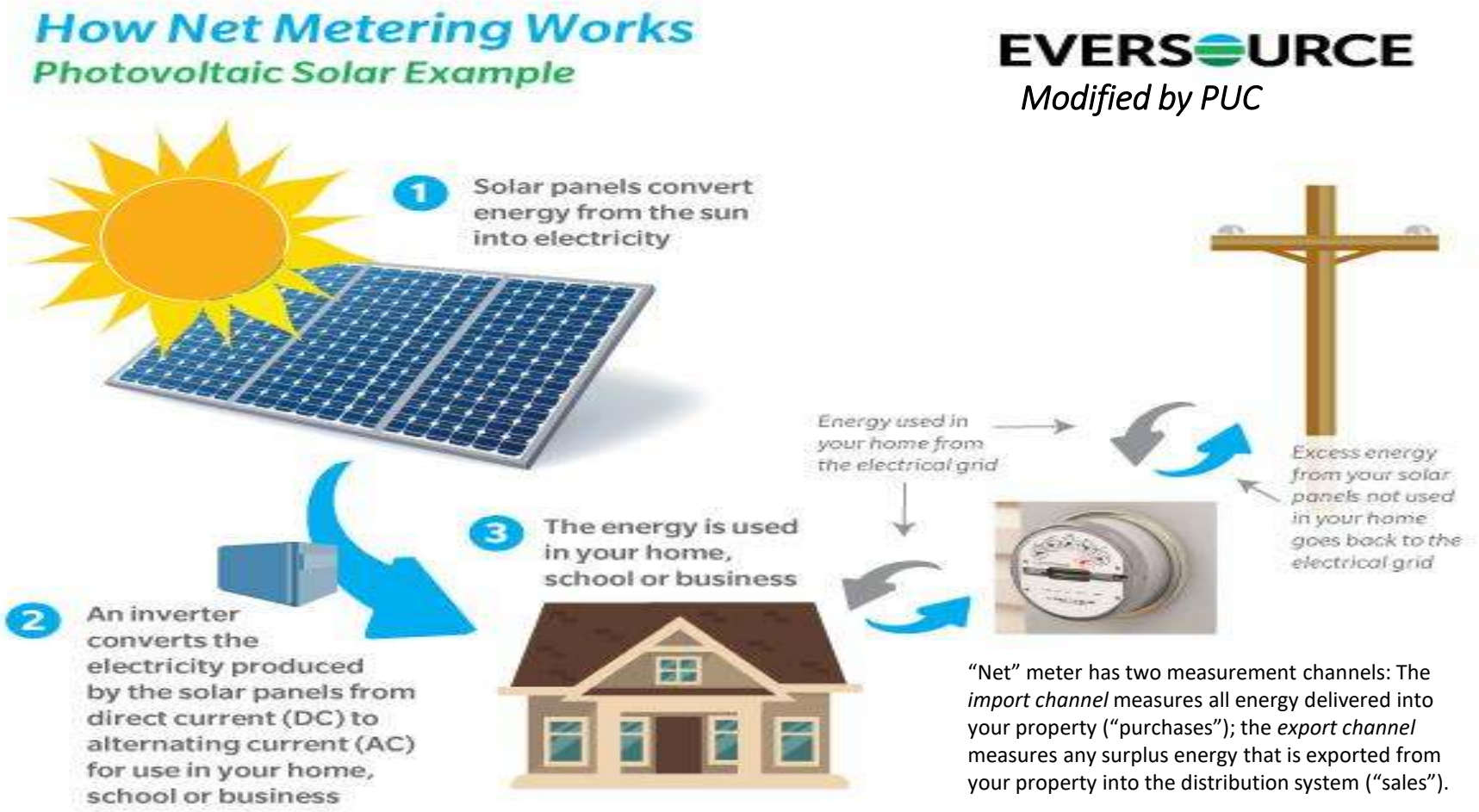
Net Metering Docket and Locational Value of Distributed Generation Study Update

Karen Cramton
Director, Sustainable Energy Division
NH Public Utilities Commission

Business and Industry Association
Energy Symposium

December 1, 2020

Net Energy Metering (NEM) Basics



"Net" meter has two measurement channels: The *import channel* measures all energy delivered into your property ("purchases"); the *export channel* measures any surplus energy that is exported from your property into the distribution system ("sales").

