

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis Updated November 25, 2019**

	<u>Phase 1</u>															
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	
1 Year																
2 Batteries Installed	200	0	300	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Benefits</b>																
3 Regional Network System (RNS) rate (\$/kW-year)	\$129.06	\$135.51	\$143.04	\$148.42	\$155.33	\$162.57	\$170.15	\$178.08	\$186.38	\$195.06	\$204.15	\$213.67	\$223.62	\$234.04	\$0.00	<b>Total</b>
4 Local Network System (LNS) rate( \$/kW-year)	\$33.93	\$35.51	\$37.17	\$38.90	\$40.71	\$42.61	\$44.59	\$46.67	\$48.85	\$51.12	\$53.51	\$56.00	\$58.61	\$61.34	\$0.00	
5 Avoided Capacity Cost rate (\$/kW-year)	\$73.90	\$59.90	\$57.60	\$58.80	\$61.20	\$65.70	\$71.20	\$76.90	\$82.50	\$88.10	\$83.90	\$82.50	\$88.10	\$83.90	\$0.00	
6 Regional Network System (RNS) Charges	\$96,795	\$101,634	\$107,281	\$111,314	\$116,501	\$121,930	\$127,612	\$133,559	\$139,783	\$146,296	\$116,367	\$96,149	\$76,032	\$56,170	\$0	<b>\$1,547,423</b>
7 Local Network System (LNS) Charges	\$25,448	\$26,634	\$26,634	\$27,875	\$29,174	\$30,534	\$31,956	\$33,446	\$35,004	\$36,635	\$29,140	\$24,078	\$19,040	\$14,066	\$0	<b>\$389,664</b>
8 Avoided Capacity Costs	\$55,425	\$44,925	\$44,925	\$43,200	\$44,100	\$45,900	\$49,275	\$53,400	\$57,675	\$61,875	\$50,217	\$37,755	\$28,050	\$21,144	\$0	<b>\$637,866</b>
9 Total Benefits	\$177,668	\$173,193	\$178,840	\$182,389	\$189,775	\$198,364	\$208,843	\$220,404	\$232,462	\$244,807	\$195,724	\$157,982	\$123,121	\$91,380	\$0	<b>\$2,574,953</b>
<b>Costs</b>																
10 Revenue Requirement - Batteries	(\$226,827)	(\$209,377)	(\$198,590)	(\$187,028)	(\$174,908)	(\$161,414)	(\$147,911)	(\$136,144)	(\$124,373)	(\$110,874)	\$0	\$0	\$0	\$0	\$0	<b>(\$1,677,445)</b>
11 Revenue Requirement - Cell Based Meters	(\$7,568)	(\$7,223)	(\$6,942)	(\$6,661)	(\$6,378)	(\$6,095)	(\$5,812)	(\$5,528)	(\$5,240)	(\$4,950)	(\$4,660)	(\$4,371)	(\$4,081)	(\$3,791)	\$0	<b>(\$79,301)</b>
Tesla Services for Peak Prediction	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$14,000)	(\$13,300)	(\$12,600)	(\$11,900)	(\$11,200)	\$0	<b>(\$189,000)</b>
12 Monthly Cellular Reading Cost	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$5,700)	(\$5,400)	(\$5,100)	(\$4,800)	\$0	<b>(\$81,000)</b>
13 Cogsdale Programming Costs	(\$102,185)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	<b>(\$102,185)</b>
14 NEM Credit for battery	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	<b>\$0</b>
15 Meter MV-90 Programming Costs	(\$107,500)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	<b>(\$107,500)</b>
16 Total Costs	(\$464,080)	(\$236,600)	(\$225,532)	(\$213,689)	(\$201,287)	(\$187,509)	(\$173,723)	(\$161,672)	(\$149,613)	(\$135,824)	(\$23,660)	(\$22,371)	(\$21,081)	(\$19,791)	\$0	<b>(\$2,236,432)</b>
17 Net Benefit to All Customers	(\$286,412)	(\$63,407)	(\$46,692)	(\$31,300)	(\$11,512)	\$10,855	\$35,120	\$58,732	\$82,849	\$108,983	\$172,064	\$135,611	\$102,040	\$71,589	\$0	<b>\$338,521</b>
<b>Net Present Value Calculation</b>																
18 Required Rate of Return		7.64%														
19 Net Present Value of Option		(\$36,745)														
20 Net Present Value of Benefits		\$1,569,049														
21 Net Present Value of Costs		(\$1,605,794)														

- 1 Year of installation
- 2 Total units in pilot
- 3 Based on ISO-NE forecast
- 4 Based on previous bills from National Grid
- 5 AESC 2018 Wholesale Capacity Values Cleared (FCA price), column j on p 273
- 6 Line 3 x amount of kW reduced
- 7 Line 4 x amount of kW reduced
- 8 Line 5 x amount of kW reduced at ISO NE coincident peak
- 9 Sum of lines 3 through 8
- 10 Battery revenue requirement
- 11 Meter revenue requirement
- 12 Liberty's estimated costs for reading meters
- 13 Liberty's estimated programming costs associated with billing TOU rates
- 14 Net Metering Credit provided to customers when batteries are exported to the grid
- 15 Liberty's estimated costs for programming meters
- 16 Sum of lines 10 through 15
- 17 Line 9 - Line 16
- 18 After-tax discount rate
- 19 Net Present Value calculation of net benefits using discount rate in Line (20) and net benefits (or costs ) in line (19)
- 20 Net Present Value calculation of benefits using discount rate in Line (20) and benefits in line (12)
- 21 Net Present Value calculation of costs using discount rate in Line (20) and costs in line (18)

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Battery Revenue Requirement**

