

**Benefit Cost Calculations**  
Battery Storage Pilot Program  
29 November, 2022

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Cell contains a value provided by Liberty Utilities.

Cell value is calculated from inputs and other calculated values.



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### Actual Data (Monthly)

Years	Month
	2020 Dec
	2021 Jan
	2021 Feb
	2021 Mar
	2021 Apr
	2021 May
	2021 Jun
	2021 Jul
	2021 Aug
	2021 Sep
	2021 Oct
	2021 Nov
	2021 Dec
	2022 Jan
	2022 Feb
	2022 Mar
	2022 Apr
	2022 May
	2022 Jun
	2022 Jul
	2022 Aug
	2022 Sep
	2022 Oct
	2022 Nov
	2022 Dec

<b>Annual Degradation</b>	2%
<b>Battery Lifetime (in Years)</b>	15
<b>Batteries Removed per year after 10 years</b>	5%

### Projected Data (Annual - Phase 1 and 2)

Year	Number of Batteries (Phase 1)
2023	200
2024	200
2025	200
2026	200
2027	200
2028	200
2029	200
2030	200
2031	190
2032	180
2033	170
2034	160
2035	150

2036  
2037

0  
0

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Batteries	Sum of average_hourly_power (kW)
130	572.66
142	630.58
142	673.67
150	644.91
158	476.75
162	757.22
162	792.14
160	767.36
162	786.79
174	787.41
180	90.79
182	812.61
182	814.66
182	777.74
182	641.60
182	595.31
182	783.05
182	531.25
182	556.48
190	765.65
190	708.30
190	752.77
190	752.77
190	752.77
190	752.77

0.1 kW

10 per year (Phase 1)

15 per year (Phase 2)

Number of Batteries (Phase 2)	Capacity per Battery (Phase 1)
0	4.90
300	4.80
300	4.70
300	4.60
300	4.50
300	4.40
300	4.30
300	4.20
300	4.10
300	4.00
300	3.90
285	3.80
270	3.70

255  
240

3.60  
3.50

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Average peak reduction by battery	Average Peak Reduction Performance
4.41	88%
4.44	89%
4.74	95%
4.30	86%
3.02	60%
4.67	93%
4.89	98%
4.80	96%
4.86	97%
4.53	91%
0.50	10%
4.46	89%
4.48	90%
4.27	85%
3.53	71%
3.27	65%
4.30	86%
2.92	58%
3.06	61%
4.03	81%
3.73	75%
3.96	79%
3.96	79%
3.96	79%
3.96	79%
	79%

Capacity per Battery (Phase 2)	Expected Monthly Peak kW Reduction
	776.54
5.00	1949.27
4.90	1909.65
4.80	1870.03
4.70	1830.41
4.60	1790.79
4.50	1751.17
4.40	1711.55
4.30	1639.44
4.20	1568.92
4.10	1499.98
4.00	1385.09
3.90	1274.15



3.80  
3.70



767.82  
703.64

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RNS Rate (\$/kW)	RNS Benefits (\$)	Total LNS Rate (NON-PTF) (\$/kWh)	LNS Benefits (\$)
\$ 10.77	\$ 6,169	\$ 2.68	\$ 1,535
\$ 10.77	\$ 6,792	\$ 2.72	\$ 1,718
\$ 10.77	\$ 7,257	\$ 2.72	\$ 1,836
\$ 10.77	\$ 6,947	\$ 2.72	\$ 1,757
\$ 10.77	\$ 5,135	\$ 2.72	\$ 1,299
\$ 10.77	\$ 8,157	\$ 2.72	\$ 2,063
\$ 11.75	\$ 9,306	\$ 2.72	\$ 2,158
\$ 11.75	\$ 9,015	\$ 2.72	\$ 2,091
\$ 11.75	\$ 9,244	\$ 2.72	\$ 2,144
\$ 11.75	\$ 9,251	\$ 2.72	\$ 2,146
\$ 11.75	\$ 1,067	\$ 2.72	\$ 247
\$ 11.75	\$ 9,547	\$ 2.72	\$ 2,214
\$ 11.75	\$ 9,571	\$ 2.72	\$ 2,220
\$ 11.90	\$ 9,254	\$ 2.72	\$ 2,115
\$ 11.90	\$ 7,634	\$ 2.72	\$ 1,745
\$ 11.90	\$ 7,083	\$ 2.72	\$ 1,619
\$ 11.90	\$ 9,317	\$ 2.72	\$ 2,130
\$ 11.90	\$ 6,321	\$ 2.72	\$ 1,445
\$ 11.90	\$ 6,621	\$ 2.72	\$ 1,514
\$ 11.90	\$ 9,110	\$ 2.72	\$ 2,083
\$ 11.90	\$ 8,428	\$ 2.72	\$ 1,927
\$ 11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$ 11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$ 11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$ 11.90	\$ 8,957	\$ 2.72	\$ 2,047

RNS Rate (\$/kW)	RNS Benefits (\$)	Total LNS Rate (\$)
\$ 140.94	\$ 109,448	\$ 34.16
\$ 147.51	\$ 287,540	\$ 35.75
\$ 154.39	\$ 294,823	\$ 37.42
\$ 161.58	\$ 302,160	\$ 39.16
\$ 169.11	\$ 309,541	\$ 40.99
\$ 176.99	\$ 316,953	\$ 42.90
\$ 185.24	\$ 324,384	\$ 44.90
\$ 193.87	\$ 331,819	\$ 46.99
\$ 202.90	\$ 332,651	\$ 49.18
\$ 212.36	\$ 333,177	\$ 51.47
\$ 222.26	\$ 333,381	\$ 53.87
\$ 232.61	\$ 322,190	\$ 56.38
\$ 243.45	\$ 310,197	\$ 59.01

\$	254.80	\$	195,639	\$	61.76
\$	266.67	\$	187,640	\$	64.63

FCA Rate (\$/kW)	FCA Benefits (\$)
\$ 55.60	\$ 44,043
\$ 44.70	\$ 31,661

LNS Benefits (\$)	FCA Rate (\$/kW)	FCA Benefits (\$)
\$ 26,527	\$ 36.61	\$ 28,429
\$ 69,691	\$ 39.05	\$ 76,119
\$ 71,456	\$ 39.56	\$ 75,546
\$ 73,235	\$ 39.94	\$ 74,689
\$ 75,023	\$ 40.12	\$ 73,436
\$ 76,820	\$ 40.49	\$ 72,509
\$ 78,621	\$ 41.80	\$ 73,199
\$ 80,423	\$ 41.99	\$ 71,868
\$ 80,625	\$ 42.86	\$ 70,267
\$ 80,752	\$ 43.74	\$ 68,625
\$ 80,802	\$ 44.04	\$ 66,059
\$ 78,089	\$ 44.73	\$ 61,955
\$ 75,182	\$ 45.57	\$ 58,063

\$	47,417	\$	47.39	\$	36,389
\$	45,478	\$	49.29	\$	34,681

### Actual Data (Monthly)

Year	Month
	2020 Dec
	2021 Jan
	2021 Feb
	2021 Mar
	2021 Apr
	2021 May
	2021 Jun
	2021 Jul
	2021 Aug
	2021 Sep
	2021 Oct
	2021 Nov
	2021 Dec
	2022 Jan
	2022 Feb
	2022 Mar
	2022 Apr
	2022 May
	2022 Jun
	2022 Jul
	2022 Aug
	2022 Sep
	2022 Oct
	2022 Nov
	2022 Dec

### Projected Data (Annual - Phase 1 and 2)

Year	Number of Batteries (Phase 1)	
2023		200
2024		200
2025		200
2026		200
2027		200
2028		200
2029		200
2030		200
2031		190
2032		180
2033		170
2034		160
2035		150
2036		0
2037		0

Number of Batteries	Net Energy Metering Credits	Net Energy Metering Credits (per battery)
130		0.00
144	\$ 1,056	7.33
144	\$ 280	1.94
150	\$ 162	1.08
156	\$ 484	3.10
160	\$ 1,807	11.29
160	\$ 1,753	10.95
160	\$ 1,200	7.50
166	\$ 1,735	10.45
172	\$ 835	4.86
178	\$ 679	3.81
180	\$ 5,900	32.78
180	\$ 2,382	13.23
182	\$ 1,498	8.23
186	\$ 1,387	7.46
186	\$ 2,182	11.73
186	\$ 1,630	8.76
186	\$ 2,149	11.56
188	\$ 3,893	20.71
188	\$ 2,888	15.36
188	\$ 2,703	14.38
190	\$ 1,830	9.63
190	\$ 1,830	9.63
190	\$ 1,830	9.63
190	\$ 1,830	9.63

Number of Batteries (Phase 2)	Battery Capacity (Phase 1)	Battery Capacity (Phase 2)
0	4.90	0.00
300	4.80	5.00
300	4.70	4.90
300	4.60	4.80
300	4.50	4.70
300	4.40	4.60
300	4.30	4.50
300	4.20	4.40
300	4.10	4.30
300	4.00	4.20
300	3.90	4.10
285	3.80	4.00
270	3.70	3.90
255	3.60	3.80
240	3.50	3.70

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<b>Expected NEM Annual Credits</b>	
\$	24,287
\$	60,966
\$	59,726
\$	58,487
\$	57,248
\$	56,009
\$	54,770
\$	53,531
\$	51,276
\$	49,070
\$	46,914
\$	43,320
\$	39,851
\$	24,014
\$	22,007



	(1)	(2)
1 Year	<b>2020</b>	<b>2021</b>
2 Batteries Installed	130	52
Cumulative batteries	130	182
Effective capacity (kW)		
Peak reduction (kW)		

### Benefits

3 Regional Network System (RNS) rate (\$/kW-year)	\$ 129.00	\$ 136.10
4 Local Network System (LNS) rate( \$/kW-year)	\$ 25.17	\$ 32.70
5 Avoided Capacity Cost rate (\$/kW-year)	\$ 59.90	\$ 55.60
6 Regional Network System (RNS) Charges	\$ 6,168.62	\$ 91,289
7 Local Network System (LNS) Charges	\$ 1,534.74	\$ 21,893
8 Avoided Capacity Costs	\$ -	\$ 44,043
<b>Total Benefits</b>	<b>\$ 7,703.35</b>	<b>\$ 157,225</b>
	35.99	700.66