Net Metering

2016

- House Bill 1116 (2016) required the Commission to initiate a proceeding to develop new alternative net metering tariffs, which may include other regulatory mechanisms and tariffs for customer-generators …

- *See Commission Docket DE 16-576 and Order No. 26,029*

2017

- Adoption of an alternative net metering tariff to be in effect for a period of years while further data is collected and analyzed, pilot programs are implemented, and VDER study is conducted. **Studies and pilot projects include**:

- Value of Distributed Energy Resources (VDER) Study
- Non-Wire Alternatives Pilot
- Time of Use Pilot
- Low Moderate Income Pilot
- Real-time Pricing Pilot
- Marginal Cost of Service Study (Eversource only)

Net Metering Studies

2018

- With stakeholder input, Staff submitted to the Commission a proposed Value of Distributed Energy Resources (VDER) Study Scope & Timeline
- Staff filed proposed VDER study scope to the Commission
- Spring 2018 Non-Wires Alternative pilot changed to a study of locational value of distributed generation (LVDG) **at the distribution level**
- Working group sessions and development of LVDG Study Scope & Timeline

2019

- Staff filed proposed LVDG study scope to the Commission. Public hearing and written comments
- Commission issued Order No. 26,221 approving the LVDG Study Scope and directing Staff to hire a consultant to perform the study
- RFP issued including approved LVDG study scope. LVDG consultant contract approved by Governor & Executive Council
- LVDG Study underway
- Commission issued Order No. 26,316 on December 18, 2019 approving the VDER Study Scope and directing Staff to hire a consultant to perform the study

Net Metering Studies in 2020

2020 – LVDG Study

- With Staff and stakeholder input, Consultant conducted the LVDG Study in accordance with the approved LVDG Scope
- Stakeholder sessions occurred throughout the study period
- LVDG Study Final Report filed with the Commission in Docket DE 16-576 on August 21, 2020

2020 – VDER Study

- RFP issued including approved VDER study scope.
- Next Steps:
  - Selecting and contracting with a consultant
  - Consultant contract approval by Governor & Executive Council
  - 2021+ - Working group sessions and consultant will complete VDER Study

Net Metering

Docket DE 16-576: Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators

Order No. 26,029: Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff

Order No. 26,221

Approving Scope of Locational Value of Distributed Generation (LVDG) Study

Order No. 26,316

Approving Scope of Value of Distributed Energy Resources (VDER) Study

NEM Tariff or Other Compensation Mechanisms

Locational Value of Distributed Generation (LVDG) Study Results

Location-specific value of distributed generation eligible to net meter in New Hampshire due to avoided distribution infrastructure investment costs

Locational Value of DG Study Overview

Study Objective

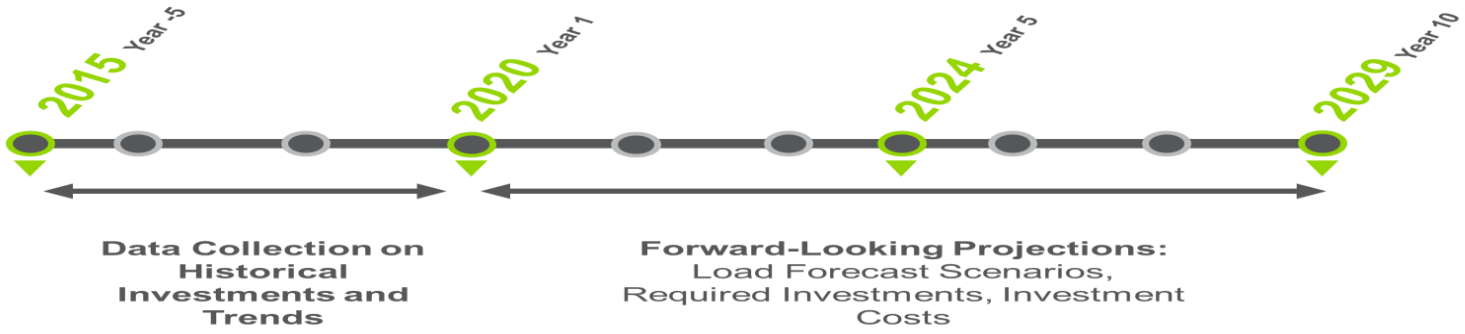
Determine the avoided costs due to avoided, or deferred, capital investments and related operating expense reductions at specific distribution level locations.

- **Step 1: Location Identification**
  - Identify potential locations with expected capacity constraints requiring investments over the study timeframe, including base, low, and high load growth sensitivity analysis.
- **Step 2: Estimation of Investment Costs for Avoidance**
  - Determine the value of potential avoided capacity investments at the selected locations.
- **Step 3: Economic Analysis and Mapping of Distributed Generation (DG) Production Profiles with Distribution Capacity Needs**
  - Perform economic analysis to estimate the benefit of capacity avoidance and map representative DG production profiles with distribution system capacity needs.

