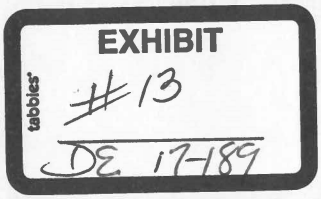


STATE OF NEW HAMPSHIRE
PUBLIC UTILITIES COMMISSION

DOCKET DE 17-189

IN THE MATTER OF: Liberty Utilities (Granite State Electric) Corp d/b/a Liberty Utilities Petition to Approve Battery Storage Pilot Program

# DIRECT TESTIMONY

OF

Elizabeth R. Nixon
Utility Analyst

May 2, 2018

## Introduction

**Q. Please state your full name.**

A. My name is Elizabeth R. Nixon.

**Q. By whom are you employed and what is your business address?**

A. I am employed by the New Hampshire Public Utilities Commission as a Utility Analyst. My business address is 21 S. Fruit Street, Suite 10, Concord, NH 03301.

**Q. Please summarize your education and professional work experience.**

A. My educational and professional background is summarized in Attachment EN-1.

**Q. Have you previously submitted testimony to the Commission?**

A. Yes. I have submitted written testimony previously in the energy efficiency program dockets.

**Q. What is the purpose of your testimony in this proceeding?**

A. The purpose of my testimony is to evaluate the battery storage pilot program proposed by Liberty Utilities (Granite State Electric) Corp d/b/a Liberty Utilities (Liberty). My evaluation includes a review of the cost-effectiveness of the proposed pilot program by first reviewing the benefit-cost analysis conducted by Liberty and then conducting a revised benefit-cost analysis using revised assumptions based on the technical matters addressed in Mr. Kurt Demmer's testimony and other revised assumptions. In addition, my testimony provides Staff's conclusions and recommended approach regarding Liberty's proposed pilot program.

**Q. Please provide a summary of your testimony.**

A. My testimony reviews and critiques Liberty's benefit-cost analysis and compares it to Staff's benefit-cost analysis. In what Liberty characterized as a conservative analysis, it estimated that the proposed pilot would result in a net present value (NPV) cost of $1.1 million over a

15-year timeframe ($2.0 million)[1] using a utility cost test (UCT). Staff estimates that the proposed pilot would result in an NPV net cost of approximately $2.8 million using a UCT or an NPV net cost of $1.8 million using a total resource cost (TRC) test. See Attachment EN-2 for a summary and comparison of Liberty's analysis and Staff's analysis. In general, Staff commends Liberty's initiative to investigate alternatives for using batteries to reduce transmission costs and test non-wire alternatives (NWA) to defer distribution upgrades, and using time-of-use (TOU) rates for transmission and distribution services. Staff is concerned, however, that the proposed program is too expensive and not cost-effective, and that Liberty has not adequately planned and prepared to conduct a pilot of such scale and scope. Staff concludes that it would not be in the public interest to approve the program as proposed. Staff recommends that Liberty consider an alternative, smaller scale battery program and develop and test a methodology for forecasting ISO-New England (ISO-NE) system peaks and feeder violation periods prior to implementing such a program.

## Overview of Liberty's Proposal

**Q. Please provide a brief overview of Liberty's proposal.**

A. Liberty proposes to install and own 1,000 Tesla Powerwall 2 batteries for residential customers as part of a ten-year pilot program with a five-year study period. Liberty is targeting 300 of the batteries for the Craft Hill 11L1 and 11L2 feeder as part of a NWA strategy to defer a distribution system upgrade for a number of years. The batteries would also be used to reduce load coincident with ISO-NE system peak on a monthly basis, which would have the effect of reducing both regional network system (RNS) and local network

[1] For comparison purposes, Staff has evaluated Liberty's analysis over a 10 -year period, the same timeframe used in Staff's analysis. Staff's revised evaluation of Liberty's analysis is shown in parentheses.

system (LNS) transmission charges assessed to Liberty. Participating customers would also be placed on TOU rates for distribution and transmission services with an off-peak period (7 p.m. through 8 a.m.), on-peak period (8 a.m. through 2 p.m.), and critical peak period (2 p.m. through 7 p.m.). Customers will make a financial contribution toward the cost of the batteries, either by paying $1,000 upfront or by paying $10 per month for 10 years, at the customer's option. If a customer decides within the 10-year period to no longer participate in the program, the customer would have to pay $450 to have the battery removed. Liberty plans to issue a request for proposals to select and engage a vendor to install the batteries at customers' homes.

