Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-001 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1 Bates p. 8.

a. Please provide Footnote 1.
b. Please explain why you are referring to a PURA proceeding (Docket No. 17-12-03RE07) for the LCIRP in NH.

Response:

a. http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/00518f190846819a8525861f007803e3/$FILE/Doc.%2017.12.03RE07.Written%20Comments%20(Nov.13.2020).FINAL.pdf
b. The Company is referencing the written Comments filed November 13, 2020 under PURA Docket No. 17-12-03RE07 because the comments provide a detailed overview of how the NWA screening tool is integrated into Eversource's distribution planning process and are the first publicly filed description of this integrated process. Eversource's objective is to be transparent and consistent, and therefore we believe that information provided in regulatory filings, even in other jurisdictions, should be taken into consideration so that a complete, cohesive view is provided to the Commission.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-002 | **Page 1 of 5**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1. Please provide a list of all equation variables listed throughout the document or in the cost model, and the basis for each assumption underlying those variables.

Response:
Please see the table below.

Variable	Description	Default
$P_{PVInstalled\_BTM}$	The total installed behind the meter solar capacity	Input Value
$P_{DRInstalled\_BTM}$	The total installed residential demand response capacity	Input Value
$P_{BESInstalled\_BTM}$	The total installed behind the meter battery storage capacity	Input Value
$P_{DRCom_{Reliable}}$	The total installed commercial demand response capacity	Calculated Value
ε_{capPV}	Saturated Reliability Factor for BTM Solar	0.95 Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 16, Table 2
ε_{capDR}	Saturated Reliability Factor for Demand Response	0.80 Docket No. DE 20-161 Least

		Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 16, Table 2
ε_{capBES}	Saturated Reliability Factor for BTM Storage	0.80 Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 16, Table 2
$P_{Available}$	Refers to available power from programs	Calculated Value
$P_{Installed}$	Refers to total installed power	Input Value
$P_{AC_{Rated}}$	AC power rating of a DER	Input Value
P_{Bat}	Installed Battery Power	Input Value
$P_{Transformer}$	Transformer Rated Power	Input Value
P_{DG}	Installed Distributed Generation Power	Input Value
$P_{DG_{Reliable}}$	Installed Distributed Generation Power after N-1 criteria	Calculated Value
P_{DC}	Installed DC rated power at solar panels	Calculated Value
$P_{DC}(t)$	Time dependent output of solar panels	Calculated Value
$I_{ClearSky}(t)$	Time dependent irradiance values	Input Value
$\varepsilon_{Irr_{MWAC}}$	Minimal Weather Adjusted Relative Irradiance	• Summer: Jun, Jul, Aug = 16.6% • Transition: Mar, Apr, May,

		Sept, Oct, Nov = 18.1% • Winter: Dec, Jan, Feb = 24.1% Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b.
$P_{DC_{Rated}}$	DC rated power	Input Value
$P_{DC_{MWAC}}(t)$	Minimal weather adjusted capacity DC output	Calculated Value
$P_{AC_{MWAC}}(t)$	Minimal weather adjusted capacity AC output	Calculated Value
$\varepsilon_{Type}(t)$	Time variant Energy Efficiency Profile	Calculated Value
$P_{EE_{Type}}$	Total Energy Efficiency Power by Type	Calculated Value
P_{EE}	Contributing Energy Efficiency impact in kW	Calculated Value
$\varepsilon_{HVAC_{Comm}Yearly}(t)$	Commercial HVAC Yearly Profile	Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 20, Equation 8.C.02
$\varepsilon_{HVAC_{Comm}Daily}(t)$	Commercial HVAC Daily Profile	Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 20, Equation 8.C.03

$\varepsilon_{HVAC_{Res}Yearly}(t)$	Residential HVAC Yearly Profile	Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 20, Equation 8.C.04
$\varepsilon_{HVAC_{Res}Daily}(t)$	Residential HVAC Daily Profile	Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 20, Equation 8.C.05
$\%_{roundtrip}$	Battery roundtrip efficiency	85% (Default)
$\$_{PropertyPurchase}$	Cost of property purchase	Input Value
$\varepsilon_{Discount\ Rate}$	Discount rate	3.37% Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 28, Line 514
$\varepsilon_{Inflation\ Rate}$	Inflation rate	2.0% Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 28, Line 512
$\varepsilon_{Earning}$	Assumed Performance Incentive	Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 29, Table 4

$\varepsilon_{Replace}$	Assumed Replacement Cost	20% Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 30, Line 561
WACC	Weighted Average Cost of Capital	Calculated Value
$\$_{Gen Credit}$	Revenue from generation credits	Input Value
$\$_{Wholesale Energy}$	Levelized cost of wholesale energy	$40/MWh Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 43, Line 911
$\$_{Arbitrage}$	Levelized arbitrage value of a MWh	$40/MWh Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 45, Line 988
$\$_{Energy Revenue}$	Revenue from Energy Sales	Calculated Value
$\$_{Gen Credit}$	Revenue from Credits	Input Value

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-003 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 9. Please provide an organization chart showing each of these individuals listed, his/her title, department, and which retail/wholesale company that he/she works for (e.g., PSNH, CP&L, etc.)

Response:
Please refer to Attachment STAFF 1-003 for the requested information.

Group	Name	Title, Department	Company*#
Lead Developer and Coordinator	Gerhard Walker	Principal Engineer, Distribution Planning	EESCO
SME-Regulatory Finance	Brian Rice	Manager, Regulatory Projects	EESCO
SME-Regulatory Finance	Conner Eller	Associate Analyst, Revenue Requirements	EESCO
SME-Energy Efficiency	Mike Goldman	Director, Regulatory Planning Support and Evaluation	EESCO
SME-Energy Efficiency	Roshan Bhakta	Manager, Energy Efficiency	EESCO
SME-Energy Efficiency	Brian Greenfield	Analyst, Energy Efficiency-MA	EESCO
SME-Grid Mod	Steven Casey	Senior Project Manager, Grid Modernization	EESCO
SME-Market Participation	David Errichetti	Manager, NEPOOL Markets, Power Supply Analysis and PLC, Electric Supply	EESCO
SME- Reliability and Asset Health Index	Jaydeep Deshpande	Program Manager, Substation Analytics, Substation & Trans Engineering	EESCO
SME- Distribution Planning	Juan Martinez	Manager, System Planning, Distribution	EESCO
Reviewer-Distribution Planning MA	Juan Martinez	Manager, System Planning, Distribution	EESCO
Reviewer-Distribution Planning CT	Dalia Nunes	Manager, System Planning, Distribution	EESCO
Reviewer-Distribution Planning NH	Matthew Cosgro	Senior Engineer, Distribution System Planning	EESCO
Reviewer-DER Planning MA	Shakir Iqbal	Manager, Distributed Energy Resources and Technology	NSTAR
Reviewer-DER Planning CT	Dave Ferrante	Manager, Distributed Energy Resources and Technology	CL&P
Reviewer-DER Planning NH	Richard Labrecque	Manager, Distributed Generation & Distribution Planning	PSNH
Reviewer-Transmission Planning	Janny Dong	Manager, System Planning, Transmission Reliability	EESCO
Reviewer-Transmission Planning	Joe Adadjo	Manager, System Planning, Transmission Reliability	EESCO
Reviewer-Grid Modernization	Ben Byboth	Director, Grid Modernization	EESCO
Reviewer-ISO Policy & Econ Analysis	David Burnham	Manager, ISO Policy and Economic Analysis, ISO Policy & Compliance	EESCO
Reviewer-ISO Policy & Econ Analysis	Andrew Tan	Senior Engineer, Transmission System Planning & Strategy	EESCO
Dir/Exec Review- Distribution Planning	Lavelle Freeman	Director, System Planning, Distribution	EESCO
Dir/Exec Review-Transmission Planning	Jacob Lucas	Director, System Planning, Transmission	EESCO
Dir/Exec Review-System Planning	Digaunto Chatterjee	Vice President, System Planning	EESCO
Dir/Exec Review-Grid Modernization	Jennifer Schilling	Vice President, Grid Modernization	EESCO
Dir/Exec Review-Engineering	Aftab Khan	Senior Vice President, Engineering	EESCO

*Company

CL&P: Connecticut Light & Power

EESCO: Eversource Energy Service Company

PSNH: Public Service Company of New Hampshire

NSTAR: NSTAR Electric

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-004 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 10. Please list and describe the 3rd criteria referenced in line 78.

Response:
The referenced sentence under Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 10, Line 78 should read "Any project site that does not pass both criteria will be disqualified from further NWA…".

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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-005 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 10, Line 87. Please explain why a capital project already approved at a station could not be reconsidered if an NWA could benefit both projects and the project had not been purchased/installed.

Response:
Under section 5.B. of the NWA Framework, March 31, 2021 Supplement, Appendix A-1, Bates p. 10 the company outlines “additional screening considerations” for NWA application. If the additional screening questions are answered “No”, the solution will be “evaluated on a case by case basis”. It is important to note that these additional screening considerations are not automatic disqualifiers for an NWA solution, but require the Company to conduct a more detailed review and analysis.

Capital projects already approved at the station have gone through the Eversource Capital Project Approval process, which includes a certain level of engineering design, cost estimation, planning and scheduling to meet a specific in-service date (ISD). The driver for this project could be an entirely different need other than capacity, such as reliability or asset health concerns. In this case, the timing and scheduling considerations as well as the driving need for the project and the sunk engineering costs will need to be reviewed specifically to determine whether an NWA solution is suitable to replace the approved capital project.

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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-006 **Page 1 of 4**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp.16-19. For Figure 2. (four 2 MWAC solar systems) , please provide the following results including the assumptions and all of the data used for the calculation:

a. Time Variant Output;
b. Minimal Weather Adjusted Output for Summer
c. Minimal Weather Adjusted Output for Transition seasons
d. Minimal Weather Adjusted Output for Winter
e. Minimal Weather adjusted clear sky irradiance profile for each season
f. Minimal Weather adjusted DC capacity for each season
g. The live spreadsheet for Figure 2 showing all of the data used in the calculation.

Response:

A. The time variant output is based on clear sky profiles of irradiance data in watts per square meter. These data sets are obtained from Clean Power Research's SolarAnywhere® Application. A Sample Dataset can be found in Appendix A.

B. The Company provided a Minimal Weather Adjusted Output referenced in Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. The Minimal Weather Adjusted Output is based on the Minimal Weather Adjusted Relative Irradiance which Eversource has determined in a study conducted using the Solar Anywhere Historic Weather Data.
The historic weather data from Solar Anywhere is a licensed data set which Eversource pays for on an annual basis and is contractually prohibited from sharing outside of the Company.

Eversource used the historic irradiance data and compared it with the clear sky irradiance data to calculate a relative irradiance as

$$I_{relative} = \frac{I_{Historic}}{I_{ClearSky}}$$

These historic $I_{relative}$ values were collected at 15 min intervals for an entire year and the probability of occurrence of each $I_{relative}$ value was calculated. Figure 1 shows the relative Irradiance Percentiles from the analysis during the summer.

