Water Heater, Gas: Installation of a high-efficiency gas-fired water heater.

Baseline Efficiency:

All Water Heaters: The baseline efficiency case assumes compliance with the efficiency requirements as mandated by Massachusetts State Building Code. As described in the MA State Building Code, energy efficiency must be met via compliance with the relevant International Energy Conservation Code (IECC).

- Midstream Heat Pump Water Heater
- Midstream Indirect Water Heater: For indirect water heaters the baseline is a hot water boiler operating at 78% recovery efficiency. Additionally, a baseline storage water heater was assumed for purposed of estimating standby losses. [1]
- Midstream On Demand Tankless Water Heater, Gas: For on-demand tankless water heaters the baseline is a code-compliant gas-fired storage water heater with EF = 0.61.[1]
- Midstream Volume Water Heater, Gas: The assumed baseline is a code specified 80% TE volume 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

Algorithms for Calculating Primary Energy Impact:

Unit savings are deemed based on study results.

BC Measure ID	Measure Name	Program	ΔkWh	ΔMMBtu	ΔMMBtu / Mbtuh
E21C1c044 E21C2c044	Midstream Heat Pump Water Heater, 120 gallons	LBES Mid SBES Mid			
E21C1c046 E21C2c046	Midstream Heat Pump Water Heater, 80 gallons	LBES Mid SBES Mid			
E21C1c045 E21C2c045	Midstream Heat Pump Water Heater, 50 gallons	LBES Mid SBES Mid			
G21C1c009 G21C2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid		19.0	
G21C1c010 G21C2c010	Midstream on Demand Tankless Water Heater	LBES Mid SBES Mid		8.9	
G21C1c011 G21C2c011	Midstream Volume Water Heater	LBES Mid SBES Mid			0.6077

Measure Life:

BC Measure ID	Measure Name	Program	Measure Life
E21C1c044 E21C2c044 E21C1c045 E21C2c045 E21C1c046 E21C2c046	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	
G21C1c009 G21C2c009	Midstream Indirect Water Heater:	LBES Mid SBES Mid	15 [3]
G21C1c010 G21C2c010	Midstream on Demand Tankless Water Heater, Gas:	LBES Mid SBES Mid	20 [4]
G21C1c011 G21C2c011	Midstream Volume Water Heater, Gas:	LBES Mid SBES Mid	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}
E21C1c044 E21C2c044	Midstream Heat Pump Water Heater, 120 gallons	LBES Mid SBES Mid	1.00	1.00	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}
E21C1c046 E21C2c046	Midstream Heat Pump Water Heater, 80 gallons	LBES Mid SBES Mid	1.00	1.00	n/a	n/a	n/a		
E21C1c045 E21C2c045	Midstream Heat Pump Water Heater, 50 gallons	LBES Mid SBES Mid	1.00	1.00	n/a	n/a	n/a		
G21C1c009 G21C2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1c010 G21C2c010	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
G21C1c011 G21C2c011	Midstream Volume Water Heater, Gas	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):[5]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
E21C1c044 E21C2c044 E21C1c045 E21C2c045 E21C1c046 E21C2c046	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	18.2%	7.6%	0.0%	89.4%
G21C1c009 G21C2c009	Midstream Indirect Water Heater	LBES Mid SBES Mid	18.2%	7.6%	0.0%	89.4%
G21C1c010 G21C2c010	Midstream on Demand Tankless Water Heater	LBES Mid SBES Mid	18.2%	7.6%	0.0%	89.4%
G21C1c011 G21C2c011	Midstream Volume Water Heater	LBES Mid SBES Mid	18.2%	7.6%	0.0%	89.4%

Endnotes:
1: 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
2: Savings for indirect water heaters are based on: KEMA, June 27, 2013. Impact Evaluation of 2011 Prescriptive Gas Measures Final Report. http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-of-2011-Prescription-Gas-Measures-6.27.13.pdf
For volume and tankless water heaters, savings are based on: Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures. 2019 Plan-Year Report Version. May 2020.
3: GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks; Table B-2a, measure C-WH-16. http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-in-MA.pdf
4: 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
5: 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. Midstream Lighting

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity/Retrofit
Category	Lighting

Description:

This measure includes 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:

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:

The high efficiency case is project-specific and is determined using actual fixture counts for the project and the delta watt values in the table below.

Algorithms for Calculating Primary Energy Impact:

$\Delta kWh = n * (DeltaWatts/1000) * Hours$

$\Delta kW = n * DeltaWatts /1000$

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.[2]

Product	Product Type	delta Watts[2]
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
Decoratives	Screw-In LEDs	13.6
LED Retrofit kit, <25W	Screw-In LEDs	38.4

LED Retrofit kit, >25W	Screw-In LEDs	56.6
Stairwell Kit, Low-Output w/sensor	LED Stairwell Kits	19.2
Stairwell Kit, Mid-Output w/sensor	LED Stairwell Kits	40.0
G24 LED	Screw-In LEDs	15.3
G23 LED	Screw-In LEDs	8.4
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
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.[3] 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 of the midstream measures. Note these AML values account for the estimated fraction of program lighting measures that are assumed to be lost opportunity (replace on failure) vs. retrofit (early replacement) based on MA evaluation research, as well as an outyear factor (accounting for future, naturally occurring adoption of LEDs) that calculates the second-period savings of early replacement dual baseline measures.[4]

BC Measure ID	Measure Category	Measure	Program	AML
E21C1c015 E21C2c015	Ambient Linear	TLED	LBES Midstream, SBES Midstream	10.53
E21C1c013 E21C2c013 E21C1c014 E21C2c014	Ambient Linear	LED Fixture	LBES Midstream, SBES Midstream	10.99
E21C1c012 E21C2c012	High/Low Bay	TLED	LBES Midstream, SBES Midstream	12.81
E21C1c012 E21C2c012	High/Low Bay	LED Fixture	LBES Midstream, SBES Midstream	12.84
E21C1c012 E21C2c012	High/Low Bay	LED Lamp	LBES Midstream, SBES Midstream	12.56
E21C1c011 E21C2c011	Exterior/Outdoor	TLED	LBES Midstream, SBES Midstream	10.12
E21C1c011 E21C2c011	Exterior/Outdoor	LED Fixture	LBES Midstream, SBES Midstream	10.18
E21C1c011 E21C2c011	Exterior/Outdoor	LED Lamp	LBES Midstream, SBES Midstream	9.74
E21C1c016 E21C2c016	Screw-Based	A-Line	LBES Midstream, SBES Midstream	4.69
E21C1c010 E21C2c010	Screw-Based	Downlight/Track	LBES Midstream, SBES Midstream	5.86
	Screw-Based	Decorative	LBES Midstream, SBES Midstream	3.78

Other Resource Impacts:

The following heating penalties are associated with lighting projects, determined from MA lighting evaluations.[5]

BC Measure ID	Measure Name	Program	MMBtu/kWh
E21C1c010 E21C2c010	LED Downlight	LBES Midstream, SBES Midstream	-0.000329
E21C1c011 E21C2c011	LED Exterior	LBES Midstream, SBES Midstream	N/A
E21C1c012 E21C2c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	-0.000162
E21C1c013 E21C2c013	LED Linear Fixture	LBES Midstream, SBES Midstream	-0.000162
E21C1c014 E21C2c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	-0.000162
E21C1c015 E21C2c015	LED Linear Lamp	LBES Midstream, SBES Midstream	-0.000162
E21C1c016 E21C2c016	LED Screw In	LBES Midstream, SBES Midstream	-0.000329
E21C1c017 E21C2c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	N/A

Impact Factors for Calculating Adjusted Gross Savings:[3 5]

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1c010 E21C2c010	LED Downlight	LBES Midstream, SBES Midstream	0.859	1.267	1.00	1.00	0.70	0.49
E21C1c011 E21C2c011	LED Exterior	LBES Midstream, SBES Midstream	0.955	0.989	1.00	1.00	0.00	1.00
E21C1c012 E21C2c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	0.996	0.747	1.00	1.00	0.83	0.65
E21C1c013 E21C2c013	LED Linear Fixture	LBES Midstream, SBES Midstream	0.971	1.135	1.00	1.00	0.83	0.65
E21C1c014 E21C2c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	0.971	1.135	1.00	1.00	0.83	0.65

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1c015 E21C2c015	LED Linear Lamp	LBES Midstream, SBES Midstream	0.971	1.135	1.00	1.00	0.83	0.65
E21C1c016 E21C2c016	LED Screw In	LBES Midstream, SBES Midstream	0.714	1.712	1.00	1.00	0.70	0.49
E21C1c017 E21C2c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	0.955	0.989	1.00	1.00	0.82	0.82

In-Service Rates:

In-service rates are based on the C1635 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program Report.[3]

Realization Rates:

Realization rates are based on the C1635 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program Report. [3] The HVAC interaction adjustment factor is determined from MA[3, 4] and CT[8] lighting project evaluations.

Coincidence Factors:

Summer and winter coincidence factors are based on MA 2017 Upstream Lighting Impact evaluation.[5] 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.[6]

Measure Name	Summer On-peak	Winter On-peak	Summer Off-peak	Winter Off-peak
Interior Lighting	33.7%	30.1%	18.4%	17.7%
Exterior Lighting	19.2%	20.1%	29.0%	31.6%

Impact Factors for Calculating Net Savings:

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.[7]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c010 E21C2c010	LED Downlight	LBES Midstream, SBES Midstream	50%	23%	0%	73%
E21C1c011 E21C2c011	LED Exterior	LBES Midstream, SBES Midstream	50%	23%	0%	73%

E21C1c012 E21C2c012	LED High Bay/Low Bay	LBES Midstream, SBES Midstream	50%	23%	0%	73%
E21C1c013 E21C2c013	LED Linear Fixture	LBES Midstream, SBES Midstream	27%	11%	0%	84%
E21C1c014 E21C2c014	LED Linear Fixture with Controls	LBES Midstream, SBES Midstream	27%	11%	0%	84%
E21C1c015 E21C2c015	LED Linear Lamp	LBES Midstream, SBES Midstream	27%	11%	0%	84%
E21C1c016 E21C2c016	LED Screw In	LBES Midstream, SBES Midstream	50%	23%	0%	73%
E21C1c017 E21C2c017	LED Stairwell Kit	LBES Midstream, SBES Midstream	50%	23%	0%	73%

Endnotes

1: The blend of retrofit and lost opportunity lighting was determined based on MA evaluation results. See DNV GL (2015) Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative, Massachusetts Program Administrators and Energy Efficiency Advisory Council, November 22, 2017 http://ma-eeac.org/wordpress/wp-content/uploads/Upstream-Lighting-Initiative-Impact-Evaluation-PY2015.pdf

2: C&I Upstream Lighting Program. Mass Saves. Available at: https://www.masssave.com/en/learn/partners/upstream-lighting/

3: DNV GL, June 30, 2020, C1653 Impact Evaluation of PY 2016 and 2017 Energy Opportunities (EO) Program. Prepared for Connecticut Energy Efficiency Board (EEB). Available at: https://www.energizect.com/connecticut-energy-efficiency-board/evaluation-reports

4: DNV GL, April 6, 2020. MA19C14-E-LGHTMKT: 2019 C&I Lighting Inventory and Market Model Updates. http://ma-eeac.org/wordpress/wp-content/uploads/MA19C14-E-LGHTMKT_2019-CI-Lighting-Inventory-and-Market-Model-Report_Final_2020.04.06.pdf. Table 3-7.

5: DNV GL, November 22, 2017. Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative. http://ma-eeac.org/wordpress/wp-content/uploads/Upstream-Lighting-Initiative-Impact-Evaluation-PY2015.pdf

6: DNV GL (2018). P72 Prescriptive C&I Loadshapes of Savings.

7: EMI, September 25, 2019 . C1644 EO Net-to-Gross Study, Final Report (Table ES-1-1, and Recommendation 1 on p. 51). To separate the contribution of free-ridership and spillover to these NTG values, we used a proportion equivalent to the levels of free-ridership (40%) and spillover (23%) found for screw-based LEDs in 2020.

2.55. Midstream HVAC

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	HVAC

Description:

Midstream Heat Pump Systems: This measure includes the installation of 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.

Midstream VRF Systems: This measure includes in the installation of high-efficiency variable flow refrigerant (VRF) heat pumps.

Midstream Circulator Pump: Single-phase circulator pumps up used in C&I buildings used for hydronic heating and system hot water.

Midstream Demand Control Ventilation (DCV): The measure controls the quantity of outside air to an air handling system based on detected space CO2 levels. The installed systems monitor the CO2 in the spaces or return air and reduce the outside air use when possible to save energy while \meeting indoor air quality standards.

Midstream Dual Enthalpy Economizer Controls: The measure is to upgrade the outside-air dry-bulb economizer to a dual enthalpy economizer. 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.

Midstream Unitary Air Conditioners: 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:

Midstream Heat Pump Systems: 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.

Midstream Heat Pump Systems: 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.

Midstream Circulator Pump: 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.

<u>Midstream Demand Control Ventilation (DCV):</u> The baseline efficiency case assumes the relevant HVAC equipment has no ventilation control.

<u>Midstream Dual Enthalpy Economizer Controls:</u> The baseline efficiency case for this measure assumes the relevant HVAC equipment is operating with a fixed dry-bulb economizer.

<u>Midstream Unitary Air Conditioners:</u> The baseline efficiency case for new installations assumes compliance with the efficiency requirements as mandated by Massachusetts State Building Code.