Consultant: Guidehouse

Locational Value of DG Study Parameters

- Technologies Considered
  - Solar PV, hydroelectric, and solar PV paired with storage, all with capacities rated up to, and including, one megawatt (MW)
- Geographic Scope
  - Eversource, Liberty Utilities, and Unitil service territories
- Timeframe (15 years total)
  - 5 years of historical experience & 10 years projected



- Load Growth Projections
  - Utility load growth forecasts (i.e., base), plus low and high-load growth scenarios

Locational Value of DG Study Parameters

- Distribution System Analysis Level

Number of Distribution Substation and Lines			
Electric Distribution Companies (EDC)	**Distribution Substations (Bulk & Non-Bulk)**	**Distribution Lines (34.5 kV)**	**Distribution Lines (<34.5 kV)**
Eversource	131	180	181
Liberty	14	0	61
Unitil	25	41	58

- Eligible Avoided or Deferred Investment (Capital) Costs
  - Significant distribution system capacity deficiencies to be addressed through planned or potential capital investments, such as replacements or upgrades of substations or lines/circuits.

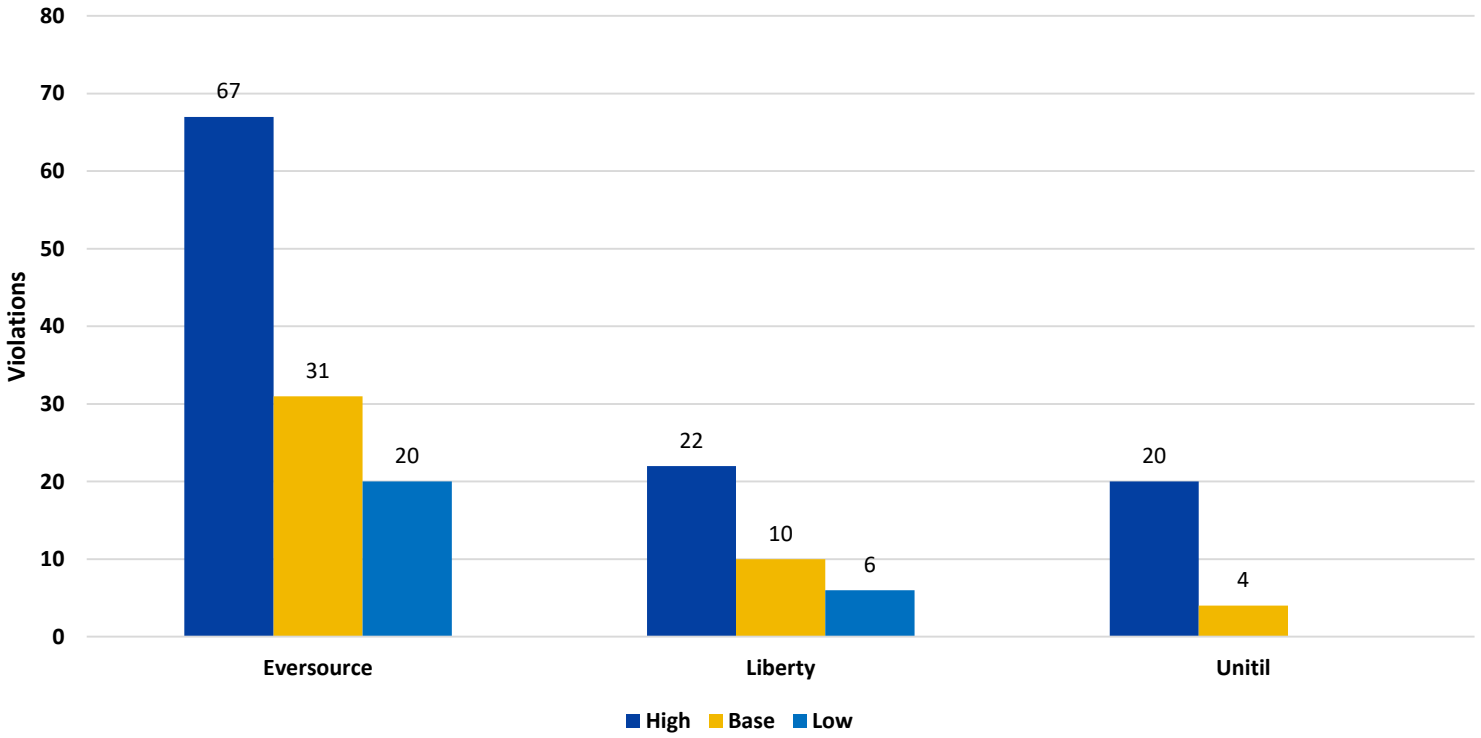
- Investment Threshold
  - No minimum investment threshold level for the cost of upgrades is required for a location to be evaluated; however, small capital investments such as pole top distribution transformers and capacitors will be included in an upcoming separate system-wide Value of Distributed Energy Resources (VDER) study and are not covered in the LVDG study.