### Costs

	2020	2021
9 Revenue Requirement - Batteries		(\$211,438)
10 Revenue Requirement - Cell Based Meters		(\$7,196)
11 Monthly Cellular Reading Cost		(\$6,000)
12 Cogsdale Programming Costs		(\$189,372)
13 NEM Credit for battery		(\$18,272)
14 Meter MV-90 Programming Costs		\$0
15 <b>Total Costs</b>		<b>(\$432,278)</b>
16 <b>Net Benefit to All Customers</b>		<b>\$ (275,053)</b>
17 Net Present Value Calculation		
18 Required Rate of Return		7.60%
19 Net Present Value of Option		\$14,371
20 Net Present Value of Benefits		\$3,422,449
21 Net Present Value of Costs		(\$3,408,078)
Benefit-Cost Ratio		<b>1.00</b>

- 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 2021 Wholesale Capacity Energy Price Projection p156 Col 1-16, Col 17
- 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
- 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)

**Benefit/Cost Analysis**  
**Phases 1 and 2**

(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
8	10	300	0	0	0	0
190	200	500	500	500	500	500
	980	2460	2410	2360	2310	2260
	777	1949	1910	1870	1830	1791
\$ 142.78	\$ 140.94	\$ 147.51	\$ 154.39	\$ 161.58	\$ 169.11	\$ 176.99
\$ 32.64	\$ 34.16	\$ 35.75	\$ 37.42	\$ 39.16	\$ 40.99	\$ 42.90
\$ 44.70	\$ 36.61	\$ 39.05	\$ 39.56	\$ 39.94	\$ 40.12	\$ 40.49
\$ 99,594	\$ 109,448	\$ 287,540	\$ 294,823	\$ 302,160	\$ 309,541	\$ 316,953
\$ 22,767	\$ 26,527	\$ 69,691	\$ 71,456	\$ 73,235	\$ 75,023	\$ 76,820
\$ 31,661	\$ 28,429	\$ 76,119	\$ 75,546	\$ 74,689	\$ 73,436	\$ 72,509
<b>\$ 154,022</b>	<b>\$ 164,404</b>	<b>\$ 433,350</b>	<b>\$ 441,825</b>	<b>\$ 450,083</b>	<b>\$ 458,000</b>	<b>\$ 466,282</b>
699.72	776.54	1,949.27	1,909.65	1,870.03	1,830.41	1,790.79

<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
(\$254,748)	(\$210,757)	(\$199,468)	(\$557,429)	(\$521,822)	(\$485,922)	(\$451,801)
(\$6,877)	(\$6,534)	(\$6,197)	(\$16,830)	(\$16,184)	(\$15,536)	(\$14,888)
(\$6,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$25,651)	(\$24,287)	(\$60,966)	(\$59,726)	(\$58,487)	(\$57,248)	(\$56,009)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$293,276)</b>	<b>(\$256,578)</b>	<b>(\$281,631)</b>	<b>(\$648,985)</b>	<b>(\$611,493)</b>	<b>(\$573,707)</b>	<b>(\$537,698)</b>
<b>\$ (139,254)</b>	<b>\$ (92,174)</b>	<b>\$ 151,719</b>	<b>\$ (207,160)</b>	<b>\$ (161,410)</b>	<b>\$ (115,707)</b>	<b>\$ (71,416)</b>



(10)	(11)	(12)	(13)	(14)	(15)	(16)
<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>
0	0	0	0	0	0	0
500	500	490	480	470	445	420
2210	2160	2069	1980	1893	1748	1608
1751	1712	1639	1569	1500	1385	1274

\$ 185.24	\$ 193.87	\$ 202.90	\$ 212.36	\$ 222.26	\$ 232.61	\$ 243.45
\$ 44.90	\$ 46.99	\$ 49.18	\$ 51.47	\$ 53.87	\$ 56.38	\$ 59.01
\$ 41.80	\$ 41.99	\$ 42.86	\$ 43.74	\$ 44.04	\$ 44.73	\$ 45.57
\$ 324,384	\$ 331,819	\$ 332,651	\$ 333,177	\$ 333,381	\$ 322,190	\$ 310,197
\$ 78,621	\$ 80,423	\$ 80,625	\$ 80,752	\$ 80,802	\$ 78,089	\$ 75,182
\$ 73,199	\$ 71,868	\$ 70,267	\$ 68,625	\$ 66,059	\$ 61,955	\$ 58,063
<b>\$ 476,204</b>	<b>\$ 484,110</b>	<b>\$ 483,542</b>	<b>\$ 482,553</b>	<b>\$ 480,242</b>	<b>\$ 462,234</b>	<b>\$ 443,443</b>
1,751.17	1,711.55	1,639.44	1,568.92	1,499.98	1,385.09	1,274.15

<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>
(\$418,128)	(\$278,230)	(\$256,580)	(\$235,152)	(\$57,182)	(\$57,182)	\$0
(\$14,234)	(\$13,578)	(\$12,915)	(\$12,251)	(\$11,587)	(\$10,923)	(\$10,259)
(\$15,000)	(\$15,000)	(\$14,700)	(\$14,400)	(\$13,620)	(\$12,840)	(\$12,060)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$54,770)	(\$53,531)	(\$51,276)	(\$49,070)	(\$46,914)	(\$43,320)	(\$39,851)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$502,132)</b>	<b>(\$360,339)</b>	<b>(\$335,471)</b>	<b>(\$310,873)</b>	<b>(\$129,303)</b>	<b>(\$124,266)</b>	<b>(\$62,170)</b>
<b>\$ (25,928)</b>	<b>\$ 123,771</b>	<b>\$ 148,072</b>	<b>\$ 171,681</b>	<b>\$ 350,939</b>	<b>\$ 337,969</b>	<b>\$ 381,273</b>



(17)	(18)
<b>2036</b>	<b>2037</b>
0	0
255	240
969	888
768	704

\$ 254.80	\$ 266.67
\$ 61.76	\$ 64.63
\$ 47.39	\$ 49.29
\$ 195,639	\$ 187,640
\$ 47,417	\$ 45,478
\$ 36,389	\$ 34,681
<b>\$ 279,446</b>	<b>\$ 267,800</b>
767.82	703.64

<b>2036</b>	<b>2037</b>
\$0	\$0
(\$9,971)	(\$9,616)
(\$11,220)	\$0
\$0	\$0
(\$24,014)	(\$22,007)
\$0	\$0
<b>(\$45,206)</b>	<b>(\$31,623)</b>
<b>\$ 234,240</b>	<b>\$ 236,177</b>

**Liberty Utilities (G)**

	<b>1</b>	<b>2</b>	
	<b>2020</b>	<b>2021</b>	<b>2022</b>
<b><u>Deferred Tax Calculation</u></b>			
1	Battery Capital Cost		
	2020 Battery Install (200)	\$1,294,795	\$415,000
	CIAC	291,258	\$139,794
	2024 Battery Install (300)		
	CIAC		
	Net Battery Install Costs for Depr (200)	\$1,003,537	\$282,340
	Net Battery Install Costs for Depr (300)		(\$139,794)
2	Total Plant In Service	\$1,003,537	\$1,285,877
			\$1,146,083
3	FEDERAL Vintage Year Tax Depreciation:	\$143,405	\$286,112
4	Annual Tax Depreciation	\$143,405	\$286,112
5	Cumulative Tax Depreciation	\$143,405	\$429,517
			\$654,204
6	STATE Vintage Year Tax Depreciation:	\$143,405	\$286,112
7	Annual Tax Depreciation	\$143,405	\$286,112
8	Cumulative Tax Depreciation	\$143,405	\$429,517
			\$654,204
9	Book Depreciation Rate (a)	10.00%	10.00%
10	Book Depreciation	\$100,354	\$128,588
11	Cumulative Book Depreciation	\$100,354	\$228,941
			\$343,550
12	Book/Tax Timer (Federal)	\$43,051	\$157,524
13	less: Deferred Tax Reserve (State)	\$3,315	\$12,129
14	Net Book/Tax Timer (Federal)	\$39,736	\$145,395
15	Effective Tax Rate (Federal)	21.00%	21.00%
16	Deferred Tax Reserve (Federal)	\$9,041	\$33,080
17	Book/Tax Timer (State)	\$43,051	\$157,524
18	Effective Tax Rate (State)	7.70%	7.70%
19	Deferred Tax Reserve (State)	\$3,315	\$12,129
20	TOTAL Deferred Tax Reserve	\$12,356	\$45,209
			\$31,482
21	<b><u>Rate Base Calculation</u></b>		
22	Plant In Service	\$1,003,537	\$1,285,877
23	Accumulated Book Depreciation	(\$100,354)	(\$228,941)
24	Deferred Tax Reserve	(\$12,356)	(\$45,209)
25	Year End Rate Base	\$890,828	\$1,011,726
			\$771,051
26	<b><u>Revenue Requirement Calculation</u></b>		
27	Year End Rate Base	\$890,828	\$1,011,726
28	Pre-Tax ROR	9.35%	9.35%
			9.35%



29	Return and Taxes		\$83,291	\$94,594	\$72,092
30	Book Depreciation		\$100,354	\$128,588	\$114,608
31	Property Taxes (b)	3.12%	\$27,794	\$31,566	\$24,057
32	Annual Revenue Requirement		\$211,438	\$254,748	\$210,757

33 **Imputed Capital Structure (c)**

					Weighted
			Ratio	Rate	Rate
34	Long Term Debt		48.00%	5.97%	2.87%
35	Common Equity		52.00%	9.10%	4.73%
36			<u>100.00%</u>		<u>7.60%</u>



\$63,628	\$203,179	\$176,481	\$149,564	\$123,980	\$98,732	\$79,770
\$114,608	\$286,449	\$286,449	\$286,449	\$286,449	\$286,449	\$171,841
\$21,232	\$67,800	\$58,891	\$49,909	\$41,372	\$32,947	\$26,619
<u>\$199,468</u>	<u>\$557,429</u>	<u>\$521,822</u>	<u>\$485,922</u>	<u>\$451,801</u>	<u>\$418,128</u>	<u>\$278,230</u>