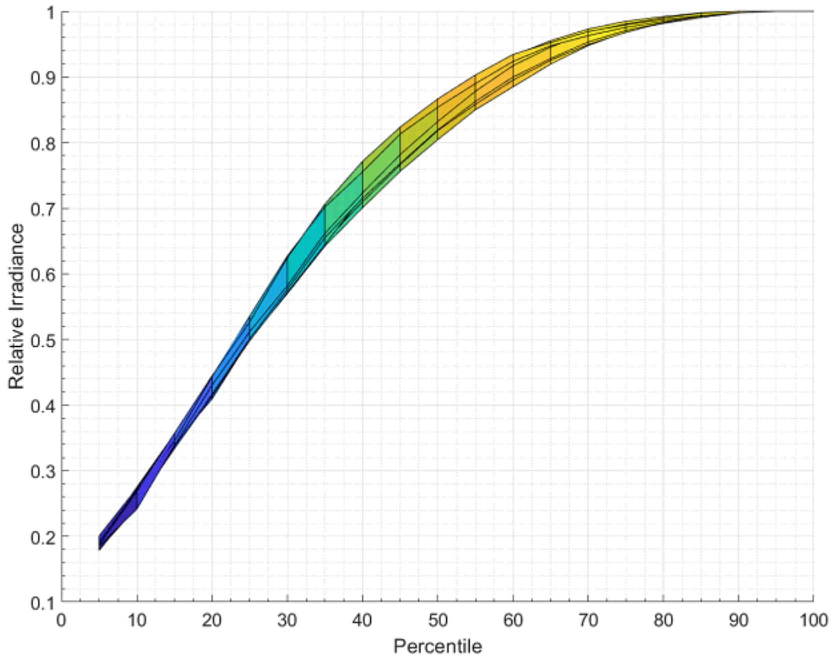

Figure 1: Relative Irradiance Percentile

The relative irradiance hereby is an indication of the likelihood of there being cloud coverage at any point in time. The way to correctly read Figure 1 is, for example, at the 20th percentile, the relative irradiance ranges between 0.42 and 0.45 and averages 0.435, meaning that in 80% of all cases, weather will permit the solar panels to operate at 43.5% or higher of the clear sky output. For a 1 MW system at noon, this would equal 0.435 MW or more in 80% of cases. During evening hours when solar generation, even under clear sky conditions, is no longer at peak, this means that the 43.5% are applied to the respective value of the clear sky profile at the point of observation. E.g. at 6pm the clear sky profile is 40%. Observing the 20th percentile to ensure that 80% of all cases are above the observed value would result in 40% * 43.5% = 17.4%, or 0.174 MW. In summary, the clear sky profile is multiplied by the respective percentile value for every interval.

The company has always used a 90/10 probability approach to forecasting, as a result, here the 10th percentile was chosen, resulting in the value referenced under Docket No. DE 20-161 Least

Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. To compute the Minimal Weather Adjusted Output the following steps are taken

- Retrieve clear sky profile for location
- Multiply clear sky profile with Minimal Weather Adjusted Relative Irradiance resulting in the Minimal Weather Adjusted Clear Sky Profile using equation 8.B.02 reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18
- Calculate Value

  - Calculate a panel output based on the installed panel capacity and the Minimal Weather Adjusted Clear Sky Profile for every interval of the year resulting in the Minimal Weather Adjusted Output using equation 8.B.04 reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18
  - Minimal Weather adjusted DC capacity calculated using Equation 8.B.03 reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18

The minimal weather adjusted DC capacity represents the panel capacity using the 90/10 probability of weather impact on panel output at nameplate rating whereas the Minimal Weather Adjusted Output is the time series data showing the 90/10 probability of weather impacts on the output.

C) For Minimal Weather Adjusted Relative Irradiance for Transition values, please refer to Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. For the methodology, refer to Information Request 1-6.b.

D) For Minimal Weather Adjusted Relative Irradiance for Winter values, please refer to Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. For the methodology, refer to Information Request 1-6.b. E) For Minimal Weather Adjusted Relative Irradiance values, please refer to Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. For the methodology, refer to Information Request 1-6.b.

F) For Minimal Weather adjusted DC capacity values, please refer to Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 18, Section 8.B.b. For the methodology, refer to Information Request 1-6.b.

G) Figure 2, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, shows a sample data set. A "live spreadsheet" in this case constitutes the NWA Screening Tool Workbook as it is a collection of interdependent sheets. Therefore, as part of the response the company will be providing the NWA Screening Tool with Loudon Station Data (Attachment C and D). All calculations conducted can be reviewed in Section 8. Dispatch Model.

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-007 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp.18-19, Line 290.

a. Please explain why only 3 of the 4 systems are accounted for.
b. Is the reduction of the largest DER dependent on ownership and control? If so, please explain why this is the case.

Response:

A) Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Page 15 of 45, Chapter 7.B states that for N-1 reliability calculations the largest distributed generation asset is removed from the calculation to account for the worst possible single contingency system failure. As all assets in the sample calculation in Appendix A-1, Bates pp.18-19 are 2 MW rated, it does not matter which asset is removed. The overall count of assets considered is reduced from 4 to 3.

B) No, the outlined N-1 assumptions under Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Page 15 of 45, Chapter 7.B are not dependent on ownership or control. The reduction assumption is purely technical to ensure continuity of service under the worst single contingency scenario.

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-008 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp 19-21, regarding energy efficiency.

a. Line 303 indicates the four distinct applications plus a generic application are modeled. The explanation only explains the distinct applications. Please explain the generic application in more detail.
b. Please explain how the following equations were derived:
   i. 8.C.02
   ii. 8.C.03
   iii. 8.C.04
   iv. 8.C.05
c. Please explain how the residential and commercial HVAC can have the same yearly distribution, but yet the daily distribution is very different.

Response:

a. The generic application would simply allow a reduction of load using the same energy efficiency value at any point in time. It is only used to evaluate remaining requirements and does not represent any actual technology. For the purpose of evaluating energy efficiency impacts, the statement can be ignored, and the Company will remove it in future revisions of the Framework to avoid confusion.
b. The Company designed the profiles listed under equations 8.C.02-05 in PSNH dba Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Page 18 of 45 “based on internal experience”. To ensure usability in the NWA Screening Tool, these equations were created allowing the tool to cycle through each year and calculate the respective energy efficiency component based on the day of the year. The profiles used are intended for a high level screening and a more detailed analysis follows once the solution passes screening and an outreach to customers is considered, they are representative and not intended to accurately model actual, specific measured load profiles. See also responses to Questions 10 and 11.
c. Residential and commercial HVAC are both driven by seasonal conditions, primarily ambient temperature, providing for the same yearly distribution. However, within a day, both are used quite differently. Where residential usage peaks towards the late afternoon with people returning home, commercial HVAC sees earlier utilization as offices and factories are running during the day, but empty towards the evening and nighttime hours.

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Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-009 | **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 19-21 regarding energy efficiency. Given that some energy efficiency measures may impact winter and summer peaks and transitional months differently, please explain and justify why an annual load profile and a single daily load profile is used instead of a seasonal load profile and different daily load profiles in a given season.

Response:
For the NWA Framework, which is intended to provide an initial high level screening of station upgrades for the feasibility to further investigate a more detailed engineering study of NWA solutions, the company represents energy efficiency measure impacts using annual and daily profiles as described in Section 8. Dispatch Model, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1. Hereby the annual profiles provide a scaling of the energy efficiency measure by time of year, representing the maximum value that can be achieved each day, while the daily profiles provide insight into when during a day these measures produce the most impact, scaled to the applicable value on the annual profile. As stated under Question 8, these profiles are representative and not intended to accurately model actual measured load profiles.

There are many alternative ways of evaluating EE impacts, for the purpose of providing a high level screening approach profiles based on functions, rather than discrete values, allow for better automation in the calculations.

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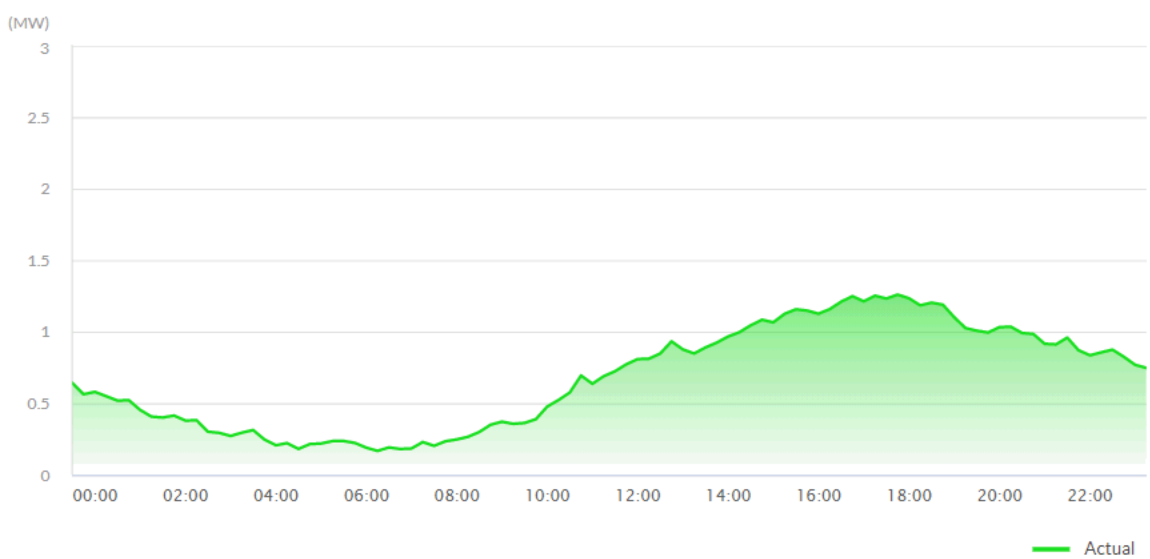
Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-010 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 20-21 regarding HVAC Commercial and HVAC residential.

a. Please provide the supporting data and documentation for NH C&I HVAC load that justifies the statement in Lines 315-316 on Bates p. 20 stating that "The underlying assumption is that HVAC load will be the highest during summer months, the lowest during spring and fall, with a minor peak during winter.
b. Please provide the supporting data and documentation for NH residential HVAC load that justifies the statement in Lines 337-339 stating that "However, given that residential HVAC applications typically have a higher yield in the evening hours and at night as opposed to the commercial HVAC which typically operates during the day, the profile has been adjusted.

Response:
A: The statement should clarify that this is representative for electric consumption only. This is an industry standard practice for commercial building electric HVAC loads. Commercial buildings do consume large amounts of energy during the winter months, however this consumption is mainly natural gas and other fuel sources. These profiles may change and thus NWA Framework assumptions updated as building heating electrification continues to grow.
B: The statement should clarify that this is representative for electric consumption only. The early afternoon and evening is when residential load is highest. The chart below shows actual NH residential HVAC load for approximately 800 homes on a typical summer day (July 29th 2020):



Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-011 **Page 1 of 2**
Request from: New Hampshire Public Utilities Commission Staff

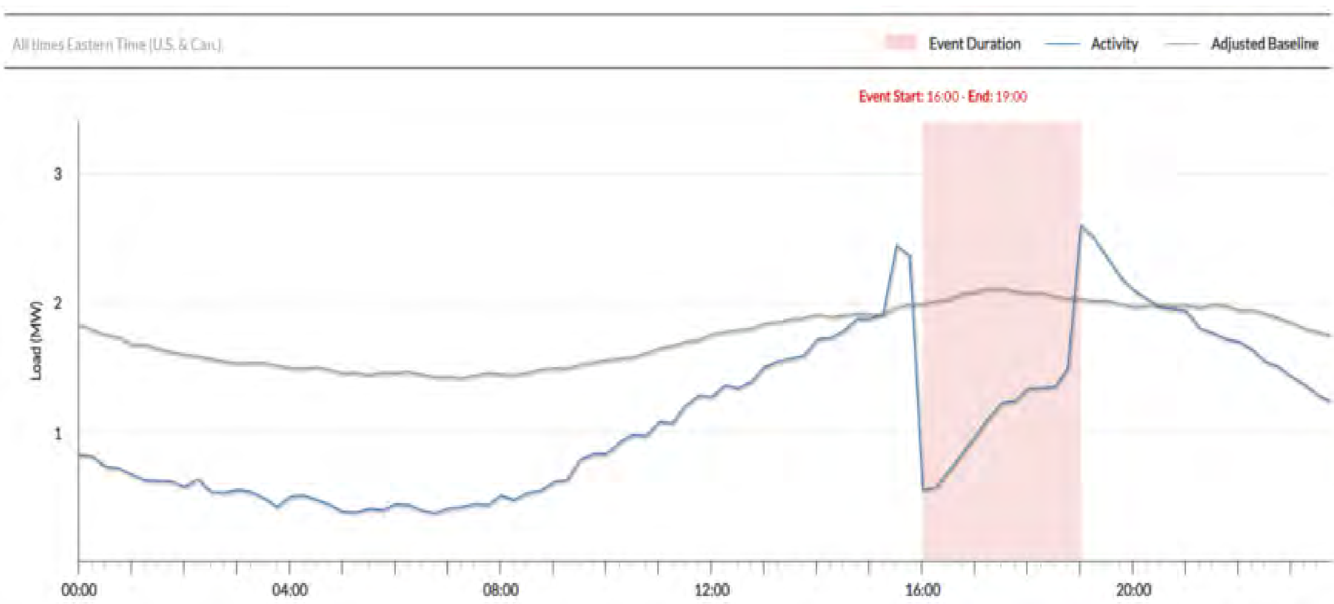
Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 22 regarding demand response pre-event and snap back periods. Please provide the supporting documentation that shows that shows the pre-event periods and snap back periods and associated load for each for:

a. NH residential demand response programs
b. NH commercial demand response programs

Response:

A: The below graphs shows the July 27th, 2020 event that was dispatched to approximately 900 NH Residential customers via the Eversource energy efficiency demand response pilot. The event was called from 16:00 - 19:00. The Pre-Cooling and Snapback loads are clearly seen in the hours immediately prior to and after the event duration.