Locational Value of DG Study – Step 1

- **Step 1:** Location Identification
  - Identify potential locations with expected capacity constraints requiring investments over the study timeframe, including base, low, and high load growth sensitivity analysis
- **Results**
  - **696 locations reviewed**
  - **122 locations identified on the EDC distribution systems** (i.e., circuits and substations) with capacity deficiencies, where capital investments potentially could be avoided through load reduction attributable to NEM-eligible DG.
  - Base, low and high load growth sensitivity analysis
    - The base, low, and high load growth forecasts varied among the three EDCs.
    - Under the **Base Case** load growth scenario, **45 actual or potential capacity deficient locations were identified**;
    - **64 additional locations** were identified under the **high load growth scenario**.
    - Under the **low load growth scenario, 26 locations** would have capacity deficiencies during the study timeframe.

Locational Value of DG Study – Step 1

Forward-Looking Capacity Deficiencies by EDC



Source: Guidehouse, EDC data

Locational Value of DG Study – Step 1

Summary of Historical Projects

EDC	Project	Year in Service
Eversource	Mill Pond Substation	2017
Eversource	Rimmon Substation	2020
Eversource	Bristol Substation	2015
Eversource	White Lake Substation	2020
Eversource	Pemi Substation	2020
Eversource	West Rd Overloaded Steps	2020
Eversource	388 Line Overload	2020
Eversource	34.5kV lines Rimmon Substation	2016
Eversource	Londonderry	2015
Liberty	Mount Support	2017
Liberty	Golden Rock Substation	2019
Unitil	New Sub-transmission Lines – Broken Ground to Hollis	2020
Unitil	Kingston Substation	2017

Source: Guidehouse, EDC data

Locational Value of DG Study – Step 1

- From the 122 locations identified, a subset of 16 locations were selected for detailed analysis.
- The subset of locations includes:
  - Locations from each EDC's service territory and regions
  - Future and historical projects, including circuits, and bulk and non-bulk substations
  - Winter and summer peaking locations
  - Midday and late-day peaking locations
  - Locations with identified capacity deficiencies under various load growth forecasts
  - Locations with small and large capacity deficiencies
  - Locations with normal and contingency overloads or performance violations
  - Locations where data was available to comprehensively analyze each site to determine the cost of traditional capacity solutions

Locational Value of DG Study – Step 1

Subset of 16 locations for detailed review

EDC	Description	Region	Type of Investment	Load Growth Forecast Scenario	Historical or Future	First Year of Capacity Deficiency
Eversource	Pemigewassett (Pemi)	Northern	Substation (Bulk)	Base	Future	2020
	Portsmouth	Eastern	Substation (Bulk)	Base	Future	2020
	South Milford	Southern	Substation (Bulk)	Base	Future	2020
	Monadnock	Western	Substation (Bulk)	Base	Future	2020
	East Northwood	Eastern	Substation (Non-Bulk)	High	Future	2021
	Rye	Eastern	Substation (Non-Bulk)	High	Future	2022
	Bristol	Northern	Substation (Non-Bulk)	Base	Historical	2015
	Madbury ROW	Eastern	Circuit (34.5 kV)	Base	Future	2020
	North Keene	Northern	Circuit (12.47 kV)	High	Future	2028
	Londonderry	Southern	Circuit (34.5 kV)	Base	Historical	prior to 2014
Liberty	Vilas Bridge	Walpole	Substation (Non-Bulk)	Base	Future	2020
	Mount Support	Lebanon	Substation (Bulk)	Base	Historical	2014
	Golden Rock	Salem	Substation (Bulk)	Base	Historical	2020
Unitil	Bow Bog	Capital	Substation (Non-Bulk)	High	Future	2024
	Dow's Hill	Seacoast	Substation (Bulk)	High	Future	2020
	Kingston	Seacoast	Substation (Bulk)	Base	Historical	prior to 2014

Source: Guidehouse, EDC data

Locational Value of DG Study – Step 2

- **Step 2:** Estimation of Investment Costs for Avoidance
  - Determine the value of potential avoided capacity investments at the 16 selected locations
- For each selected location, comprehensive data was analyzed to determine cost estimates for traditional utility investments designed to meet specific locational capacity needs.
- For each historical distribution capacity project, the study applies the assumptions, including EDC planning criteria that existed at the time the project was initially proposed or placed into service, to determine utility investment costs that might have been avoided.