High Efficiency:

<u>Midstream Heat Pump Systems:</u> The high efficiency 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.

<u>Midstream VRF Systems:</u> The high efficiency case is the site-specific VRF heat pump unit.

<u>Midstream Circulator Pump:</u> The high efficiency case is a circulator pump with an ECM.

<u>Midstream Demand Control Ventilation (DCV):</u> The high efficiency case is the installation of an outside air intake control based on CO2 sensors.

<u>Midstream Dual Enthalpy Economizer Controls:</u> 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.

<u>Midstream Unitary Air Conditioners:</u> 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:

<u>Midstream Heat Pump Systems:</u> 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:
ΔkW = Gross annual demand savings for heat pump unit
Cap_{cool} = Cooling capacity (in kBtu/h) of the energy efficient heat pump unit, from equipment specifications
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

The algorithm for calculating annual electric energy savings is:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

For ductless mini split heat pumps

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate ductless mini split heat pump
$Cap_{heat} = Cap_{cool} \times 0.9$ for all other ductless mini split heat pump

For water source and ground source heat pumps

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{hea} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

$$Cap_{hea} = Cap_{cool} \times \left(\frac{HSPF_{EE}}{EER_{EE}}\right)$$

Where:
ΔkWh_{cool} = Gross annual cooling savings for heat pump unit
ΔkWh_{heat} = Gross annual heating savings for heat pump unit
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 equation to convert from cooling capacity value if standard equipment literature does not provide this value.
$SEER_{BASE}$ = Seasonal Energy Efficiency Ratio of baseline heat pump equipment
$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of energy efficient heat pump unit, from equipment specifications
$HSPF_{BASE}$ = 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
$EFLH_{heat}$ = Equivalent Full Load Hours for heating
0.9 = Conversion factor[1] to convert cooling capacity to heating capacity for ductless mini split heat pump units not on NEEP's cold climate air source heat pump (ccASHP) product list. The conversion factor for ccASHPs is 1.0.

Heat Pump Type	Cooling Capacity Range	Parameter	Value	Units
	≤65,000 Btu/h	EER_{BASE}	12.72[1]	Btu/W-h

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Ductless Mini Split		$SEER_{BASE}$	14.00[2]	Btu/W-h
		$HSPF_{BASE}$	8.20[2]	Btu/W-h
Water Source	<17,000 Btu/h	EER_{BASE}	12.20[2]	Btu/W-h
		$HSPF_{BASE}$	14.67[2]	Btu/W-h
	≥17,000 Btu/h	EER_{BASE}	13.00[2]	Btu/W-h
		$HSPF_{BASE}$	14.67[2]	Btu/W-h
Ground Source (Open Loop)	All Sizes	EER_{BASE}	18.00[2]	Btu/W-h
		$HSPF_{BASE}$	12.62[2]	Btu/W-h
Ground Source (Closed Loop)	All Sizes	EER_{BASE}	14.1[2]	Btu/W-h
		$HSPF_{BASE}$	10.91[2]	Btu/W-h
All		$EFLH_{cool}$	755[3]	hours
		$EFLH_{heat}$	1329[3]	hours

Midstream VRF Systems: 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:
ΔkW = 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:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{IEER_{BASE}} - \frac{1}{IEER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = \frac{Cap_{hea}}{3.412} \times \left(\frac{1}{COP_{BASE}} - \frac{1}{COP_{EE}}\right) \times EFLH_{heat}$$

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.
$IEER_{BASE}$ = Integrated Energy Efficiency Ratio of baseline VRF equipment
$IEER_{EE}$ = Integrated Energy Efficiency Ratio of energy efficient VRF unit
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

VRF System Type	Parameter	Value[4]
Air Cooled	EER_{BASE}	11
	$IEER_{BASE}$	12.9
	COP_{BASE}	3.3
Water Cooled	EER_{BASE}	12
	$IEER_{BASE}$	16.0
	COP_{BASE}	4.2

Midstream Circulator Pump: Savings depend on application and pump size as described in table below[5].

Size	Type	ΔkW	ΔkWh
<= 1 HP	Hydronic Heating	$\Delta kW = 0.245 * HP_{rated} + 0.02$	$\Delta kWh = 1{,}325 * HP_{rated} + 111$
	Service Hot Water	$\Delta kW = 0.245 * HP_{rated} + 0.02$	$\Delta kWh = 2{,}780 * HP_{rated} + 233$
> 1 HP	Hydronic Heating	ΔkW = 0.265	ΔkWh = 1,436
	Service Hot Water	ΔkW = 0.265	ΔkWh = 3,013

Midstream Demand Control Ventilation (DCV): Gross energy and demand savings for implementation of demand control ventilation are custom calculated. Alternatively, the energy and demand savings may be calculated using the following algorithms and inputs:

$$\Delta kWh = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kWh}$$
$$\Delta kW = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kW}$$

Where:
$kBtuh$ = Capacity of the cooling equipment in kBtu per hour
$SAVE_{kWh}$ = Average annual kWh reduction per ton of cooling capacity: 170 kWh/ton [6]
$SAVE_{kW}$ = Average kW reduction per ton of cooling capacity: 0.15 kW/ton [7]

Midstream Dual Enthalpy Economizer Controls: Gross energy and demand savings for implementation of dual enthalpy economizer controls are custom calculated. Alternatively, the energy and demand savings may be calculated using the following algorithms and inputs:

$$\Delta kWh = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kWh}$$
$$\Delta kW = kBtuh \times \frac{1\ ton}{12\ kBtuh} \times SAVE_{kW}$$

Where:
$kBtuh$ = Capacity of the cooling equipment in kBtu per hour
$SAVE_{kWh}$ = Average annual kWh reduction per ton of cooling capacity: 289 kWh/ton [8]
$SAVE_{kW}$ = Average kW reduction per ton of cooling capacity: 0.289 kW/ton [8]

Midstream Unitary Air Conditioners:

For units with cooling capacities less than 65 kBtu/h:

$$\Delta kWh = kBtuh \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{Cool}$$
$$\Delta kW = kBtuh \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

For units with cooling capacities equal to or greater than 65 kBtu/h and EER available:

$$\Delta kWh = kBtuh \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times EFLH_{Cool}$$
$$\Delta kW = kBtuh \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

For units with cooling capacities equal to or greater than 65 kBtu/h and IEER available

$$\Delta kWh = kBtuh \times \left(\frac{1}{IEER_{BASE}} - \frac{1}{IEER_{EE}}\right) \times Hours_{Cool}$$
$$\Delta kW = kBtuh \times \left(\frac{1}{IEER_{BASE}} - \frac{1}{IEER_{EE}}\right)$$

Where:
ΔkWh = Gross annual kWh savings from the measure.

