REVISED

Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty Utilities

DG 17-152
Least Cost Integrated Resource Plan

Staff Data Requests - Set 4

Date Request Received: 7/9/18
Request No. Staff 4-5

Date of Response: 8/7/18
Respondent: William R. Killeen
James M. Stephens
Adam Perry

REQUEST:

Regarding the Detailed Review of EnergyNorth's Demand Forecast, provided as Attachment Staff Tech 1-7.1, please provide updated versions of the following, after giving effect to the changes described in that detailed review:

a. The forecast results presented at pages 14-27 and 30-32 of the Company's Least Cost Integrated Resource Plan, filed in Docket No. DG 17-152 on October 2, 2017

b. All appendices to that document affected by the changes to the Demand Forecast

c. The responses to Data Requests No. Staff 1-8, 1-9 in Docket No. DG 17-152

d. The responses to Data Requests No. Staff 1-8, 1-9, OCA 1-12, 3-14 in Docket No. DG 17-198.

REVISED RESPONSE:

a. The Company did not make any changes to the econometric forecast models. As such, Tables 5 through 20 are unchanged. Table 21, which summarizes the Company's energy efficiency goals, also remains unchanged. Please see Attachment Staff 4-5.a for updated Tables 22 through 33. Please note, as discussed in Attachment Staff Tech 1-7.1, the updated demand forecast does not significantly change the Company's results or conclusions as presented in the LCIRP.

b. The Company did not make any changes to the econometric forecast models. As such, Appendices 1 through 4 are unchanged. Appendix 5, which summarizes the Company's existing supply resource portfolio, also remains unchanged. Please see Confidential Attachment Staff 4-5.b for the updated SENDOUT® results (i.e., Appendix 6).

c. Please see Attachment Staff 4-5.c.1.xlsx for an updated version of Attachment Staff 1-8.xlsx, and Attachment Staff 4-5.c.2.xlsx for an updated version of Attachment Staff 1-9.xlsx. The referenced responses do not otherwise change.

d. Please see Attachment Staff 4-5.d.1 for an updated response to Staff 1-8. Please see Attachment Staff 4-5.d.2 for an updated version of Attachment Staff 1-9.a. The response

to Staff 1-9 does not otherwise change. Please see Attachment Staff 4-5.d.3 for an updated version of Attachment OCA 1-12.b. Please see Attachment Staff 4-5.d.4.xlsx and Attachment Staff 4-5.d.5 for updated versions of Attachment OCA 1-13 and the chart presented in the response to OCA 1-14, which are referenced in response to parts d. and e. of the response to OCA 1-12. The response to OCA 1-12 does not otherwise change. Please see Attachment Staff 4-5.d.6.xlsx for an updated version of Attachment Staff 3-14.xlsx. The Company has assumed the request was for an updated version of Attachment Staff 3-14.xlsx, and has not otherwise updated the response.

Please note, the Company's demand forecast methodology, as outlined in Figure 2 on Bates 012, does not separately forecast Normal Year, Design Year, or Design Day demand for each of the out-of-model adjustments. The Company develops a forecast of total monthly demand, which includes the econometric forecast and out-of-model adjustments (and excludes demand associated with Innovative Natural Gas, LLC) and adjusts the total monthly demand for energy efficiency measures, unaccounted for gas, and unbilled sales. Then, the Company allocates the net monthly demand to a daily basis. As such, the data presented in Attachment Staff 4-5.d.4.xlsx and Attachment Staff 4-5.d.6.xlsx are estimates of the effect of each out-of-model adjustment on the Normal Year, Design Year, and Design Day and are subject to change and revision.