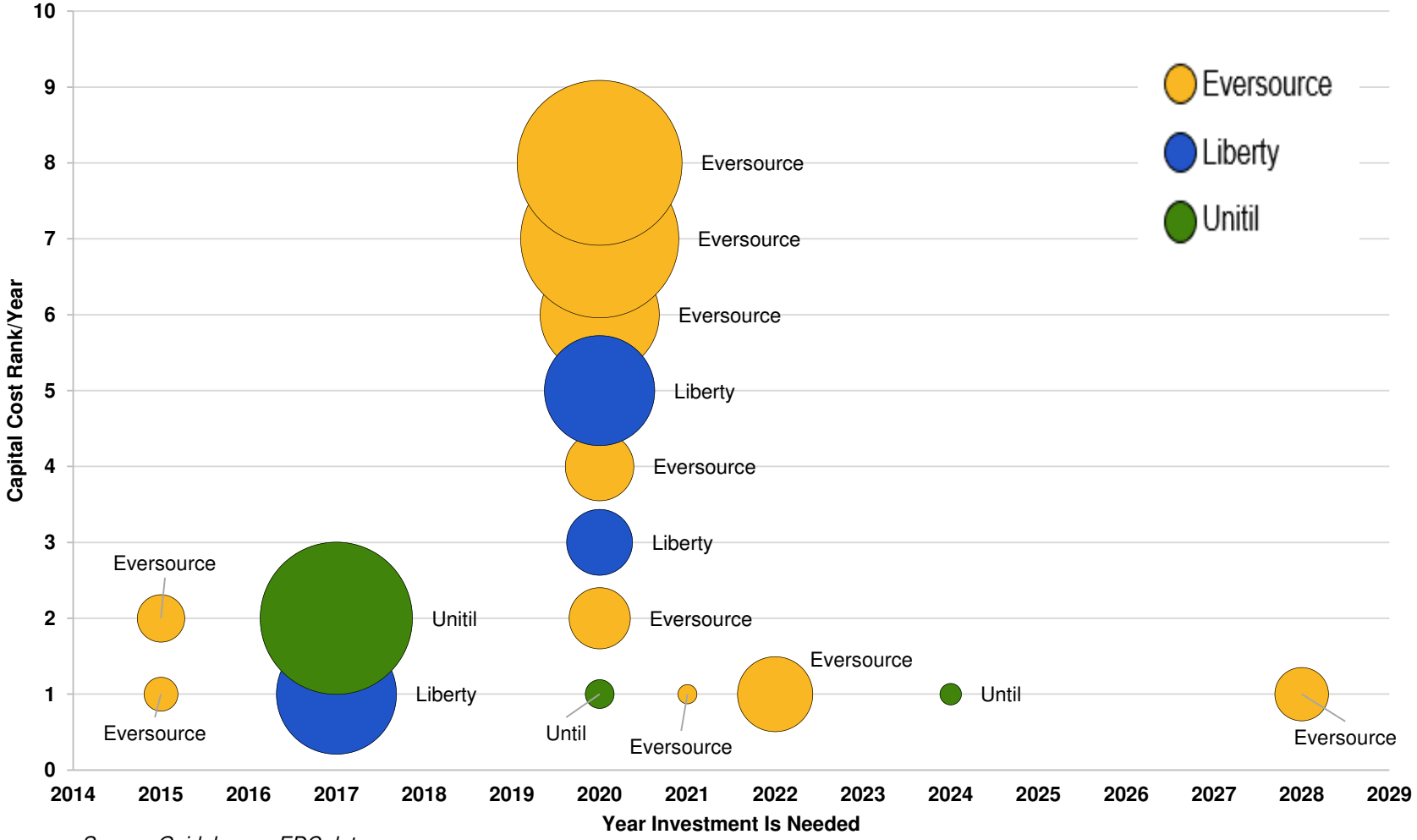
Locational Value of DG Study – Step 2

Subset of 16 locations for detailed review

Capital Investment by Location		
EDC	**Location**	**Traditional Investment Estimated Capital Costs for Capacity Additions**
Eversource	Pemi Substation (Bulk)	$7,469,000
	Portsmouth Substation (Bulk)	$2,500,000
	South Milford Substation (Bulk)	$13,150,000
	Monadnock Substation (Bulk)	$14,300,000
	East Northwood Substation (Non-Bulk)	$200,000
	Rye Substation (Non-Bulk)	$3,000,000
	Bristol Substation (Non-Bulk)	$1,200,000
	Madbury ROW Circuit (34.5 kV)	$2,000,000
	North Keene Circuit (12.47 kV)	$1,530,000
	Londonderry Circuit (34.5 kV)	$615,000
Liberty	Vilas Bridge Substation (Non-Bulk)	$2,300,000
	Mount Support Substation (Bulk)	$7,608,000
	Golden Rock Substation (Bulk)	$6,400,000
Unitil	Bow Bog Substation (Non-Bulk)	$254,000
	Dow's Hill Substation (Bulk)	$446,000
	Kingston Substation (Bulk)	$12,193,000

Source: Guidehouse, EDC data

Step 2 - High Load Forecast Capital Costs by Year of Investment Need