ΔkW = Gross connected kW savings from the measure.
kBtuh = Capacity of the cooling equipment in kBtu per hour (1 ton of cooling capacity equals 12 kBtuh)
$SEER_{BASE}$ = 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.
EER_{BASE} = Energy Efficiency Ratio of the baseline equipment.
EER_{EE} = Energy Efficiency Ratio of the energy efficient equipment.
$IEER_{BASE}$ = Integrated Energy Efficiency Ratio of the baseline equipment.
$IEER_{EE}$ = Integrated Energy Efficiency Ratio of the energy efficient equipment.
$Hours_{Cool}$ = Annual Cooling Hours

The baseline efficiency values are based on the IECC 2015.[9]

Size (Btu/h)	Units with Electric Resistance of No Heating	Units with Heating Section Other Than Electric Resistance
< 65,000	13.0 SEER (Split System) 14.0 SEER (Single Package)	13.0 SEER (Split System) 14.0 SEER (Single Package)
≥65,000 and <135,000	11.2 EER 12.8 IEER	11.0 EER 12.6 IEER
≥135,000 and <240,000	11.0 EER 12.4 IEER	10.8 EER 12.2 IEER
≥240,000 and <760,000	10.0 EER 11.6 IEER	9.8 EER 11.4 IEER
≥760,000	9.7 EER 11.2 IEER	9.5 EER 11.0 IEER

Measure Life:

BC Measure ID	Measure Name	Program	Measure Life
	Midstream Heat Pump Systems	LBES Mid SBES Mid	Ground source – 26[10] All others – 12[11]
	Midstream VRF Systems	LBES Mid SBES Mid	12[11]
E21C1c001 E21C2c001	Midstream Circulator Pump	LBES Mid SBES Mid	15[11]
E21C1c002 E21C2c002	Midstream Demand Control Ventilation (DCV)	LBES Mid SBES Mid	10[12]
E21C1c004 E21C2c004	Midstream Dual Enthalpy Economizer Controls	LBES Mid SBES Mid	10[11]
E21C1c007 E21C2c007	Midstream Unitary Air Conditioners	LBES Mid SBES Mid	12[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}
	Midstream Heat Pump Systems	LBES mid SBES mid	1.00	1.00	1.00	1.00	1.00	Ground-source: 0.43 All others: 0.45	0.00
	Midstream VRF Systems	LBES mid SBES mid	1.00	1.00	1.00	1.00	1.00	0.45	0.00
E21C1c001 E21C2c001	Midstream Circulator Pump	LBES mid SBES mid	1.00	0.86	0.86	0.86	0.86	0.82	0.05
E21C1c002 E21C2c002	Midstream Demand Control Ventilation (DCV)	LBES mid SBES mid	1.00	0.86	0.86	0.86	0.86	0.82	0.05
E21C1c004 E21C2c004	Midstream Dual Enthalpy Economizer Controls	LBES mid SBES mid	1.00	0.86	0.86	0.86	0.86	0.00	0.00
E21C1c007 E21C2c007	Midstream Unitary Air Conditioners	LBES mid SBES mid	1.00	0.86	0.86	0.86	0.86	0.45	0.00

<u>In-Service Rates:</u>

All installations have a 100% in-service rate unless an evaluation finds otherwise.

<u>In-Service Rates:</u>

As shown in the table.

Coincidence Factors:

As shown in the table.

Energy Load Shape:

Midstream Heat Pump Systems: see Appendix 1 – "DMSHP" for ductless minisplit units, "Central Heat Pump" for all others.

Midstream VRF Systems: see Appendix 1 – "Central Heat Pump".

Midstream Circulator Pump: see Appendix 1 – "Boiler Distribution".

Midstream Demand Control Ventilation (DCV): see Appendix 1 – "C&I – Heating & Cooling".

Midstream Dual Enthalpy Economizer Controls: see Appendix 1 – "C&I – Heating & Cooling".

Midstream Unitary Air Conditioners: see Appendix 1 – "HVAC – Unitary Air Conditioner".

Impact Factors for Calculating Net Savings (Upstream/Midstream Only):[13]

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	2021 NTG
	Midstream Heat Pump Systems	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%
	Midstream VRF Systems	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%
E21C1c001 E21C2c001	Midstream Circulator Pump	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%
E21C1c002 E21C2c002	Midstream Demand Control Ventilation (DCV)	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%
E21C1c004 E21C2c004	Midstream Dual Enthalpy Economizer Controls	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%
E21C1c007 E21C2c007	Midstream Unitary Air Conditioners	LBES mid SBES mid	31.5%	4.1%	0.0%	72.6%

Endnotes:

1: Since IECC 2015 does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER≈SEER/1.1.

2: International Energy Conservation Code 2015, table C403.2.3(2) Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps

3: KEMA, August 2011. C&I Unitary AC Load Shape Project - Final Report. https://neep.org/sites/default/files/resources/NEEP_HVAC_Load_Shape_Report_Final_August2_0.pdf

4: ANSI/ASHRAE/IES Standard 90.1-2013. Table 6.8.1-10

5: The Cadmus Group, 2017. Circulator Pump Technical Memo. Prepared for National Grid and Eversource engineers.
6: Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid
7: Keena, Kevin, 2008. Analysis of CO2 Control Energy Savings on Unitary HVAC Units. Prepared for National Grid
8: Patel, Dinesh, 2001. Energy Analysis: Dual Enthalpy Control. Prepared for Eversource (NSTAR).
9: 2015 IECC Table C403.2.3(1).
10: ASHRAE Owning and Operating Cost Database. Equipment Life/Maintenance Cost Survey. http://weblegacy.ashrae.org/publicdatabase/system_service_life.asp?c_region=2&state=NA&building_function=NA&c_size=0&c_age=0&c_height=0&c_class=0&c_location=0&selected_system_type=1&c_equipment_type=NA.
11: 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
12: Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities; Table 1-1. Measure life is assumed to be the same as Enthalpy Economizer.
13: 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

2.56. Midstream Food Service – Dishwasher

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 defined by the U.S. Department of Energy (DOE) federal requirements. They are as follows:

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 defined by the U.S. Department of Energy (DOE) federal requirements. They are as follows:

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
Low Temp Pots & Pans Dishwasher	1.00	0.70

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 as follows:

Dishwasher Type	Idle Energy Rate (kW)	Water Consumption (gal/rack)
High Temp Under Counter Dishwasher	0.50	0.86
High Temp Door Type Dishwasher	0.70	0.89
High Temp Single Tank Conveyer Dishwasher	1.50	0.70
High Temp Multi Tank Conveyer Dishwasher	2.25	0.54
High Temp Pots & Pans Dishwasher	1.20	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 as follows:

Dishwasher Type	Idle Energy Rate (kW)	Water Consumption (gal/rack)
Low Temp Under Counter Dishwasher	0.50	1.19
Low Temp Door Type Dishwasher	0.60	1.18
Low Temp Single Tank Conveyor Dishwasher	1.60	0.79
Low Temp Multi Tank Conveyor Dishwasher	2.00	0.54
Low Temp Pots & Pans Dishwasher	1.00	0.58

Algorithms for Calculating Primary Energy Impact:

kWh = kWh
kW = kWh / hours
MMBtu = MMBtu

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, see section below.