Confidential Attachment Staff 4-5.b contains third party pricing information that is "confidential, commercial, or financial information" that is protected from disclosure by RSA 91-A:5, IV, and for which similar information the Commission granted confidential treatment in Order No. 26,159 (July 17, 2018). Therefore, pursuant to that statute and Puc 203.08(d), the Company has a good faith basis to seek confidential treatment of this information and will submit a motion seeking confidential treatment prior to the final hearing in this docket

Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty Utilities

DG 17-152
Least Cost Integrated Resource Plan

Staff Data Requests - Set 4

Date Request Received: 7/9/18
Request No. Staff 4-14

Date of Response: 7/23/18
Respondent: James M. Stephens
Kim N. Dao

REQUEST:

Regarding (1) the Killeen-Stephens testimony, at pages 80 and 81, reporting the basic sources of natural gas price information that the Company used for its SENDOUT analysis, the results of which are summarized in Table 9, at page 81 (Bates No. 193), and Table 10, at page 90 (Bates No. 202), and (2) the SENDOUT analysis revised to correct errors in the specification of gas requirements, and (3) the revised results presented in the Company's response to Staff Data Request No. Tech 1-7 in Docket No. DG 17-152. See Attachment Staff Tech 1-7.1, Tables 2 and 3 on page 3 of 9, please:

a. Confirm (or correct) that the revised SENDOUT analysis used the same gas price information as the original analysis.
b. Provide all natural gas price information that the Company specified to the model for each of the cases analyzed, as specified by the Company rather than as received from S&P Global Market Intelligence
c. Identify all changes made from the information as received.
d. Provide the justification for all such changes.
e. Explain the derivation of each of the gas price series specified to the model for each case analyzed:
    i. Base prices
    ii. Basis differentials
    iii. Any other adjustments necessary for specification to the model.
f. Provide comparisons of those prices with all other sources of price information that could be used to develop them, including:
    i. NYMEX forward prices
    ii. Publicly-available forward prices for basis differentials
    iii. Price forecasts for the relevant locations from the U. S. Department of Energy.

RESPONSE:

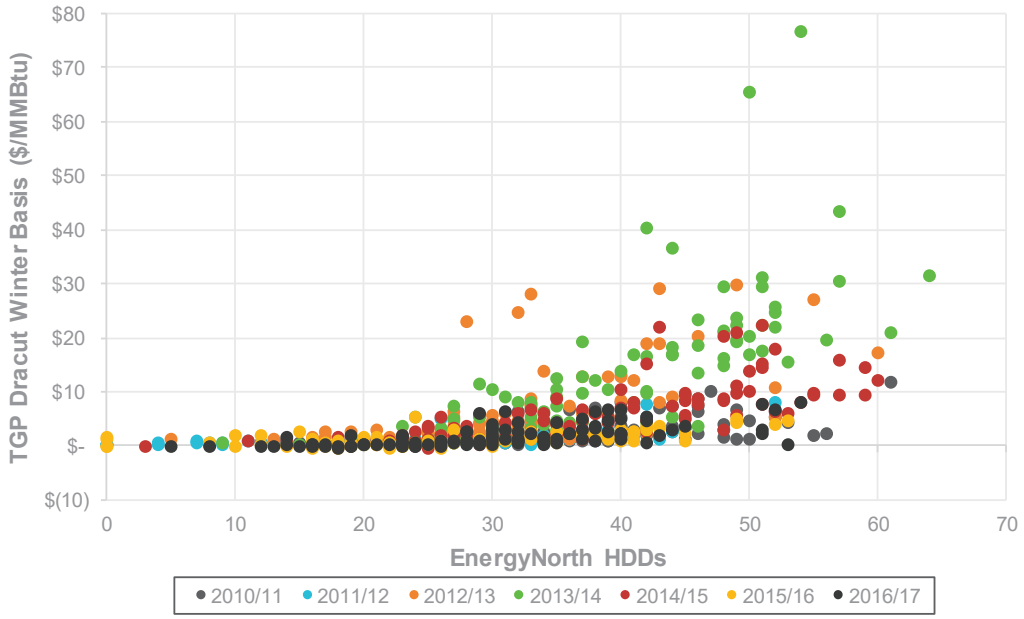
a. Confirmed.

b. As discussed on Bates 055 of the Company's 2017 Least Cost Integrated Resource Plan, the Company used monthly forward natural gas prices and/or basis values as of August 18, 2017, from S&P Global Market Intelligence. Please see Confidential Attachment Staff 4-14.1.xlsx, which contains the proprietary data from S&P Global Market Intelligence.