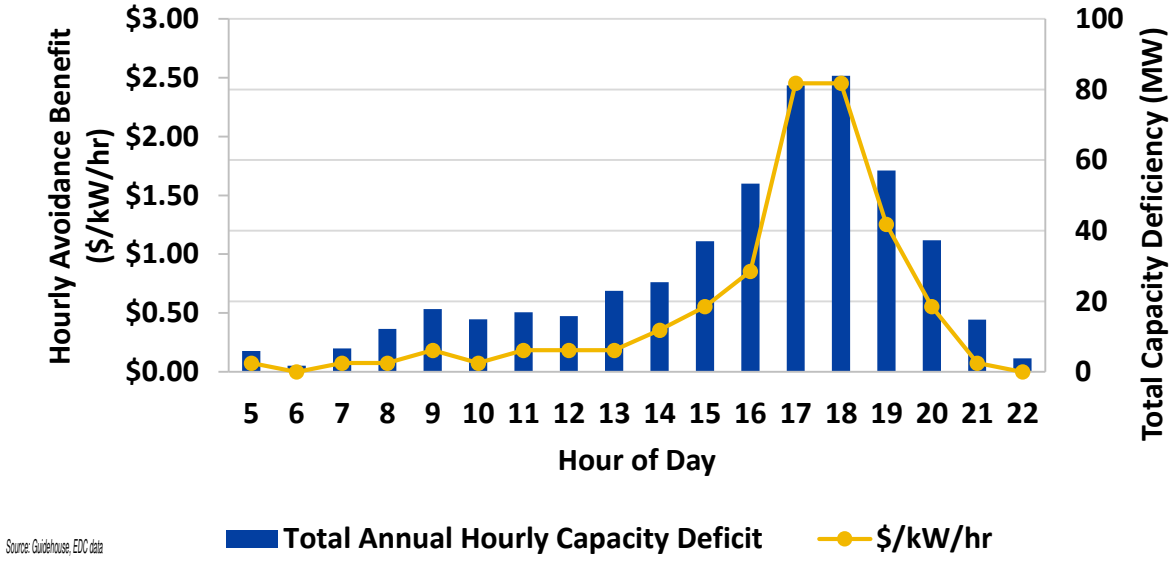
Source: Guidehouse, EDC data

Locational Value of DG Study – Step 3

- **Step 3:** Economic Analysis and Mapping of DG Production Profiles with Distribution Capacity Needs
  - Perform economic analysis to estimate the benefit of capacity avoidance and map representative DG production profiles with distribution system capacity needs.
- The study analyzed the potential value of capacity deficiency avoidance resulting from load reduction, including the time-differentiated value of avoiding traditional capacity investments on an hourly basis.
- The time-differentiated revenue requirement is determined by spreading the first-year revenue requirement across the hours of locational capacity deficiency using a weighted average approach. Those hourly capacity avoidance values are determined on a technology-neutral basis, based on locational load reduction.
- The study also evaluates the alignment of DG production profiles with capacity deficiency profiles for the three NEM-eligible DG technologies.