**Q. Did Liberty model this program after any other battery pilot program?**

A. Yes. Liberty substantially based its proposed pilot on a battery pilot program currently being conducted in Vermont by Green Mountain Power (GMP), a vertically integrated utility serving approximately 265,000 customers. GMP proposes to install 2,000 Tesla Powerwall 2 batteries for residential customers, who will pay either $1,500 upfront or $15 per month for 10 years. GMP's operation and maintenance (O&M) costs are limited because they have partnered with Tesla, who is responsible for marketing to customers, enrolling customers, preparing site designs, and installing the batteries. Certain participating GMP customers will also receive a NEST thermostat. GMP projects that the batteries will provide benefits, including reduced RNS costs as well as revenues or reduced costs in ISO-NE regional wholesale markets (forward capacity market, day-ahead energy, operating reserves, and frequency regulation). GMP will provide status updates on a nine-month basis, until the pilot expires after 18 months. The program will continue after the pilot period unless GMP

terminates the program prior to the expiration of the pilot period. Because the GMP pilot is still in the preliminary stages, we are not aware that any status reports have been filed yet.

**Q. What are some of the key differences between GMP's program and Liberty's proposed program?**

A. GMP is a vertically integrated utility with about six times more total customers than Liberty. That is, about 0.7 percent of GMP's customers will be part of the pilot (if it is fully subscribed), whereas Liberty has proposed to enroll over 2 percent of its customers. GMP has also partnered with Tesla to market the program, educate customers, and install the batteries, while Liberty plans to market and educate customers itself but hire Tesla or another installer to install the batteries. GMP's pilot period will only last for 18 months, after which the project will continue unless terminated prior to the pilot period ending. Liberty has proposed that its pilot continue for ten years with a five-year study period. GMP will provide status reports on various metrics to confirm the effectiveness of its program, but Liberty has not specified the metrics or schedule for any such reporting regarding its pilot program. GMP is not coupling its battery pilot with a new TOU rate design, but focuses instead on peak load reductions as well as providing grid stability in areas of high distributed generation. In contrast, Liberty is testing multiple variables at the same time: a new TOU rate design, discharge of batteries to decrease transmission costs, discharge of batteries as an NWA to defer a distribution feeder upgrade, and the use of a revised rate design and batteries to encourage customer behavioral changes. GMP is focused primarily on gaining experience with a platform that enables the aggregated dispatch of distributed energy resources (DERs). See Letter from GMP to the Vermont Public Utility Commission provided by Liberty in response to Staff 1-19 and provided as Attachment EN-3.

**Statutory Standard for Pilot Program Approval**

**Q. Please summarize the applicable standard for approval of Liberty's battery storage pilot program.**

A. Liberty proposes to purchase and install batteries in residential customers' homes and recover its associated costs through rates under RSA 374-G. Batteries (energy storage) are included in the definition of "distributed energy resource" in RSA 374-G, and Liberty, therefore, seeks Commission approval of the proposed battery pilot program under that statute in order to recover its related investment. RSA 374-G:5, II provides that the Commission can authorize utility DER cost recovery if it determines that the proposed investment and recovery in rates are in the "public interest." In making that determination, the Commission must consider, among other factors, "[w]hether the expected value of the economic benefits of the investment to the utility's ratepayers over the life of the investment outweigh the economic costs to the utility's ratepayers." In its filing for Commission approval under RSA 374-G:5, I, a utility must include the following:

> A discussion of the costs, benefits, and risks of the proposal with specific reference to the factors listed in [RSA 374-G:5, II], including an analysis of the costs, benefits, and rate implications to the participating customers, to the company's default service customers, and to the utility's distribution customers.

**Q. Has Liberty addressed these standards?**

A. As part of its filing, Liberty outlined the standards in RSA 374-G:5. They conducted a benefit-cost analysis as discussed in my testimony. Liberty primarily focused on the benefit-cost analysis; therefore, the focus of my testimony is on the respective benefits and costs of the proposed pilot program.