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Defered Tax Calculation</b>															
1 Battery Capital Cost															
2019 Battery Install (200)	\$1,670,000														
CIAC	\$600,000														
2021 Battery Install (300)					\$0										
CIAC					\$0										
Net Battery Install Costs for Depr (200)	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$0	\$0	\$0	\$0	\$0
Net Battery Install Costs for Depr (300)					\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2 Total Plant In Service	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$0	\$0	\$0	\$0	\$0
3 FEDERAL Vintage Year Tax Depreciation:	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
4 Annual Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
5 Cumulative Tax Depreciation	\$152,903	\$414,946	\$602,089	\$735,732	\$831,283	\$926,727	\$1,022,278	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000
6 STATE Vintage Year Tax Depreciation:	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
7 Annual Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8 Cumulative Tax Depreciation	\$152,903	\$414,946	\$602,089	\$735,732	\$831,283	\$926,727	\$1,022,278	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000
9 Book Depreciation Rate (a)	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	0.00%	0.00%	0.00%
10 Book Depreciation	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$0	\$0	\$0	\$0	\$0
11 Cumulative Book Depreciation	\$107,000	\$214,000	\$321,000	\$428,000	\$535,000	\$642,000	\$749,000	\$856,000	\$963,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000
12 Book/Tax Timer (Federal)	\$45,903	\$155,043	\$80,143	\$26,643	(\$11,449)	(\$11,556)	(\$11,449)	(\$59,278)	(\$107,000)	(\$107,000)	\$0	\$0	\$0	\$0	\$0
13 less: Deferred Tax Reserve (State)	\$3,535	\$11,938	\$6,171	\$2,052	(\$882)	(\$890)	(\$882)	(\$4,564)	(\$8,239)	(\$8,239)	\$0	\$0	\$0	\$0	\$0
14 Net Book/Tax Timer (Federal)	\$42,368	\$143,105	\$73,972	\$24,591	(\$10,567)	(\$10,666)	(\$10,567)	(\$54,714)	(\$98,761)	(\$98,761)	\$0	\$0	\$0	\$0	\$0
15 Effective Tax Rate (Federal)	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%
16 Deferred Tax Reserve (Federal)	\$9,640	\$32,559	\$16,830	\$5,595	(\$2,404)	(\$2,427)	(\$2,404)	(\$12,448)	(\$22,470)	(\$22,470)	\$0	\$0	\$0	\$0	\$0
17 Book/Tax Timer (State)	\$45,903	\$155,043	\$80,143	\$26,643	(\$11,449)	(\$11,556)	(\$11,449)	(\$59,278)	(\$107,000)	(\$107,000)	\$0	\$0	\$0	\$0	\$0
18 Effective Tax Rate (State)	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%
19 Deferred Tax Reserve (State)	\$3,535	\$11,938	\$6,171	\$2,052	(\$882)	(\$890)	(\$882)	(\$4,564)	(\$8,239)	(\$8,239)	\$0	\$0	\$0	\$0	\$0
20 TOTAL Deferred Tax Reserve	\$13,174	\$44,497	\$23,001	\$7,647	(\$3,286)	(\$3,317)	(\$3,286)	(\$17,013)	(\$30,709)	(\$30,709)	\$0	\$0	\$0	\$0	\$0
<b>Rate Base Calculation</b>															
21 Plant In Service	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$0	\$0	\$0	\$0	\$0
22 Accumulated Book Depreciation	(\$107,000)	(\$214,000)	(\$321,000)	(\$428,000)	(\$535,000)	(\$642,000)	(\$749,000)	(\$856,000)	(\$963,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)
23 Deferred Tax Reserve	(\$13,174)	(\$44,497)	(\$23,001)	(\$7,647)	\$3,286	\$3,317	\$3,286	\$17,013	\$30,709	\$30,709	\$0	\$0	\$0	\$0	\$0
24 Year End Rate Base	\$949,826	\$811,503	\$725,999	\$634,353	\$538,286	\$431,317	\$324,286	\$231,013	\$137,709	\$30,709	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)
<b>Revenue Requirement Calculation</b>															
25 Year End Rate Base	\$949,826	\$811,503	\$725,999	\$634,353	\$538,286	\$431,317	\$324,286	\$231,013	\$137,709	\$30,709	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)	(\$1,070,000)
26 Pre-Tax ROR	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%
27 Return and Taxes	\$89,148	\$76,165	\$68,140	\$59,538	\$50,522	\$40,482	\$30,436	\$21,682	\$12,925	\$2,882	\$0	\$0	\$0	\$0	\$0
28 Book Depreciation	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$107,000	\$0	\$0	\$0	\$0	\$0
29 Property Taxes (b) 3.23%	\$30,679	\$26,212	\$23,450	\$20,490	\$17,387	\$13,932	\$10,474	\$7,462	\$4,448	\$992	\$0	\$0	\$0	\$0	\$0
30 Annual Revenue Requirement	\$226,827	\$209,377	\$198,590	\$187,028	\$174,908	\$161,414	\$147,911	\$136,144	\$124,373	\$110,874	\$0	\$0	\$0	\$0	\$0
<b>Imputed Capital Structure (c)</b>															
	Ratio	Rate	Weighted Rate	Pre Tax											
34 Long Term Debt	50.00%	5.97%	2.94%	2.94%											
35 Common Equity	50.00%	9.40%	4.70%	6.45%											
36	100.00%		7.64%	9.39%											
23a Total annual customer contribution collected on a montly basis															

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis Updated November 25, 2019  
Meter Revenue Requirement**