B: The graph below shows a typical commercial participant in Eversource's demand response pilot. The Pre-Cooling load is measurable however not pronounced. The Snapback loads are clearly seen in the hours immediately after the event duration.


kW
350
300
250
200
150
100
50
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-012 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 22-23 regarding demand response capacity availability profile. Please explain why the demand response capacity availability is less in the winter and transitional months.

Response:
When the Company observes Demand Response impact, the technology type is considered as well as how much of that technology that receives the Demand Response call is online and contributing to demand at the time of the call. As such, most of the demand response capabilities are typically centered around cooling applications, which tend to run at a higher utilization rate during summer months than during other times of the year. Therefore, a demand response call to customers during the winter and transitional months will find less customers active at the time of the call (due to reduced need for cooling), which translates into less customers being able to reduce their consumption, and consequently less of a demand response impact.

For a demand response event to have a large impact, a significant number of the demand response assets under contract need to be actively consuming at the time of the call. If no assets are active at the time, the demand response call will have no impact on the power grid as nothing would be turned off.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-013 **Page 1 of 1**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Gerhard Walker, Lavelle A Freeman**

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 24. Please provide the supporting documentation for the 1.8% maximum reduction value for the conservation voltage reduction.

Response:
Achievable CVR reduction is dependent on many factors, including feeder and load profiles. Based on other CVR pilots and implementations in the industry as shown in Attachment STAFF 1-013, Eversource determined that a 0.6% reduction in demand for every 1% in voltage would be a conservative estimate for achievable reduction. Further, we estimate that we can reduce feeder voltages by 3% with a CVR/VVO scheme compared to normal, which amounts to the 1.8%. reduction stated in the filing.

CONSERVATION VOLTAGE REDUCTION: CUSTOMER AND UTILITY BENEFITS

PRESENTED BY: LARRY GELBIEN
ERIK GILBERT

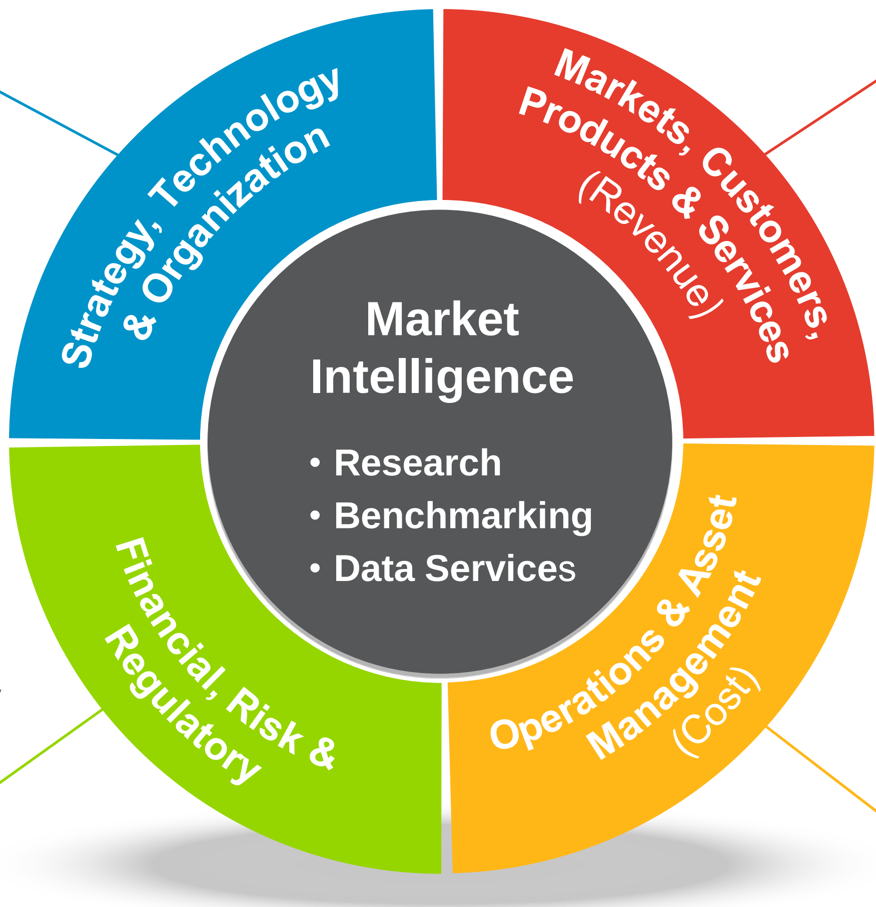
JANUARY 26, 2017

NAVIGANT

NAVIGANT GLOBAL ENERGY PRACTICE SOLUTION OFFERINGS AND CAPABILITIES

- Business Strategy and Implementation
- Innovation and R&D Management
- Organizational Design
- Change Management
- Technology Advisory
- Merger & Acquisitions
- Integrated Resource Planning

- Market Strategy and Pricing
- Customer Engagement
- Emerging Technologies (renewables, distributed generation, storage, micro grids and others)
- Energy Efficiency
- Demand Response
- Customer Analytics



- Business Case Development
- Risk Management
- Physical and Cybersecurity
- Regulatory Compliance
- Federal and State Regulatory Support
- Policy Development and Code & Standards

- Operational Excellence
- Asset Management
- Grid Operations
- Distributed Resource Management
- Restoration and Outage Management
- Manufacturing Impact Analysis
- Equipment / Appliance Testing

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AGENDA

1 » Conservation Voltage Reduction (CVR) Fundamentals

2 » CVR Factor Drives Results

3 » CVR Benefits and Costs

4 » From CVR Concept to Pilot to Full Deployment

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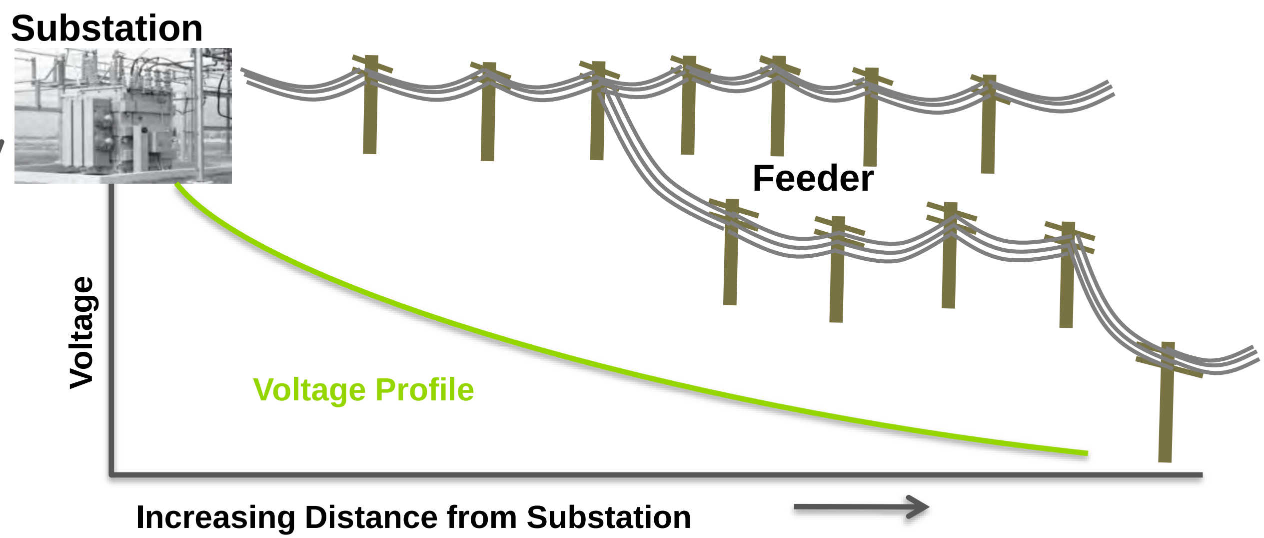
CONSERVATION VOLTAGE REDUCTION (CVR) FUNDAMENTALS

Voltage drops over the length of a feeder due to resistance in the line. As a result, some electricity is “lost” during distribution.

Voltage is boosted at the substation to maintain required voltage over the entire feeder length.



Factors that Increase Line Losses	Factors that Minimize Line Losses
• Customer loads that create reactive power (e.g., motorized appliances such as a clothes washer) • High current and temperatures heat the distribution wire and increase resistance • Long feeder length	• Customer devices that operate through electric resistance (e.g., incandescent bulb) • Moderate temperatures • Shorter feeder length • Technologies that boost or regulate voltage

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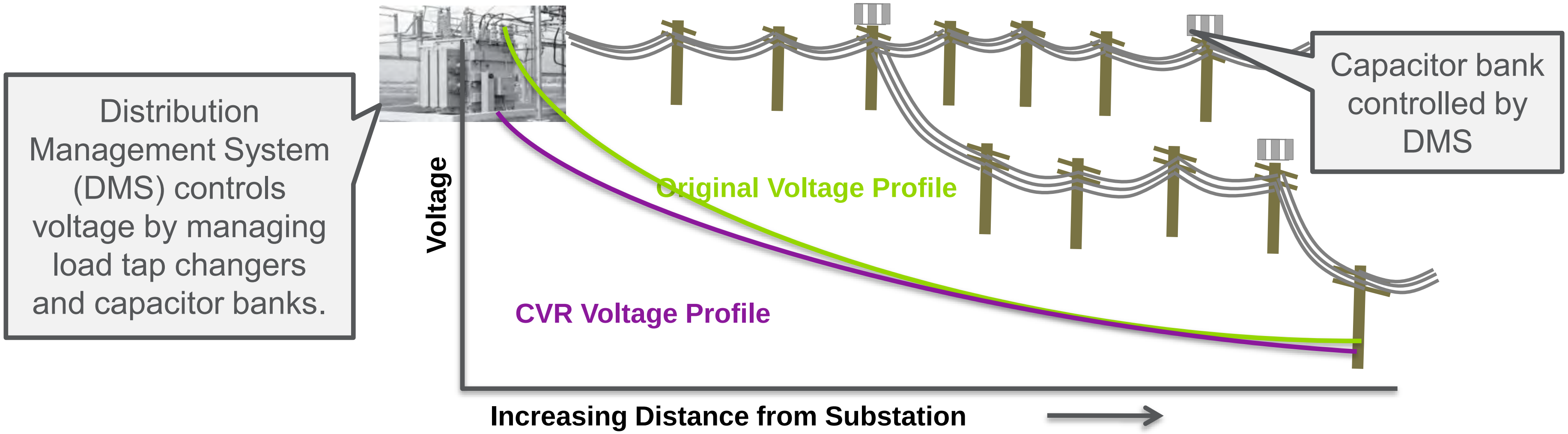
CONSERVATION VOLTAGE REDUCTION (CVR) FUNDAMENTALS