**Overview of Benefit-Cost Analyses**

**Q. Please provide a brief explanation of how the benefits and costs of utility programs are typically analyzed.**

A. To assess the benefits and costs of utility programs, various types of tests can be used, depending upon whose perspective should be analyzed under the circumstances. For example, the utility cost test (UCT) analyzes the benefits and costs to the utility. The total resource cost (TRC) test analyzes the benefits and costs to both the utility and the participating customers. New Hampshire utilities have traditionally used the TRC test to assess energy efficiency programs. In the past, utility investments in DERs also have been analyzed using the TRC test. For example, see Docket No. DE 09-137.

**Q. How was the proposed battery storage pilot program analyzed by Liberty?**

A. In Liberty's supplemental testimony and its later technical statement, it referenced only benefit-cost analyses it conducted using the UCT. Liberty provided an initial benefit-cost analysis in its supplemental testimony dated February 9, 2018, with a correction filed on February 12, 2018. In Liberty's technical statement filing dated April 6, 2018, it provided a revised and updated benefit-cost analysis using the UCT. Liberty has provided two options for the program with different types of meters; however, Liberty has indicated that option 2 using cellular based metering is the preferred alternative, so Staff's review of Liberty's analysis focused only on option 2.

**Q. How was the proposed pilot program analyzed by Staff?**

A. Staff has a conducted a benefit-cost analysis using the UCT for purposes of comparison with Liberty's UCT analysis. Staff has also conducted a benefit-cost analysis using the TRC test to show the benefits and costs to both the utility and pilot program participants.

**Liberty's Benefit-Cost Analysis**

**Q. What are the costs of the proposed pilot program as estimated by Liberty?**

In Liberty's technical statement filing dated April 6, 2018, it included a revised benefit-cost analysis from the utility perspective, using the UCT. Based on the analysis contained in that filing, the estimated NPV costs[2] of the program include the cost of the batteries ($7.2 million), costs of new meters ($0.3 million) to address the new TOU rate intervals and the bidirectional electricity flow, costs associated with reading the meters ($0.3 million), programing costs for Liberty's Cogsdale billing system to adapt it for the TOU rates ($0.08 million), and programming costs for the meters ($0.07 million). The total NPV of all the identified costs is estimated to be $7.9 million (or $7.8 million over a 10-year period).

**Q. What assumptions did Liberty make in estimating those costs?**

A. For purposes of calculating the depreciation and revenue requirements for the batteries, Liberty assumed a total capital cost of $7,192,000.[3] In addition, Liberty stated that the new meters would cost $426 each. The additional costs for software programming of the Cogsdale billing system to address TOU rates are estimated to total $92,900, and the estimated costs for programming the meters are $80,000.

**Q. Do you believe that there will be any other costs associated with the proposed pilot program that have not been included in Liberty's analysis?**

A. Yes. Liberty has not included costs for developing a plan to collect data from and evaluate the pilot program and then conduct an analysis of that pilot data. The costs of installation are

[2] Note that Liberty evaluated the benefits and costs over a 15-year period. Staff later discusses the NPV of the benefits and costs for Liberty's analysis over a 10-year period for comparison purposes.

[3] Note that Liberty witness Tebbetts, in her Supplemental Testimony dated February 9, 2018 (Bates p. 9), estimates that the total capital costs of 1,000 batteries is $7.3 million. Her testimony states that the capital costs were reduced by the upfront payment by customers in the amount of $108,000, which overstates the upfront payment of $1,000 for 100 customers which should be $100,000.

also not definite because a battery installer has not been selected. In addition, Liberty has not estimated any specific costs associated with marketing the pilot and educating the program participants. Participating residential customers also may need to incur additional costs for configuring their circuit breaker panel so the battery can be used for back-up, and potentially other expenses associated with battery installation. Furthermore, the homeowner may incur increased homeowner insurance premium costs that have been recognized in Liberty's testimony but not quantified in its analysis. Note that the participant costs would be considered only under a TRC test.

**Q. What are the benefits of the proposed pilot program as estimated by Liberty?**

A. Liberty has indicated that the primary cost-saving purposes of the pilot are to lower transmission costs by decreasing both the RNS and LNS charges, and by deferring distribution system upgrades through the use of batteries as an NWA strategy. Based on Liberty's revised UCT analysis included in its filing dated April 6, 2018, it has estimated that the NPV[4] of the RNS benefits would be $4.6 million ($3.8 million) and the NPV of LNS benefits would be $0.9 million ($0.8 million). In addition, Liberty estimated that the NPV of the distribution feeder upgrade NWA deferral would be $0.6 million ($0.5 million). Liberty also included customer contribution NPV benefits of $0.8 million ($0.8 million). Liberty's estimated total NPV benefits would be $6.8 million ($5.8 million).