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
<b>Deferred Tax Calculation</b>																		
1 Meter Capital Cost																		
2019 Meter Install (200)	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$0	\$0	
2021 Meter Install (300)			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
2 Total	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$0	\$0	
3 FEDERAL Vintage Year Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$0	\$0	
4 Annual Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$0	\$0	
5 Cumulative Tax Depreciation	\$1,646	\$4,815	\$7,746	\$10,458	\$12,966	\$15,286	\$17,432	\$19,417	\$21,376	\$23,334	\$25,293	\$27,251	\$29,210	\$31,168	\$33,127	\$33,127	\$33,127	
6 STATE Vintage Year Tax Depreciation:	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$0	\$0	
7 Annual Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$0	\$0	
8 Cumulative Tax Depreciation	\$1,646	\$4,815	\$7,746	\$10,458	\$12,966	\$15,286	\$17,432	\$19,417	\$21,376	\$23,334	\$25,293	\$27,251	\$29,210	\$31,168	\$33,127	\$33,127	\$33,127	
9 Book Depreciation Rate (a)	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%
10 Book Depreciation	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$0	\$0	
11 Cumulative Book Depreciation	\$2,296	\$4,592	\$6,888	\$9,184	\$11,480	\$13,776	\$16,072	\$18,368	\$20,664	\$22,960	\$25,256	\$27,552	\$29,848	\$32,144	\$34,440	\$34,440	\$34,440	
12 Book/Tax Timer (Federal)	(\$650)	\$873	\$635	\$416	\$212	\$24	(\$150)	(\$311)	(\$337)	(\$338)	(\$337)	(\$338)	(\$337)	(\$338)	(\$337)	\$0	\$0	
13 less: Deferred Tax Reserve (State)	(\$50)	\$67	\$49	\$32	\$16	\$2	(\$12)	(\$24)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	\$0	\$0	
14 Net Book/Tax Timer (Federal)	(\$600)	\$806	\$586	\$384	\$196	\$22	(\$138)	(\$287)	(\$311)	(\$312)	(\$311)	(\$312)	(\$311)	(\$312)	(\$311)	\$0	\$0	
15 Effective Tax Rate (Federal)	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	121.00%	221.00%	
16 Deferred Tax Reserve (Federal)	(\$136)	\$183	\$133	\$87	\$45	\$5	(\$31)	(\$65)	(\$71)	(\$71)	(\$71)	(\$71)	(\$71)	(\$71)	(\$71)	\$0	\$0	
17 Book/Tax Timer (State)	(\$650)	\$873	\$635	\$416	\$212	\$24	(\$150)	(\$311)	(\$337)	(\$338)	(\$337)	(\$338)	(\$337)	(\$338)	(\$337)	\$0	\$0	
18 Effective Tax Rate (State)	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	
19 Deferred Tax Reserve (State)	(\$50)	\$67	\$49	\$32	\$16	\$2	(\$12)	(\$24)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	(\$26)	\$0	\$0	
20 TOTAL Deferred Tax Reserve	(\$187)	\$251	\$182	\$119	\$61	\$7	(\$43)	(\$89)	(\$97)	(\$97)	(\$97)	(\$97)	(\$97)	(\$97)	(\$97)	\$0	\$0	
<b>Rate Base Calculation</b>																		
21 Plant In Service	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$0	\$0	
22 Accumulated Book Depreciation	(\$2,296)	(\$4,592)	(\$6,888)	(\$9,184)	(\$11,480)	(\$13,776)	(\$16,072)	(\$18,368)	(\$20,664)	(\$22,960)	(\$25,256)	(\$27,552)	(\$29,848)	(\$32,144)	(\$34,440)	(\$34,440)	(\$34,440)	
23 Deferred Tax Reserve	\$187	(\$251)	(\$182)	(\$119)	(\$61)	(\$7)	\$43	\$89	\$97	\$97	\$97	\$97	\$97	\$97	\$97	\$0	\$0	
24 Year End Rate Base	\$41,791	\$39,058	\$36,830	\$34,597	\$32,359	\$30,117	\$27,871	\$25,621	\$23,333	\$21,037	\$18,741	\$16,445	\$14,149	\$11,853	\$9,557	(\$34,440)	(\$34,440)	
<b>Revenue Requirement Calculation</b>																		
25 Year End Rate Base	\$41,791	\$39,058	\$36,830	\$34,597	\$32,359	\$30,117	\$27,871	\$25,621	\$23,333	\$21,037	\$18,741	\$16,445	\$14,149	\$11,853	\$9,557	(\$34,440)	(\$34,440)	
26 Pre-Tax ROR	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	
27 Return and Taxes	\$3,922	\$3,666	\$3,457	\$3,247	\$3,037	\$2,827	\$2,616	\$2,405	\$2,190	\$1,974	\$1,759	\$1,544	\$1,328	\$1,113	\$897	\$0	\$0	
28 Book Depreciation	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$2,296	\$0	\$0	
29 Property Taxes (b)	\$1,350	\$1,262	\$1,190	\$1,117	\$1,045	\$973	\$900	\$828	\$754	\$680	\$605	\$531	\$457	\$383	\$309	\$0	\$0	
30 Annual Revenue Requirement	\$7,568	\$7,223	\$6,942	\$6,661	\$6,378	\$6,095	\$5,812	\$5,528	\$5,240	\$4,950	\$4,660	\$4,371	\$4,081	\$3,791	\$3,502	\$0	\$0	
<b>Imputed Capital Structure (c)</b>																		
	Ratio	Rate	Weighted															
			Rate	Pre Tax														
34 Long Term Debt	50.00%	5.97%	2.94%	2.94%														
35 Common Equity	50.00%	9.40%	4.70%	6.45%														
36	100.00%		7.64%	9.39%														
23a Total annual customer contribution collected on a montly basis																		

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Battery Depreciation Calculation**  
**Phase 1**