Pre Tax

2.87%

6.48%

9.35%

<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>
<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b><u>2029</u></b>	<b><u>2030</u></b>	<b><u>2031</u></b>	<b><u>2032</u></b>

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\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$2,864,492	\$2,864,492	\$2,864,492	\$2,864,492

\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$1,146,081	\$1,146,081	\$1,146,081	\$1,146,081

\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$1,146,081	\$1,146,081	\$1,146,081	\$1,146,081

10.00%	10.00%	0.00%	0.00%
\$171,841	\$171,841	\$0	\$0
\$2,234,086	\$2,405,927	\$2,405,927	\$2,405,927

(\$171,841)	(\$171,841)	\$0	\$0
(\$13,060)	(\$13,060)	\$0	\$0
(\$158,781)	(\$158,781)	\$0	\$0

21.00%	21.00%	121.00%	221.00%
(\$36,087)	(\$36,087)	\$0	\$0

(\$171,841)	(\$171,841)	\$0	\$0
7.60%	7.60%	7.60%	7.60%

(\$13,060)	(\$13,060)	\$0	\$0
(\$49,146)	(\$49,146)	\$0	\$0

\$2,864,492	\$2,864,492	\$2,864,492	\$2,864,492
(\$2,234,086)	(\$2,405,927)	(\$2,405,927)	(\$2,405,927)
\$49,146	\$49,146	\$0	\$0
\$679,553	\$507,712	\$458,565	\$458,565

\$679,553	\$507,712	\$458,565	\$458,565
9.35%	9.35%	9.35%	9.35%

\$63,537	\$47,470	\$42,875	\$42,875
\$171,841	\$171,841	\$0	\$0
\$21,202	\$15,841	\$14,307	\$14,307
<hr/>	<hr/>	<hr/>	<hr/>
\$256,580	\$235,152	\$57,182	\$57,182



**Liberty Utilities (Granite State Electric) d/b/a Liberty**  
**Benefit/Cost**  
**Battery Depreciation**  
**Phase**

	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
1 Plant Additions	1,294,795				
2 <u>less CIAC</u>	<u>\$291,258</u>				
3 Total Plant In Service	1,003,537				
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions	\$1,003,537				
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
7 Remaining Tax Depreciation	\$143,405	\$245,766	\$175,519	\$125,342	\$89,616
8					
9 <u>Remaining Tax Depreciation (State)</u>					
10 Plant Additions	\$1,003,537				
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
12 Remaining Tax Depreciation	\$143,405	\$245,766	\$175,519	\$125,342	\$89,616
13					
14 Federal Tax Depreciation	<u>\$ 143,405</u>	<u>\$ 245,766</u>	<u>\$ 175,519</u>	<u>\$ 125,342</u>	<u>\$ 89,616</u>
15 State Tax Depreciation	<u>\$143,405</u>	<u>\$245,766</u>	<u>\$175,519</u>	<u>\$125,342</u>	<u>\$89,616</u>

1 Plant Additions		415,000			
2 <u>less CIAC</u>		<u>\$132,660</u>			
3 Total Plant In Service		282,340			
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions		\$282,340			
6 7 Year MACRS Rate		14.290%	24.490%	17.490%	12.490%
7 Remaining Tax Depreciation	\$0	\$40,346	\$69,145	\$49,381	\$35,264
8					
9 <u>Remaining Tax Depreciation (State)</u>					
10 Plant Additions		282,340			
11 7 Year MACRS Rate		14.290%	24.490%	17.490%	12.490%
12 Remaining Tax Depreciation	\$0	\$40,346	\$69,145	\$49,381	\$35,264
13					
14 Federal Tax Depreciation	<u>\$ -</u>	<u>\$ 40,346</u>	<u>\$ 69,145</u>	<u>\$ 49,381</u>	<u>\$ 35,264</u>
15 State Tax Depreciation	<u>\$0</u>	<u>\$40,346</u>	<u>\$69,145</u>	<u>\$49,381</u>	<u>\$35,264</u>

1 Plant Additions		-			
2 <u>less CIAC</u>			<u>\$139,794</u>		
3 Total Plant In Service			(139,794)		
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions			(\$139,794)		

6	7 Year MACRS Rate			14.290%	24.490%	17.490%
7	Remaining Tax Depreciation	0	\$0	(\$19,977)	(\$34,236)	(\$24,450)
8						
9	<u>Remaining Tax Depreciation (State)</u>					
10	Plant Additions			(\$139,794)		
11	7 Year MACRS Rate			14.290%	24.490%	17.490%
12	Remaining Tax Depreciation	\$0	\$0	(\$19,977)	(\$34,236)	(\$24,450)
13						
14	Federal Tax Depreciation	\$ -	\$ -	\$ (19,977)	\$ (34,236)	\$ (24,450)
15	State Tax Depreciation	\$0	\$0	(\$19,977)	(\$34,236)	(\$24,450)



**erty Utilities Proposed Battery Pilot Project**

**Analysis**

**on Calculation**

1

<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>
8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
\$ 89,516	\$ 89,616	\$ 44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0

8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
\$ 25,213	\$ 25,185	\$ 25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0

12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

\$ (17,460)	\$ (12,484)	\$ (12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities**  
**Benefit/Cost Analysis**  
**Battery Depreciation Calculation**  
**Phase 2**

	<b><u>2024</u></b>	<b><u>2025</u></b>	<b><u>2026</u></b>	<b><u>2027</u></b>	<b><u>2028</u></b>
1 Plant Additions	2,564,693				
2 <u>less CIAC</u>	<u>\$846,284</u>				
3 Total Plant In Service	1,718,409				
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions	\$1,718,409				
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
7 Remaining Tax Depreciation	<u>\$245,561</u>	<u>\$420,838</u>	<u>\$300,550</u>	<u>\$214,629</u>	<u>\$153,454</u>
8					
9 <u>Remaining Tax Depreciation (State)</u>					
10 Plant Additions	\$1,718,409				
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
12 Remaining Tax Depreciation	<u>\$245,561</u>	<u>\$420,838</u>	<u>\$300,550</u>	<u>\$214,629</u>	<u>\$153,454</u>
13					
14 Federal Tax Depreciation	<u>\$ 245,561</u>	<u>\$ 420,838</u>	<u>\$ 300,550</u>	<u>\$ 214,629</u>	<u>\$ 153,454</u>
15 State Tax Depreciation	<u>\$245,561</u>	<u>\$420,838</u>	<u>\$300,550</u>	<u>\$214,629</u>	<u>\$153,454</u>

**ties Proposed Battery Pilot Project**

**ation**

**2029**      **2030**      **2031**      **2032**      **2033**      **2034**      **2035**      **2036**

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8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
\$153,282	\$153,454	\$76,641	\$0	\$0	\$0	\$0	\$0

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8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
\$153,282	\$153,454	\$76,641	\$0	\$0	\$0	\$0	\$0

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\$ 153,282	\$ 153,454	\$ 76,641	\$0	\$0	\$0	\$0	\$0
\$153,282	\$153,454	\$76,641	\$0	\$0	\$0	\$0	\$0

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**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis**  
**Meter Depreciation Calculation**  
**Phase I**

	<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>CY 2032</u>	<u>CY 2033</u>
1 <u>Tax Depreciation (Federal)</u>															
Number of Meters	100														
Cost of Meter (\$/meter)	426														
2 Plant Additions	\$42,600														
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	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
5 <u>Remaining Tax Depreciation (State)</u>															
6 Plant Additions	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600
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	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
9 Federal Tax Depreciation	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
10 State Tax Depreciation	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis**  
**Meter Depreciation Calculation**  
**Phase 2**

	<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)	426												
2 Plant Additions	\$63,900												
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 Remaining Tax Depreciation	\$2,396	\$4,613	\$4,267	\$3,947	\$3,651	\$3,377	\$3,123	\$2,890	\$2,851	\$2,851	\$2,851	\$2,851	\$2,851
5 <u>Remaining Tax Depreciation (State)</u>													
6 Plant Additions	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900	\$63,900
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%
8 Remaining Tax Depreciation	\$2,396	\$4,613	\$4,267	\$3,947	\$3,651	\$3,377	\$3,123	\$2,890	\$2,851	\$2,851	\$2,851	\$2,851	\$2,851
9 Federal Tax Depreciation	\$2,396	\$4,613	\$4,267	\$3,947	\$3,651	\$3,377	\$3,123	\$2,890	\$2,851	\$2,851	\$2,851	\$2,851	\$2,851
10 State Tax Depreciation	\$2,396	\$4,613	\$4,267	\$3,947	\$3,651	\$3,377	\$3,123	\$2,890	\$2,851	\$2,851	\$2,851	\$2,851	\$2,851

Number of Batteries		200	200
<b>Benefits</b>	<b>2019</b>	<b>2020</b>	
Regional Network System (RNS) rate (\$/kW-year)	\$117.00	\$123.00	
Local Network System (LNS) rate( \$/kW-year)	\$23.57	\$24.46	
Avoided Capacity Cost rate (\$/kW-year)	\$100.00	\$73.90	
Regional Network System (RNS) Charges	\$87,750	\$92,250	
Local Network System (LNS) Charges	\$17,675	\$18,347	
Avoided Capacity Costs	\$75,000	\$55,425	
<b>Total Benefits</b>	<b>\$ 180,425</b>	<b>\$ 166,022</b>	
<b>Costs</b>	<b>2019</b>	<b>2020</b>	
Revenue Requirement - Batteries	(\$222,944)	(\$205,447)	
Revenue Requirement - Cell Based Meters	(\$7,549)	(\$7,200)	
Monthly Cellular Reading Cost	(\$6,000)	(\$6,000)	
Cogsdale Programming Costs	(\$102,185)	\$0	
NEM Credit for battery	(\$15,782)	(\$15,309)	
Meter MV-90 Programming Costs	(\$107,500)	\$0	
<b>Total Costs</b>	<b>(\$461,960)</b>	<b>(\$233,956)</b>	
<b>Net Benefit to All Customers</b>	<b>\$ (281,535)</b>	<b>\$ (67,934)</b>	
Net Present Value Calculation			
Required Rate of Return	7.69%		
Net Present Value of Option	\$8,473		
Net Present Value of Benefits	\$3,346,804		
Net Present Value of Costs	(\$3,338,331)		