**Q. What assumptions did Liberty make in estimating those benefits?**

A. In Liberty's supplemental testimony, the RNS and LNS rates are estimated as shown in Table 1 below. Liberty assumed that the batteries will initially reduce load coincident with ISO-NE peak by 5,000 kW in the first year, and then degrade by three percent per year thereafter.

[4] Liberty evaluated the benefits and costs over a 15-year period. Staff discusses the NPV of the benefits and costs for Liberty's analysis over a 10-year period for comparison purposes as shown in parentheses.

Liberty also assumed that the program would defer the Craft Hill distribution feeder upgrade cost of $644,000 for a period of 15 years. Liberty further assumed that customers would make upfront payments of $1,000 each for 100 batteries, for a total customer contribution of $100,000 in the first year, and that customers would pay $10 monthly for 10 years for the remaining 900 batteries, for a total of $108,000 per year, which would be used to offset O&M costs associated with reading the meters.

**Table 1. Liberty's Estimated RNS and LNS Rates ($/kW-year)**

| | 2019 | 2020 | 2021 | 2022 | 2023-2033 |
|---|---|---|---|---|---|
| RNS Rate ($/kW-year) | $128.00 | $133.00 | $137.00 | $137.00 | $138.37 |
| LNS Rate ($/kW-year) | $26.04 | $27.03 | $27.82 | $28.09 | $28.09 |

**Q. What is the NPV of the proposed pilot program according to Liberty?**

A. In its revised benefit-cost analysis dated April 6, 2018, Liberty estimated that the NPV[5] of the proposed pilot program would be a net cost of $1.1 million ($2.0 million). Liberty has characterized this estimate as a conservative analysis or alternatively as a worst case scenario.

**Q. Do you agree with Liberty's benefit-cost analysis?**

A. No. As detailed in Mr. Demmer's testimony, Staff disagrees with a number of important technical and operational assumptions used by Liberty in its benefit-cost analysis. Mr. Demmer reviews and analyzes the technical and operational capabilities of the Powerwall 2 battery system, in particular regarding the ability to reduce peak loads to decrease RNS and

[5] For purposes of comparison, Staff evaluated Liberty's benefits and costs over a 10-year period instead of the 15-year period proposed by Liberty. Staff's alternative analysis estimate is shown in parentheses.

LNS charges and meet the NWA objectives of the pilot. He also addresses the appropriate deferral period for the Craft Hill feeder upgrade NWA. He further assesses the probability that Liberty's proposed peak period battery discharges will succeed in reducing load coincident with ISO-NE system peaks and distribution feeder peak loads during the ten-year program period. In addition, Staff has included other revised assumptions and modelling changes in its benefit-cost analysis, as discussed below.

**Staff's Benefit-Cost Analysis**

**Q. What are the results of Staff's benefit-cost analysis?**

A. Please refer to Attachment EN-4. The total NPV of the proposed pilot under a UCT analysis is a net cost of $2.8 million. The total NPV of the benefits is $4.6 million, and the total NPV of the costs is $7.4 million.

**Q. How does your analysis compare to Liberty's?**

A. Please refer to Attachment EN-2. For comparison purposes, Staff evaluated Liberty's analysis using a timeframe of 10 years rather than 15 years. Using the 10-year timeframe, Liberty's analysis results in an NPV net cost of $2.0 million, as compared to Staff's analysis resulting in an NPV net cost of $2.8 million.