	<u>CY 2019</u>	<u>CY 2020</u>	<u>CY 2021</u>	<u>CY 2022</u>	<u>CY 2023</u>	<u>CY 2024</u>	<u>CY 2025</u>	<u>CY 2026</u>	<u>CY 2027</u>	<u>CY 2028</u>	<u>CY 2029</u>	<u>CY 2030</u>	<u>CY 2031</u>	<u>CY 2032</u>	<u>CY 2033</u>
1 Plant Additions	1,670,000														
2 less CIAC	\$600,000														
3 Total Plant In Service	1,070,000														
4 <u>Tax Depreciation (Federal)</u>															
5 Plant Additions	\$1,070,000														
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
7 Remaining Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8															
9 <u>Remaining Tax Depreciation (State)</u>															
10 Plant Additions	\$1,070,000														
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
12 Remaining Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
13															
14 Federal Tax Depreciation	\$ 152,903	\$ 262,043	\$ 187,143	\$ 133,643	\$ 95,551	\$ 95,444	\$ 95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
15 State Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Meter Depreciation Calculation**

	<u>CY 2019</u>	<u>CY 2020</u>	<u>CY 2021</u>	<u>CY 2022</u>	<u>CY 2023</u>	<u>CY 2024</u>	<u>CY 2025</u>	<u>CY 2026</u>	<u>CY 2027</u>	<u>CY 2028</u>	<u>CY 2029</u>	<u>CY 2030</u>	<u>CY 2031</u>	<u>CY 2032</u>	<u>CY 2033</u>
1 <u>Tax Depreciation (Federal)</u>															
Number of Meters		100													
Cost of Meter (\$/meter)		439													
2 Plant Additions		\$43,900													
3 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
4 Remaining Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
5 <u>Remaining Tax Depreciation (State)</u>															
6 Plant Additions	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900
7 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
8 Remaining Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
9 Federal Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
10 State Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**

		<b>Phases 1 and 2</b>																	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	
1 Year		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	
2	Batteries Installed	200	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Benefits</b>																			
3	Regional Network System (RNS) rate (\$/kW-year)	\$129.41	\$135.51	\$143.04	\$148.42	\$155.33	\$162.57	\$170.15	\$178.08	\$186.38	\$195.06	\$204.15	\$213.67	\$223.62	\$234.04	\$244.95	\$256.36	\$0	<b>Total</b>
4	Local Network System (LNS) rate( \$/kW-year)	\$33.93	\$35.51	\$37.17	\$38.90	\$40.71	\$42.61	\$44.59	\$46.67	\$48.85	\$51.12	\$53.51	\$56.00	\$58.61	\$61.34	\$64.20	\$67.19	\$0	
5	Avoided Capacity Cost rate (\$/kW-year)	\$73.90	\$59.90	\$57.60	\$58.80	\$61.20	\$65.70	\$71.20	\$76.90	\$82.50	\$88.10	\$83.90	\$82.50	\$88.10	\$83.90	\$82.50	\$88.10	\$0	
6	Regional Network System (RNS) Charges	\$97,060	\$101,634	\$268,202	\$278,285	\$291,253	\$304,825	\$319,030	\$333,897	\$349,456	\$330,630	\$321,539	\$254,689	\$203,496	\$174,128	\$117,958	\$86,712	\$0	<b>\$3,832,794</b>
7	Local Network System (LNS) Charges	\$25,448	\$26,634	\$69,688	\$72,935	\$76,334	\$79,891	\$83,614	\$87,510	\$91,588	\$95,857	\$100,323	\$89,711	\$83,224	\$76,920	\$30,915	\$22,726	\$0	<b>\$1,113,320</b>
8	Avoided Capacity Costs	\$55,425	\$44,925	\$108,000	\$110,250	\$114,750	\$123,188	\$133,500	\$144,188	\$154,688	\$165,188	\$157,313	\$132,165	\$125,102	\$105,211	\$42,286	\$29,205	\$0	<b>\$1,745,381</b>
9	Total Benefits	\$177,933	\$173,424	\$446,128	\$445,890	\$461,470	\$482,337	\$507,904	\$536,144	\$565,595	\$595,732	\$591,674	\$579,175	\$476,565	\$411,823	\$356,259	\$191,159	\$0	<b>\$6,691,495</b>
<b>Costs</b>																			
10	Revenue Requirement - Batteries	(\$226,827)	(\$209,377)	(\$538,830)	(\$501,093)	(\$472,793)	(\$441,956)	(\$410,274)	(\$378,264)	(\$346,239)	(\$315,090)	(\$160,500)	(\$160,500)	\$0	\$0	\$0	\$0	\$0	(\$4,161,742)
11	Revenue Requirement - Cell Based Meters	(\$7,568)	(\$7,223)	(\$18,295)	(\$17,496)	(\$16,792)	(\$16,086)	(\$15,380)	(\$14,672)	(\$13,958)	(\$13,242)	(\$12,520)	(\$11,796)	(\$11,071)	(\$10,347)	(\$9,623)	(\$3,444)	\$0	(\$199,512)
	Tesla Services for Peak Prediction	(\$14,000)	(\$14,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$35,000)	(\$34,300)	(\$33,600)	(\$31,780)	(\$29,960)	(\$28,140)	(\$26,180)	\$0	(\$491,960)
12	Monthly Cellular Reading Cost	(\$6,000)	(\$6,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$14,700)	(\$14,400)	(\$13,620)	(\$12,840)	(\$12,060)	(\$11,220)	\$0	(\$210,840)
13	Cogsdale Programming Costs	(\$102,185)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	(\$102,185)
	NEM Credit for battery	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		(\$107,500)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	(\$107,500)
16	Total Costs	(\$464,080)	(\$236,600)	(\$607,125)	(\$568,589)	(\$539,585)	(\$508,042)	(\$475,653)	(\$442,936)	(\$410,197)	(\$378,332)	(\$222,020)	(\$220,296)	(\$56,471)	(\$53,147)	(\$49,823)	(\$40,844)	\$0	(\$5,273,739)
17	Net Benefit to All Customers	(\$286,147)	(\$63,176)	(\$160,997)	(\$122,699)	(\$78,115)	(\$25,705)	\$32,251	\$93,208	\$155,398	\$217,400	\$369,654	\$358,879	\$420,093	\$358,675	\$306,436	\$150,315	\$0	<b>\$1,417,756</b>
<b>Net Present Value Calculation</b>																			
18	Required Rate of Return		7.64%																
19	Net Present Value of Option		\$393,706																
20	Net Present Value of Benefits		\$3,821,567																
21	Net Present Value of Costs		(\$3,427,861)																

