

STATE OF NEW HAMPSHIRE  
BEFORE THE  
PUBLIC UTILITIES COMMISSION

Docket No. DE 23-039

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty  
Distribution Service Rate Case  
Marginal Cost Study

DIRECT TESTIMONY

OF

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1 **I. INTRODUCTION**

2 **Q. Please state your name, address, employer, position, and professional qualifications.**

3 A. My name is Melissa F. Bartos. I am a Vice President with Concentric Energy Advisors,  
4 293 Boston Post Road West, Suite 500, Marlborough, Massachusetts. My professional  
5 qualifications and experience have been provided in Attachment MFB-11.

6 **II. SCOPE OF TESTIMONY**

7 **Q. What is your responsibility in this proceeding?**

8 A. In this proceeding, I am responsible for preparing the Marginal Cost Study for Liberty  
9 Utilities (Granite State Electric) Corp. d/b/a Liberty (“Liberty” or “the Company”).

10 **Q. Please summarize your testimony concerning the Marginal Cost Study.**

11 A. I have prepared a Marginal Cost Study (“MCS”), which is contained in Attachments  
12 MFB-1 through MFB-10. The marginal costs that I have calculated are derived from data  
13 and special studies obtained from the Company.

14 As also shown in Attachment MFB-10, the estimated annual marginal distribution costs  
15 by rate class are summarized in Table 1 below.

16 *Table 1: Total Marginal Costs by Rate Class (\$000)*

	D	D-10	D-11	G-1	G-2	G-3	M	T	V	Total
Customer	\$16,099	\$194	\$43	\$152	\$905	\$2,711	\$0	\$388	\$7	\$20,499
Capacity	\$9,763	\$130	\$1	\$11,975	\$6,585	\$3,888	\$0	\$266	\$12	\$32,620
Lighting	\$0	\$0	\$0	\$0	\$0	\$0	\$648	\$0	\$0	\$648
Total	\$25,862	\$324	\$44	\$12,127	\$7,489	\$6,599	\$648	\$654	\$19	\$53,766
%	48.10%	0.60%	0.08%	22.56%	13.93%	12.27%	1.20%	1.22%	0.04%	100.0%

17

1 **III. MARGINAL COST STUDY**

2 **A. Economic Theory and Marginal Costs**

3 **Q. Please provide an economist's view of marginal cost.**

4 A. "Marginal Cost" is an economic concept; it is a measure of the additional cost that a firm  
5 incurs to provide an additional unit of a good or a service. A well-established principle  
6 of economic theory is that the price of a good that is sold in a perfectly competitive  
7 market will be set at the marginal cost to produce that good. It is a further well-  
8 established principle of economic theory that the best allocation of resources will occur,  
9 and the best consumption decisions will be made, in an economy in which the prices of  
10 goods are set at marginal costs.

11 It has been the Commission's rate-design policy and precedent since the mid-1980s to  
12 apply the concepts of marginal cost pricing in a rate case (a) to determine the share of  
13 total rate case revenue requirement for which each rate class is responsible, and (b) to set  
14 base distribution rates to promote appropriate price signals and, therefore, proper energy  
15 consumption decisions. The basis for the Company's current allocation of revenue  
16 requirement to classes, rate design, and current rate classifications was approved by the  
17 Commission in Order No. 26,376 (June 30, 2020) in the Company's 2019 rate case filing,  
18 Docket No. DE 19-064.



1           **B. Marginal Cost Study Methodology**

2           **1. Overview**

3   **Q. Please describe the components of the Company’s marginal costs that you**  
4   **estimated.**

5   A. I prepared calculations and analyses to estimate the marginal Distribution Function-  
6   related costs that the Company would incur to serve (a) additional demand when the  
7   Company is experiencing peak conditions, and (b) additional customers. In general  
8   terms, to estimate the costs that the Company would incur to serve additional peak  
9   demand, I calculated (1) the additional capacity-related distribution plant costs, and (2)  
10   the additional Operations and Maintenance (“O&M”) costs that would be caused by an  
11   increment to peak demand. I also calculated (3) the additional general plant-related costs  
12   associated with additional plant, (4) the additional Administrative and General (“A&G”)  
13   expenses associated with the additional O&M expenses and additional plant, and (5) the  
14   additional materials and supplies (“M&S”) and prepayment costs associated with the  
15   additional plant. Lastly, I calculated additional factors to account for the effects of bad  
16   debt and working capital on the calculated marginal costs.