Conservation voltage reduction (CVR) technology optimizes voltage over the feeder length, reducing the need to boost voltage at the substation



CVR Equipment and Software Needs	Deployment Considerations
• Automated capacitors • Automated regulators • Load tap changers (LTC) • Distribution circuit monitors or SCADA • DMS (integration with AMI) • CVR algorithms • Load balancing software	• Substation transformer size and loading • Customer types per feeder • Feeder length • Feeder loading, including peak periods • Existing IT/OT systems • Existing LTC, voltage regulators, and capacitor bank controllers

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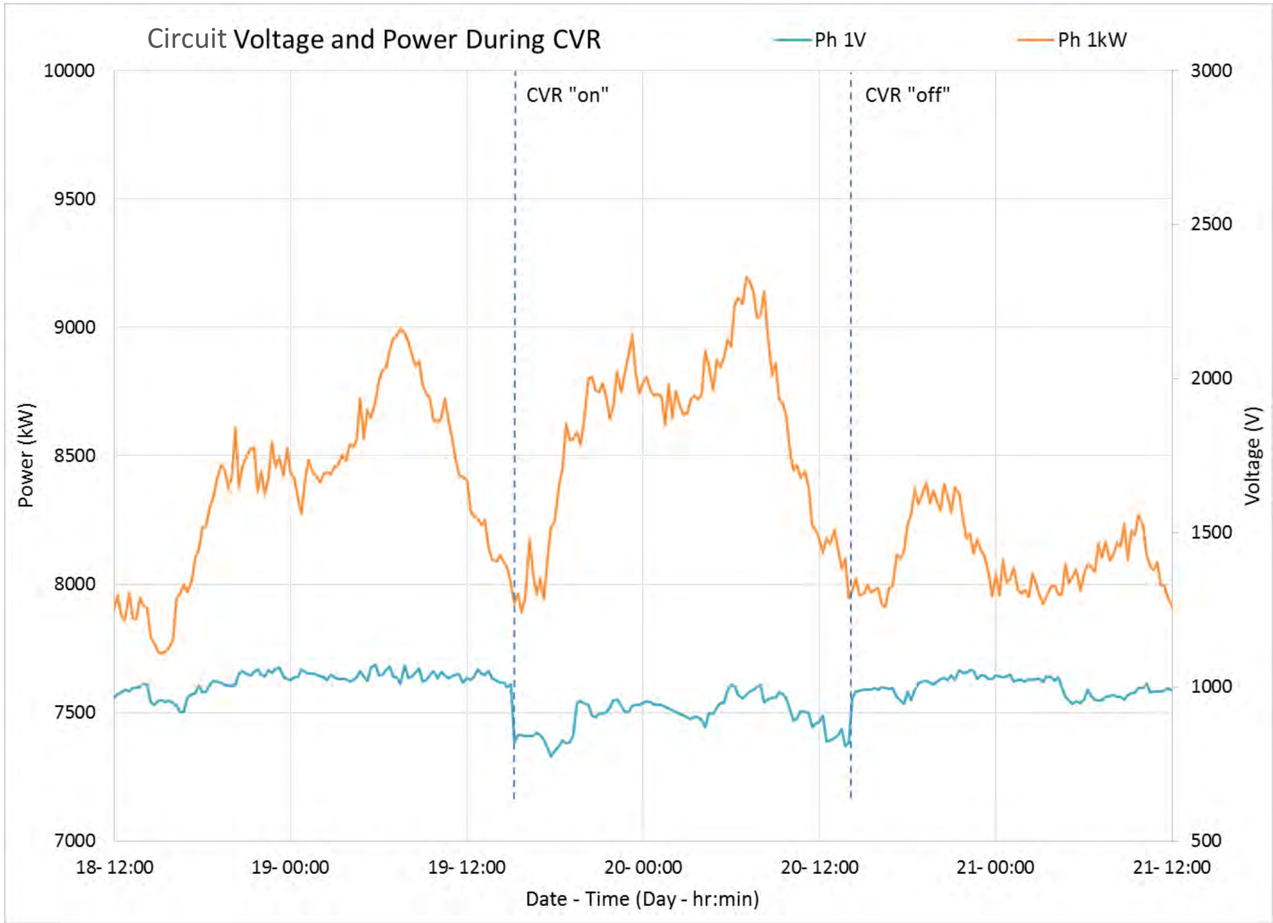
CVR FUNDAMENTALS IN ACTION

With enough sample data, can see a clear “on” and “off” signal to determine impact.



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AGENDA

1 » Conservation Voltage Reduction (CVR) Fundamentals

2 » CVR Factor Drives Results

3 » CVR Benefits and Costs

4 » From CVR Concept to Pilot to Full Deployment

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CVR FACTOR DRIVES RESULTS

Recent reports and results suggest CVR Factors (% energy savings/% voltage reduction) range between 0.5 to 1.5

Study	Date	Location	Voltage Reduction	CVR Factor
EPRI GA Power Peak-Time Voltage Reduction Study	2014	Southeastern US	1.2% – 3.1%	**0.1 - 1.6**
EPRI AL Power CVR Tests	2014	Southeastern US	2.7% – 3.6%	**0.4 - 0.7**
EPRI SMUD CVR Tests	2015	Northern California	1.7%	**0.6**
Navigant Avista IVVC pilot project evaluation report	2014	Spokane and Pullman, WA (Avista)	1.9% - 2.0%	**0.7 - 0.9**
Triplett and Kufel Study	2012	New York	1.8% - 2.1% (winter) 2% - 2.6% (summer)	**0.8**
Utilidata Murray State demonstration project	2011	Kentucky	Avg 4.7%	**1.0**
Thomas Wilson IEEE conference paper	2010	Spokane, WA (Avista) Canada (Hydro Ottawa)	1.2V - 1.5V 3.5V - 3.8V	**2.0 - 2.4** **1.9 - 2.3**
PNNL CVR National Potential Study	2010	Southeastern US	2.5% - 5.9%	**0.7**
EPRI Green Circuits (field trial results)	2010	Primarily Southeastern US	2% - 4%	**0.6 - 0.8**

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FACTORS DRIVING CVR FACTORS

- CVRf's vary by type of load:
  - Non-thermostatically controlled resistive loads (e.g., incandescent lamps) have high CVRf's ≅ 1.5
  - Thermostatically-controlled resistive loads (e.g., water heaters) have CVRf's ≅ 0
  - Air conditioner compressor motors tend to have low CVRf's depending on outside temperature (0.2 for outside temp=46°C, up to 0.6 for outside temp=29°C)
  - Induction motors, esp. larger ones, tend to have very low CVRf's (≅ 0.02)
  - Refrigerators can have a CVRf ≅ 2.3
- Given this, CVRf values will vary by:
  - Customer mix (residential, commercial, industrial, agricultural) on feeder
  - Season (summer, winter, shoulder)
  - Time of day
  - Day-type (weekday vs weekend/holiday load shapes)
    - Navigant's Avista IVVC evaluation found higher CVRf's on weekdays

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AGENDA

1 » Conservation Voltage Reduction (CVR) Fundamentals

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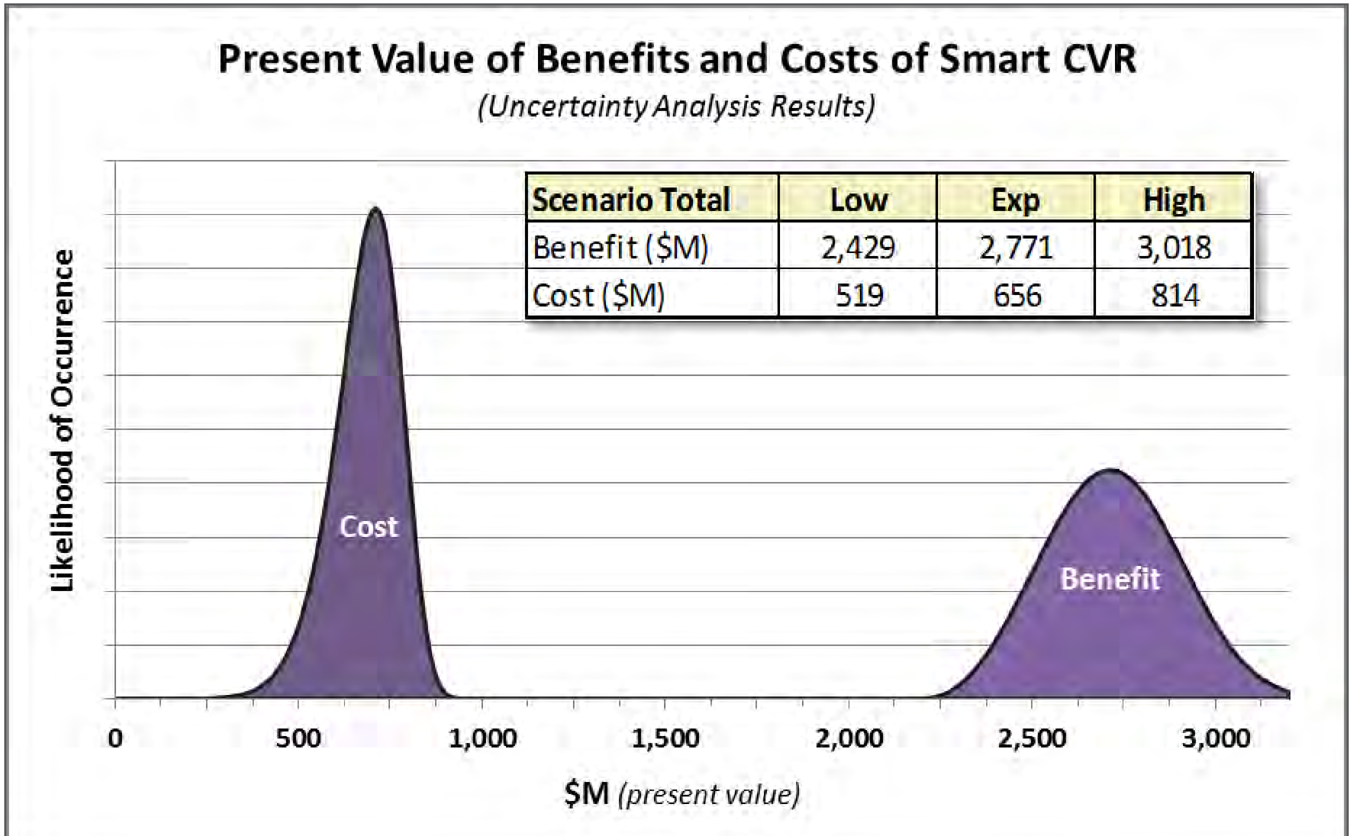
CVR BENEFITS AND COSTS: BONNEVILLE POWER ADMINISTRATION

Regional smart CVR benefits are expected to greatly surpass costs *(on TRC basis)*



Scenario Total	Low	Exp	High
Benefit ($M)	2,429	2,771	3,018
Cost ($M)	519	656	814

Source: Navigant. *Smart Grid Regional Business Case for the Pacific Northwest*. Prepared for Bonneville Power Administration. December 17, 2013. http://www.bpa.gov/Projects/Initiatives/SmartGrid/DocumentsSmartGrid/Navigant-BPA-PNW-Smart-Grid-Regional-Business-Case-2013-White-Paper.pdf

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SOME RECENT PROJECT RESULTS

The Challenge

Our client was investigating the possibility of implementing the technology and protocols necessary for CVR. In order to gain internal and regulatory approval, the client needed to estimate the potential benefits of CVR without performing a long-term study.