- 1 Year of installation
- 2 Total units in pilot
- 3 Based on ISO-NE forecast
- 4 Based on previous bills from National Grid
- 5 AESC 2018 Wholesale Capacity Values Cleared (FCA price), column j on p 273
- 6 Line 3 x amount of kW reduced
- 7 Line 4 x amount of kW reduced
- 8 Line 5 x amount of kW reduced at ISO NE coincident peak
- 9 Sum of lines 3 through 8
- 10 Battery revenue requirement
- 11 Meter revenue requirement
- 12 Liberty's estimated costs for reading meters
- 13 Liberty's estimated programming costs associated with billing TOU rates
- 14 Net Metering Credit provided to customers when batteries are exported to the grid
- 15 Liberty's estimated costs for programming meters
- 16 Sum of lines 10 through 15
- 17 Line 9 - Line 16
- 18 After-tax discount rate
- 19 Net Present Value calculation of net benefits using discount rate in Line (20) and net benefits (or costs ) in line (19)
- 20 Net Present Value calculation of benefits using discount rate in Line (20) and benefits in line (12)
- 21 Net Present Value calculation of costs using discount rate in Line (20) and costs in line (18)

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Battery Revenue Requirement**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
<b>Defered Tax Calculation</b>															
1	Battery Capital Cost														
	2019 Battery Install (200)	\$1,670,000													
	CIAC	\$600,000													
	2021 Battery Install (300)														
	CIAC			\$2,505,000											
				\$900,000											
	Net Battery Install Costs for Depr (200)	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$1,070,000	\$0	\$0	\$0	\$0	\$0
	Net Battery Install Costs for Depr (300)			\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$1,605,000	\$0	\$0	\$0
2	Total Plant In Service	\$1,070,000	\$1,070,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$1,605,000	\$1,605,000	\$0	\$0	\$0
3	FEDERAL Vintage Year Tax Depreciation:	\$152,903	\$262,043	\$416,498	\$526,708	\$376,266	\$295,909	\$238,878	\$190,888	\$143,327	\$71,583	\$0	\$0	\$0	\$0
4	Annual Tax Depreciation	\$152,903	\$262,043	\$416,498	\$526,708	\$376,266	\$295,909	\$238,878	\$190,888	\$143,327	\$71,583	\$0	\$0	\$0	\$0
5	Cumulative Tax Depreciation	\$152,903	\$414,946	\$831,444	\$1,358,152	\$1,734,418	\$2,030,327	\$2,269,205	\$2,460,093	\$2,603,420	\$2,675,003	\$2,675,003	\$2,675,003	\$2,675,003	\$2,675,003
6	STATE Vintage Year Tax Depreciation:	\$152,903	\$262,043	\$416,498	\$526,708	\$376,266	\$295,909	\$238,878	\$190,888	\$143,327	\$71,583	\$0	\$0	\$0	\$0
7	Annual Tax Depreciation	\$152,903	\$262,043	\$416,498	\$526,708	\$376,266	\$295,909	\$238,878	\$190,888	\$143,327	\$71,583	\$0	\$0	\$0	\$0
8	Cumulative Tax Depreciation	\$152,903	\$414,946	\$831,444	\$1,358,152	\$1,734,418	\$2,030,327	\$2,269,205	\$2,460,093	\$2,603,420	\$2,675,003	\$2,675,003	\$2,675,003	\$2,675,003	\$2,675,003
	Book Depreciation Rate (a)	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	0.00%	0.00%	0.00%
	Book Depreciation	\$107,000	\$107,000	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$160,500	\$160,500	\$0	\$0	\$0
11	Cumulative Book Depreciation	\$107,000	\$214,000	\$481,500	\$749,000	\$1,016,500	\$1,284,000	\$1,551,500	\$1,819,000	\$2,086,500	\$2,354,000	\$2,514,500	\$2,675,000	\$2,675,000	\$2,675,000