17   **Q. Please describe the data used to develop your estimates of the Company’s marginal**  
18   **costs.**

19   A. The Company provided Concentric with plant balances and distribution O&M, customer,  
20   customer accounting, A&G, and Materials and Supplies and Prepayments Expenses, for  
21   the period 1997 to the present. In addition, the Company provided Concentric with

1 historical system peak, normalized peak, and customer count data for the years 2000 to  
2 the present.<sup>1</sup>

3 **Q. Please describe the new data series you created using the Company data.**

4 A. I created the following types of new data series:

- 5 1. I adjusted the Company's data to constant dollars using an appropriate price  
6 index. I used a Handy-Whitman index to restate plant additions in 2022 constant  
7 dollars, and I used the Implicit Price Deflator for Gross Domestic Product,  
8 published by Bureau of Economic Analysis, to restate expenses in constant 2022  
9 dollars.
- 10 2. I used two analyses provided by the Company to (1) identify the amount of the  
11 capacity-related distribution plant additions related to growth, and (2) classify the  
12 growth-related plant additions as being related to either the primary distribution  
13 system, secondary distribution system, or line transformers.
- 14 3. I used an analysis of expense accounts provided by the Company to functionalize  
15 distribution Operations expenses and Maintenance expenses as either capacity-  
16 related or customer-related, and also to classify the capacity-related expenses as  
17 being related to either the primary distribution system, secondary distribution  
18 system, or line transformers.

---

<sup>1</sup> The historical data for a few of the data series was obtained from S&P Capital IQ Pro, which compiles historical FERC Form 1 data.

1 **Q. Please describe the primary type of analysis used to calculate the components of**  
2 **marginal cost.**

3 A. I used a statistical process for estimating the relationship between a specific “Cost  
4 Variable” (i.e., measure of costs)<sup>2</sup> and a specific “Cost Driver” variable<sup>3</sup> for many of the  
5 marginal cost components. The general form of the regression equations that I estimated  
6 is as follows<sup>4</sup>:

7 
$$\text{Cost Variable} = a + b * \text{Cost Driver variable}$$

8 Regression analyses are often used to estimate components of marginal costs because the  
9 regression coefficient, “b” in the equation above, sometimes referred to as the slope of  
10 the equation, is the estimated marginal cost of the Cost Variable associated with a small  
11 change in the Cost Driver variable.<sup>5</sup>

12 **Q. Please describe the general approach used in performing the marginal cost study**  
13 **regression analyses.**

14 A. I reviewed the regression equations that I developed to ensure that the estimates were  
15 reasonable and that they did not violate important statistical requirements.

---

<sup>2</sup> Some of the Cost Variables that I used include capacity-related distribution plant, customer-related O&M expense, and A&G Expense.

<sup>3</sup> Some of the “Cost Driver” variables that I used include normalized peak demand and number of customers.

<sup>4</sup> This is a simplified version of the regression equations that were estimated. Each of the regression equations that are provided in Attachments MFB-MCS-1, 4, 5, and 6 may include more than one cost driver and/or dummy variables.

<sup>5</sup> The term “a” is the intercept of the equation. It is the level of the Cost Variable that is constant, regardless of the level of the Cost Driver variable.

1 Specifically, I tested each equation to ensure that there is no statistically significant level  
2 of autocorrelation in the regression equation. Autocorrelation is a violation of the  
3 requirements of regression analysis,<sup>6</sup> which, if not corrected, would inappropriately affect  
4 the regression statistics. The statistical software that I used, SPSS, can identify and  
5 correct for autocorrelation.