The Approach

Navigant worked with the client to gather existing data from their operational systems from periods when voltage had been reduced (or increased) for other reasons. Navigant then performed a regression analysis on the data to account for time of day, day of week, holidays, and temperature impacts. The regression analysis produced CVR factors for selected feeders within the client's service territory. These results were then compared against a thorough literature review in order to extrapolate the results and account for anomalies based on the feeders and events analyzed.

The Result

Based on the literature review and data analysis, Navigant was able to give a conservative value and range of values for the expected CVR factor within the client's service territory. This value was then used for internal financial modelling and in the client's regulatory filings

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SOME RECENT PROJECT RESULTS

The Challenge

Navigant led the design for Tucson Electric Power's (TEP) Conservation Voltage Reduction pilot program as part of TEP's 2014 demand-side management (DSM) portfolio.

The Approach

The pilot program included implementing dynamic voltage reduction for 4 commercial and residential feeders from one substation. We analyzed 15-minute interval data and calculated CVRf for each feeder. In collaboration with TEP distribution engineers, we estimated voltage reductions using parametric distribution models to ensure the system maintained integrity at the lowered voltages. Our model and comprehensive assessment of the ex ante energy savings will simplify the ex post analysis after one year of the program.

The Result

Based on the ex ante analysis, TEP will save an estimated 2 percent of the delivered energy from the feeders. We also worked with TEP DSM staff to design savings parameters, such as avoided cost load shapes and administration costs, and developed the program implementation plan for inclusion in TEP's filing with the Arizona Corporation Commission. Upon review of ex post energy savings, our team will consult TEP's expansion of the pilot dynamic CVR program.

NAVIGANT

SOME RECENT PROJECT RESULTS

The Challenge

PECO Energy is conducting a conservation voltage reduction program throughout its service territory. The CVR program involves a physical adjustment in transformer settings governing voltage at the substation. PECO asked Navigant to evaluate the savings.

The Approach

The PECO evaluation team conducted studies of the likely energy and peak demand using a regression approach and an on/off experimental design.

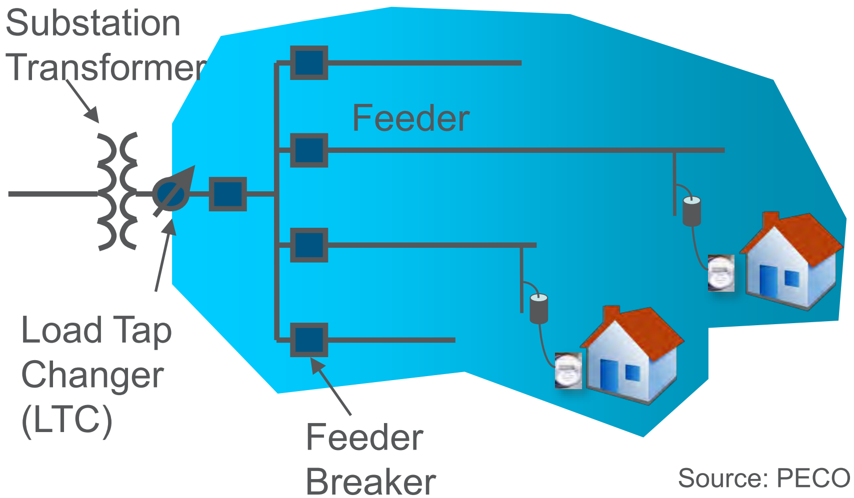
The Result

The analysis found substantial savings – more than anticipated. The energy and peak demand study findings include:

» Energy savings of 1.1% for each 1.0% change in measured voltage.

» Peak demand reduction of 1.4% for each 1.0% change in voltage

Results were accepted by the PUC.



Source: PECO

Source: Navigant Consulting, Inc.

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DE 20-161
Exh. 9

AGENDA

1 » Conservation Voltage Reduction (CVR) Fundamentals
2 » CVR Factor Drives Results
3 » CVR Benefits and Costs
4 » **From CVR Concept to Pilot to Full Deployment**

FROM CONCEPT TO PILOT

We design pilot programs that target representative feeders and provide insights into how CVR will affect a utility's system

Implement

- Design pilot project
- Design and run vendor RFP
- Collect operational data
- Estimate impact

Impacts

CVR Example

1% feeder voltage reduction

Design pilot

- Perform detailed feasibility study on feeders to be targeted, accounting for voltage reduction to be achieved, existing equipment and operating conditions, and existing maintenance processes and cycles
- Develop a statistically sound EM&V plan that can be executed with data to be measured and historical records
- Recommend feeders, equipment, and EM&V plan for pilot

Design and run RFP

- Develop short-list of recommended vendors, to obtain recommended equipment, based on Navigant Research industry expertise
- Draft equipment RFP with internal stakeholders, accounting for existing systems and future needs
- Review vendor proposals, provide short-list of vendors to utility to review and select from

Deploy and evaluate impact

- Work with utility to collect and evaluate CVR performance data
- Execute EM&V plan to estimate reduced line loss, reduced no-load losses, reduced end use consumption, reduced end use peak load, reduced emissions, and reduced costs of manual distribution switching

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FROM PILOT TO BUSINESS CASE

Our business case approach is used for expanding the pilot to a targeted or full deployment of CVR

Evaluate

- Collaboratively define benefits of interest
- Estimate value of benefits
- Create business case for additional deployment

Benefits → **Monetary Value**

CVR Example	Reduced feeder losses worth $60/MWh	$6,000

Define benefits of interest

- Benefits are related to impacts evaluated
- Impacts can include reduced line loss, reduced no-load losses, reduced end use consumption, reduced end use peak load, reduced emissions, and reduced costs of manual distribution switching

Monetize benefits

- Customize Navigant's cost-benefit analysis models to account for utility specific operation, maintenance, and wholesale electricity costs, as well as customer costs as required by regulators
- Estimate the value of CVR benefits

Business case

- Summarize pilot costs and benefits, as well as research issues, approach, methods, and results
- Create written report, testimony, presentation, or briefing for regulator, executive board, or other stakeholders

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CONCLUSIONS AND KEY TAKEAWAYS

1. CVR is a proven approach to reduce energy consumption
   - Many utilities have deployed CVR and resultant energy savings have contributed to energy conservation results
2. CVR can be a very cost-effective program within energy efficiency portfolio and as part of Grid Modernization efforts
3. CVR Factors vary significantly by load and across feeders
   - Important for estimates of savings to reflect typical loads and representative feeders
   - Any test or pilot should ideally cover a one year period (four seasons)
4. Navigant has significant experience and expertise to help utilities move from CVR concept to pilot to full deployment

NAVIGANT

CONTACTS

LARRY GELBIEN
Director
(781)270-8418
larry.gelbien@navigant.com

ERIK GILBERT
Director
(303) 728-2536
Erik.Gilbert@navigant.com

PAUL HIGGINS
Associate Director
(608) 497-2342
paul.higgins@navigant.com

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-014 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 24, lines 384-385 regarding direct control of BTM batteries. Please explain in more detail what is meant by "only battery resources that are under direct control of the utility." Please confirm whether this includes a program where the company directs a third party, such as curtailment service provider, to discharge the battery.

Response:
For the purpose of NWA applications, the company defines assets "under direct control of the utility" for Behind the Meter batteries as assets that can receive a dispatch signal directly from the utility and respond with the requested magnitude (of supply or demand reduction) at the required time. The requirements for BTM DR assets that are part of a reliability program, specifically those that help defer necessary distribution investments (as opposed to BTM DR assets dispatched for environmental, economic or other attributes), are not contemplated to rely on a third party for real time operational support on curtailment to discharge the battery or to charge the battery based on real time changes on distribution feeder or station loading. Direct Control here means that it is a non-optional compliance with the requested dispatch.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-015 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 24. Please provide footnote 6.

Response:
The footnote requested is below:

https://www.sciencedirect.com/topics/engineering/state-of-charge

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-016 | **Page 1 of 1**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Gerhard Walker**

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 24-25. Please explain how equation 8.F.01 is used and applied, including an example calculation.

Response:
Equation 8.F.01 provides the charging and discharging efficiency based on the total roundtrip efficiency $\%_{roundtrip}$.

If $\%_{roundtrip} = 85\%$, the battery has a charge and discharge efficiency of 92.2% (=Ö0.85) which is then applied to a charging and discharging cycle.

- A 5 MW/10 MWh battery is charging at 5 MW
- Of the 5 MW taken from the grid a total of 4.61 MW charges the battery cells $(5\text{MW} * 92.2\%)$
- The battery will take about 130 min to fully charge $(\frac{10\text{ MWh}}{4.61\text{ MW}})$
- After it is fully charged, the battery starts discharging
- As a result of the losses when discharging, only 9.22 MWh make it back to the grid. $(10\text{MWh} * 92.2\%)$
- Total Energy Imported from Grid 10.85MWh and total Energy Exported to Grid 9.22 MWh

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-017 | **Page 1 of 3**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Gerhard Walker, Brian J. Rice**

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 26-28 regarding NWA costs.

a. For the CapEx costs, please explain in more detail what the technology cost reduction is.
b. Under replacement cost, please provide the supporting documentation and justification for the replacement years for each technology, including whether the replacement years are tied to the warranties.
c. For Overhead, please provide the % overhead used for projects for PSNH. i. Please explain why Project Management costs are included in the overhead rather than a direct cost similar to engineering costs.
d. Please explain why removal costs considered in a CAPEx determination if removal costs are a different treatment in plant accounting and reduce the overall plant rate base.
e. What is Pinst?
f. Please explain whether the inflation rate is adjusted or is always assumed to be 2%. If it is held constant at 2%, please explain why this is appropriate when other programs, such as EE adjusts the inflation rate.
g. Please justify why a discount rate of -3.37% is used for the NWA framework.
    i. Please explain why the discount rate used is not consistent with the discount rate used elsewhere (energy efficiency programs, traditional utility capital projects, etc.)
    ii. Why it is not adjusted?
    iii. What is the discount rate for other capital projects?
    iv. Why is the discount rate negative, especially since the referenced source does not show a negative discount rate?
h. Please describe in more detail what is included in the real estate costs, including whether it is the cost of purchasing the real estate and/or the value of the real estate, whether it includes property taxes, etc. Please explain why the real estate costs are increased for inflation.

Response:

a. For the purpose of conducting an NWA screening with variable deployment time frames 10 years into the future, high-level assumptions on the rate of change of technology cost must be made. Technology cost reduction (or increase) represents a change in the cost of specific technologies that is above and beyond the impact of inflation.
b. The company uses lifespans (or useful life) for certain technology types as outlined in Section 10.A reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 37. The proposed lifespans for certain technologies represent a best practice industry assumption with the understanding that actual lifespan will vary based on actual utilization, environmental conditions, and other external factors, which can result in assets having longer, or shorter lifespans.

- Battery Cells typically are expected to last from 7 https://www.nrel.gov/docs/fy17osti/67102.pdf to 15 https://www.nrel.gov/transportation/battery-lifespan.html years, depending on application and utilization. Given the projected utilization during an NWA dispatch application, and Eversource's discussions and experience with vendors for such projects, a 12-year lifespan was deemed appropriate as a levelized assumption for the purposes of feasibility calculations. Actual lifespans may vary based on specific assets and would likely be considered in further engineering analysis of solutions initially identified through the NWA Screening Framework.

- Inverter Technology lifespans are typically cited as being more complicated to determine https://www.nrel.gov/docs/fy20osti/74462.pdf as they are highly dependent on the manner and the environment, they are operated in. For residential inverters, the typical expected lifespan is 12 yearshttps://www.igs.com/energy-resource-center/energy-101/how-long-do-solar-panels-last#:~:text=The%20solar%20inverters%20on%20panels,efficient%20operation%20of%20solar%20panels.. However, companies such as GE provide extended Long-Term Services Agreements that cover up to 20 years. Actual lifespans may vary based on specific assets and would likely be considered in further engineering analysis of solutions initially identified through the NWA Framework.