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1c024 E21C2c024	High Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.32	1,791	n/a
E21C1c020 E21C2c020	High Temp Door Type Dishwasher	LBES Mid SBES Mid	0.74	4,151	n/a
E21C1c023 E21C2c023	High Temp Single Tank Conveyer Dishwasher	LBES Mid SBES Mid	0.75	4,243	n/a
E21C1c021 E21C2c021	High Temp Multi Tank Conveyer Dishwasher	LBES Mid SBES Mid	1.71	9,630	n/a
E21C1c022 E21C2c022	High Temp Pots & Pans Dishwasher	LBES Mid SBES Mid	0.18	1,032	n/a
E21C1c028 E21C2c028	Low Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.39	2,178	n/a
E21C1c025 E21C2c025	Low Temp Door Type Dishwasher	LBES Mid SBES Mid	2.46	13,851	n/a
E21C1c027 E21C2c027	Low Temp Single Tank Conveyor Dishwasher	LBES Mid SBES Mid	2.07	11,685	n/a
E21C1c026 E21C2c026	Low Temp Multi Tank Conveyor Dishwasher	LBES Mid SBES Mid	2.86	16,131	n/a

Hours:

Operating hours include active and idle time.

Dishwasher Type	Number of Racks per Day (racks/day)	Operating Hours per Year (hr/yr)
Under Counter Dishwasher		
Door Type Dishwasher (including Pots and Pans)		
Conveyer Dishwasher		

Measure Life:

The measure life for a new high temperature dishwasher is given by type below[1]:

BC Measure ID	Measure Name	Program	Measure Life

E21C1c024 E21C2c024	High Temp Under Counter Dishwasher	LBES Mid SBES Mid	10
E21C1c020 E21C2c020	High Temp Door Type Dishwasher	LBES Mid SBES Mid	15
E21C1c023 E21C2c023	High Temp Single Tank Conveyer Dishwasher	LBES Mid SBES Mid	20
E21C1c021 E21C2c021	High Temp Multi Tank Conveyer Dishwasher	LBES Mid SBES Mid	20
E21C1c022 E21C2c022	High Temp Pots & Pans Dishwasher	LBES Mid SBES Mid	10
E21C1c028 E21C2c028	Low Temp Under Counter Dishwasher	LBES Mid SBES Mid	10
E21C1c025 E21C2c025	Low Temp Door Type Dishwasher	LBES Mid SBES Mid	15
E21C1c027 E21C2c027	Low Temp Single Tank Conveyor Dishwasher	LBES Mid SBES Mid	20
E21C1c026 E21C2c026	Low Temp Multi Tank Conveyor Dishwasher	LBES Mid SBES Mid	20

Other Resource Impacts:

Dishwasher high temp: There are water savings associated with this measure.

Dishwasher Type	Annual water savings (gal/unit)
High Temp Under Counter Dishwasher	5,399
High Temp Door Type Dishwasher	35,056
High Temp Single Tank Conveyer Dishwasher	21,284
High Temp Multi Tank Conveyer Dishwasher	80,754
High Temp Pots & Pans Dishwasher	10,517

Dishwasher low temp: There are water savings associated with this measure.

Dishwasher Type	Annual water savings (gal/unit)
Low Temp Under Counter Dishwasher	12,677
Low Temp Door Type Dishwasher	80,629
Low Temp Single Tank Conveyor Dishwasher	65,104
Low Temp Multi Tank Conveyor Dishwasher	93,900

Low Temp Pots & Pans Dishwasher	TBD

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}
E21C1c024 E21C2c024	High Temp Under Counter Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c020 E21C2c020	High Temp Door Type Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c023 E21C2c023	High Temp Single Tank Conveyer Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c021 E21C2c021	High Temp Multi Tank Conveyer Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c022 E21C2c022	High Temp Pots & Pans Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c028 E21C2c028	Low Temp Under Counter Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c025 E21C2c025	Low Temp Door Type Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c027 E21C2c027	Low Temp Single Tank Conveyor Dishwasher	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c026 E21C2c026	Low Temp Multi Tank Conveyor Dishwasher	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 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

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[2]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG

E21C1c024 E21C2c024	High Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c020 E21C2c020	High Temp Door Type Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c023 E21C2c023	High Temp Single Tank Conveyer Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c021 E21C2c021	High Temp Multi Tank Conveyer Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c022 E21C2c022	High Temp Pots & Pans Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c028 E21C2c028	Low Temp Under Counter Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c025 E21C2c025	Low Temp Door Type Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c027 E21C2c027	Low Temp Single Tank Conveyor Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c026 E21C2c026	Low Temp Multi Tank Conveyor Dishwasher	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:

1: ENERGY STAR Commercial Kitchen Equipment Calculator. Updated October 2016.

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)

2.57. Midstream Food Service – Fryer

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 requirements.

Gas Fryer: The high efficiency case is an fryers is a deep-fat gas fryer with a cooking energy efficiency, shortening capacity, and idle energy rate in line with ENERGY STAR requirements.

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

$\Delta MMBtu = \Delta MMBtu$
Where:
$\Delta MMBtu$ = gross annual MMBtu gas savings from the measure per table below

Energy Savings for Commercial Fryer

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1c032 E21C2c032	Electric Fryer, Standard Vat	LBES Mid SBES Mid	0.50	2,976	n/a
E21C1c031 E21C2c031	Electric Fryer, Large Vat	LBES Mid SBES Mid	0.50	2,841	n/a
G21C1c004 G21C2c004	Gas Fryer	LBES Mid SBES Mid	n/a	n/a	78.3

Measure Life:

The measure life for a new commercial fryer is 12 years.[1]

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}
E21C1c032 E21C2c032	Electric Fryer, Standard Vat	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c031 E21C2c031	Electric Fryer, Large Vat	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1c004 G21C2c004	Gas Fryer	LBES Mid SBES Mid	1.00	n/a	1.00	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>

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

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[2]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c032 E21C2c032	Electric Fryer, Standard Vat	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c031 E21C2c031	Electric Fryer, Large Vat	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c004 G21C2c004	Gas Fryer	LBES Mid SBES Mid	0.237	0.07	0	0.83

Endnotes:
1: 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/
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)

2.58. Midstream Food Service – Griddle

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 relevant 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 relevant 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 requirements.

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 requirements.