6 I also tested each equation to look for “structural shifts,” which are changes in the  
7 relationship between the Cost Variable and Cost Driver variable starting in a specific year  
8 and continuing for a period of time. I specifically looked for structural shifts that might  
9 have been related to the 2012 acquisition of Liberty. If I determined that there was a  
10 structural shift, I tested additional regression equations that allowed the slope and  
11 intercept terms to be different for the time periods before and after the time of the  
12 structural shift. If a regression equation with terms addressing the structural shift was  
13 superior to other regression equations, I used the slope coefficient of the structural shift  
14 regression equation as the marginal cost estimate.

15 **Q. What criteria did you use to accept or reject a regression equation?**

16 A. To assess whether a regression equation provided a reliable estimate of the marginal cost  
17 component, I reviewed the regression equation statistics. Specifically, I reviewed:

---

<sup>6</sup> Autocorrelation is a violation of the assumption that the regression equation error terms are uncorrelated. In the presence of autocorrelation, the regression does not produce Best Linear Unbiased Estimates.

- 1           • The reasonableness of the regression equation results. I considered that an
- 2           equation was reasonable if the slope coefficient had the “right sign”<sup>7</sup> and was the
- 3           “right size.”<sup>8</sup>
- 4           • The explanatory power of the regression equation as a whole, as measured by the
- 5           R-squared statistic.
- 6           • The explanatory power of the slope coefficient, as well as other variables included
- 7           in the model, as measured by the t statistic.

8           **C. Marginal Cost Study Results**

9                       **1. Overview**

10   **Q. Please describe how you have organized the marginal cost study.**

11   A. The schedules that make up the Marginal Cost Study are provided in the List of  
12   Attachments. Table 2 provides a summary of the Marginal Cost Study schedules.

13                               *Table 2: Summary of Marginal Cost Study Schedules*

<b>Attachment</b>	<b>Pages</b>	<b>Topics</b>
MFB-1	1–3	Calculation of marginal Capacity-related Plant Additions
MFB-2	1	Calculation of marginal Customer-related Plant Additions
MFB-3	1–5	Calculation of marginal cost of Outdoor Lighting
MFB-4	1–6	Calculation of marginal Distribution Capacity-related Expenses
MFB-5	1–5	Calculation of marginal Customer-related Expenses
MFB-6	1–3	Development of loading factors
MFB-7	1–13	Calculation of Levelized Fixed Charge Rates
MFB-8	1–3	Summary of Marginal Capacity Costs
MFB-9	1	Summary of Marginal Customer Costs
MFB-10	1	Summary of Marginal Cost Estimates

7   The slope coefficient is the “right” sign if the coefficient is positive. A negative slope would mean, for example, that as peak demand increased, capacity related distribution plant additions would decrease.

8   The “right size” is a subjective test to ensure that the slope coefficient is not implausibly large or small.

1                   **2. Marginal Distribution Capacity-related Plant Addition Costs**

2   **Q. Please explain how you prepared regression analyses to estimate the marginal cost**  
3   **of capacity-related distribution plant additions attributed to growth.**

4   A. I prepared regression analyses to estimate the statistical relationship between normalized  
5   peak demand and the following types of growth-related distribution plant addition costs:  
6   (1) capacity-related primary distribution plant additions, (2) capacity-related secondary  
7   distribution plant additions, and (3) capacity-related line transformer plant additions.

8   **Q. In summary, what is the marginal cost of distribution capacity-related plant**  
9   **additions attributed to growth?**

10   A. The total marginal cost of distribution capacity-related plant additions attributed to  
11   growth is summarized in Table 3 below.

12                   *Table 3: Marginal Cost of Distribution Capacity-related Plant Additions*

<b>Marginal Plant additions Component</b>	<b>\$ per MW</b>	<b>Source</b>
Primary	\$108,329	MFB-1 page 1
Secondary	\$ 156,699	MFB-1 page 2
Line Transformers	\$ 111,351	MFB-1 page 3
Total cost of Marginal Plant additions	\$376,379	

13  
14                   **3. Marginal Customer-related Plant Addition Costs**

15   **Q. Please explain how you estimated marginal Customer-related plant addition costs.**

16   A. Marginal Customer-related plant addition costs measure the marginal cost to connect a  
17   customer, which includes the current installed cost of a meter and a service. Because the  
18   cost of a meter and a service is generally correlated with the size of the customer, I asked

1 the Company to provide an analysis of the current installed cost of a meter and the  
2 installed cost of a service that is typical for each rate class.