- Solar Panels are expected to de-rate over time. With various studies conducted on the subject and different results being published, a common assumption is to set expected lifespan to match deration to 90% of initial peak power https://www.nrel.gov/state-local-tribal/blog/posts/stat-faqs-part2-lifetime-of-pv-panels.html, https://www.nrel.gov/docs/fy20osti/74462.pdf. Actual lifespans may vary based on specific assets and would likely be considered in engineering further analysis of solutions initially identified through the NWA Framework.

- The company uses a uniform 40-year depreciation period for traditional power system infrastructure for the purposes of simplifying the screening assessment tool. This is not based on warranties or specific documentation. Actual depreciation periods may vary based on specific assets and would likely be considered in further engineering analysis of solutions initially identified through the NWA Framework.

c. The NWA Framework published by the Company, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, assumes a levelized % overhead for projects as stated in Section 9.F. The purpose of the Framework is to provide the ability to screen traditional station projects for their feasibility to successfully be deferred by an NWA option. As such, levelized assumptions are used. Every project that passes the NWA screening process has to undergo an engineering study which includes detailed cost estimates. During this study, the % overhead value will be refined.

   i. The company is basing its decision to include project management cost as part of the overhead cost on the fact that there is no direct correlation between project management cost and the size of the asset.

d. Removal costs are not specifically itemized within the screening analysis or necessarily included in CapEx estimates. Removal costs are categorized within CapEx under the NWA Framework because, when applicable, they could have an impact on rate base.

e. Pinst represents the installed Power. It is used to estimate costs based on the size of the system.

f. The NWA Framework applies a uniform long-term inflation rate of 2.0%. This is consistent with the application of the same long-term inflation rate used to convert future nominal dollars to constant dollars in the 2018 AESC.

g. The screening tool applies the average nominal discount rate identified in the 2018 AESC of 3.37%, which is consistent with evaluation of energy efficiency programs in New Hampshire and throughout New England.

   The NWA framework applies a nominal discount rate to nominal revenue projections. An average rate was applied instead of an annual series to simplify the analysis without materially impacting initial screening results.

   A discount rate is not always applied in the course of all capital project approvals. A discounted NPV is calculated when project approval involves the comparison of different solutions or is expected to support ongoing cost savings. The Company's after-tax weighted average cost of capital is often applied as a discount rate for Company expenditures. A customer, or societal, discount rate used for energy efficiency program evaluation was chosen for the NWA Framework since it screens NWA solutions based upon the estimated revenue requirement ultimately recovered from customers.

   The discount rate is presented as a negative number because the screening tool calculates present value by reducing nominal value by the compounded amount of the discount rate, e.g. PVy = NVy * (1-3.37%)^y. This convention for applying a discount rate is somewhat different from other financial evaluations, but produces a suitably similar result for the purposes of initial screening of potential NWA solutions. The Company will likely incorporate a more conventional NPV calculation into future versions of the NWA screening tool.

h. Real estate costs as defined under Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 are considered to be the cost of purchasing the land. The cost of real estate is being increased by inflation to adjust for the increase in property value.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-018 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 28, Table 3.

a. Please explain why Table 3 does not match the explanation of the annual rates of change explained above it. Please confirm which methodology is used—the explanation or that in Table 3.
b. Please explain what “Int. Hardware” is.
c. Please explain how electricity cost is used and explain why an inflation rate and discount rate is applied.

Response:

a. Table 3, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.28 is correct.
b. Int. Hardware in Table 3 reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.28 refers to interconnection hardware.
c. Electricity cost in Tables 3 reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 is used for cost and revenue calculations in Chapter 11. Electricity cost is used to determine cost of energy losses for storage (reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.24 Line 406) as well as potential wholesale energy revenues outlined in Chapter 11. Depending on the asset type and its market participation, this can represent wholesale or retail electricity cost.

   The inflation rate is applied to account for any increases in energy cost over time. The discount rate is applied to allow calculation of the net present value of future expenses or revenues.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-019 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 29, Lines 529-530. If company-specific and/or state specific information is available, please explain whether those specific assumptions will be incorporated. If not, please justify why not.

Response:
The referenced lines 529 – 530 from Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.29 state: "Note: All technology rates of change can be edited within the NWA Screening Tool to adjust to the ever-changing landscape. To provide a unified source of information, the NWA Framework uses NREL's publications."

All key technologies described here are national/global market driven technologies which will likely cost the same to procure in any state. State specific tax rates are accounted for under the Chapter 10.A. Pre-Tax WACC. At this point, the Company sees no difference in those state specific technology costs.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-020 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 29, lines 531-543.

a. Please provide a detailed description of a BTM solar program where the Company will receive an annual performance incentive of 5%. Please also explain whether this program applies the PI to the net metering credit.
b. Please explain why the earnings on other types of investments is not included in this section/description. Please explain where and how those Company earnings are accounted for.

Response:

a. The Company proposed a conceptual behind the meter solar program stating that such a program currently does not exist and that "behind the meter solar generation could provide an NWA" reference targeted Resource Plan March 31, 2021 Supplement Appendix A-1 Bates p.31. The Company's intention in the document was to show how such a conceptual program might be used. A proposed description of such a program is beyond the scope of this Framework.
b. Section 9.D reference Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Bates p.29 outlines earnings for utility programs. Given the nature of the tool as a high-level screening tool to narrow down potential candidates for further NWA evaluation, a levelized performance inventive was assumed in Table 4 for the purpose of the screening of NWA opportunities. Earnings from other investments are captured in their respective sections under Chapter 10: Revenue Requirements (earnings on traditional investments) as well as Chapter 11: Revenue Estimation Model.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-021 | **Page 1 of 1**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Gerhard Walker, Brian J. Rice**

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 29-30 regarding useful life assumptions.

a. Please define useful life. Please confirm whether useful life is the same as the expected operating life. If not, please explain why not.
b. Please explain which MACRs rate is associated with each asset type.
c. Please explain what tax and book depreciation rate is used for each asset type.
d. Please explain whether 40 years is used as the useful life for all projects that are not part of an NWA. If not, please explain what useful life is used, and justify why an alternative useful life is used in non-NWA calculations.

Response:

a) Yes, useful life is the same as the expected operating life or lifespan (see response to 17-b). It is also the period over which assets are assumed to be depreciated for the purposes of initial NWA screening.
b) Please refer to PSNH dba Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Page 36 of 45, Bates 37, Chapter 10.A.Accounts.
c) Please refer to PSNH dba Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1 Page 36 of 45, Bates 37, Chapter 10.A.Accounts, Equation 10.A.01 using data from Appendix A-1 Page 36 of 45, Bates 37, Chapter 10.A.Accounts.
d) Yes. A uniform 40-year depreciation period for traditional bulk system infrastructure was applied for the purposes of simplifying the screening assessment tool. The useful lives of equipment used in many NWA solutions are materially different from many traditional distribution assets, which is reflected in the NWA Framework.

   Actual depreciation periods may vary based on specific assets and would likely be considered in further engineering analysis of solutions initially identified through the NWA Framework.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-022 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1. Please explain how state or Federal or other rebates, incentives, grants or other funding sources are incorporated into the NWA model. For example, how is the solar investment tax credit accounted for, or state solar rebates, or USDA grants? If they are not considered, please explain why not.

Response:
The Framework does not provide default values for state or Federal or other rebates, incentives, grants or other funding sources under its filing in Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, as they vary significantly by state, type of technology, location, and mode of operation. Instead, a generic model has been provided which allows the use of such value streams on a $/kWh basis for a variety of distributed energy resources, such as solar PV, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 44 Line 944.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-023 **Page 1 of 3**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 30, regarding solar generation costs.

a. Please confirm whether the prices listed that are per MW, whether it is MWAC or MWDC.
b. Refer to footnote 8. Page 45 of that reference states that the median installed cost of a utility PV system in 2019 ranged from $1.06/WAC to $1.85/WAC with a median price of $1.34/WAC. Please explain why the prices listed on Bates p. 30 are so much greater and why they should be used instead of those referenced in footnote 8.
c. Please explain what the overclocking rate is, how it is used in the cost estimate, and how double counting is avoided if the AC:DC ratio is also taken into account elsewhere as noted on Bates p. 18.
d. Please provide the reference for the Fixed O&M costs. The reference cited shows a graph with costs in 2020 ranging from about $11-14/kWDC/year (in 2017 $). If these costs were used, please explain provide the calculation and assumptions to get to $50,000/year.
e. Please explain the basis for the costs in Equation 9.F.01 and how this calculation is used.

Response:

a.

- Panel cost are in $/MW$_{DC}$
- Inverter cost are in $/MW$_{AC}$
- All other MW related cost are in $/MW$_{AC}$

b.
The company, under Section 9.F uses high level default cost values for the installation of utility scale solar sites, reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.30. The total assumed cost for the installation of a 1 MW$_{AC}$ system using the assumptions under Section 9.F comes to:

Panels:	$340 000/MW$_{DC}$ *1.2 DC/AC * 1MW$_{AC}$ =	$408 000
Inverter		$62,000
Interconnection Equipment		$330,000
Engineering, Installation, and Commissioning		$240,000

Sum	$1,040,000
Overhead	$530,000
Total	**$1,560,000**

Conversion of the cost to a per W_{AC} yields $1.56/$W_{AC}$. As there are multiple sources for determining an average cost of deploying a technology in addition to the Company's own experience with costs in the New England Region, the Company supports using values cited under Section 9.F, which are well within the published ranges.

c.

The term "overclocking rate" is used to describe the DC/AC ratio. Another term used for the same ratio is inverter loading ratio, reference Footnote 12 Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 30.

The DC/AC ratio is used in several places in the NWA Framework documentation.

- Calculating the Cost of Solar Installations, reference Section 9.F Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.30
- Revenue calculations, reference Section 11.F Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 44
- Solar Generation, reference Section 8.b. Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 17/18

Double counting is avoided as each of the calculations are independent and produce independent results.

d.

The company provided a levelized O&M cost for large scale solar installations under Section 9.F reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 30 of $50 000/year, independent of the size of the installation. Citation 12 shows a range of $11-14/k$W_{DC}$/year, which in turn equates to sites sized from 3.5 MW to 4.5 MW using the Company's levelized assumption. However, some components of the cited annual cost per kW are invariable based on asset size, such as site security, legal, administrative fees. Proposing a linear scaling of cost per kW therefore would provide a false sense of accuracy with overall minimal change of the solutions cost. With the objective of providing a high-level screening of NWA opportunities and large-scale installations in the above outlined range, a fixed annual O&M cost would serves this objective best.

e. The Equation 9.F.01 referred to in Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.30 should read $\$340{,}000/_{MW} * P_{inst_{DC}} + \$62{,}000/_{MW} * P_{inst_{AC}}$ and refer to the equipment cost of the panels and inverters as listed on lines 558 and 559.

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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-024 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Roshan V. Bhakta

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 32-34, regarding demand response programs. Please explain the basis for the reoccurring program costs of $50,000/MW-yr for Commercial and $120,000/MW-yr for residential and $250,000/MW-yr for storage.

Response:
The program costs described in the analysis are largely made up of assumed customer facing incentives specific for participation in this offering. However, areas where this offering could be combined with other company initiatives those costs were proportionately distributed, such as platform fees, vendor fees, and program management. In all cases these costs are reoccurring on a year-to-year basis. That is due to the fact that demand response, unlike traditional energy efficiency, requires year-to-year participation from customers.

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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-025 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 26-36, regarding the cost model. Please list each cost assumption and other assumptions and provide the basis and reference for each.

Response:
Under section 9. Cost Model of the NWA Framework reference Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p.30 and following, the Company has provided the default cost assumptions. These default cost assumptions are based on NREL and Solar Energy Industries Association publications cited under section 9.F of the same document. These assumptions are meant to provide a standardized high-level screening of NWA opportunities with the clear understanding that final project costs can range lower, or significantly higher, but that they will on average be consistent with these assumptions. A detailed engineering analysis for all locations which has passed the screening process will revise the final numbers, at which point a solution can still be deemed too expensive.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-026 **Page 1 of 1**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Gerhard Walker, Brian J. Rice**

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 37. Why do solar panels, generators and inverters use a 5-year MACRS depreciation and a 20 year book depreciation?