12	Book/Tax Timer (Federal)	\$45,903	\$155,043	\$148,998	\$259,208	\$108,766	\$28,409	(\$28,622)	(\$76,612)	(\$124,173)	(\$195,917)	(\$160,500)	(\$160,500)	\$0	\$0
13	less: Deferred Tax Reserve (State)	\$3,535	\$11,938	\$11,473	\$19,959	\$8,375	\$2,187	(\$2,204)	(\$5,899)	(\$9,561)	(\$15,086)	(\$12,359)	(\$12,359)	\$0	\$0
14	Net Book/Tax Timer (Federal)	\$42,368	\$143,105	\$137,525	\$239,249	\$100,391	\$26,222	(\$26,418)	(\$70,713)	(\$114,612)	(\$180,831)	(\$148,142)	(\$148,142)	\$0	\$0
15	Effective Tax Rate (Federal)	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%
16	Deferred Tax Reserve (Federal)	\$9,640	\$32,559	\$31,290	\$54,434	\$22,841	\$5,966	(\$6,011)	(\$16,089)	(\$26,076)	(\$41,143)	(\$33,705)	(\$33,705)	\$0	\$0
17	Book/Tax Timer (State)	\$45,903	\$155,043	\$148,998	\$259,208	\$108,766	\$28,409	(\$28,622)	(\$76,612)	(\$124,173)	(\$195,917)	(\$160,500)	(\$160,500)	\$0	\$0
18	Effective Tax Rate (State)	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%
19	Deferred Tax Reserve (State)	\$3,535	\$11,938	\$11,473	\$19,959	\$8,375	\$2,187	(\$2,204)	(\$5,899)	(\$9,561)	(\$15,086)	(\$12,359)	(\$12,359)	\$0	\$0
20	TOTAL Deferred Tax Reserve	\$13,174	\$44,497	\$42,762	\$74,393	\$31,216	\$8,153	(\$8,215)	(\$21,988)	(\$35,638)	(\$56,228)	(\$46,064)	(\$46,064)	\$0	\$0
<b>Rate Base Calculation</b>															
21	Plant In Service	\$1,070,000	\$1,070,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$2,675,000	\$1,605,000	\$1,605,000	\$0	\$0	\$0
23	Accumulated Book Depreciation	(\$107,000)	(\$214,000)	(\$481,500)	(\$749,000)	(\$1,016,500)	(\$1,284,000)	(\$1,551,500)	(\$1,819,000)	(\$2,086,500)	(\$2,354,000)	(\$2,514,500)	(\$2,675,000)	(\$2,675,000)	(\$2,675,000)
24	Deferred Tax Reserve	(\$13,174)	(\$44,497)	(\$42,762)	(\$74,393)	(\$31,216)	(\$8,153)	\$8,215	\$21,988	\$35,638	\$56,228	\$46,064	\$46,064	\$0	\$0
25	Year End Rate Base	\$949,826	\$811,503	\$2,150,738	\$1,851,607	\$1,627,284	\$1,382,847	\$1,131,715	\$877,988	\$624,138	\$377,228	(\$863,437)	(\$1,023,937)	(\$2,675,000)	(\$2,675,000)
<b>Revenue Requirement Calculation</b>															
27	Year End Rate Base	\$949,826	\$811,503	\$2,150,738	\$1,851,607	\$1,627,284	\$1,382,847	\$1,131,715	\$877,988	\$624,138	\$377,228	(\$863,437)	(\$1,023,937)	(\$2,675,000)	(\$2,675,000)
28	Pre-Tax ROR	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%
29	Return and Taxes	\$89,148	\$76,165	\$201,861	\$173,786	\$152,732	\$129,790	\$106,219	\$82,405	\$58,580	\$35,405	\$0	\$0	\$0	\$0
30	Book Depreciation	\$107,000	\$107,000	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$267,500	\$160,500	\$160,500	\$0	\$0	\$0
31	Property Taxes (b) 3.23%	\$30,679	\$26,212	\$69,469	\$59,807	\$52,561	\$44,666	\$36,554	\$28,359	\$20,160	\$12,184	\$0	\$0	\$0	\$0
32	Annual Revenue Requirement	\$226,827	\$209,377	\$538,830	\$501,093	\$472,793	\$441,956	\$410,274	\$378,264	\$346,239	\$315,090	\$160,500	\$160,500	\$0	\$0
<b>Imputed Capital Structure (c)</b>															
		Ratio	Rate	Weighted Rate	Pre Tax										
34	Long Term Debt	50.00%	5.97%	2.94%	2.94%										
35	Common Equity	50.00%	9.40%	4.70%	6.45%										
36		100.00%		7.64%	9.39%										
23a	Total annual customer contribution collected on a montly basis														