In addition, given the variability of TGP Dracut daily pricing in the winter period (i.e., the time when the Company is experiencing high demand for heating from its residential and commercial customers), a daily basis string for TGP Dracut was developed for the winter period using the Palisades @Risk software.

The @Risk software performs risk analysis using a Monte Carlo simulation method, which results in a distribution of possible outcomes and probability of occurrence. Specifically, a Monte Carlo simulation analysis consists of the following two distinct operations based on the statistical relationships of the underlying data: (1) values are selected based on the probability distribution functions defined in the input cells of the specified model (i.e., sampling); and (2) recalculates (i.e., draws) using a new set of sampled values with each recalculation (i.e., draw) called an "iteration." The @RISK software then generates output distributions by consolidating the output values from all of the iterations. In this case, the @Risk software was used to analyze and model the relationship between winter weather and the daily TGP Dracut to Henry Hub basis differential. The scatterplot below (see Figure Staff 4-14.1) illustrates the relationship between weather, using actual heating degree days ("HDDs") for EnergyNorth's service territory, and winter basis differentials between TGP Dracut and Henry Hub, using proprietary daily pricing data from S&P Global Market Intelligence, over the seven winters from 2010/11 through 2016/17 (excluding weekends and holidays).

Figure Staff 4-14.1



As shown by Figure Staff 4-14.1, once the HDD level approaches or exceeds 20 HDDs, the probability of a high TGP Dracut basis value significantly increases. Therefore, days that have colder weather are also likely to have higher and more volatile TGP Dracut basis differentials. The historical relationship between daily weather and the TGP Dracut basis differentials was different across each of the winter months (i.e., November, December, January, February, and March). By way of example, there were a total of 716 observations in the analysis period with 180 observations that exceeded 40 HDDs, of which 2, 27, 68, 60, and 23 occurred in November, December, January, February, and March, respectively. Stated differently, based on the actual daily winter data over the 2010/11 through 2016/17 time period, there is a chance of having an HDD greater than 40 in December, January, February, or March; however, there is a higher probability of having an HDD greater than 40 in January or February as compared to December or March. In addition to the various probabilities of occurrence, the TGP Dracut basis value for an HDD greater than 40 varies by individual month. Specifically, the average TGP Dracut basis value for an HDD greater than 40 was approximately $9.15, $11.47, $11.20, and $10.00 per MMBtu for December, January, February, and March, respectively. In other words, an HDD of greater than 40 in January will likely result in a higher TGP Dracut basis value than in March. As a result, models for each individual winter month were developed using the following approach:

- First, for each winter month, a distribution formula for (1) weather was defined using a normal distribution, and (2) TGP Dracut basis was defined using a lognormal distribution where values are positively skewed and exhibit high kurtosis values (i.e., level of outlier observations). Figure Staff 4-14.2 below is the distribution of weather data for January, while Figure Staff 4-14.3 is the distribution of TGP Dracut basis data for January, which illustrates the normal

distribution of weather observations and the skewed, high kurtosis distribution of the TGP Dracut basis data.

- Second, the relationship (i.e., correlation) between weather and daily TGP Dracut basis was defined and modeled using the copula command in the @Risk software for each winter month. Figure Staff 4-14.4 below illustrates the historical weather and TGP Dracut basis differentials for January.
- Finally, a Monte Carlo simulation with 100,000 iterations was performed based on the defined distribution formulas for each winter month. The simulation run resulted in 100,000 basis observations across a range of HDDs for each winter month. Figure Staff 4-14.5 is a scatterplot of the simulation results (i.e., 100,000 observations) for January.