**Q. What changes did you make to the analysis of the benefits?**

As noted in Mr. Demmer's testimony, the assumed success rate of Liberty meeting the ISO-NE peak is 75 percent for the first four years and then 50 percent from 2023 through 2028, except for the months of June, July, and August, when the 300 batteries used as part of the NWA are assumed to meet the ISO-NE peak 100 percent of the time from 2019 through 2022. The total kW reduced coincident with ISO-NE monthly system peaks is assumed to be

2,625 kW for the non-NWA batteries (5 kW x 700 x 75%) for 2019 through 2023 and 450 kW for the NWA batteries for June, July, and August for 2019 through 2022 (1.5 kW x 300 x 100%) and 1,125 kW for the NWA batteries for the rest of the months of the year for 2019 through 2022 (5 kW x 300 batteries x 75%). For the period of 2023 through 2028, the load reduced coincident with ISO-NE monthly peak is assumed to be 2,500 kW (5 kW x 1000 batteries x 50%). In addition, we also assumed that the Craft Hill distribution feeder upgrade will only be deferred for three years, through 2022. For more details related to these assumptions, please refer to Mr. Demmer's testimony.

We have not included the customer contribution as a benefit in the analysis, but instead included the customer contribution as a reduction in the rate base calculation. We have included an additional benefit associated with avoided capacity costs, using the wholesale capacity values for Cleared FCA prices in the most recent Avoided Energy Supply Components in New England: 2018 Report (AESC) prepared for AESC 2018 Study Group (March 30, 2018) (p. 273).[6] Note that this study presents various avoided capacity cost estimates. In order to present a conservative estimate, Staff has used the highest avoided capacity cost rate presented. We have assumed that 3,075 kW will be reduced during the annual ISO-NE peak system load for 2019 through 2022, and 2,500 kW for 2023 through 2028. These load reductions are based on the total estimated load reductions from both the NWA and non-NWA batteries discussed above for a summer month (June, July, or August). We have assumed that the benefits (not including the distribution upgrade deferral) will only last for ten years, since the battery is only under warranty for 10 years, and the pilot program is only in effect for 10 years. Accordingly, we only analyzed a 10-year period versus Liberty's 15-year timeframe. See Attachment EN-5 for a comparison of Liberty's

[6] http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/AESC%202018.pdf

assumptions and Staff's assumptions. With these changes, the NPV benefits estimated by Staff are about $1.2 million less as compared to Liberty's estimate evaluated for a 10-year period.

**Q. What changes did you make to the analysis for the costs?**

A. We changed the battery revenue requirement by assuming that the initial capital cost is $7.2 million (the initial $7.3 million less the upfront customer contribution of $0.1 million), and we also included the monthly customer contribution ($108,000 annually) as a reduction to the rate base calculation. Also, as noted above, we only analyzed a 10-year period versus Liberty's 15-year timeframe. See Attachment EN-5 for a comparison of Liberty's assumptions and Staff's assumptions. With these changes, the NPV costs estimated by Staff are about $0.4 million less than Liberty's estimate evaluated for a 10-year period.

**Q. How would you characterize Staff's analysis?**

A. Given the information that is known, we have provided a reasonable estimate of the benefits and costs. Our analysis assumes that Liberty will have an initial 75 percent success rate in reducing load coincident with the monthly ISO-NE system peak. The success rate will decrease to 50 percent in 2023 when the battery degradation does not allow it to operate for as many hours. Our analysis also assumes that only 1.5 kW will be available from the 300 NWA batteries during June, July, and August with a 100% success rate of reducing load coincident with the monthly ISO-NE system peak through 2022 after which the NWA cannot be deferred. Please refer to Mr. Demmer's testimony. This assumption is based on the fact that Liberty Utilities has no experience forecasting the ISO-NE coincident peak. In addition, Liberty also has not yet developed a methodology for forecasting when the system peaks occur. Similarly, Liberty has not proposed a methodology for estimating feeder violations

and does not have experience predicting the day and the length (hours) of the violations. No attempt was made to quantify the energy costs that might be avoided as a result of the load shifting from the higher cost energy periods during ISO-NE peak period when the batteries are in use to the lower cost energy off-peak periods in the night when the batteries are charging. The actual costs of installation may also be higher since the battery installer has not been selected.

**Q. Did Staff perform any other benefit-cost analyses?**

A. Yes. We also conducted a benefit-cost analysis using the total resource cost (TRC) test. See Attachment EN-6.

**Q. What are the results of Staff's analysis?**

A. The total NPV of the proposed pilot using the TRC is a net cost of $1.8 million with NPV benefits of $6.2 million and NPV costs of $8.0 million.