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	ΔMMBtu
E21C1c033 E21C2c033	Electric Griddle	LBES Mid SBES Mid	0.90	3,965	n/a
G21C1c005 G21C2c005	Gas Griddle	LBES Mid SBES Mid	n/a	n/a	37.9

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.[1]

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}
E21C1c033 E21C2c033	Electric Griddle	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.9	0.9
G21C1c005 G21C2c005	Gas Griddle	LBES Mid SBES Mid	1.00	n/a	1.00	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>

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

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[2]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c033 E21C2c033	Electric Griddle	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c005 G21C2c005	Gas Griddle	LBES Mid SBES Mid	0.237	0.07	0	0.83

Endnotes:

1: 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/
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)

2.59. Midstream Food Service – Holding Cabinet

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

Description:

Installation of a qualified ENERGY STAR hot food holding cabinet (HFHC). ENERGY STAR hot food holding cabinets are 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 half size HFHC.

Baseline Efficiency:

The baseline case is a hot food holding cabinet (HFHC) with efficiency idle energy rate as defined by the U.S. Department of Energy (DOE) federal requirements .

High Efficiency:

The high efficiency case is a hot food holding cabinet (HFHC) with efficiency idle energy rate value meeting the minimum ENERGY STAR requirements .

Algorithms for Calculating Primary Energy Impact:

kWh = ΔkWh
kW = ΔkWh / 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	Equipment Type	Program	ΔkW	ΔkWh
E21C1c035 E21C2c035	Full Size – 20 cu.ft.	LBES Mid SBES Mid	0.50	2,737
E21C1c034 E21C2c034	3/4 Size – 12 cu.ft.	LBES Mid SBES Mid	0.20	1,095
E21C1c036	1/2 Size – 8 cu.ft.	LBES Mid	0.20	1,095

E21C2c036		**SBES Mid**		

Measure Life:

The measure life for a new commercial HFHC is 12 years.[1]

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}
E21C1c035 E21C2c035	Hot Food Holding Cabinet Full Size	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c034 E21C2c034	Hot Food Holding Cabinet 3/4 Size	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c036 E21C2c036	Hot Food Holding Cabinet Half Size	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 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

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[2]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c035 E21C2c035	Hot Food Holding Cabinet Full Size	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c034 E21C2c034	Hot Food Holding Cabinet 3/4 Size	LBES Mid SBES Mid	0.225	0.085	0	0.86

E21C1c036 E21C2c036	Hot Food Holding Cabinet Half Size	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:
1: 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/
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)

2.60. Midstream Food Service – Ice Machine

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

Description:

Installation of a qualified ENERGY STAR commercial ice machine. Commercial ice machines meeting the ENERGY STAR specifications are more energy efficient and 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 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.

kWh = kWh_baseline – kWh_ee
kW = kWh / hours

Where:
kWh = gross annual kWh savings from the measure.
kWh_baseline = annual kWh usage for the base case, based on ice harvest rate H. See table below.
kWh_ee = annual kWh usage for the efficient case, based on ice harvest rate H. See table below.
kW = gross average kW savings from the measure.
Hours = Average annual equipment operating hours.

Energy Savings Inputs for Commercial Ice Machine [2]

BC Measure ID	Measure Name	Program	Daily Ice Harvest Rate, H (lb ice/24 hr)	Baseline Daily Energy Use (kWh/100 lb ice)[1]	Efficient Daily Energy Use (kWh/100 lb ice)[3]

E21C1c037 E21C2c037	Ice Making Head	LBES New SBES New	H < 300	10 – 0.01233 x H	9.20 – 0.01134 x H
			300 ≤ H < 800	7.05 – 0.0025 x H	6.49 – 0.0023 x H
			800 ≤ H < 1500	5.55 – 0.00063 x H	5.11 – 0.00058 x H
			1500 ≤ H < 4000	4.61	4.24
E21C1c038 E21C2c038	Self Contained Unit	LBES New SBES New	50 ≤ H < 1000	7.97 – 0.00342 x H	7.17 – 0.00308 x H
			1000 ≤ H < 4000	4.55	4.13
			H < 110	14.79 – 0.0469 x H	12.57 – 0.0399 x H
E21C1c039 E21C2c039	Remote Condensing Unit (Batch)	LBES New SBES New	110 ≤ H < 200	12.42 – 0.02533 x H	10.56 – 0.0215 x H
			200 ≤ H < 4000	7.35	6.25
E21C1c040 E21C2c040	Remote Condensing Unit (Continuous)	LBES New SBES New	H < 800	9.7 – 0.0058 x H	7.76 – 0.00464 x H
			800 ≤ H < 4000	5.06	4.05

Measure Life:

The measure life for a new commercial griddle is 8 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}
E21C1c037 E21C2c037	Ice Machine - Ice Making Head	LBES New SBES New	1.00	1.00	n/a	1.00	1.00	0.9	0.9
E21C1c038 E21C2c038	Ice Machine - Remote Cond./Split Unit - Batch	LBES New SBES New	1.00	1.00	n/a	1.00	1.00	0.9	0.9
E21C1c039 E21C2c039	Ice Machine - Remote Cond./Split Unit - Continuous	LBES New SBES New	1.00	1.00	n/a	1.00	1.00	0.9	0.9

BC Measure ID	Measure Name	Program	ISR	RR_E	RR_{NE}	RR_{SP}	RR_{WP}	CF_{SP}	CF_{WP}
E21C1c040 E21C2c040	Ice Machine - Self Contained	LBES New SBES New	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 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.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[3]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c037 E21C2c037	Ice Machine - Ice Making Head	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c038 E21C2c038	Ice Machine - Remote Cond./Split Unit - Batch	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c039 E21C2c039	Ice Machine - Remote Cond./Split Unit - Continuous	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c040 E21C2c040	Ice Machine - Self Contained	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:
1: 10 CFR 431.136. Effective January 28, 2018
2: ENERGY STAR® Program Requirements For Automatic Commercial Ice Makers. V3.0.
3: NMR, DNV-GL, and Tetra-Tech, Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, Aug. 14, 2018 (Table 48, Table 52)

2.61. Midstream Food Service – Oven

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 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	≥ 71%	≤ 1.60 kW
Electric	Combination Oven	≥ 55% steam mode ≥ 76% convection mode	≤ 0.133P+0.6400 kW steam mode ≤ 0.080P+0.4989 kW convection mode
Gas	Convection Oven	≥ 46%	≤ 12,000 Btu/hr
Gas	Combination Oven	≥ 41% steam mode ≥ 56% convection mode	≤ 200P + 6,511 Btu/hr steam mode ≤ 150P + 5,425 Btu/hr convection mode

Gas	Conveyer Oven		
Gas	Rack Oven	≥ 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 based on the CA Energy Wise Foodservice Calculators for Ovens:[5]
$\Delta kWh = kWh$
$\Delta kW = kWh / hours$
$\Delta MMBtu = MMBtu$