Please see the worksheet tab for each individual winter month and the "Results 100,000 Iterations" worksheet provided in Confidential Attachment Staff 4-14.2.xlsx. Please note that the @Risk software uses special formulas; and without the @Risk add-in, Excel cannot interpret the @Risk formulas and, therefore, the formulas are shown as errors.

Figure Staff 4-14.2

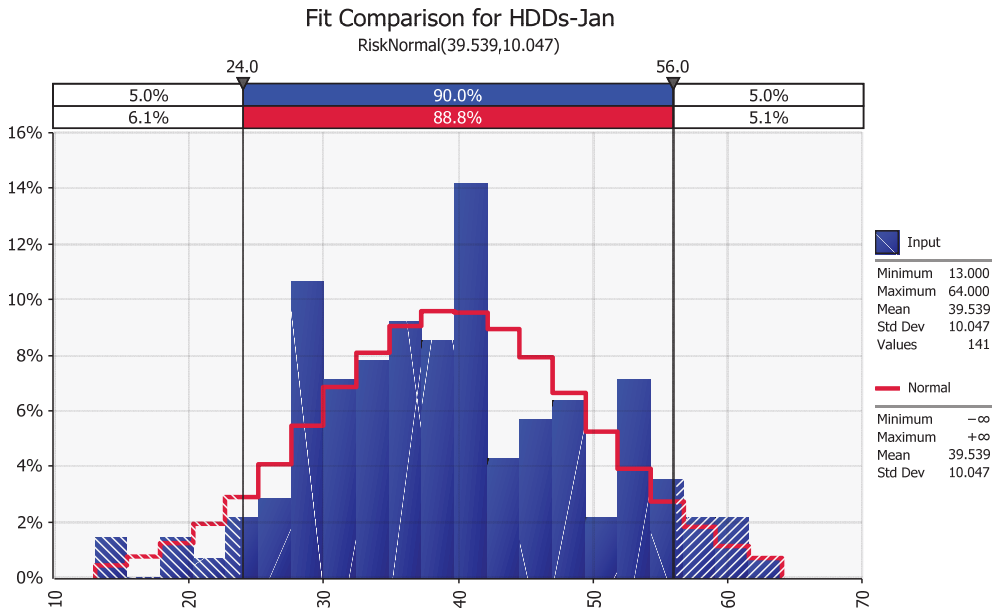


Figure Staff 4-14.3

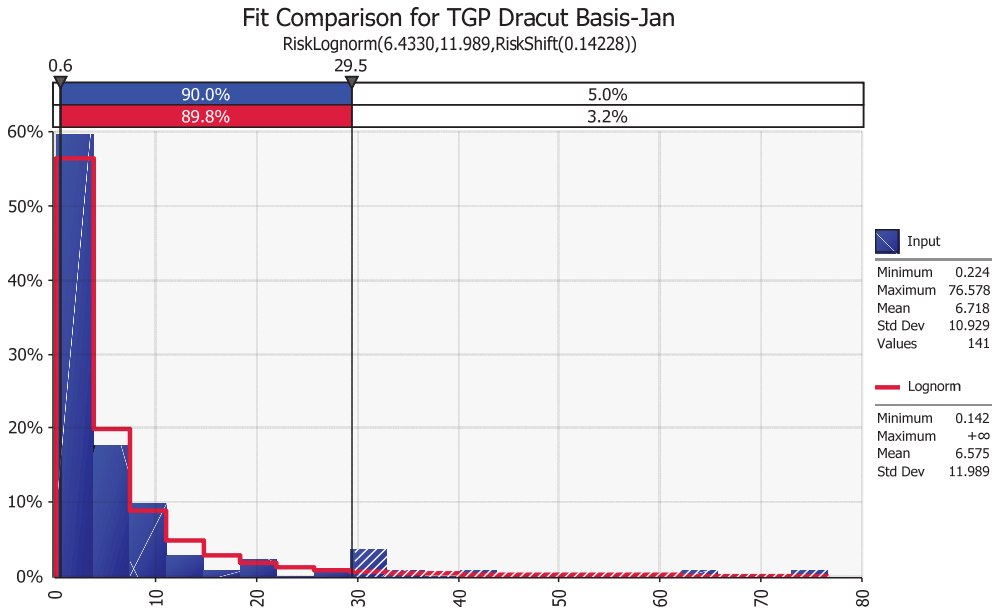


Figure Staff 4-14.4

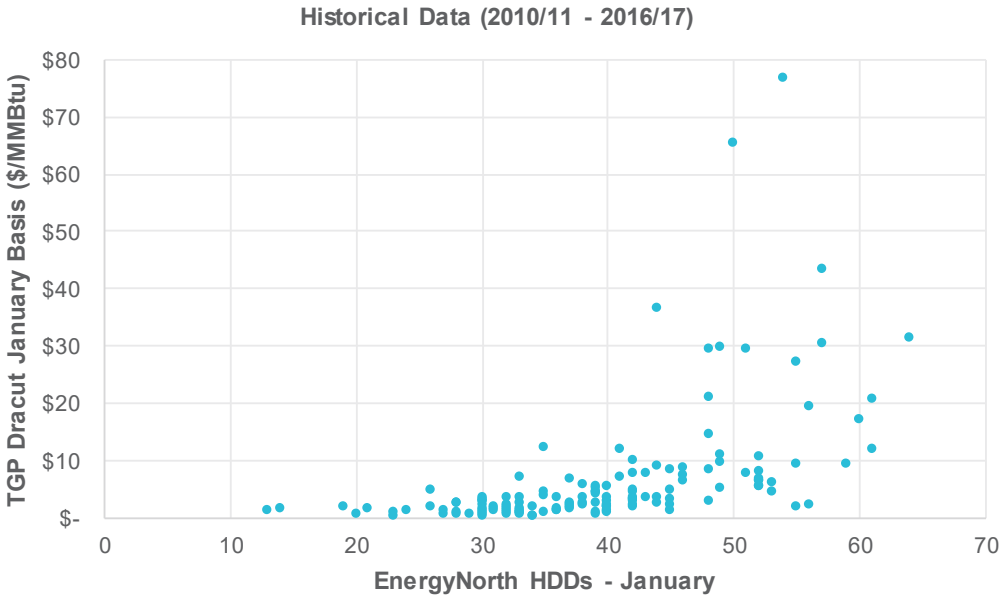
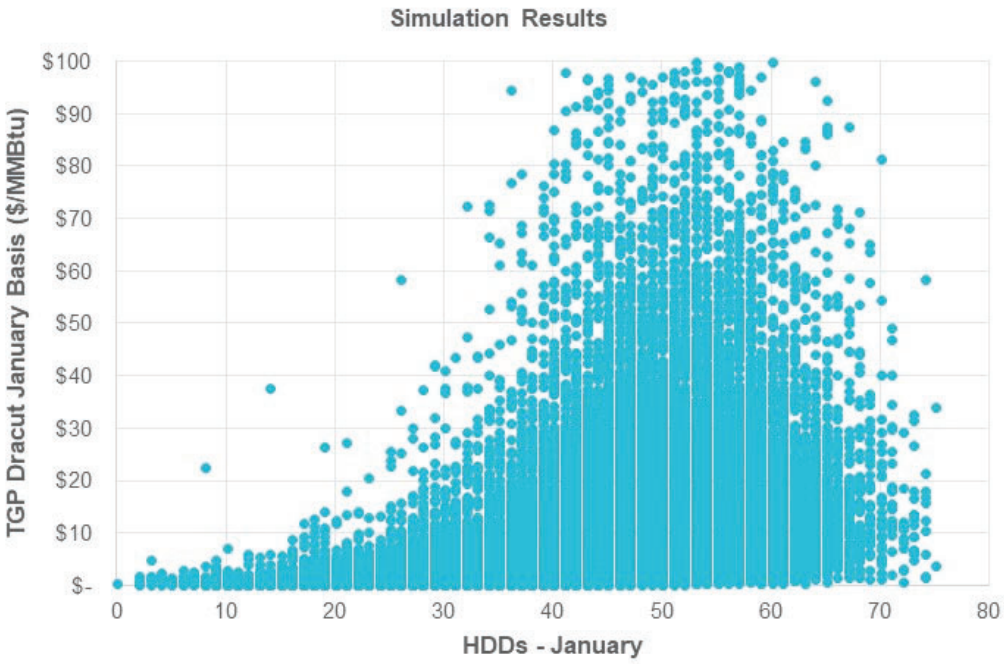