**Phase 1 and 2 Original Filing**

500                      500                      500                      500                      500                      500

2021	2022	2023	2024	2025	2026	2027
\$ 129.00	\$ 135.00	\$ 141.29	\$ 147.88	\$ 154.77	\$ 161.98	\$ 169.53
\$ 25.17	\$ 25.42	\$ 26.61	\$ 27.85	\$ 29.14	\$ 30.50	\$ 31.92
\$ 59.90	\$ 57.60	\$ 58.80	\$ 61.20	\$ 65.70	\$ 71.20	\$ 76.90
\$ 241,875	\$ 253,125	\$ 264,921	\$ 277,266	\$ 290,187	\$ 303,709	\$ 317,862
\$ 47,190	\$ 47,665	\$ 49,886	\$ 52,211	\$ 54,644	\$ 57,191	\$ 59,856
\$ 112,313	\$ 108,000	\$ 110,250	\$ 114,750	\$ 123,188	\$ 133,500	\$ 144,188
<b>\$ 401,378</b>	<b>\$ 408,790</b>	<b>\$ 425,057</b>	<b>\$ 444,227</b>	<b>\$ 468,019</b>	<b>\$ 494,400</b>	<b>\$ 521,906</b>

2021	2022	2023	2024	2025	2026	2027
(\$529,084)	(\$491,278)	(\$462,986)	(\$432,136)	(\$400,434)	(\$368,402)	(\$336,355)
(\$18,240)	(\$17,433)	(\$16,723)	(\$16,011)	(\$15,298)	(\$14,583)	(\$13,863)
(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$38,508)	(\$37,325)	(\$36,141)	(\$34,957)	(\$33,774)	(\$32,590)	(\$31,406)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$600,832)</b>	<b>(\$561,036)</b>	<b>(\$530,850)</b>	<b>(\$498,104)</b>	<b>(\$464,506)</b>	<b>(\$430,575)</b>	<b>(\$396,624)</b>

\$ (199,454)    \$ (152,246)    \$ (105,793)    \$ (53,877)    \$ 3,513    \$ 63,825    \$ 125,282



500	500	500	500	500	500	500	500
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2028	2029	2030	2031	2032	2033	2034	2035
\$ 177.43	\$ 185.69	\$ 194.35	\$ 203.40	\$ 212.88	\$ 222.80	\$ 233.19	\$ 244.05
\$ 33.41	\$ 34.97	\$ 36.60	\$ 38.30	\$ 40.09	\$ 41.96	\$ 43.91	\$ 45.96
\$ 82.50	\$ 88.10	\$ 83.90	\$ 82.50	\$ 88.10	\$ 83.90	\$ 82.50	\$ 88.10
\$ 332,674	\$ 314,752	\$ 306,098	\$ 242,458	\$ 193,724	\$ 42,286	\$ 29,205	\$ -
\$ 62,645	\$ 59,270	\$ 57,640	\$ 45,657	\$ 36,480	\$ 21,146	\$ 15,544	\$ -
\$ 154,688	\$ 149,330	\$ 132,143	\$ 98,340	\$ 80,171	\$ 42,286	\$ 29,205	\$ -
<b>\$ 550,007</b>	<b>\$ 523,352</b>	<b>\$ 495,881</b>	<b>\$ 386,455</b>	<b>\$ 310,375</b>	<b>\$ 105,718</b>	<b>\$ 73,954</b>	<b>\$ -</b>

2028	2029	2030	2031	2032	2033	2034	2035
(\$305,190)	(\$154,500)	(\$154,500)	\$0	\$0	\$0	\$0	\$0
(\$13,141)	(\$12,412)	(\$11,681)	(\$10,950)	(\$10,220)	(\$9,489)	(\$3,342)	\$0
(\$15,000)	(\$14,700)	(\$14,400)	(\$13,620)	(\$12,840)	(\$12,060)	(\$11,220)	\$0
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$30,223)	(\$28,487)	(\$26,798)	(\$24,273)	(\$21,871)	(\$12,727)	(\$11,360)	\$
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$363,554)</b>	<b>(\$210,099)</b>	<b>(\$207,379)</b>	<b>(\$48,843)</b>	<b>(\$44,931)</b>	<b>(\$34,276)</b>	<b>(\$25,922)</b>	<b>\$0</b>

\$ 186,453	\$ 313,253	\$ 288,502	\$ 337,612	\$ 265,444	\$ 71,442	\$ 48,032	\$ -
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Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis  
Phases 1 and 2

	-1	-2
	2021	2022
1 Year		
2 Batteries Installed	200	0
Benefits		
3 Regional Network System (RNS) rate (\$/kW-year)	136.0981833	142.77923
4 Local Network System (LNS) rate( \$/kW-year)	32.69735666	32.6396214
5 Avoided Capacity Cost rate (\$/kW-year)	55.6	44.7
6 Regional Network System (RNS) Charges	89507.81992	104828.5107
7 Local Network System (LNS) Charges	20966.55556	23964.01003
8 Avoided Capacity Costs	36513.44667	32818.74
9 Total Benefits	146987.8222	161611.2607
Costs		
10 Revenue Requirement - Batteries	-211438.2582	-166632.0403
11 Revenue Requirement - Cell Based Meters	-7284.838964	-6954.154768
12 Monthly Cellular Reading Cost	-6000	-6000
13 Cogsdale Programming Costs	-189371.79	0
14 NEM Credit for battery	-16146.34275	-15661.95247
15 Meter MV-90 Programming Costs	0	0
16 Total Costs	-430241.2299	-195248.1475
17 Net Benefit to All Customers	-283253.4078	-33636.88683
Net Present Value Calculation		
18 Required Rate of Return	0.076	
19 Net Present Value of Option	567551.5169	
20 Net Present Value of Benefits	3345364.462	
21 Net Present Value of Costs	-2777812.945	

- 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 272
- 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
- 20 Net Present Value calculation of benefits using discount rate in Line (20) and benefits in line
- 21 Net Present Value calculation of costs using discount rate in Line (20) and costs in line (18)

	-3 2023	-4 2024	-5 2025	-6 2026	-7 2027	-8 2028	-9 2029
	0	300	0	0	0	0	0
	140.94401	147.5120009	154.3860601	161.5804505	169.1100995	176.9906301	185.2383935
	34.16062776	35.75251301	37.41858012	39.16228595	40.98724848	42.89725425	44.8962663
	23.1	29.5	32.3	32.3	39.9	39.6	40.9
	269672.8725	282239.6283	295391.995	309157.262	323563.9904	338642.0723	354422.7929
	65360.66778	68406.47489	71594.21662	74930.50712	78422.26875	82076.74647	85901.52286
	43464.96	55507.2	60775.68	60775.68	75075.84	74511.36	76957.44
	378498.5002	406153.3032	427761.8916	444863.4491	477062.0991	495230.1788	517281.7558
	-275914.1716	-84366.80312	-451637.8041	-424160.929	-395794.3886	-366855.6249	-337901.0266
	-6599.223782	-6249.929023	-17004.09595	-16327.47274	-15649.49432	-14970.26767	-14285.6558
	-15000	-15000	-15000	-15000	-15000	-15000	-15000
	0	0	0	0	0	0	0
	-39900.93752	-38674.84598	-37448.75443	-36222.66289	-34996.57135	-33770.47981	-32544.38826
	0	0	0	0	0	0	0
	-337414.3329	-144291.5781	-521090.6544	-491711.0646	-461440.4542	-430596.3724	-399731.0707
	41084.16736	261861.7251	-93328.76282	-46847.61555	15621.64488	64633.80642	117550.6851
	2288123.992						
	552650.3662						
	504590.1037						
	3345364.462						
Revenue Requirement - Batteries			-2124441.29				
Revenue Requirement - Cell Base			-100248.4515				
Monthly Cellular Reading Cost			-116255.8507				
Cogsdale Programming Costs			-175996.0874				
NEM Credit for battery			-260871.2656				
Meter MV-90 Programming Cost:			0				
			-2777812.945				

47814.35417

519737.1627

NPV of Estimated Avoided Interruption Costs 30436

NPV of Savings from ISO-NE RTM 37476

587649.1627

635463.5169

(or costs ) in line (19)

(12)

-10	-11	-12	-13	-14	-15	-16
2030	2031	2032	2033	2034	2035	2036
0	0	0	0	0	0	0
193.8705026	202.9048681	212.3602349	222.2562219	232.6133618	243.4531445	254.798061
46.98843231	49.17809326	51.4697924	53.86828473	56.3785468	59.00578708	61.75545676
45.2	45.8	46.3	48.2	53.7	46.3	47.1
370938.895	343923.7514	334467.37	264929.4165	211678.1592	122700.3848	90198.51359
89904.53383	83356.86807	81064.92304	64210.9954	51304.47759	29738.91669	21861.43169
85048.32	77631	72922.5	57454.4	48867	23335.2	16673.4
545891.7489	504911.6194	488454.793	386594.8119	311849.6368	175774.5015	128733.3453
-310095.7607	-171840.904	-171840.904	0	0	0	0
-13599.43908	-12906.23227	-12211.70592	-11517.10823	-10822.58187	-10127.98419	-3341.97
-15000	-14700	-14400	-13620	-12840	-12060	-11220
0	0	0	0	0	0	0
-31318.29672	-29515.32642	-27761.80287	-25134.72006	-22636.1988	-13096.46025	-11679.1746
0	0	0	0	0	0	0
-370013.4964	-228962.4627	-226214.4128	-50271.82829	-46298.78067	-35284.44443	-26241.1446
175878.2524	275949.1567	262240.3802	336322.9836	265550.8562	140490.0571	102492.2007



Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities  
Docket No. DE 17-189  
Attachment 2  
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-17  
2037 2038  
0

Total

266.6716506	
64.63326104	
48	
0	4106263.434
0	993065.1164
0	898332.1667
0	5997660.718
0	
0	-3368478.615
0	-179852.1546
0	-210840
0	-189371.79
0	-446508.9152
0	0
0	-4395051.475
0	
0	1602609.243





monthly kw

130 batteries in phase 1 are removed in year 15, 15 or 5% of phase 2 batteries are removed in year 15 as it's only