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 = 4,390 hr/yr at 12 hr/day

Energy Savings for Commercial Ovens [5]

BC Measure ID	Equipment Type	Program	ΔkW	ΔkWh	ΔMMbtu
E21C1c019 E21C2c019	Electric Full Size Convection Oven	LBES Mid SBES Mid	0.70	2,787	n/a
E21C1c018 E21C2c018	Electric Combination Oven	LBES Mid SBES Mid	3.50	15,095	n/a
G21C1c002 G21C2c002	Gas Convection Oven	LBES Mid SBES Mid	n/a	n/a	35.7
G21C1c001 G21C2c001	Gas Combination Oven	LBES Mid SBES Mid	n/a	n/a	110.3
G21C1c003 **G21C2c003**	Gas Conveyer Oven	LBES Mid SBES Mid	n/a	n/a	88.4
G21C1c007 **G21C2c007**	Gas Rack Oven	LBES Mid **SBES Mid**	n/a	n/a	211.3

Measure Life:

The measure life for a new commercial oven 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}
E21C1c019 E21C2c019	Electric Convection Oven	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
E21C1c018 E21C2c018	Electric Combination Oven	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1c002 G21C2c002	Gas Convection Oven	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1c001 G21C2c001	Gas Combination Oven	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1c003 G21C2c003	Gas Conveyer Oven	LBES Mid SBES Mid	1.00	n/a	1.00	n/a	n/a	n/a	n/a
G21C1c007 G21C2c007	Gas Rack Oven	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:

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.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[7]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c019 E21C2c019	Electric Convection Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c018 E21C2c018	Electric Combination Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c002 G21C2c002	Gas Convection Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c001 G21C2c001	Gas Combination Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86

G21C1c003 G21C2c003	Gas Conveyer Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c007 G21C2c007	Gas Rack Oven	LBES Mid SBES Mid	0.225	0.085	0	0.86

Endnotes:
1: ENERGY STAR Program Requirements for Commercial Ovens. Version 2.2.
https://www.energystar.gov/sites/default/files/Commercial%20Ovens%20Final%20Version%202.2%20Specification.pdf
2: FSTC Life Cycle Savings Calculators https://fishnick.com/saveenergy/tools/calculators/

2.62. Midstream Food Service – Steam Cooker

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 requirements.

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 requirements.

Algorithms for Calculating Primary Energy Impact:

BC Measure ID	Measure Name	Program	ΔkW	ΔkWh	Δmmbtu
E21C1c043 E21C2c043	Electric Steam Cooker	LBES Mid SBES Mid	30,156	6.89	n/a
G21C1c008	Gas Steam Cooker	LBES Mid	n/a	n/a	370.7

G21C2c008		SBES Mid			

Quantity = Number of pans.
Hours = Average annual equipment operating hours.

Measure Life:

The measure life for a new steamer is 12 years. [1]

Other Resource Impacts:

Electric Steam Cooker: Deemed annual water savings.

Gas Steam Cooker: Deemed annual water savings.

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}
E21C1c043 E21C2c043	Electric Steam Cooker	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	0.90	0.90
G21C1c008 G21C2c008	Gas Steam Cooker	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.

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.

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[2]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c043 E21C2c043	Electric Steam Cooker	LBES Mid SBES Mid	0.225	0.085	0	0.86
G21C1c008 G21C2c008	Gas Steam Cooker	LBES Mid SBES Mid	0.237	0.07	0	0.83

Energy Load Shape:

See Appendix 1

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: 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/

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)

2.63. Midstream Food Service – Freezer

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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 (ft^3)

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
E21C1c030 E21C2c030	Freezer, Transparent Door	12
E21C1c029 E21C2c029	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}
E21C1c030 E21C2c030	Freezer, Transparent Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1c029 E21C2c029	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

Impact Factors for Calculating Net Savings (Upstream/Midstream Only)[4]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c030 E21C2c030	Freezer, Transparent Door	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c029 E21C2c029	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)

2.65. Midstream Food Service – Refrigerator

Measure Code	[To Be Defined in ANB system]
Market	Commercial
Program Type	Lost Opportunity
Category	Food Service

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)
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 (ft^3)

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
E21C1c041 E21C2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	12
E21C1c042 E21C2c042	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}
E21C1c041 E21C2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	1.00	1.00	n/a	1.00	1.00	1.00	1.00
E21C1c042 E21C2c042	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)[4]:

BC Measure ID	Measure Name	Program	FR	SO_P	SO_{NP}	NTG
E21C1c041 E21C2c041	Refrigerator, Transparent Door	LBES Mid SBES Mid	0.225	0.085	0	0.86
E21C1c042 E21C2c042	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)

2.66. HVAC – Heat Pump Systems

Measure Code	[Code]
Market	Commercial
Program Type	Retrofit/Lost Opportunity
Category	HVAC

Description:

This measure includes the installation of 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: :

$$\Delta kW = \Delta kW_{cool} + \Delta kW_{heat}$$

$$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right)$$

$$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right)$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate ductless mini split heat pump

$Cap_{hea} = Cap_{cool} \times 0.9$ for all other ductless mini split heat pump

$Cap_{heat} = Cap_{cool} \times \left(\frac{HSPF_{EE}}{EER_{EE}}\right)$ for water source and ground source heat pumps

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 ductless mini-split heat pump 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_{hea} = 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
$HSPF_{BASE}$ = Heating Seasonal Performance Factor of baseline heat pump equipment
$HSPF_{EE}$ = Heating Seasonal Performance Factor of energy efficient heat pump unit, from equipment specifications

The algorithm for calculating annual electric energy savings is:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{he}$$

For ductless mini split heat pumps

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{heat}$$

$Cap_{heat} = Cap_{cool} \times 1.0$ if unit is a cold climate ductless mini split heat pump

$Cap_{heat} = Cap_{cool} \times 0.9$ for all other ductless mini split heat pump

For water source and ground source heat pumps

$$\Delta kWh_{cool} = Cap_{cool} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{hea} = Cap_{heat} \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) \times EFLH_{hea}$$

$$Cap_{heat} = Cap_{cool} \times \left(\frac{HSPF_{EE}}{EER_{EE}}\right) Cap_{hea} = Cap_{cool} \times \left(\frac{HSPF_{EE}}{EER_{EE}}\right)$$

Where:
ΔkWh_{cool} = Gross annual cooling savings for heat pump unit
ΔkWh_{heat} = Gross annual heating savings for heat pump unit
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 equation to convert from cooling capacity value if standard equipment literature does not provide this value.
$SEER_{BASE}$ = Seasonal Energy Efficiency Ratio of baseline heat pump equipment
$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of energy efficient heat pump unit, from equipment specifications
$HSPF_{BASE}$ = 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
$EFLH_{hea}$ = Equivalent Full Load Hours for heating
0.9 = Conversion factor[1] to convert cooling capacity to heating capacity for ductless mini split heat pump units not on NEEP's cold climate air source heat pump (ccASHP) product list. The conversion factor for ccASHPs is 1.0.