**Q. What assumptions did you make for this analysis regarding benefits?**

A. We used the same assumptions as discussed above as in the UCT analysis. Note that we have not included any additional participant benefits because not enough information is known to quantify them. However, in order for the benefit-cost analysis to result in a net benefit, the NPV of any additional benefits would need to be more than $1.8 million, and it seems highly unlikely that benefits of that magnitude would be achieved.

**Q. What assumptions did you make for this analysis regarding the costs?**

A. In addition to the assumptions discussed above in the UCT analysis, we also included the customer contributions as a cost since the TRC test includes both the utility and participant costs (and benefits). Since Liberty did not provide any estimates for the additional costs that

participants would have to incur (e.g., for battery installation, insurance, internet, etc.), we did not include those additional costs.

**Q. Were any other assumptions different with the TRC test analysis?**

A. Yes. Since the latest energy efficiency program benefit-cost analysis used a real discount rate of 2.4 percent, we have used the 2.4 percent discount rate instead of 9.4 percent used by Staff and Liberty in the UCT. By using this lower discount rate, it increases the overall NPV benefits by about $1.6 million and slightly increases the NPV costs by about $0.09 million resulting in a lower NPV net cost. In other words, with a lower discount rate, the NPV benefits are higher.

**Other Concerns Regarding the Proposed Pilot**

**Q. Do have any other concerns related to the proposed pilot program?**

Yes. We are concerned that Liberty has not done enough upfront planning and preparation to successfully implement the proposed pilot program. In addition, Liberty has not done careful analysis of the benefits and costs, as evidenced through confusing assumptions made for the analysis and changes made in their assumptions from the initial filing to their last filing and in data responses. In terms of planning and preparation, Liberty has not prepared a detailed plan for implementation and administration of the pilot, including the determination of control groups and the development of an evaluation plan, including the data elements to be collected and how that data will be evaluated. As noted above, Liberty also has not yet determined the methodology to forecast the peak hours during which batteries will need to be discharged to achieve the benefits assumed. Liberty has not prepared any marketing or educational materials for prospective participants, including a description and illustration of

the potential impacts of the TOU rates and battery usage by the customer or when Liberty takes control of the battery. Also, Liberty has not developed a requirement list outlining the specific criteria that potential customers must meet (e.g., being up-to-date on electric bills, not requiring backup generation for oxygen or other such equipment, having certain space requirements for the battery, etc.) In addition, as noted above, Liberty has not estimated all of the potential costs that a participant may have to incur, such as additional installation costs, insurance costs, internet costs, and other costs. Liberty also has proposed a pilot program lasting far longer than the typical one-year to three-year time frame for a pilot.

**Conclusions and Recommendation**

**Q. What do you conclude about the proposed program?**

A. The benefit-cost analyses show that the proposed pilot program is not beneficial from the utility's perspective or from a combined utility and participant perspective (i.e., the TRC test). While a pilot program that is marginally not cost-effective could nonetheless be beneficial because it may be a useful tool to analyze alternatives and collect relevant data, the estimated NPV cost and initial overall cost of the program make proceeding too risky as proposed.

**Q. What do you recommend regarding this proposed program?**

Based on the evaluation and analysis described above in my testimony, Staff recommends that the Commission find that the proposed battery storage pilot program is not in the public interest and should not be implemented as proposed. Staff encourages Liberty, however, to consider development of alternative pilot designs, with a more limited scale. For example, Liberty might first conduct a study to evaluate whether its algorithm, once developed, is able

to reliably predict ISO-NE system peaks and feeder violations or distribution system peaks associated with the NWA candidate as well as determine the capacity violation timeframe (i.e., start time and duration). A cost-effective battery installation pilot program could then be designed and implemented, subject to Commission review and approval, with fewer batteries (e.g., 50-75) with statistical significance (including different size load customers and customers with and without PV). The pilot could measure and evaluate RNS and LNS charge decreases attributable to monthly load reductions coincident with ISO-NE system peaks, behavioral changes between customers without PV and those with PV, and other relevant issues. Alternatively, Liberty could evaluate other ways to reduce the utility costs, such as assessing whether a utility scale battery would be cost-effective, possibly in combination with a TOU rate. Liberty could also evaluate and identify potential NWA projects that better align with ISO-NE system peaks and are more predictable with those ISO-NE system peaks.

**Q. Does this conclude your testimony?**

A. Yes, it does.