	3	4	5	6	7
	2021	2022	2023	2024	2025
		#DIV/0!			
	933281	-1			
	1125	1125	1125	1125	1125

year 13

300 batteries net metering credit per year

0	0	0	0	0
---	---	---	---	---

300 batteries avoided capacity

25987.5	33187.5	36337.5	36337.5	44887.5
---------	---------	---------	---------	---------

300 battery rns

158562.0113	165951.001	173684.3176	181778.0068	190248.8619
-------------	------------	-------------	-------------	-------------

300 battery lns

38430.70623	40221.57714	42095.90263	44057.57169	46110.65454
-------------	-------------	-------------	-------------	-------------



8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032
1125	1125	1125	1125	1125	852	670
0	0	0	0	0	0	0
44550	46012.5	50850	51525	52087.5	41066.4	35979
199114.4589	208393.1927	218104.3155	228267.9766	238905.2643	189362.301	155850.9524
48259.41104	50508.29959	52861.98635	55325.35492	57903.51645	45895.77859	37773.62636



15	16	17
2033	2033	2033

504	354	0
-----	-----	---

0	0	0
---	---	---

23335.2	16673.4	0
---------	---------	---

122700.3848	90198.51359	0
-------------	-------------	---

29738.91669	21861.43169	0
-------------	-------------	---



**Benefit Cost Calculations**  
Battery Storage Pilot Program  
29 November, 2022

**DISCLAIMER**

**Copyright**

**Disclaimer**

**Confidentiality**

**CELL COLOR CODING**

**LIGHT YELLOW = ASSUMPTION**

**LIGHT GRAY = GUIDEHOUSE ANALYSIS**

**LIGHT BLUE = LIBERTY INPUT**

**WHITE = CALCULATION**



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Cell contains Guidehouse assumptions.

Cell contains inputs based on Guidehouse analysis

Cell contains a value provided by Liberty Utilities.

Cell value is calculated from inputs and other calculated values.



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*mplexity*

### Actual Data (Monthly)

Years	Month
	2020 Dec
	2021 Jan
	2021 Feb
	2021 Mar
	2021 Apr
	2021 May
	2021 Jun
	2021 Jul
	2021 Aug
	2021 Sep
	2021 Oct
	2021 Nov
	2021 Dec
	2022 Jan
	2022 Feb
	2022 Mar
	2022 Apr
	2022 May
	2022 Jun
	2022 Jul
	2022 Aug
	2022 Sep
	2022 Oct
	2022 Nov
	2022 Dec

<b>Annual Degradation</b>	2%
<b>Battery Lifetime (in Years)</b>	15
<b>Batteries Removed per year after 10 years</b>	5%

### Projected Data (Annual - Phase 1 and 2)

Year	Number of Batteries (Phase 1)
2023	200
2024	200
2025	200
2026	200
2027	200
2028	200
2029	200
2030	200
2031	190
2032	180
2033	170
2034	160
2035	150

2036  
2037

0  
0

---

Batteries	Sum of average_hourly_power (kW)
130	572.66
142	630.58
142	673.67
150	644.91
158	476.75
162	757.22
162	792.14
160	767.36
162	786.79
174	787.41
180	90.79
182	812.61
182	814.66
182	777.74
182	641.60
182	595.31
182	783.05
182	531.25
182	556.48
190	765.65
190	708.30
190	752.77
190	752.77
190	752.77
190	752.77

0.1 kW

10 per year (Phase 1)

0 per year (Phase 2)

Number of Batteries (Phase 2)	Capacity per Battery (Phase 1)
	4.90
	4.80
	4.70
	4.60
	4.50
	4.40
	4.30
	4.20
	4.10
	4.00
	3.90
	3.80
	3.70

3.60

3.50

---

Average peak reduction by battery	Average Peak Reduction Performance
4.41	88%
4.44	89%
4.74	95%
4.30	86%
3.02	60%
4.67	93%
4.89	98%
4.80	96%
4.86	97%
4.53	91%
0.50	10%
4.46	89%
4.48	90%
4.27	85%
3.53	71%
3.27	65%
4.30	86%
2.92	58%
3.06	61%
4.03	81%
3.73	75%
3.96	79%
3.96	79%
3.96	79%
3.96	79%
	79%

Capacity per Battery (Phase 2)	Expected Monthly Peak kW Reduction
	776.54
	760.69
	744.84
	728.99
	713.15
	697.30
	681.45
	665.60
	617.27
	570.52
	525.35
	481.77
	439.77



0.00

0.00

RNS Rate (\$/kW)		RNS Benefits (\$)	Total LNS Rate (NON-PTF) (\$/kWh)	LNS Benefits (\$)
\$	10.77	\$ 6,169	\$ 2.68	\$ 1,535
\$	10.77	\$ 6,792	\$ 2.72	\$ 1,718
\$	10.77	\$ 7,257	\$ 2.72	\$ 1,836
\$	10.77	\$ 6,947	\$ 2.72	\$ 1,757
\$	10.77	\$ 5,135	\$ 2.72	\$ 1,299
\$	10.77	\$ 8,157	\$ 2.72	\$ 2,063
\$	11.75	\$ 9,306	\$ 2.72	\$ 2,158
\$	11.75	\$ 9,015	\$ 2.72	\$ 2,091
\$	11.75	\$ 9,244	\$ 2.72	\$ 2,144
\$	11.75	\$ 9,251	\$ 2.72	\$ 2,146
\$	11.75	\$ 1,067	\$ 2.72	\$ 247
\$	11.75	\$ 9,547	\$ 2.72	\$ 2,214
\$	11.75	\$ 9,571	\$ 2.72	\$ 2,220
\$	11.90	\$ 9,254	\$ 2.72	\$ 2,115
\$	11.90	\$ 7,634	\$ 2.72	\$ 1,745
\$	11.90	\$ 7,083	\$ 2.72	\$ 1,619
\$	11.90	\$ 9,317	\$ 2.72	\$ 2,130
\$	11.90	\$ 6,321	\$ 2.72	\$ 1,445
\$	11.90	\$ 6,621	\$ 2.72	\$ 1,514
\$	11.90	\$ 9,110	\$ 2.72	\$ 2,083
\$	11.90	\$ 8,428	\$ 2.72	\$ 1,927
\$	11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$	11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$	11.90	\$ 8,957	\$ 2.72	\$ 2,047
\$	11.90	\$ 8,957	\$ 2.72	\$ 2,047

RNS Rate (\$/kW)		RNS Benefits (\$)	Total LNS Rate (\$/kWh)	LNS Benefits (\$)
\$	140.94	\$ 109,448	\$ 34.16	
\$	147.51	\$ 112,211	\$ 35.75	
\$	154.39	\$ 114,993	\$ 37.42	
\$	161.58	\$ 117,791	\$ 39.16	
\$	169.11	\$ 120,600	\$ 40.99	
\$	176.99	\$ 123,415	\$ 42.90	
\$	185.24	\$ 126,231	\$ 44.90	
\$	193.87	\$ 129,041	\$ 46.99	
\$	202.90	\$ 125,247	\$ 49.18	
\$	212.36	\$ 121,155	\$ 51.47	
\$	222.26	\$ 116,763	\$ 53.87	
\$	232.61	\$ 112,066	\$ 56.38	
\$	243.45	\$ 107,064	\$ 59.01	

\$	254.80	\$	-	\$	61.76
\$	266.67	\$	-	\$	64.63

---

FCA Rate (\$/kW)	FCA Benefits (\$)
\$ 55.60	\$ 44,043
\$ 44.70	\$ 31,661

LNS Benefits (\$)	FCA Rate (\$/kW)	FCA Benefits (\$)
\$ 26,527	\$ 36.61	\$ 28,429
\$ 27,197	\$ 39.05	\$ 29,705
\$ 27,871	\$ 39.56	\$ 29,466
\$ 28,549	\$ 39.94	\$ 29,116
\$ 29,230	\$ 40.12	\$ 28,611
\$ 29,912	\$ 40.49	\$ 28,234
\$ 30,595	\$ 41.80	\$ 28,485
\$ 31,276	\$ 41.99	\$ 27,949
\$ 30,356	\$ 42.86	\$ 26,456
\$ 29,364	\$ 43.74	\$ 24,954
\$ 28,300	\$ 44.04	\$ 23,136
\$ 27,161	\$ 44.73	\$ 21,550
\$ 25,949	\$ 45.57	\$ 20,040

\$	-	\$	47.39	\$	-
\$	-	\$	49.29	\$	-

### Actual Data (Monthly)

Year	Month
	2020 Dec
	2021 Jan
	2021 Feb
	2021 Mar
	2021 Apr
	2021 May
	2021 Jun
	2021 Jul
	2021 Aug
	2021 Sep
	2021 Oct
	2021 Nov
	2021 Dec
	2022 Jan
	2022 Feb
	2022 Mar
	2022 Apr
	2022 May
	2022 Jun
	2022 Jul
	2022 Aug
	2022 Sep
	2022 Oct
	2022 Nov
	2022 Dec

### Projected Data (Annual - Phase 1 and 2)

Year	Number of Batteries (Phase 1)	
2023		200
2024		200
2025		200
2026		200
2027		200
2028		200
2029		200
2030		200
2031		190
2032		180
2033		170
2034		160
2035		150
2036		0
2037		0

Number of Batteries	Net Energy Metering Credits	Net Energy Metering Credits (per battery)
130		0.00
144 \$	1,056	7.33
144 \$	280	1.94
150 \$	162	1.08
156 \$	484	3.10
160 \$	1,807	11.29
160 \$	1,753	10.95
160 \$	1,200	7.50
166 \$	1,735	10.45
172 \$	835	4.86
178 \$	679	3.81
180 \$	5,900	32.78
180 \$	2,382	13.23
182 \$	1,498	8.23
186 \$	1,387	7.46
186 \$	2,182	11.73
186 \$	1,630	8.76
186 \$	2,149	11.56
188 \$	3,893	20.71
188 \$	2,888	15.36
188 \$	2,703	14.38
190 \$	1,830	9.63
190 \$	1,830	9.63
190 \$	1,830	9.63
190 \$	1,830	9.63

Number of Batteries (Phase 2)	Battery Capacity (Phase 1)	Battery Capacity (Phase 2)
0	4.90	0.00
0	4.80	0.00
0	4.70	0.00
0	4.60	0.00
0	4.50	0.00
0	4.40	0.00
0	4.30	0.00
0	4.20	0.00
0	4.10	0.00
0	4.00	0.00
0	3.90	0.00
0	3.80	0.00
0	3.70	0.00
0	3.60	0.00
0	3.50	0.00