Heat Pump Type	Cooling Capacity Range	Parameter	Value (Lost Opportunity)	Value (Retrofit)	Units
Ductless Mini Split	≤65,000 Btu/h	EER_{BASE}	12.72[2]	Pre-existing equipment EER	Btu/W-h
		$SEER_{BASE}$	14.00[3]	Pre-existing equipment SEER	Btu/W-h
		$HSPF_{BASE}$	8.20[3]	Pre-existing equipment HSPF	Btu/W-h
Water Source	<17,000 Btu/h	EER_{BASE}	12.20[3]	Pre-existing equipment EER	Btu/W-h
		$HSPF_{BASE}$	14.67[3]	Pre-existing equipment HSPF	Btu/W-h
	≥17,000 Btu/h	EER_{BASE}	13.00[3]	Pre-existing equipment EER	Btu/W-h
		$HSPF_{BASE}$	14.67[3]	Pre-existing equipment HSPF	Btu/W-h
Ground Source (Open Loop)	All Sizes	EER_{BASE}	18.00[3]	Pre-existing equipment EER	Btu/W-h
		$HSPF_{BASE}$	12.62[3]	Pre-existing equipment HSPF	Btu/W-h

<table>
<tr><td rowspan="2">Ground Source (Closed Loop)</td><td rowspan="2">All Sizes</td><td>EER_{BASE}</td><td>14.1[3]</td><td>Pre-existing equipment EER</td><td>Btu/W-h</td></tr>
<tr><td>$HSPF_{BASE}$</td><td>10.91[3]</td><td>Pre-existing equipment HSPF</td><td>Btu/W-h</td></tr>
<tr><td colspan="2">All</td><td>$HSPF_{BASE}$</td><td colspan="2">3.142
For when baseline/pre-existing system is electric resistance heat</td><td>Btu/W-h</td></tr>
<tr><td colspan="2" rowspan="2">All</td><td>$EFLH_{cool}$</td><td colspan="2">755[4]</td><td>hours</td></tr>
<tr><td>$EFLH_{heat}$</td><td colspan="2">1329[4]</td><td>hours</td></tr>
</table>

Measure Life:

The measure life is listed below by measure.

BC Measure ID	Measure Name	Program	Measure Life
E21C1a022	Ductless Mini Split Heat Pump	LBES Retrofit	12
E21C1d024	Ductless Mini Split Heat Pump	LBES Direct Install	12
E21C2a022	Ductless Mini Split Heat Pump	SBES Retrofit	12
E21C2d024	Ductless Mini Split Heat Pump	SBES Direct Install	12
E21C3a035	Ductless Mini Split Heat Pump	Muni Retrofit	12
E21C3d037	Ductless Mini Split Heat Pump	Muni Direct Install	12
E21C1b050	Water Source Heat Pump	LBES NEC	26[5]
E21C2b050	Water Source Heat Pump	SBES NEC	26[5]
E21C3b081	Water Source Heat Pump	Muni NEC	26[5]
E21C1b035	Ground Source Heat Pump	LBES NEC	26[5]
E21C2b035	Ground Source Heat Pump	SBES NEC	26[5]
E21C3b056	Ground Source Heat Pump	Muni NEC	26[5]

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}
E21C1a022	Ductless Mini Split Heat Pump	LBES Retrofit	1.00	0.99	1.00	1.00	1.00	0.37	0.000.00
E21C1d024	Ductless Mini Split Heat Pump	LBES Direct Install	1.00	0.99	1.00	1.00	1.00	0.37	0.00
E21C2a022	Ductless Mini Split Heat Pump	SBES Retrofit	1.00	1.00	1.00	1.00	1.00	0.37	0.00
E21C2d024	Ductless Mini Split Heat Pump	SBES Direct Install	1.00	1.00	1.00	1.00	1.00	0.37	0.00
E21C3a035	Ductless Mini Split Heat Pump	Muni Retrofit	1.00	1.00	1.00	1.00	1.00	0.37	0.00
E21C3d037	Ductless Mini Split Heat Pump	Muni Direct Install	1.00	1.00	1.00	1.00	1.00	0.37	0.00
E21C1b050	Water Source Heat Pump	LBES NEC	1.00	0.99	1.00	1.00	1.00	0.37	0.37
E21C2b050	Water Source Heat Pump	SBES NEC	1.00	1.00	1.00	1.00	1.00	0.37	0.37
E21C3b081	Water Source Heat Pump	Muni NEC	1.00	1.00	1.00	1.00	1.00	0.37	0.37
E21C1b035	Ground Source Heat Pump	LBES NEC	1.00	0.99	1.00	1.00	1.00	0.37	0.37
E21C2b035	Ground Source Heat Pump	SBES NEC	1.00	1.00	1.00	1.00	1.00	0.37	0.37
E21C3b056	Ground Source Heat Pump	Muni NEC	1.00	1.00	1.00	1.00	1.00	0.37	0.37

<u>In-Service Rates:</u>

All installations have 100% in-service-rates since programs include verification of equipment installations.

Realization Rates[6]:

All programs use 100% realization rate except for LBES (Retrofit, Direct Install, and NEC), which use a value of 99.90%.

Coincidence Factors[7]:

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 37% and a winter coincidence factor is 37%.
For water source heat pumps and ground source heat pumps, summer & winter coincidence factor is 37%.

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"

Endnotes:
1: Conversion factor is based on internal ERS analysis of Mass Save and NEEP ccASHP product data.
2: Since IECC 2015 does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER≈SEER/1.1.
3: International Energy Conservation Code 2015, table C403.2.3(2) Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps
4: KEMA((2011). C&I Unitary AC Loadshape Project - Final Report. KEMA_2011_CI Unitary HVAC Load Shape Project
5:http://weblegacy.ashrae.org/publicdatabase/system_service_life.asp?c_region=2&state=NA&building_function=NA&c_size=0&c_age=0&c_height=0&c_class=0&c_location=0&selected_system_type=1&c_equipment_type=NA. . See mean age of replaced water-to-air, geothermal heat pumps
6: New Hampshire Utilities Large Commercial & Industrial (C&I) Retrofit and New Equipment & Construction Impact Evaluation report. Table 3
7. Coincidence Factors are from 2011 NEEP HVAC Loadshape Study Table 0-6 (ISO_NE on Peak for NE-North)

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 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).

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

C&I energy loadshapes are shown in each relevant measure chapter, and except where noted are derived from site-level metering of project sites in MA. See DNV GL, 2018. P72 Prescriptive C&I Loadshapes of Savings.