Figure Staff 4-14.5



From the @Risk simulation runs (i.e., 100,000 basis observations), the average TGP Dracut basis differential at each HDD level was calculated for each winter month (provided in the "Results Summary" worksheet of Confidential Attachment Staff 4-14. 2.xlsx). For example, Table Staff 4-14 summarizes the simulation results for each winter month at a 49 HDD level.

Table Staff 4-14

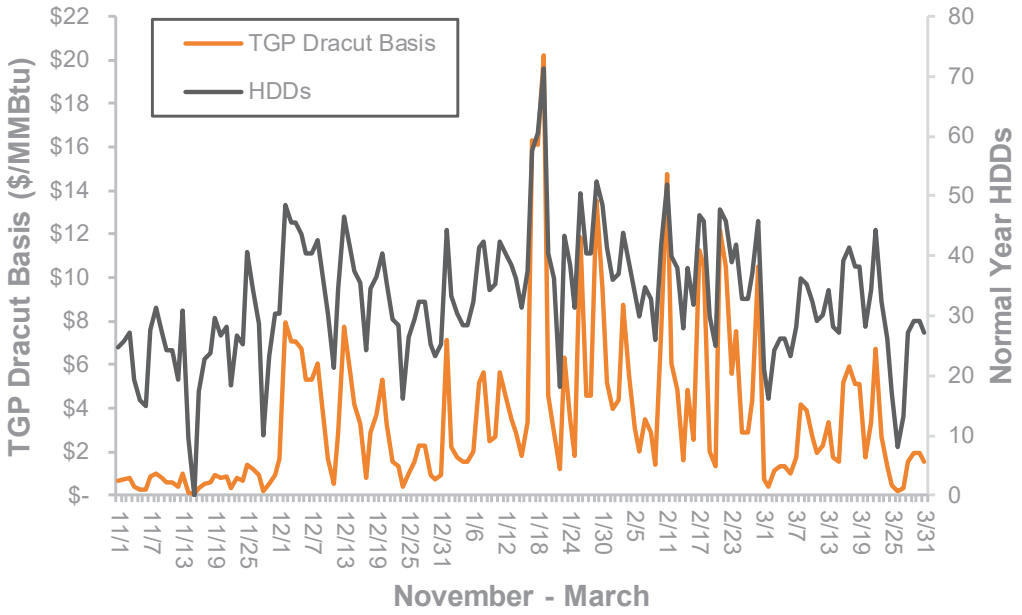
HDDs = 49	November	December	January	February	March
Number of Observations	42	638	2,535	2,002	644
Average TGP Dracut Basis	$3.77	$8.90	$11.73	$15.38	$8.58

As shown by Table Staff 4-14, the probability of occurrence and average TGP Dracut basis is specific to the winter month. Specifically, there is a higher probability of having 49 HDDs in January (i.e., 2,535 out of 100,000 observations, or approximately 2.5% of the observations) as compared to March (i.e., 644 out of 100,000 observations, or approximately 0.6% of the observations). In addition, a 49 HDD in January has a higher TGP Dracut basis value than a 49 HDD in March (i.e., an average TGP Dracut basis of $11.73 per MMBtu in January compared to $8.58 per MMBtu in March).