Locational Value of DG Study – Step 3 - Example

Pemi Hourly Analysis for All Hours of Year

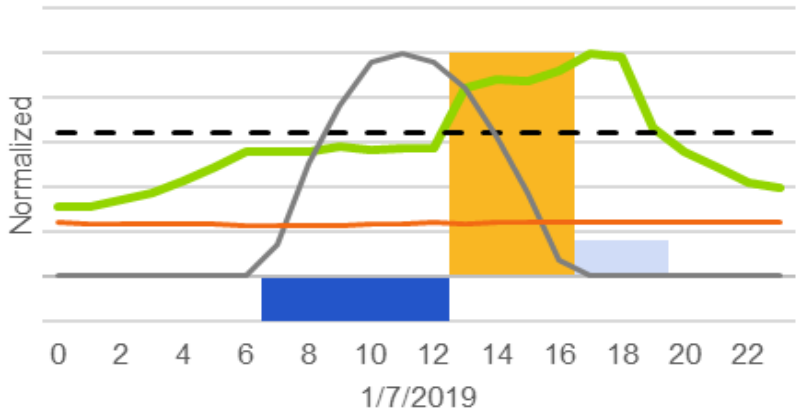


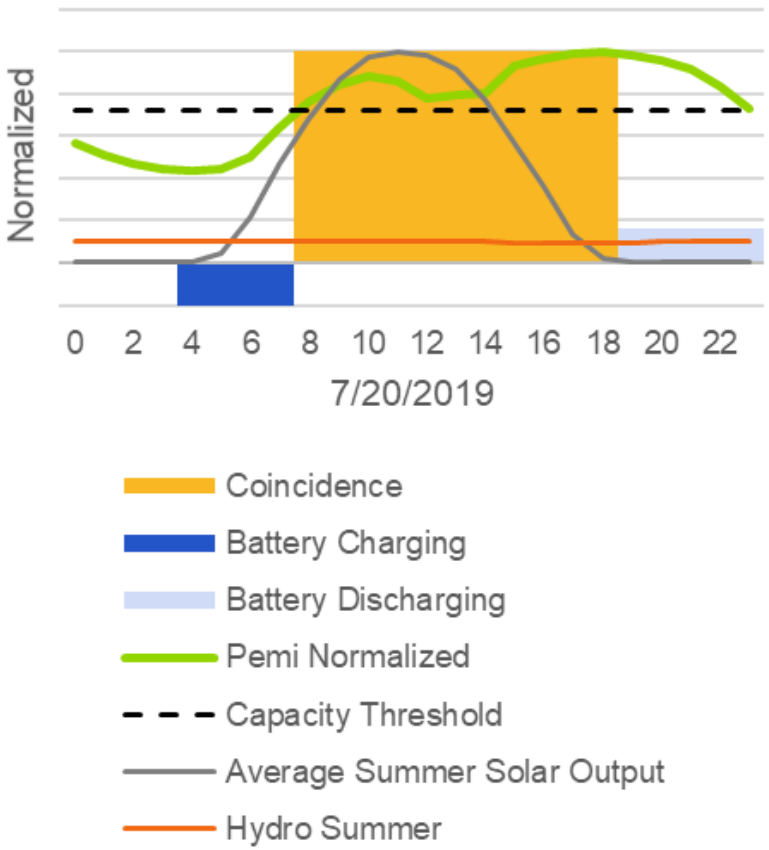
Annual Load Profile and Capacity Threshold – Pemi Substation (Bulk)				
Location	**Region**	**Peak (MW)**	**Time of Peak**	**First Year Deficit (MW)**
Pemi Substation (Bulk)	Northern	23	1/7/19 17:00	8.29

Source: Guidehouse, EDC data

Locational Value of DG Study – Step 3 - Example

Solar, Storage, Hydro Coincidence Analysis – Pemi Substation





Source: Guidehouse, EDC data

Locational Value of DG Study Results

- Out of 696 total potential locations, **122 distribution system substations or lines were identified as candidate locations for detailed analysis of capacity investment avoidance opportunities under base, low, and high load growth forecast scenarios**.
  - Of the 122 locations considered, 13 are historical and 109 are future, with 77 triggered only in the high case during the study time horizon.
- The **projected capacity deficiencies** for the three EDCs **beginning in 2020 total approximately 107 MW, increasing to 147 MW by 2029**, under the base load forecast.
  - Total capacity deficiencies in 2029 for the low load growth forecast are 63 MW and for the high load growth forecast are 317 MW.
- Of the **16 locations selected for detailed analysis**, five are historical investments. Five of the 16 locations have first year capacity deficiencies that occur during both winter and summer months; the remaining 11 are summer peaking only.

Locational Value of DG Study Results

- The total value of traditional **capacity investments at the 16 selected locations is approximately $75 million**.
  - The cost of traditional distribution system investments to address capacity deficiencies at the selected locations, expressed in terms of a revenue requirement, ranges from less than $1 million to over $14 million.
- The **economic value of capacity investment avoidance varies significantly** among the 16 locations based on a theoretical analysis of capacity avoidance using the RECC* approach.
  - The maximum hourly economic value of capacity investment avoidance ranges **from under $1 per kilowatt (kW) per hour to over $4,000 per kW per hour**.
  - The **greatest driver for that variance is the total number of hours over which capacity deficiencies that occur** at a specific location. The lower value is generally indicative of a capacity deficiency occurs over a large number of hours, while the higher value is generally indicative of a capacity deficiency that occurs during fewer hours.