3 **Q. In summary, what is the marginal cost of customer-related plant additions?**

4 A. The total marginal cost of customer-related plant additions is summarized in Table 4  
5 below.

6 *Table 4: Marginal Cost of Customer-Related Plant Additions*

	D	D-10	D-11	G-1	G-2	G-3	T	V
Service	\$741.11	\$741.11	\$741.11	\$821.47	\$821.47	\$741.11	\$820.61	\$741.11
Meter	\$ 158.20	\$ 185.20	\$ 185.20	\$ 1,267.37	\$ 1,267.37	\$ 244.72	\$ 158.20	\$ 244.72
Total	\$899.31	\$926.31	\$926.31	\$2,088.84	\$2,088.84	\$985.83	\$978.81	\$985.83

7 Source: MFB-2, Page 1, Lines 4, 8, 9

8 **4. Marginal Outdoor Lighting Costs**

9 **Q. Please explain how you estimated the total Marginal Cost of Outdoor Lighting.**

10 A. Marginal outdoor lighting costs measure the marginal cost to provide service to outdoor  
11 lighting customers, which includes the current installed costs of the luminaire and of the  
12 pole and accessories. Because the cost of a luminaire and of a pole is dependent on the  
13 size and type, I asked the Company to provide an analysis of the current installed cost for  
14 each size and type of luminaire and pole and accessory listed in the Company's tariff.

15 I estimated the total marginal cost for outdoor lighting by applying the fixed carrying  
16 charge rate (as discussed below) to the marginal cost for each size and type of luminaire,  
17 and pole and accessory to develop a levelized annual cost, which was then adjusted for  
18 inflation. The calculated levelized annual costs were multiplied by the total number of

1           luminaires and poles and accessories by size and type to arrive at a total marginal cost for  
2           outdoor lighting, which is provided in Attachment MFB-3.

3                           **5. Marginal Distribution Capacity-related Operations and Maintenance**  
4                           **Expense**

5   **Q. Please explain how you estimated the Marginal Cost of Capacity-related**  
6   **Distribution Operations and Maintenance Expense.**

7   A. I prepared six regression analyses to estimate the statistical relationship between  
8       normalized peak demand and the following types of capacity-related distribution  
9       operations and maintenance expense: (1) primary operations expense, (2) secondary  
10      operations expense, (3) line transformers operations expense, (4) primary maintenance  
11      expense, (5) secondary maintenance expense, and (6) line transformers maintenance  
12      expense. The regression results are summarized in Attachment MFB-4.

13                           **6. Marginal Customer-related Operations and Maintenance Expense**

14   **Q. Please explain how you estimated Marginal Customer-related Distribution**  
15   **Operations and Maintenance Expenses.**

16   A. I prepared a regression analysis to estimate the statistical relationship between (a) the  
17       customer-related distribution operations and maintenance expense, and (b) the number of  
18       annual customers based on historical data that the Company provided. The regression  
19       results are summarized on Attachment MFB-5, page 1.

20       I prepared an additional analysis, which is provided in Attachment MFB-5, page 2, to  
21       allocate the customer-related O&M expense to rate classes in a way that reflects that the



1 cost to maintain meters and services is related to the size of the meter and service, which  
2 varies by rate class. The marginal customer-related O&M expense was allocated to rate  
3 classes based on the marginal service and meter plant per customer, from Attachment  
4 MFB-2.

## 5 **7. Marginal Customer Accounting Expenses**

6 **Q. Please explain how you estimated Marginal Customer Accounting Expenses.**

7 A. I prepared a regression analysis to estimate the statistical relationship between (a)  
8 customer accounting expenses, excluding bad debt expense, and (b) the number of annual  
9 customers, based on historical data that the Company provided. The regression results  
10 are summarized in Attachment MFB-5, page 3.

11 I prepared an additional analysis, which is provided in Attachment MFB-5, page 4, where  
12 the Company provided the relative weighting factors for each rate class to allocate the  
13 customer accounting expenses.