---

<b>Expected NEM Annual Credits</b>	
\$	24,287
\$	23,791
\$	23,296
\$	22,800
\$	22,304
\$	21,809
\$	21,313
\$	20,818
\$	19,306
\$	17,844
\$	16,431
\$	15,068
\$	13,754
\$	-
\$	-



	(1)	(2)
1 Year	<b>2020</b>	<b>2021</b>
2 Batteries Installed	130	52
Cumulative batteries	130	182
Effective capacity (kW)		
Peak reduction (kW)		

### Benefits

3 Regional Network System (RNS) rate (\$/kW-year)	\$ 129.00	\$ 136.10
4 Local Network System (LNS) rate( \$/kW-year)	\$ 25.17	\$ 32.70
5 Avoided Capacity Cost rate (\$/kW-year)	\$ 59.90	\$ 55.60
6 Regional Network System (RNS) Charges	\$ 6,168.62	\$ 91,289
7 Local Network System (LNS) Charges	\$ 1,534.74	\$ 21,893
8 Avoided Capacity Costs	\$ -	\$ 44,043
<b>Total Benefits</b>	<b>\$ 7,703.35</b>	<b>\$ 157,225</b>
	35.99	700.66

### Costs

	2020	2021
9 Revenue Requirement - Batteries		(\$211,438)
10 Revenue Requirement - Cell Based Meters		(\$7,196)
11 Monthly Cellular Reading Cost		(\$6,000)
12 Cogsdale Programming Costs		(\$189,372)
13 NEM Credit for battery		(\$18,272)
14 Meter MV-90 Programming Costs		\$0
15 <b>Total Costs</b>		<b>(\$432,278)</b>
16 <b>Net Benefit to All Customers</b>		<b>\$ (275,053)</b>
17 Net Present Value Calculation		
18 Required Rate of Return		7.60%
19 Net Present Value of Option		(\$221,623)
20 Net Present Value of Benefits		\$1,491,838
21 Net Present Value of Costs		(\$1,713,461)
Benefit-Cost Ratio		<b>0.87</b>

- 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 2021 Wholesale Capacity Energy Price Projection p156 Col 1-16, Col 17
- 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
- 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)

**Benefit/Cost Analysis**

**Phase 1**

(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
8	10	0	0	0	0	0
190	200	200	200	200	200	200
	980	960	940	920	900	880
	777	761	745	729	713	697
\$ 142.78	\$ 140.94	\$ 147.51	\$ 154.39	\$ 161.58	\$ 169.11	\$ 176.99
\$ 32.64	\$ 34.16	\$ 35.75	\$ 37.42	\$ 39.16	\$ 40.99	\$ 42.90
\$ 44.70	\$ 36.61	\$ 39.05	\$ 39.56	\$ 39.94	\$ 40.12	\$ 40.49
\$ 99,594	\$ 109,448	\$ 112,211	\$ 114,993	\$ 117,791	\$ 120,600	\$ 123,415
\$ 22,767	\$ 26,527	\$ 27,197	\$ 27,871	\$ 28,549	\$ 29,230	\$ 29,912
\$ 31,661	\$ 28,429	\$ 29,705	\$ 29,466	\$ 29,116	\$ 28,611	\$ 28,234
<b>\$ 154,022</b>	<b>\$ 164,404</b>	<b>\$ 169,112</b>	<b>\$ 172,330</b>	<b>\$ 175,456</b>	<b>\$ 178,442</b>	<b>\$ 181,561</b>
699.72	776.54	760.69	744.84	728.99	713.15	697.30

<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
(\$254,748)	(\$210,757)	(\$199,468)	(\$186,605)	(\$172,427)	(\$157,955)	(\$145,262)
(\$6,877)	(\$6,620)	(\$6,362)	(\$6,103)	(\$5,844)	(\$5,585)	(\$5,325)
(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)	(\$6,000)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$25,651)	(\$24,287)	(\$23,791)	(\$23,296)	(\$22,800)	(\$22,304)	(\$21,809)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$293,276)</b>	<b>(\$247,664)</b>	<b>(\$235,622)</b>	<b>(\$222,005)</b>	<b>(\$207,071)</b>	<b>(\$191,844)</b>	<b>(\$178,396)</b>
<b>\$ (139,254)</b>	<b>\$ (83,260)</b>	<b>\$ (66,509)</b>	<b>\$ (49,675)</b>	<b>\$ (31,615)</b>	<b>\$ (13,403)</b>	<b>\$ 3,166</b>



(10)	(11)	(12)	(13)	(14)	(15)	(16)
<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>
0	0	0	0	0	0	0
200	200	190	180	170	160	150
860	840	779	720	663	608	555
681	666	617	571	525	482	440

\$ 185.24	\$ 193.87	\$ 202.90	\$ 212.36	\$ 222.26	\$ 232.61	\$ 243.45
\$ 44.90	\$ 46.99	\$ 49.18	\$ 51.47	\$ 53.87	\$ 56.38	\$ 59.01
\$ 41.80	\$ 41.99	\$ 42.86	\$ 43.74	\$ 44.04	\$ 44.73	\$ 45.57
\$ 126,231	\$ 129,041	\$ 125,247	\$ 121,155	\$ 116,763	\$ 112,066	\$ 107,064
\$ 30,595	\$ 31,276	\$ 30,356	\$ 29,364	\$ 28,300	\$ 27,161	\$ 25,949
\$ 28,485	\$ 27,949	\$ 26,456	\$ 24,954	\$ 23,136	\$ 21,550	\$ 20,040
<b>\$ 185,310</b>	<b>\$ 188,265</b>	<b>\$ 182,059</b>	<b>\$ 175,474</b>	<b>\$ 168,199</b>	<b>\$ 160,777</b>	<b>\$ 153,054</b>
681.45	665.60	617.27	570.52	525.35	481.77	439.77

<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>
(\$133,018)	(\$14,548)	(\$14,326)	(\$14,326)	(\$14,326)	(\$14,326)	\$0
(\$5,060)	(\$4,794)	(\$4,529)	(\$4,263)	(\$3,997)	(\$3,732)	(\$3,466)
(\$6,000)	(\$5,700)	(\$5,400)	(\$5,100)	(\$4,800)	(\$4,500)	(\$4,200)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$21,313)	(\$20,818)	(\$19,306)	(\$17,844)	(\$16,431)	(\$15,068)	(\$13,754)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$165,391)</b>	<b>(\$45,860)</b>	<b>(\$43,560)</b>	<b>(\$41,532)</b>	<b>(\$39,554)</b>	<b>(\$37,626)</b>	<b>(\$21,421)</b>
<b>\$ 19,919</b>	<b>\$ 142,405</b>	<b>\$ 138,499</b>	<b>\$ 133,942</b>	<b>\$ 128,645</b>	<b>\$ 123,152</b>	<b>\$ 131,633</b>



(17)	(18)
<b>2036</b>	<b>2037</b>
0	0
0	0
0	0
0	0

\$ 254.80	\$ 266.67
\$ 61.76	\$ 64.63
\$ 47.39	\$ 49.29
\$ -	\$ -
\$ -	\$ -
\$ -	\$ -
\$ -	\$ -
\$ -	\$ -

<b>2036</b>	<b>2037</b>
\$0	\$0
(\$3,534)	(\$3,534)
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
(\$3,534)	(\$3,534)
\$ (3,534)	\$ (3,534)

**Liberty Utilities (G)**

	<b>1</b>	<b>2</b>	
	<b>2020</b>	<b>2021</b>	<b>2022</b>
<b><u>Deferred Tax Calculation</u></b>			
1	Battery Capital Cost		
	2020 Battery Install (200)	\$1,294,795	\$415,000
	CIAC	291,258	\$139,794
	2024 Battery Install (300)		
	CIAC		
	Net Battery Install Costs for Depr (200)	\$1,003,537	\$282,340
	Net Battery Install Costs for Depr (300)		(\$139,794)
2	Total Plant In Service	\$1,003,537	\$1,285,877
			\$1,146,083
3	FEDERAL Vintage Year Tax Depreciation:	\$143,405	\$286,112
4	Annual Tax Depreciation	\$143,405	\$286,112
5	Cumulative Tax Depreciation	\$143,405	\$429,517
			\$654,204
6	STATE Vintage Year Tax Depreciation:	\$143,405	\$286,112
7	Annual Tax Depreciation	\$143,405	\$286,112
8	Cumulative Tax Depreciation	\$143,405	\$429,517
			\$654,204
9	Book Depreciation Rate (a)	10.00%	10.00%
10	Book Depreciation	\$100,354	\$128,588
11	Cumulative Book Depreciation	\$100,354	\$228,941
			\$343,550
12	Book/Tax Timer (Federal)	\$43,051	\$157,524
13	less: Deferred Tax Reserve (State)	\$3,315	\$12,129
14	Net Book/Tax Timer (Federal)	\$39,736	\$145,395
15	Effective Tax Rate (Federal)	21.00%	21.00%
16	Deferred Tax Reserve (Federal)	\$9,041	\$33,080
17	Book/Tax Timer (State)	\$43,051	\$157,524
18	Effective Tax Rate (State)	7.70%	7.70%
19	Deferred Tax Reserve (State)	\$3,315	\$12,129
20	TOTAL Deferred Tax Reserve	\$12,356	\$45,209
			\$31,482
21	<b><u>Rate Base Calculation</u></b>		
22	Plant In Service	\$1,003,537	\$1,285,877
23	Accumulated Book Depreciation	(\$100,354)	(\$228,941)
24	Deferred Tax Reserve	(\$12,356)	(\$45,209)
25	Year End Rate Base	\$890,828	\$1,011,726
			\$771,051
26	<b><u>Revenue Requirement Calculation</u></b>		
27	Year End Rate Base	\$890,828	\$1,011,726
28	Pre-Tax ROR	9.35%	9.35%
			9.35%