Response:
Renewable energy technologies such as solar panels and renewable generation equipment, including inverters, are classified as 5-year property under federal tax code.

Public Service of New Hampshire d/b/a Eversource Energy
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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-027 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 41, line 890-893 regarding SOG storage. Please explain why storage participating in the ISO as a Settlement Only Generator charges/discharges at the wholesale rate, rather than the retail rate.

Response:
As part of the NWA Framework for high level screening of NWA opportunities, battery storage was treated according to current valid market rules as published by the ISO New England. Per market rule III.1.10.6(f) https://www.iso-ne.com/static-assets/documents/2014/12/mr1_sec_1_12.pdf, Generation injecting into the grid by facilities registered as Settlement Only Generators (SOGs) are paid the nodal locational marginal price (LMP). Any load registered as asset-related demand is charged the corresponding nodal LMP per Order 841.

"(f) A storage facility not participating as an Electric Storage Facility may, if it satisfies the associated requirements, be registered as a Generator Asset (including a Settlement Only Resource) for settlement of its injection of electricity to the grid and as an Asset Related Demand for settlement of its wholesale load."

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-028 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 43 regarding levelized wholesale energy prices. Since the wholesale energy price is not constant and could potentially be higher (or lower) than the assumed $40/MWh, please explain why it is appropriate to use $40/MWh since the NWA technology would potentially benefit from the wholesale market participation at a different rate, which in most cases is probably higher than the assumed rate.

Response:
Under Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates p. 43 the Company outlines the use of a default levelized wholesale energy cost at $40/MWh. This is based on the ISO New England's published average wholesale energy price https://www.iso-ne.com/about/key-stats/markets. The price merely indicates that any asset that produces energy over a longer period of time and is compensated through a wholesale mechanism can expect to see an average compensation of $40/MWh.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-029 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates p. 43. Please explain why the AESC benefit values are used for some values, but are not used for the FCM projected price.

Response:
FCM price projections within the AESC study for 2025/26 year have changed from $12.55/kW-mo (AESC 2015) to $5.95/kW-mo (AESC 2018) to about $2.6/kW-mo (Average of the four scenarios within AESC 2021). These projected price fluctuations for the same year demonstrate that forward capacity market price projections within New England maybe significantly uncertain. We therefore believe that, specifically as it relates to accounting for capacity market revenues beyond the NWA deferral period, projections of FCM prices should be limited to escalating current prevailing actual cleared prices adjusted for inflation within evaluation of Benefit/Cost ratios when comparing against traditional solutions.

Reference Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Bates 43, Lines 913-916.

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Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-030 **Page 1 of 2**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Lavelle A Freeman

Request:
Refer to March 31, 2021 Supplement, Appendix A-1, Bates pp. 44-45 regarding DER revenue.

a. Please explain why additional benefits, such as avoided energy, avoided capacity, avoided transmission, etc., are not considered similar to what is presented in the AESC study.
b. Please explain why demand response is not considered for ISO revenue streams.
c. Please explain why conservation voltage reduction is not considered for ISO revenue streams.

Response:

a. For the purpose of the NWA Framework which describes methods to conduct a screening of proposed capacity upgrade projects for their feasibility to be deferred by NWA solutions, subject to further engineering analysis, the benefit cost analysis is focused on the value generated from deferral of a traditional investment, such as a station transformer upgrade. Therefore, value can only be realized if an investment is actually deferred. Consequently, if a proposed NWA does not defer transmission work as part of the station upgrade, it will not be generating, in this example, value through avoided transmission cost.

   The key difference between a site-specific, location based NWA evaluation and the type of evaluation conducted in the AESC study lies in the objective and the metrics used for evaluation. Where the AESC study focuses on determining the highest impact energy efficiency (EE) investments while not competing with a traditional upgrade, it allows for the consideration of system wide, levelized values. However, with an NWA evaluation there is a very concrete alternative solution at a specific location, and the evaluation based on the impact on the revenue requirements, focuses on directly deferring this investment.
   As proposed, the budgetary requirements as well as the benefits for these energy efficiency investments are tracked and reported separately and in addition to the Energy Efficiency program.

   Where the AESC study focuses on determining the highest impact energy efficiency (EE) investments while not competing with a traditional upgrade, it allows for the consideration of system wide, levelized values. However, with an NWA evaluation there is a very concrete alternative solution at a specific location, and the evaluation based on the impact on the revenue requirements, focuses on directly deferring this investment.

b. As part of the NWA Framework the company treats demand response as a dispatchable resource, similar to that of a battery, but with significantly more limitations (dispatch frequency and duration as part of demand response contract limitations). With the same underlying requirements to provide a ready-to-dispatch asset at any point in time, these resources cannot participate in ISO markets for several reasons:

1. A potential conflict of interest based on contradicting needs
2. Market activities could use up yearly events before an NWA event is called

The company does not plan to bid any demand response assets into the ISO markets. Where a customer may choose to also participate in multiple programs with the same asset a prioritization of dispatches must be established.

c. The company has excluded conservation voltage reduction measures from consideration for ISO revenue streams as referenced in Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1, Chapter 11 Revenue Estimation Model, based on the ISO New England's Classification of conservation voltage reduction under Operating Procedure No. 4 - Action During a Capacity Deficiency. https://www.iso-ne.com/static-assets/documents/rules_proceds/operating/isone/op4/op4a_rto_final.pdf Assets under Operating Procedure 4 are precluded from participating in ISO wholesale and forward capacity markets.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-031 **Page 1 of 2**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Gerhard Walker, Matthew D. Cosgro

Request:
Refer to March 31, 2021 Supplement, Appendix A-2, regarding the Loudon Station NWA.

a. Please provide the model used for this analysis.
b. Please provide a list of all of the underlying assumptions for this analysis.
c. Please provide the results in live spreadsheet format showing the benefit cost analysis for each alternative.
d. Please provide any and all live spreadsheets comparing the alternatives.
e. Please provide the distribution circuit (31W1, 31W2) maps (either in CAD or in GIS).
f. Please provide all distribution circuit maps depicting distribution circuits that are connected to or could be utilized to tie with the 31W1 and 31W2 distribution circuits.
g. Please provide all 34.5kV circuit maps for circuits that are geographically located in the towns where circuits in e. and f. above are located.

Response:

a. As part of the response the company will be providing the NWA Screening Tool with Loudon Station Data.

   Attachment STAFF 1-031 a-1 contains data for 31W1 (confidential)
   Attachment STAFF 1-031 a-2 contains data for 31W2 (confidential)

   The NWA Screening Tool was developed by Eversource and is Eversource's property, and as such requires confidential treatment.

b. The underlying assumptions in the analysis conducted under *PSNH dba Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-2, NWA Screening of Loudon Station to Defer a Capital Investment,* are the same assumptions and default values the company has outlined under *PSNH dba Eversource Energy Docket No. DE 20-161 Least Cost Integrated Resource Plan March 31, 2021 Supplement Appendix A-1* as well as *DE 20-161, Eversource Energy, 2020 Least Cost Integrated Resource Plan, Staff Data Requests- Set 1, April 21, 2021, Information Request 1-2*.

c. As part of the response the company will be providing the NWA Screening Tool with Loudon Station Data

d. As part of the response the company will be providing the NWA Screening Tool with Loudon Station Data. In addition, a separate spread sheet, Attachment STAFF 1-031 d will be included showing the side by side comparison of the alternatives.

e. GIS generated maps are included of the 31W1 and 31W2.
- Attachment STAFF 1-031 e-1 (confidential)
- Attachment STAFF 1-031 e-2 (confidential)

f. GIS generated maps are included of the adjacent 30W2 supplied from Chichester Substation. - Attachment STAFF 1-031 f (confidential)

g. GIS generated maps are included of the 34.5 kV supply line to Loudon and Chichester Substations. This is the only 34.5 kV line in the area.
Attachment STAFF 1-031 g (confidential)

All included maps are CEII and to be treated confidentially.

Consistent with Puc 203.08(d), Eversource states that it has a good faith basis for confidential treatment of the material provided in this response and will file an appropriate motion for confidential treatment prior to the commencement of hearings in this matter

Consistent with Puc 203.08(d), Eversource states that it has a good faith basis for confidential treatment of the material provided in this response and will file an appropriate motion for confidential treatment prior to the commencement of hearings in this matter

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-032 **Page 1 of 1**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Richard C. Labrecque, Matthew D. Cosgro

Request:

Refer to March 31, 2021 Supplement, Appendix A-2, regarding Loudon Station NWA.

a. Please provide the work papers and calculations that were used in determining the 31W1 and 31W2 substation transformer capacity ratings.

b. Please provide the name of the modelling and rating software utilized for the ratings presented in Appendix A-2.

c. Please provide the 2018 TFRAT rating of the 31W1 and 31W2 transformers.

d. Has the Company investigated temporary modifications to either transformer to increase the oil cooling efficiency of the units? Why or why not?

Response:

A) Capacity ratings noted in the Loudon Station NWA study are of the respective nameplate ratings. Transformer 31W1 was purchased with manufacturer added fans, thus the ONAF (forced-air cooling) nameplate rating is utilized. Transformer 31W2 was not purchased with manufacturer designed/installed fans, with Eversource adding fans at a later date. The required air flow to take credit for the manufacturer's ONAF nameplate rating is unknown and as a result the Company utilizes 120% of the ONAN rating for top nameplate capacity (ONAF ratings with manufacturer designed/installed fans are 125% ONAN).

B) The ratings provided in Appendix A-2 are based upon the forced-air nameplate rating of each respective transformer nameplate. Modeling or rating software was not utilized for the continuous ratings.

C) The previous continuous summer ratings of the Loudon transformers (TFRAT) were; Loudon 31W1 6.11 MVA and Loudon 31W2 3.71 MVA.

D) Both the 31W1 and 31W2 transformers already have fans installed to take credit of forced-air cooling above the self-cooling base nameplate rating.

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-033 **Page 1 of 2**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Richard C. Labrecque, Russel D. Johnson

Request:
Refer to October 1, 2020 Least Cost Integrated Resource Plan, Bates p.25.

a. Does the Company have a standard or procedure for installing parallel stepdown transformers? If so, please provide the standard/procedure.
b. If the stepdown transformers have matched impedances, why does the Company limit the capacity to 100 percent?
c. Please explain why the number of customers served factors into the capacity of the stepdown transformer?
d. Please provide the number of stepdown transformer that have failed in the 2016-2020 timeframe that have been loaded between 100-120 percent.
e. Do all of the parallel stepdown areas have real time load monitoring in order to determine the actual loading of the transformer bank? If not, approximately what percentage of the parallel stepdown locations have real time load monitoring on the units?
f. For those units that do not have real time monitoring, how does the Company accurately determine the loading on the transformer bank?

Response:

a. The Company construction standard for installing parallel stepdown transformers is attached as Attachment STAFF 1-033a (DTR17.493). Section 14.10 (Transformers General) of the Distribution System Engineering Manual includes this excerpt regarding impedances when paralleling transformers: IMPEDANCE − Single−phase transformers connected in parallel or connected for a three−phase delta−delta bank shall have the same voltage rating, be set on the same primary tap (if applicable), and have impedances that are approximately equal. An impedance variation limit of plus or minus 7 percent, one transformer to another, is acceptable. For example if transformers are intended to be connected in parallel and one unit has an impedance of 2.5%, the other unit has to be within the range of 2.3 − 2.7%. For a bank of three transformers, if the unit with the lowest impedance is 2.5%, the unit with the highest impedance can not be more than 2.7%. The impedance of the third unit must be within the range of the other two units. Failure to meet all these conditions can result in unequal load division and undesirable circulating currents.
b. The 100 percent limit applies to parallel 500 kVA stepdowns (steps) and parallel 333 kVA steps as these are typically the only size steps where paralleling is necessary. There are a very small number of parallel 333 kVA steps installed. While the Company attempts to match impedances on parallel steps upon installation this is not always possible and in the case of a failed or damaged step it is unlikely that units maintained in emergency backup would have a matched impedance to the unit replaced. Consideration of the effect of mismatched impedances as well as limiting the

number of customers impacted (load served) by step failures is the reason why the Company applies the 100% capacity limit to this application.