Next, using the daily weather conditions (i.e., Normal Year HDDs) as defined in the Company's demand forecast model, a daily TGP Dracut basis was defined for the Normal Year which shows variation in daily TGP Dracut basis for the winter period (provided in the "TGP Dracut" worksheet of Confidential Attachment Staff 4-14.2.xlsx). However, since the @Risk simulations were based on historical TGP Dracut basis and weather, and

the forward TGP Dracut basis values are lower than historical values, the @Risk results were calibrated (i.e., reduced) to the average monthly forward TGP Dracut basis values for the 10 forward years as of August 18, 2017, from S&P Global Market Intelligence (provided in the "S&P Global" worksheet of Confidential Attachment Staff 4-14.2.xlsx). The resulting daily TGP Dracut basis under EnergyNorth's Normal Year weather conditions is illustrated in Figure Staff 4-14.6 below and provided in the "TGP Dracut" worksheet of Confidential Attachment Staff 4-14.2.xlsx. This daily price string provides a more informative modeling assumption for the winter TGP Dracut basis and was used in the Company's SENDOUT® model.

Figure Staff 4-14.6



Finally, the summer prices for Dracut supplies were based on the monthly closing prices on August 18, 2017, from S&P Global Market Intelligence as provided in the "S&P Global" worksheet of Confidential Attachment Staff 4-14.2.xlsx.

c. Please see the response to parts b. and e. for the Company's approach to developing the daily TGP Dracut winter basis differentials.

d. The Company developed a daily winter basis string for TGP Dracut due to the significant variability of daily TGP Dracut to Henry Hub basis in the winter period. The Company's approach to developing the daily TGP Dracut basis is provided in part b. above.

e. Monthly values were used for summer prices for the Dracut gas supplies based on the sum of the monthly Henry Hub price (as provided in Confidential Attachment Staff 4-14.1.xlsx) and the monthly TGP Dracut summer basis values (as provided in Confidential Attachment Staff 4-14.2.xlsx).

Daily values were used for winter prices for the Dracut gas supplies based on the sum of the monthly Henry Hub price and the daily TGP Dracut winter basis developed by the Company using the @Risk software discussed in part b. above. Since the @Risk results for each of the individual winter months were calibrated (i.e., reduced) to the average

monthly forward TGP Dracut basis values for the 10 forward winter months (i.e., for the years from 2017/18 through 2026/27), the same daily TGP Dracut winter basis values were assumed for the entire forecast horizon of the 2017 LCIRP.

Monthly values were used for all other price indices as obtained from S&P Global Market Intelligence, which are provided in Confidential Attachment Staff 4-14.1.xlsx.

f. Please note that the Henry Hub prices provided in Confidential Attachment Staff 4-14.1.xlsx represent the NYMEX forward prices referenced in subpart i. of this data request. With respect to subparts ii. and iii. of this data request, the Company did not perform the requested analysis because the Company did not use other sources of price and/or basis values for its SENDOUT® analyses. As indicated in the response to part b. above, the Company used natural gas price and/or basis values from an independent, third-party source (i.e., S&P Global Market Intelligence), which the Company believes is a reasonable representation of market prices.