29	Return and Taxes		\$83,291	\$94,594	\$72,092
30	Book Depreciation		\$100,354	\$128,588	\$114,608
31	Property Taxes (b)	3.12%	\$27,794	\$31,566	\$24,057
32	Annual Revenue Requirement		<u>\$211,438</u>	<u>\$254,748</u>	<u>\$210,757</u>

33 **Imputed Capital Structure (c)**

				Weighted
			Ratio	Rate
34	Long Term Debt		48.00%	5.97%
35	Common Equity		52.00%	9.10%
36			<u>100.00%</u>	<u>7.60%</u>



\$63,628	\$53,983	\$43,352	\$32,501	\$22,984	\$13,803	\$10,908
\$114,608	\$114,608	\$114,608	\$114,608	\$114,608	\$114,608	\$0
\$21,232	\$18,014	\$14,466	\$10,846	\$7,670	\$4,606	\$3,640
<u>\$199,468</u>	<u>\$186,605</u>	<u>\$172,427</u>	<u>\$157,955</u>	<u>\$145,262</u>	<u>\$133,018</u>	<u>\$14,548</u>

<u>Pre Tax</u>
2.87%
<u>6.48%</u>
<u><u>9.35%</u></u>

<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>
<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b><u>2029</u></b>	<b><u>2030</u></b>	<b><u>2031</u></b>	<b><u>2032</u></b>

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\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
<u>\$1,146,083</u>	<u>\$1,146,083</u>	<u>\$1,146,083</u>	<u>\$1,146,083</u>

\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
<u>\$1,146,081</u>	<u>\$1,146,081</u>	<u>\$1,146,081</u>	<u>\$1,146,081</u>

\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
<u>\$1,146,081</u>	<u>\$1,146,081</u>	<u>\$1,146,081</u>	<u>\$1,146,081</u>

10.00%	10.00%	0.00%	0.00%
\$0	\$0	\$0	\$0
<u>\$1,031,200</u>	<u>\$1,031,200</u>	<u>\$1,031,200</u>	<u>\$1,031,200</u>

\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
<u>\$0</u>	<u>\$0</u>	<u>\$0</u>	<u>\$0</u>

21.00%	21.00%	121.00%	221.00%
--------	--------	---------	---------

\$0	\$0	\$0	\$0
-----	-----	-----	-----

\$0	\$0	\$0	\$0
-----	-----	-----	-----

7.60%	7.60%	7.60%	7.60%
-------	-------	-------	-------

\$0	\$0	\$0	\$0
-----	-----	-----	-----

\$0	\$0	\$0	\$0
-----	-----	-----	-----

\$1,146,083	\$1,146,083	\$1,146,083	\$1,146,083
(\$1,031,200)	(\$1,031,200)	(\$1,031,200)	(\$1,031,200)
\$0	\$0	\$0	\$0
<u>\$114,884</u>	<u>\$114,884</u>	<u>\$114,884</u>	<u>\$114,884</u>

\$114,884	\$114,884	\$114,884	\$114,884
9.35%	9.35%	9.35%	9.35%

\$10,741	\$10,741	\$10,741	\$10,741
\$0	\$0	\$0	\$0
\$3,584	\$3,584	\$3,584	\$3,584
<hr/>	<hr/>	<hr/>	<hr/>
\$14,326	\$14,326	\$14,326	\$14,326



**Liberty Utilities (Granite State Electric) d/b/a Liberty**  
**Benefit/Cost**  
**Battery Depreciation**  
**Phase**

	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
1 Plant Additions	1,294,795				
2 <u>less CIAC</u>	<u>\$291,258</u>				
3 Total Plant In Service	1,003,537				
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions	\$1,003,537				
6 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
7 Remaining Tax Depreciation	\$143,405	\$245,766	\$175,519	\$125,342	\$89,616
8					
9 <u>Remaining Tax Depreciation (State)</u>					
10 Plant Additions	\$1,003,537				
11 7 Year MACRS Rate	14.290%	24.490%	17.490%	12.490%	8.930%
12 Remaining Tax Depreciation	\$143,405	\$245,766	\$175,519	\$125,342	\$89,616
13					
14 Federal Tax Depreciation	\$ 143,405	\$ 245,766	\$ 175,519	\$ 125,342	\$ 89,616
15 State Tax Depreciation	\$143,405	\$245,766	\$175,519	\$125,342	\$89,616

1 Plant Additions		415,000			
2 <u>less CIAC</u>		<u>\$132,660</u>			
3 Total Plant In Service		282,340			
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions		\$282,340			
6 7 Year MACRS Rate		14.290%	24.490%	17.490%	12.490%
7 Remaining Tax Depreciation	\$0	\$40,346	\$69,145	\$49,381	\$35,264
8					
9 <u>Remaining Tax Depreciation (State)</u>					
10 Plant Additions		282,340			
11 7 Year MACRS Rate		14.290%	24.490%	17.490%	12.490%
12 Remaining Tax Depreciation	\$0	\$40,346	\$69,145	\$49,381	\$35,264
13					
14 Federal Tax Depreciation	\$ -	\$ 40,346	\$ 69,145	\$ 49,381	\$ 35,264
15 State Tax Depreciation	\$0	\$40,346	\$69,145	\$49,381	\$35,264

1 Plant Additions		-			
2 <u>less CIAC</u>			<u>\$139,794</u>		
3 Total Plant In Service			(139,794)		
4 <u>Tax Depreciation (Federal)</u>					
5 Plant Additions			(\$139,794)		

6	7 Year MACRS Rate			14.290%	24.490%	17.490%
7	Remaining Tax Depreciation	0	\$0	(\$19,977)	(\$34,236)	(\$24,450)
8						
9	<u>Remaining Tax Depreciation (State)</u>					
10	Plant Additions			(\$139,794)		
11	7 Year MACRS Rate			14.290%	24.490%	17.490%
12	Remaining Tax Depreciation	\$0	\$0	(\$19,977)	(\$34,236)	(\$24,450)
13						
14	Federal Tax Depreciation	\$ -	\$ -	\$ (19,977)	\$ (34,236)	\$ (24,450)
15	State Tax Depreciation	\$0	\$0	(\$19,977)	(\$34,236)	(\$24,450)



**erty Utilities Proposed Battery Pilot Project**

**Analysis**

**on Calculation**

1

<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>
8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
\$ 89,516	\$ 89,616	\$ 44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0
\$89,516	\$89,616	\$44,758	\$0	\$0	\$0	\$0	\$0	\$0	\$0

8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
\$ 25,213	\$ 25,185	\$ 25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0
\$25,213	\$25,185	\$25,213	\$12,592	\$0	\$0	\$0	\$0	\$0	\$0

12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

12.490%	8.930%	8.920%	8.930%	4.460%	0.000%	0.000%	0.000%	0.000%	0.000%
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

\$ (17,460)	\$ (12,484)	\$ (12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0
(\$17,460)	(\$12,484)	(\$12,470)	(\$12,484)	(\$6,235)	\$0	\$0	\$0	\$0	\$0

**Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project**  
**Benefit/Cost Analysis**  
**Meter Depreciation Calculation**  
**Phase I**

	<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>CY 2032</u>	<u>CY 2033</u>
1 <u>Tax Depreciation (Federal)</u>															
Number of Meters	100														
Cost of Meter (\$/meter)	426														
2 Plant Additions	\$42,600														
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	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
5 <u>Remaining Tax Depreciation (State)</u>															
6 Plant Additions	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600	\$42,600
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	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
9 Federal Tax Depreciation	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901
10 State Tax Depreciation	\$1,598	\$3,075	\$2,844	\$2,631	\$2,434	\$2,251	\$2,082	\$1,926	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901	\$1,900	\$1,901

Number of Batteries		200	200
<b>Benefits</b>	<b>2019</b>	<b>2020</b>	
Regional Network System (RNS) rate (\$/kW-year)	\$117.00	\$123.00	
Local Network System (LNS) rate( \$/kW-year)	\$23.57	\$24.46	
Avoided Capacity Cost rate (\$/kW-year)	\$100.00	\$73.90	
Regional Network System (RNS) Charges	\$87,750	\$92,250	
Local Network System (LNS) Charges	\$17,675	\$18,347	
Avoided Capacity Costs	\$75,000	\$55,425	
<b>Total Benefits</b>	<b>\$ 180,425</b>	<b>\$ 166,022</b>	
<b>Costs</b>	<b>2019</b>	<b>2020</b>	
Revenue Requirement - Batteries	(\$222,944)	(\$205,447)	
Revenue Requirement - Cell Based Meters	(\$7,549)	(\$7,200)	
Monthly Cellular Reading Cost	(\$6,000)	(\$6,000)	
Cogsdale Programming Costs	(\$102,185)	\$0	
NEM Credit for battery	(\$15,782)	(\$15,309)	
Meter MV-90 Programming Costs	(\$107,500)	\$0	
<b>Total Costs</b>	<b>(\$461,960)</b>	<b>(\$233,956)</b>	
<b>Net Benefit to All Customers</b>	<b>\$ (281,535)</b>	<b>\$ (67,934)</b>	
Net Present Value Calculation			
Required Rate of Return	7.69%		
Net Present Value of Option	\$8,473		
Net Present Value of Benefits	\$3,346,804		
Net Present Value of Costs	(\$3,338,331)		

**Phase 1 and 2 Original Filing**

500                      500                      500                      500                      500                      500

2021	2022	2023	2024	2025	2026	2027
\$ 129.00	\$ 135.00	\$ 141.29	\$ 147.88	\$ 154.77	\$ 161.98	\$ 169.53
\$ 25.17	\$ 25.42	\$ 26.61	\$ 27.85	\$ 29.14	\$ 30.50	\$ 31.92
\$ 59.90	\$ 57.60	\$ 58.80	\$ 61.20	\$ 65.70	\$ 71.20	\$ 76.90
\$ 241,875	\$ 253,125	\$ 264,921	\$ 277,266	\$ 290,187	\$ 303,709	\$ 317,862
\$ 47,190	\$ 47,665	\$ 49,886	\$ 52,211	\$ 54,644	\$ 57,191	\$ 59,856
\$ 112,313	\$ 108,000	\$ 110,250	\$ 114,750	\$ 123,188	\$ 133,500	\$ 144,188
<b>\$ 401,378</b>	<b>\$ 408,790</b>	<b>\$ 425,057</b>	<b>\$ 444,227</b>	<b>\$ 468,019</b>	<b>\$ 494,400</b>	<b>\$ 521,906</b>