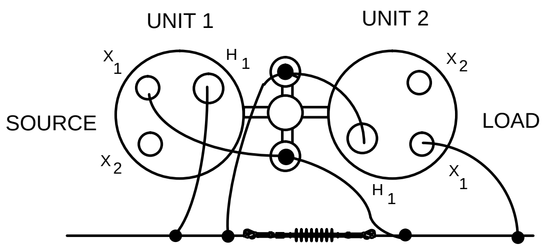
c. The number of customers served does not determine the capacity of the stepdown transformer. The consideration of the exposure to the number of customers served by 1 MW of capacity per phase to a lengthy outage and potentially 3MW of load served during repairs is one basis for limiting the load served to 1MW. An additional benefit to limiting the loading on parallel steps is the increased ability to continue to serve customers on the remaining step during non-peak load times while efforts to replace the failed step are underway.

d. Most of the approximately 2,300 stepdown transformers do not have metering installed, therefore the Company does not have the information requested. The Company is not aware of any stepdown transformers that failed in this timeframe for which the loading was between 100-120%. To our knowledge, stepdown transformers have failed during a downstream fault event, an electrical failure not associated with loading, or due to mechanical damage.

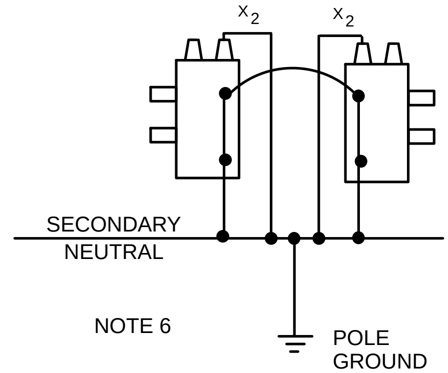
e. During the summer of 2020, 102 out of 110 instances with parallel 500 kVA steps were equipped with either SCADA or Aclara line sensors which provide real time load monitoring. A three-phase installation (three sets of parallel 500 kVA steps) is counted as three instances for the purposes of this response.

f. The remaining locations typically have a Spear recloser as protection on the secondary side which can be downloaded to obtain the loading information or the Company can use upstream loading obtained from a SCADA device and extrapolate the data. The Company also has various line sensors that can be installed temporarily if needed to capture loading data. The Company continues to add real time monitoring to those parallel stepdown locations which presently do not have this capability.

STRUCTURE LIMIT C1, C2 AND A3

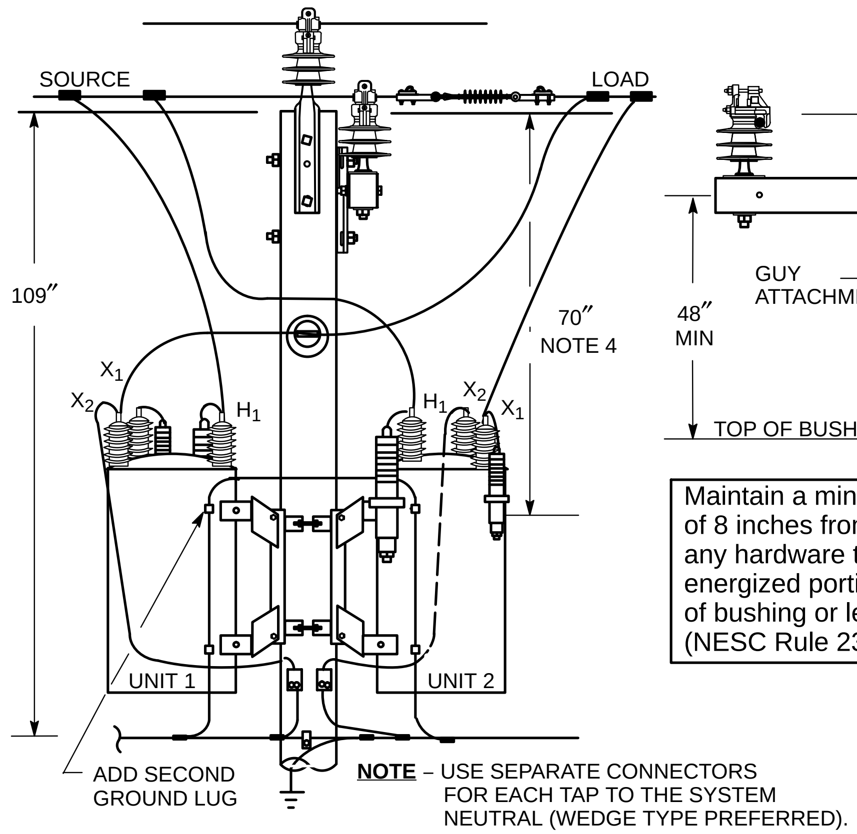


BUSHING ARRANGEMENT TOP VIEW

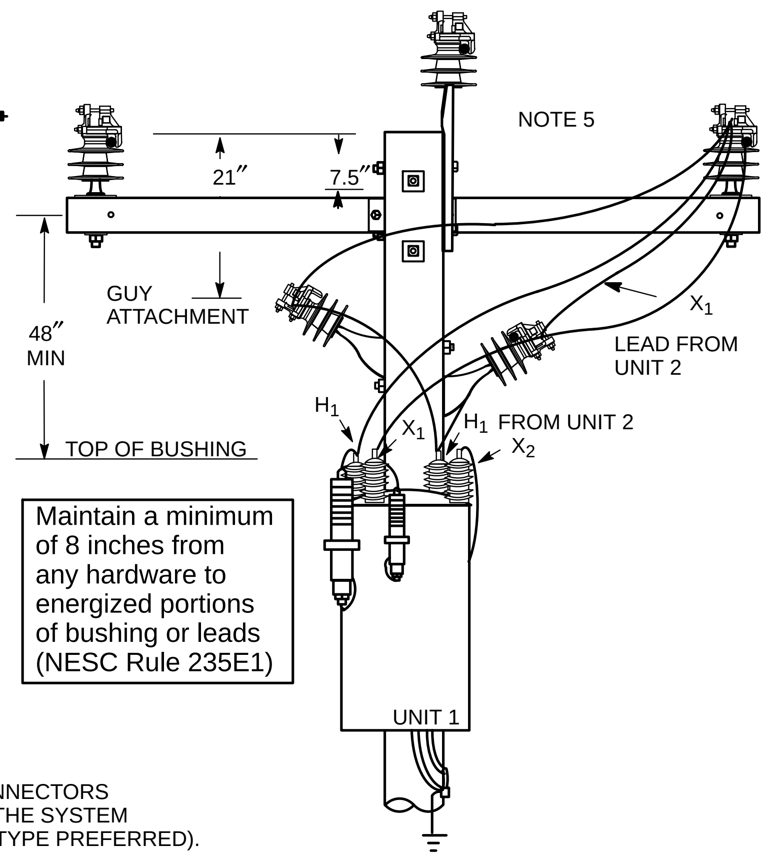


GROUNDING DIAGRAM

SELECT POLE TOP FROM SECTION 10



FRONT VIEW



Maintain a minimum
of 8 inches from
any hardware to
energized portions
of bushing or leads
(NESC Rule 235E1)

SIDE VIEW

Notes

1. Consult the Circuit Zone Manager for protective device fuse size and location.
2. For metering detail see Type II step metering, **DTR 17.151**, **17.152**, and **17.155**.
3. Mount the cluster mount at 70 inches. The mounting height may be adjusted to maintain the clearances shown on this page.
4. Select a 10–foot crossarm when installing a crossarm pole top.
5. Select pole and equipment ground from **Section 16**.

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: 04/21/2021 | **Date of Response: 05/05/2021**
Request No. STAFF 1-034 | **Page 1 of 2**
Request from: New Hampshire Public Utilities Commission Staff

Witness: Richard C. Labrecque, Matthew D. Cosgro

Request:
Refer to October 1, 2020 Least Cost Integrated Resource Plan, Bates p.28., describing the 95% nameplate limitation for bulk transformer as based on " uncertainty associated with load forecasting and the penetration and performance of distributed energy resources."

a. What forecasting model does the Company use for loading on the bulk transformer?

b. In the past 10 years has the load forecast been 5% or greater from the previous year? If so, when and what was the cause behind the significant increase (known incremental "new business" load, removal of a large generator, etc.)

Response:

A) Eversource does not forecast bulk transformers individually. Forecasts are developed for each bulk substation site by voltage class regardless if the location has a single transformer or multiple.

The substation forecasting process begins by forecasting the peak demand at the Eversource system level. The Eversource system-level peak demand is forecasted using an econometric model that evaluates historical peak demand as a function of peak day weather conditions and the economy. The econometric model utilizes two different weather variables in forecasting summer peak demand, a three-day weighted temperature-humidity index and cooling degree days. The forecast assumes normal weather conditions based on the most recent 10-year period. Eversource produces a '50/50' and a '90/10' peak demand forecast. The '50/50' forecast is based on normal 10-year weather and has a 50 percent chance of being exceeded. The 90/10 forecast is the extreme weather scenario that only has a 10 percent chance of being exceeded. Moody's Analytics, an international economic consulting company, provides the economic history and forecast.

Once Eversource finalizes the system-level forecast, the substation level forecasts are developed. Each substation is forecasted using an econometric model that evaluates substation historical annual demand as a function of the Eversource system peak demand history and forecast. The substation econometric models measure how each substation performed relative to the Eversource system and then project that relationship into the future.

After a trend forecast is produced for each substation, the forecast is adjusted for energy efficiency, solar, electric vehicles, and large customer projects. Company-sponsored energy efficiency and electric vehicles are proportionally applied to each substation based on historical peak demand. Behind the meter solar is assigned to specific substations based on historical solar penetration rates at each of the individual substations. Specific, identified large development projects or expected changes in system operations that the econometric forecasts could not otherwise predict are added to their respective substation.

B) Eversource only has forecast data at the substation level since 2017 (5 years of load forecasts). Prior to that, forecasts were performed by regional planning areas. Twenty-seven stations have experienced a load forecast year-over-year increase of 5% or greater. Reasons behind the increases of this magnitude are:

- Peak loading that close to (90%+) or surpassing that year's forecast.
- Spot load adjustments for significant new customer load.
- Permanent distribution system configuration changes between stations.
- Additional historical data. Having minimal or no historical load information yields few data points to develop individual station forecasts.
- Manual adjustment to the forecast to reflect a historical peak load.

The year-by-year analysis indicating when and specific reason for each station is attached as Attachment STAFF 1-034B.

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Docket No. DE 20-161

Date Request Received: 04/21/2021 **Date of Response: 05/05/2021**
Request No. STAFF 1-035 **Page 1 of 1**
Request from: **New Hampshire Public Utilities Commission Staff**

Witness: **Ryan C. West**

Request:
Refer to October 1, 2020 Least Cost Integrated Resource Plan, Bates p.41. Please provide all cost benefit analysis or other quantitative cost effectiveness plans listed in Appendix J, that support the statement " The associated benefits, in terms of improved reliability … investment types."

Response:
For any smart grid programs that have been implemented as part of the company's base distribution capital program, such as DMS and distribution automation, cost and benefits are detailed in project specific project authorization documentation. For smart grid programs such as AMI, energy storage and VVO, that have not yet been implemented, costs and benefits will be assessed as a part of a future approval process.