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis Updated November 25, 2019  
Meter Revenue Requirement**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
<b>Deferred Tax Calculation</b>																	
1 Meter Capital Cost																	
2019 Meter Install (200)	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$0	\$0
2021 Meter Install (300)			\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850
2 Total	\$43,900	\$43,900	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$65,850	\$65,850
<b>FEDERAL Vintage Year Tax Depreciation</b>																	
3 Annual Tax Depreciation	\$1,646	\$3,169	\$5,400	\$7,466	\$6,905	\$6,388	\$5,908	\$5,465	\$5,178	\$4,936	\$4,897	\$4,896	\$4,897	\$4,896	\$4,897	\$2,938	\$2,938
4 Cumulative Tax Depreciation	\$1,646	\$4,815	\$10,215	\$17,681	\$24,586	\$30,974	\$36,882	\$42,347	\$47,525	\$52,461	\$57,358	\$62,254	\$67,151	\$72,047	\$76,944	\$79,882	\$82,820
<b>STATE Vintage Year Tax Depreciation:</b>																	
6 Annual Tax Depreciation	\$1,646	\$3,169	\$5,400	\$7,466	\$6,905	\$6,388	\$5,908	\$5,465	\$5,178	\$4,936	\$4,897	\$4,896	\$4,897	\$4,896	\$4,897	\$2,938	\$2,938
7 Cumulative Tax Depreciation	\$1,646	\$4,815	\$10,215	\$17,681	\$24,586	\$30,974	\$36,882	\$42,347	\$47,525	\$52,461	\$57,358	\$62,254	\$67,151	\$72,047	\$76,944	\$79,882	\$82,820
<b>Book Depreciation Rate (a)</b>																	
9 Book Depreciation	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%	5.23%
10 Cumulative Book Depreciation	\$2,296	\$2,296	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$3,444	\$3,444
11 Book/Tax Timer (Federal)	(\$650)	\$873	(\$340)	\$1,726	\$1,165	\$648	\$168	(\$275)	(\$562)	(\$804)	(\$843)	(\$844)	(\$843)	(\$844)	(\$843)	(\$506)	(\$506)
less: Deferred Tax Reserve (State)	(\$50)	\$67	(\$26)	\$133	\$90	\$50	\$13	(\$21)	(\$43)	(\$62)	(\$65)	(\$65)	(\$65)	(\$65)	(\$65)	(\$39)	(\$39)
1 Net Book/Tax Timer (Federal)	(\$600)	\$806	(\$314)	\$1,593	\$1,075	\$598	\$155	(\$254)	(\$519)	(\$742)	(\$778)	(\$779)	(\$778)	(\$779)	(\$778)	(\$467)	(\$467)
2 Effective Tax Rate (Federal)	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	121.00%	221.00%
3 Deferred Tax Reserve (Federal)	(\$136)	\$183	(\$71)	\$362	\$245	\$136	\$35	(\$58)	(\$118)	(\$169)	(\$177)	(\$177)	(\$177)	(\$177)	(\$177)	(\$612)	(\$1,118)
4 Book/Tax Timer (State)	(\$650)	\$873	(\$340)	\$1,726	\$1,165	\$648	\$168	(\$275)	(\$562)	(\$804)	(\$843)	(\$844)	(\$843)	(\$844)	(\$843)	(\$506)	(\$506)
5 Effective Tax Rate (State)	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%	7.70%
6 Deferred Tax Reserve (State)	(\$50)	\$67	(\$26)	\$133	\$90	\$50	\$13	(\$21)	(\$43)	(\$62)	(\$65)	(\$65)	(\$65)	(\$65)	(\$65)	(\$39)	(\$39)
7 TOTAL Deferred Tax Reserve	(\$187)	\$251	(\$98)	\$495	\$334	\$186	\$48	(\$79)	(\$161)	(\$231)	(\$242)	(\$242)	(\$242)	(\$242)	(\$242)	(\$651)	(\$1,157)
<b>Rate Base Calculation</b>																	
21 Plant In Service	\$43,900	\$43,900	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$109,750	\$65,850	\$65,850
22 Accumulated Book Depreciation	(\$2,296)	(\$4,592)	(\$10,332)	(\$16,072)	(\$21,812)	(\$27,552)	(\$33,292)	(\$39,031)	(\$44,771)	(\$50,511)	(\$56,251)	(\$61,991)	(\$67,731)	(\$73,471)	(\$79,211)	(\$82,655)	(\$86,099)
23 Deferred Tax Reserve	\$187	(\$251)	\$98	(\$495)	(\$334)	(\$186)	(\$48)	\$79	\$161	\$231	\$242	\$242	\$242	\$242	\$242	\$651	\$1,157
24 Year End Rate Base	\$41,791	\$39,058	\$99,516	\$93,183	\$87,604	\$82,012	\$76,410	\$70,797	\$65,140	\$59,469	\$53,741	\$48,001	\$42,261	\$36,521	\$30,781	(\$16,154)	(\$19,092)
<b>Revenue Requirement Calculation</b>																	
26 Year End Rate Base	\$41,791	\$39,058	\$99,516	\$93,183	\$87,604	\$82,012	\$76,410	\$70,797	\$65,140	\$59,469	\$53,741	\$48,001	\$42,261	\$36,521	\$30,781	(\$16,154)	(\$19,092)
27 Pre-Tax ROR	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%	9.39%
28 Return and Taxes	\$3,922	\$3,666	\$9,340	\$8,746	\$8,222	\$7,697	\$7,172	\$6,645	\$6,114	\$5,582	\$5,044	\$4,505	\$3,966	\$3,428	\$2,889	\$0	\$0
29 Book Depreciation	\$2,296	\$2,296	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$5,740	\$3,444	\$3,444
30 Property Taxes (b)	\$1,350	\$1,262	\$3,214	\$3,010	\$2,830	\$2,649	\$2,468	\$2,287	\$2,104	\$1,921	\$1,736	\$1,550	\$1,365	\$1,180	\$994	\$0	\$0
31 Annual Revenue Requirement	\$7,568	\$7,223	\$18,295	\$17,496	\$16,792	\$16,086	\$15,380	\$14,672	\$13,958	\$13,242	\$12,520	\$11,796	\$11,071	\$10,347	\$9,623	\$3,444	\$3,444
<b>Imputed Capital Structure (c)</b>																	
	Ratio	Rate	Weighted														
34 Long Term Debt	50.00%	5.97%	2.94%	2.94%													
35 Common Equity	50.00%	9.40%	4.70%	6.45%													
36	100.00%		7.64%	9.39%													
23a Total annual customer contribution collected on a montly basis																	