2021	2022	2023	2024	2025	2026	2027
(\$529,084)	(\$491,278)	(\$462,986)	(\$432,136)	(\$400,434)	(\$368,402)	(\$336,355)
(\$18,240)	(\$17,433)	(\$16,723)	(\$16,011)	(\$15,298)	(\$14,583)	(\$13,863)
(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)	(\$15,000)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$38,508)	(\$37,325)	(\$36,141)	(\$34,957)	(\$33,774)	(\$32,590)	(\$31,406)
\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$600,832)</b>	<b>(\$561,036)</b>	<b>(\$530,850)</b>	<b>(\$498,104)</b>	<b>(\$464,506)</b>	<b>(\$430,575)</b>	<b>(\$396,624)</b>

\$ (199,454)    \$ (152,246)    \$ (105,793)    \$ (53,877)    \$ 3,513    \$ 63,825    \$ 125,282

500	500	500	500	500	500	500	500
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2028	2029	2030	2031	2032	2033	2034	2035
\$ 177.43	\$ 185.69	\$ 194.35	\$ 203.40	\$ 212.88	\$ 222.80	\$ 233.19	\$ 244.05
\$ 33.41	\$ 34.97	\$ 36.60	\$ 38.30	\$ 40.09	\$ 41.96	\$ 43.91	\$ 45.96
\$ 82.50	\$ 88.10	\$ 83.90	\$ 82.50	\$ 88.10	\$ 83.90	\$ 82.50	\$ 88.10
\$ 332,674	\$ 314,752	\$ 306,098	\$ 242,458	\$ 193,724	\$ 42,286	\$ 29,205	\$ -
\$ 62,645	\$ 59,270	\$ 57,640	\$ 45,657	\$ 36,480	\$ 21,146	\$ 15,544	\$ -
\$ 154,688	\$ 149,330	\$ 132,143	\$ 98,340	\$ 80,171	\$ 42,286	\$ 29,205	\$ -
<b>\$ 550,007</b>	<b>\$ 523,352</b>	<b>\$ 495,881</b>	<b>\$ 386,455</b>	<b>\$ 310,375</b>	<b>\$ 105,718</b>	<b>\$ 73,954</b>	<b>\$ -</b>

2028	2029	2030	2031	2032	2033	2034	2035
(\$305,190)	(\$154,500)	(\$154,500)	\$0	\$0	\$0	\$0	\$0
(\$13,141)	(\$12,412)	(\$11,681)	(\$10,950)	(\$10,220)	(\$9,489)	(\$3,342)	\$0
(\$15,000)	(\$14,700)	(\$14,400)	(\$13,620)	(\$12,840)	(\$12,060)	(\$11,220)	\$0
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
(\$30,223)	(\$28,487)	(\$26,798)	(\$24,273)	(\$21,871)	(\$12,727)	(\$11,360)	\$
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>(\$363,554)</b>	<b>(\$210,099)</b>	<b>(\$207,379)</b>	<b>(\$48,843)</b>	<b>(\$44,931)</b>	<b>(\$34,276)</b>	<b>(\$25,922)</b>	<b>\$0</b>

\$ 186,453	\$ 313,253	\$ 288,502	\$ 337,612	\$ 265,444	\$ 71,442	\$ 48,032	\$ -
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Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities Proposed Battery Pilot Project  
Benefit/Cost Analysis  
Phases 1 and 2

	-1	-2
	2021	2022
1 Year		
2 Batteries Installed	200	0
Benefits		
3 Regional Network System (RNS) rate (\$/kW-year)	136.0981833	142.77923
4 Local Network System (LNS) rate( \$/kW-year)	32.69735666	32.6396214
5 Avoided Capacity Cost rate (\$/kW-year)	55.6	44.7
6 Regional Network System (RNS) Charges	89507.81992	104828.5107
7 Local Network System (LNS) Charges	20966.55556	23964.01003
8 Avoided Capacity Costs	36513.44667	32818.74
9 Total Benefits	146987.8222	161611.2607
Costs		
10 Revenue Requirement - Batteries	-211438.2582	-166632.0403
11 Revenue Requirement - Cell Based Meters	-7284.838964	-6954.154768
12 Monthly Cellular Reading Cost	-6000	-6000
13 Cogsdale Programming Costs	-189371.79	0
14 NEM Credit for battery	-16146.34275	-15661.95247
15 Meter MV-90 Programming Costs	0	0
16 Total Costs	-430241.2299	-195248.1475
17 Net Benefit to All Customers	-283253.4078	-33636.88683
Net Present Value Calculation		
18 Required Rate of Return	0.076	
19 Net Present Value of Option	567551.5169	
20 Net Present Value of Benefits	3345364.462	
21 Net Present Value of Costs	-2777812.945	

- 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 272
- 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
- 20 Net Present Value calculation of benefits using discount rate in Line (20) and benefits in line
- 21 Net Present Value calculation of costs using discount rate in Line (20) and costs in line (18)



	-3	-4	-5	-6	-7	-8	-9
	2023	2024	2025	2026	2027	2028	2029
	0	300	0	0	0	0	0
	140.94401	147.5120009	154.3860601	161.5804505	169.1100995	176.9906301	185.2383935
	34.16062776	35.75251301	37.41858012	39.16228595	40.98724848	42.89725425	44.8962663
	23.1	29.5	32.3	32.3	39.9	39.6	40.9
	269672.8725	282239.6283	295391.995	309157.262	323563.9904	338642.0723	354422.7929
	65360.66778	68406.47489	71594.21662	74930.50712	78422.26875	82076.74647	85901.52286
	43464.96	55507.2	60775.68	60775.68	75075.84	74511.36	76957.44
	378498.5002	406153.3032	427761.8916	444863.4491	477062.0991	495230.1788	517281.7558
	-275914.1716	-84366.80312	-451637.8041	-424160.929	-395794.3886	-366855.6249	-337901.0266
	-6599.223782	-6249.929023	-17004.09595	-16327.47274	-15649.49432	-14970.26767	-14285.6558
	-15000	-15000	-15000	-15000	-15000	-15000	-15000
	0	0	0	0	0	0	0
	-39900.93752	-38674.84598	-37448.75443	-36222.66289	-34996.57135	-33770.47981	-32544.38826
	0	0	0	0	0	0	0
	-337414.3329	-144291.5781	-521090.6544	-491711.0646	-461440.4542	-430596.3724	-399731.0707
	41084.16736	261861.7251	-93328.76282	-46847.61555	15621.64488	64633.80642	117550.6851
	2288123.992						
	552650.3662						
	504590.1037						
	3345364.462						
Revenue Requirement - Batteries			-2124441.29				
Revenue Requirement - Cell Base			-100248.4515				
Monthly Cellular Reading Cost			-116255.8507				
Cogsdale Programming Costs			-175996.0874				
NEM Credit for battery			-260871.2656				
Meter MV-90 Programming Cost:			0				
			-2777812.945				

47814.35417

519737.1627

NPV of Estimated Avoided Interruption Costs 30436

NPV of Savings from ISO-NE RTM 37476

587649.1627

635463.5169

(or costs ) in line (19)

(12)

-10	-11	-12	-13	-14	-15	-16
2030	2031	2032	2033	2034	2035	2036
0	0	0	0	0	0	0
193.8705026	202.9048681	212.3602349	222.2562219	232.6133618	243.4531445	254.798061
46.98843231	49.17809326	51.4697924	53.86828473	56.3785468	59.00578708	61.75545676
45.2	45.8	46.3	48.2	53.7	46.3	47.1
370938.895	343923.7514	334467.37	264929.4165	211678.1592	122700.3848	90198.51359
89904.53383	83356.86807	81064.92304	64210.9954	51304.47759	29738.91669	21861.43169
85048.32	77631	72922.5	57454.4	48867	23335.2	16673.4
545891.7489	504911.6194	488454.793	386594.8119	311849.6368	175774.5015	128733.3453
-310095.7607	-171840.904	-171840.904	0	0	0	0
-13599.43908	-12906.23227	-12211.70592	-11517.10823	-10822.58187	-10127.98419	-3341.97
-15000	-14700	-14400	-13620	-12840	-12060	-11220
0	0	0	0	0	0	0
-31318.29672	-29515.32642	-27761.80287	-25134.72006	-22636.1988	-13096.46025	-11679.1746
0	0	0	0	0	0	0
-370013.4964	-228962.4627	-226214.4128	-50271.82829	-46298.78067	-35284.44443	-26241.1446
175878.2524	275949.1567	262240.3802	336322.9836	265550.8562	140490.0571	102492.2007



Liberty Utilities (Granite State Electric) d/b/a Liberty Utilities  
Docket No. DE 17-189  
Attachment 2  
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-17	
2037	2038
0	

Total

266.6716506	
64.63326104	
48	
0	4106263.434
0	993065.1164
0	898332.1667
0	5997660.718
0	
0	-3368478.615
0	-179852.1546
0	-210840
0	-189371.79
0	-446508.9152
0	0
0	-4395051.475
0	
0	1602609.243



monthly kw

130 batteries in phase 1 are removed in year 15, 15 or 5% of phase 2 batteries are removed in year 15 as it's only





	3	4	5	6	7
	2021	2022	2023	2024	2025
		#DIV/0!			
	933281	-1			
	1125	1125	1125	1125	1125

year 13

300 batteries net metering credit per year

0	0	0	0	0
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300 batteries avoided capacity

25987.5	33187.5	36337.5	36337.5	44887.5
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300 battery rns

158562.0113	165951.001	173684.3176	181778.0068	190248.8619
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300 battery lns

38430.70623	40221.57714	42095.90263	44057.57169	46110.65454
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8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032
1125	1125	1125	1125	1125	852	670
0	0	0	0	0	0	0
44550	46012.5	50850	51525	52087.5	41066.4	35979
199114.4589	208393.1927	218104.3155	228267.9766	238905.2643	189362.301	155850.9524
48259.41104	50508.29959	52861.98635	55325.35492	57903.51645	45895.77859	37773.62636



15	16	17
2033	2033	2033

504	354	0
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0	0	0
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23335.2	16673.4	0
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122700.3848	90198.51359	0
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29738.91669	21861.43169	0
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