** RECC = Real Economic Carrying Charge methodology*

Locational Value of DG Study Results

- Related **findings from the capacity deficiency analysis and evaluation of DG production profiles** are summarized as follows:
  - The **number of hours of capacity deficiency varies significantly by location**, with some locations with fewer than 15 hours of deficiency per year, while other locations are capacity deficient for several thousand hours per year.
  - **Most locations have capacity deficiencies during late afternoon or early evening hours**.
    - Solar PV production profiles do not fully align with those hours of capacity deficiency.
    - Solar PV paired with energy storage typically can produce electricity during most or all hours during which there are locational capacity deficiencies.
    - Hydro production profiles typically align with hours of capacity deficiency, but with lower production during summer months as compared to winter months.

Locational Value of DG Study Results

- Study provides detailed data on the distribution-level avoided costs realized at specific location(s) due to distributed generation (i.e., solar, hydroelectric, and solar with storage).
- The LVDG study is not intended to:
  - Determine a system-wide value of DG, but the results of this study are expected to be used in the VDER study.
  - Predetermine future NEM tariff design or applicable rates, but rather to inform further NEM tariff development proceedings before the Commission.
- Study results may inform:
  - Value of DER Study (system-wide study)
  - Future utility rate cases
  - Future least cost integrated resource plans.
  - Net Metering Tariff – tariff design and/or "compensation" rate
  - Locational incentives, including state incentive programs or utility tariff
  - Grid modernization and integrated distribution system planning issues
  - Heat map and/or hosting capacity maps for distributed generation and other distributed energy resources

Value of Distributed Energy Resources (VDER) Study

System-wide value of distributed generation eligible to net meter in New Hampshire

VDER Study Overview

Study Objective:

As directed in Order No. 26,029, the New Hampshire VDER study will examine the net present value of long-term avoided costs using marginal cost concepts and evaluate respective benefits and costs from the perspective of the electric distribution utilities, customer-generators participating in net metering, and non-participating electric ratepayers.

Steps:

- Determine specific study parameters and assumptions
- Select avoided cost, and cost criteria, and applicable tests
- Determine system-level values of hourly load reductions (and possibly relevant market values)

LVDG study will inform the VDER study and the Commission's evaluation of future net energy metering tariff development.

VDER Study Criteria

Avoided Cost Criteria	
1	Energy Market Cost
2	Capacity Market Costs
3	Ancillary Services and Load Obligation Charges
4	RPS Compliance Cost
5	Transmission Charges
6	Transmission Capacity
7	Distribution Capacity (LVDG Study)
8	Distribution System Operating Expenses (system-wide) *(if approved for inclusion)*
9	Transmission Line Losses
10	Distribution Line Losses
11	Wholesale Market Price Suppression
12	Hedging/Wholesale Risk Premium
13	Distribution Utility Administrative Expenses
14	T & D System Upgrades
15	Utility Lost Revenues
17	Distribution Grid Support Services

Avoided Cost Criteria	
16	Environmental Externality Costs (sensitivity)
18	Resilience Services *(if approved for inclusion)*
19	Customer Installed Net Costs

Certain criteria will be addressed through a qualitative and/or proxy value approach rather than a New Hampshire-specific quantitative methodology.

Three potential study scope adders:

- model development,
- high load growth sensitivity analysis, and
- market resource value sensitivity analysis

VDER Study

- Study will provide detailed information regarding costs avoided (or increased) as a result of net metered distributed generation under general conditions, and evaluate respective benefits and costs from the perspective of the electric distribution utilities, customer-generators participating in net metering, and non-participating electric ratepayers.

- Study results may inform:
  - Net Metering Tariff – tariff design and/or "compensation" rate
  - Incentives, including state incentive programs or utility tariff
  - Grid modernization and system planning issues

Thank You

Karen Cramton

Director, Sustainable Energy Division

New Hampshire Public Utilities Commission

Karen.Cramton@puc.nh.gov

603.271.2431

Docket DE 16-576

https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576.html

LVDG Study Final Report

https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/LETTERS-MEMOS-TARIFFS/16-576_2020-08-21_STAFF_LVDG_STUDY_FINAL_RPT.PDF