14 Lastly, I prepared Attachment MFB-5, page 5, to calculate the pro forma bad debt  
15 expense rate by rate class, based on data provided by the Company.

## 16 **8. Marginal Loading Factors and Adjustment Factors**

17 **Q. Please explain how you estimated Marginal Loading Factors.**

18 A. I calculated several loading factors to account for the following three cost components  
19 that are relatively small or for which it is difficult to develop marginal cost-type statistical  
20 relationships: (a) A&G expense, (b) M&S and prepayments, and (c) general plant. For  
21 each of these loading factors, I prepared regression analyses using the loading factor cost

1 component as the dependent variable, and an appropriate measure of utility plant or total  
2 O&M expense as the independent variable. The loading factor analyses are provided in  
3 Attachment MFB-6.

4 **Q. Please explain why you used loss factors to adjust the marginal capacity-related**  
5 **costs.**

6 A. The measures of capacity-related marginal cost that are used in the MCS are calculated  
7 unit costs per kW of normalized peak demand, measured at customers' meters. The total  
8 distribution system demand is greater than the demand measured at customers' meters  
9 because some energy is lost in the process of transmitting and distributing electricity to  
10 customers. Losses are greatest for those customers taking service at secondary voltage,  
11 and somewhat less for customers that are taking service at primary or higher voltages.  
12 The Company provided separate loss factors for primary and secondary service. I  
13 developed an analysis to apply the loss factors to the marginal capacity-related costs,  
14 which is provided in Attachment MFB-8, page 2.

### 15 **9. Fixed Carrying Charge Rate**

16 **Q. Please explain how you calculated the Fixed Carrying Charge Rates.**

17 A. The marginal cost that I calculated for primary and secondary capacity-related  
18 distribution plant, line transformers, services, meters, and street lighting is the initial cost  
19 of an asset that is placed into service. Fixed carrying charge rates ("FCCR") are used to  
20 convert the marginal cost of plant additions from a cost that represents the estimated  
21 marginal investment into the levelized annual cost of that investment. Attachment MFB-

1 7, page 1, is a summary of the FCCRs for (a) primary and secondary capacity-related  
2 distribution plant, (b) line transformers, (c) services, (d) meters, and (e) street lighting.

3 This page shows Economist's and Engineer's FCCR results.

4 An Economist's FCCR is based on annual streams of costs that are fixed in real dollars,  
5 and therefore vary in nominal dollars. An Engineer's FCCR is based on annual streams  
6 of costs that are constant in nominal dollars, and therefore vary in real dollars. However,  
7 the present values of the Economist's and Engineer's costs and revenues are identical.

8 For marginal cost analyses, the Economist's FCCR calculations are generally accepted as  
9 being the appropriate version because the Economist's FCCR appropriately accounts for  
10 the reduced value of the revenue requirements of that plant addition in future years, due  
11 to price inflation, and therefore better reflects the economic and financial implications of  
12 regulated ratemaking.

13 Attachment MFB-7 provides the assumptions and the detailed calculations of the five  
14 FCCRs. The calculations of the FCCRs follow standard rate making principles to  
15 determine revenue requirements associated with plant additions, including return, taxes,  
16 depreciation, salvage value, etc.

17 **D. Summary of Marginal Cost Study Results**

18 **Q. Please explain the schedules that you have prepared to summarize the Marginal**  
19 **Cost results.**

20 **A.** Attachment MFB-8 shows (1) the calculation of unit marginal distribution capacity costs,  
21 including all loading factors and adjustments; (2) the calculation of the loss-adjusted

1 marginal capacity costs; and (3) the calculation of the loss-adjusted marginal capacity  
2 costs by rate class.

3 Attachment MFB-9 shows the calculation of unit marginal customer costs, including all  
4 loading factors and adjustments.

5 Attachment MFB-10 shows the calculation of unit marginal customer and capacity costs,  
6 adjusted for bad debts. Attachment MFB-10 also shows the calculation of total marginal  
7 costs by rate class, which is used to allocate the Company's requested distribution  
8 revenue requirement to firm rate classes.

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

10 **A.** Yes, it does.