**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Battery Depreciation Calculation**  
**Phase 1**

	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>	<u>2030</u>	<u>2031</u>	<u>2032</u>	<u>2033</u>	<u>2034</u>
1 Plant Additions	1,670,000														
2 less CIAC	\$600,000														
3 Total Plant In Service	1,070,000														
4 <u>Tax Depreciation (Federal)</u>															
5 Plant Additions	\$1,070,000														
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
7 Remaining Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8															
9 <u>Remaining Tax Depreciation (State)</u>															
10 Plant Additions	\$1,070,000														
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
12 Remaining Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
13															
14 Federal Tax Depreciation	\$ 152,903	\$ 262,043	\$ 187,143	\$ 133,643	\$ 95,551	\$ 95,444	\$ 95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0
15 State Tax Depreciation	\$152,903	\$262,043	\$187,143	\$133,643	\$95,551	\$95,444	\$95,551	\$47,722	\$0	\$0	\$0	\$0	\$0	\$0	\$0

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Battery Depreciation Calculation**  
**Phase 2**

	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>	<u>2030</u>	<u>2031</u>	<u>2032</u>	<u>2033</u>	<u>2034</u>
1 Plant Additions	2,505,000												
2 less CIAC	\$900,000												
3 Total Plant In Service	1,605,000												
4 <u>Tax Depreciation (Federal)</u>													
5 Plant Additions	\$1,605,000												
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
7 Remaining Tax Depreciation	\$229,355	\$393,065	\$280,715	\$200,465	\$143,327	\$143,166	\$143,327	\$71,583	\$0	\$0	\$0	\$0	\$0
8													
9 <u>Remaining Tax Depreciation (State)</u>													
10 Plant Additions	\$1,605,000												
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
12 Remaining Tax Depreciation	\$229,355	\$393,065	\$280,715	\$200,465	\$143,327	\$143,166	\$143,327	\$71,583	\$0	\$0	\$0	\$0	\$0
13													
14 Federal Tax Depreciation	\$ 229,355	\$ 393,065	\$ 280,715	\$ 200,465	\$ 143,327	\$ 143,166	\$ 143,327	\$ 71,583	\$0	\$0	\$0	\$0	\$0
15 State Tax Depreciation	\$229,355	\$393,065	\$280,715	\$200,465	\$143,327	\$143,166	\$143,327	\$71,583	\$0	\$0	\$0	\$0	\$0

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis Updated November 25, 2019**  
**Meter Depreciation Calculation**

	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>	<u>2030</u>	<u>2031</u>	<u>2032</u>	<u>2033</u>	<u>2034</u>
1 <u>Tax Depreciation (Federal)</u>															
Number of Meters	100														
Cost of Meter (\$/meter)	439														
2 Plant Additions	\$43,900														
3 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
4 Remaining Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
5 <u>Remaining Tax Depreciation (State)</u>															
6 Plant Additions	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900	\$43,900
7 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
8 Remaining Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
9 Federal Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959
10 State Tax Depreciation	\$1,646	\$3,169	\$2,931	\$2,712	\$2,508	\$2,320	\$2,146	\$1,985	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959	\$1,958	\$1,959

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis Updated November 25, 2019  
Meter Depreciation Calculation**

	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>	<u>2030</u>	<u>2031</u>	<u>2032</u>	<u>2033</u>	<u>2034</u>	<u>2035</u>	<u>2036</u>
1 <u>Tax Depreciation (Federal)</u>															
Number of Meters		150													
Cost of Meter (\$/meter)		439													
2 Plant Additions	\$65,850														
3 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
4 Remaining Tax Depreciation	\$2,469	\$4,754	\$4,397	\$4,068	\$3,762	\$3,480	\$3,219	\$2,978	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938
5 <u>Remaining Tax Depreciation (State)</u>															
6 Plant Additions	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850	\$65,850
7 20 Year MACRS Rate	3.750%	7.219%	6.677%	6.177%	5.713%	5.285%	4.888%	4.522%	4.462%	4.461%	4.462%	4.461%	4.462%	4.461%	4.462%
8 Remaining Tax Depreciation	\$2,469	\$4,754	\$4,397	\$4,068	\$3,762	\$3,480	\$3,219	\$2,978	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938
9 Federal Tax Depreciation	\$2,469	\$4,754	\$4,397	\$4,068	\$3,762	\$3,480	\$3,219	\$2,978	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938
10 State Tax Depreciation	\$2,469	\$4,754	\$4,397	\$4,068	\$3,762	\$3,480	\$3,219	\$2,978	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938	\$2,938



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November 22, 2019

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

Subject: Time-of-Use Study for Liberty Battery Storage Pilot

Dear Ms. Howland:

We understand that Staff wishes to utilize Liberty Utilities' (Liberty) battery storage pilot as an opportunity to better understand how time-of-use (TOU) rates may impact Liberty customers and their behavior, as this is a topic of growing interest with potential customer and system benefit. Accordingly, we would like to develop a study approach that will provide information of value with respect to TOU rates.

As an alternative to Staff's recommendation (delaying battery deployment to collect baseline load data), we recommend an alternative approach that can deliver insightful results and does not require delaying the deployment of batteries.

- In parallel with the battery pilot, we propose assessing the load research customer data that Liberty is collecting to assess the potential bill impacts of TOU rates prior to behavioral changes. From this, we can assess the revenue neutrality of the current TOU rates, as well as perform sensitivity analysis to assess the impacts of assumed changes in behavior and how that may impact cost-effectiveness. We would also apply this analysis to the sample population.
- The load research data provides a more representative sample of Liberty's customer base, forming an effective control group, and the simultaneous data collection mitigates the impact of weather variables.
- This study design is expected to produce valuable insights to inform future TOU rate design. We have supported regulators with this approach before, most recently the Ontario Energy Board, in helping understand impacts of changing general service distribution rates. This is good initial exploratory analysis to see how a rate structure that better aligns with system costs might affect consumer bills.

We propose this alternative option, as the current proposal (delaying battery deployment to collect baseline load data) is expected to delay battery deployment without delivering significant findings. As detailed by a US DOE report on [12 different TOU pilots](#) and series of associated guidance documents for consumer behavior studies (including on [sample stratification](#), [randomization](#), and [data collection requirements](#)), careful study design is required for evaluation of behavioral impacts of TOU rates. Without proper study design, null findings are likely.

With respect to the current proposed study design, we have two major concerns:

Debra A. Howland  
November 22, 2019  
Page 2

- The first is the sample size. Effective consumer behavior studies require samples of thousands of participants, as there are multiple confounding factors that can drive variability. With only 100 customers, we are unlikely to be able to derive findings of significance.
- The second is sample bias. The sample – customers who have opted into a battery pilot – is not necessarily representative of Liberty's broader population. Furthermore, the presence of the battery can directly alter the impact that TOU rates might have on customer behavior. In particular, a key value of batteries is that they can be a very effective means of shifting load, which can obviate the need for customers to do so through more behavioral measures. Thus, any findings we may achieve with respect to the behavior of opt-in battery pilot customers would not necessarily be applicable to other customers.

We hope that Staff find the proposed alternative suitable. If not, we would request a conversation with Staff to better understand their objectives with respect to TOU studies so that we may arrive at a workable solution.

Sincerely,

A handwritten signature in blue ink, appearing to read "David J. Walls". The signature is fluid and cursive, with a large initial "D" and "W".

David J. Walls  
Managing Director

c: Heather Tebbetts