Confidential Attachment Staff 4-14.1.xlsx and Confidential Attachment Staff 4-14.2.xlsx contain third party confidential pricing information that is governed by a non-disclosure agreement with Liberty, and which is presumed confidential pursuant to Puc 201.06(a)(11). Even though that rule does not specifically apply here, it is an indication of the Commission's understanding that such pricing information is confidential. It is also "confidential, commercial, or financial information" that warrants protection under RSA 91-A:5, IV. The third parties have not authorized the Company to release this information. Similar information was granted confidential treatment in this docket by Order No. 25,159 (July 17, 2018). Therefore, pursuant to that statute and Puc 203.08(d), the Company has a good faith basis to seek confidential treatment of this information and will submit a motion seeking confidential treatment prior to the final hearing in this docket.

Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty Utilities

DG 17-152
Least Cost Integrated Resource Plan

Conservation Law Foundation (CLF) Data Requests - Set 6

Date Request Received: 11/1/19
Request No. CLF 6-34

Date of Response: 11/8/19
Respondent: Kim N. Dao
Adam J. Perry
Paul J. Hibbard

REQUEST:

To the extent not otherwise provided produce all analysis, documents and workpapers relied on by Company witnesses to support their rebuttal testimony.

RESPONSE:

Please see Attachment CLF 6-34.1.xlsx and Confidential Attachment CLF 6-34.2.xlsx for the supporting analysis and workpapers for the tables and figures in the Policy and Gas Supply Rebuttal Testimony. The documents relied upon by the Company in the Policy and Gas Supply Rebuttal Testimony are all publicly available at the sources noted in the footnotes.

Please see Attachment CLF 6-34.3.xlsx for the supporting analysis and workpapers for the tables and figures in the Demand Forecast Rebuttal Testimony. The documents relied upon by the Company in the Demand Forecast Rebuttal Testimony are all publicly available at the sources noted in the footnotes.

Please see Attachment CLF 6-34.4.xlsx for the supporting analysis and workpapers for the customer shares referenced in Mr. Hibbard's Rebuttal Testimony on page 6 (Bates 198) lines 13–20, page 16 (Bates 208) lines 15–18, page 17 (Bates 209) lines 1–3, and page 20 (Bates 212) lines 1–7. The remaining support for Mr. Hibbard's rebuttal testimony comes from documents previously filed in this proceeding, and publicly available documents. Links to the publicly available documents are included below:

ISO-NE, 2017 Economic Study: Exploration of Least-Cost Emissions-Compliant Scenarios, October 29, 2018, (hereafter "ISO-NE 2017 Economic Study"), https://www.iso-ne.com/static-assets/documents/2018/10/2017_economic_study_final.docx.

American Council for an Energy-Efficient Economy, Field Assessment of Cold Climate Air Source Heat Pumps,
https://aceee.org/files/proceedings/2016/data/papers/1_700.pdf.

American Council for an Energy-Efficient Economy, Report A1803, Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Propane Furnaces, Boilers, and Water Heaters with Air-Source Heat Pumps, July 2018, https://aceee.org/sites/default/files/publications/researchreports/a1803.pdf.

IPCC, Climate Change 2007 Synthesis Report, https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf.

IPCC, Climate Change 2014 Synthesis Report, https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf.

EPA, Emission Factors for Greenhouse Gas Inventories, Last Modified March 9, 2019, https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf.

EPA, Understanding Global Warming Potentials, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

New Hampshire Department of Environmental Services, The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future, March 2009, https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/documents/nhcap_final.pdf.

Confidential Attachment CLF 6-34.2.xlsx contains third party confidential pricing information that is governed by a non-disclosure agreement with Liberty, and which is presumed confidential pursuant to Puc 201.06(a)(11). Even though that rule does not specifically apply here, it is an indication of the Commission's understanding that such pricing information is confidential. It is also "confidential, commercial, or financial information" that warrants protection under RSA 91-A:5, IV. The third parties have not authorized the Company to release this information. Similar information was granted confidential treatment in this docket by Order No. 25,159 (July 17, 2018). Therefore, pursuant to that statute and Puc 203.08(d), the Company has a good faith basis to seek confidential treatment of this information and will submit a motion seeking confidential treatment prior to the final hearing in this docket.