

Cluster study potential

Operating Committee
meeting

August 17, 2023

vermont electric power company



Outline

- Solar PV forecast and effects on load
- DG modeling and study requirements

Final 2023 PV Forecast (ISO-NE)

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
CT	911.8	171.3	174.4	164.7	130.7	130.7	130.7	111.6	110.6	109.6	92.3	2,238.5
MA	3289.2	348.3	330.0	311.7	311.7	311.7	311.7	232.2	228.1	224.1	220.0	6,118.7
ME	294.6	276.8	262.2	107.4	107.4	107.4	107.4	107.4	83.2	82.0	80.8	1,616.8
NH	183.4	25.2	23.8	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	412.5
RI	325.6	52.1	49.4	46.6	46.6	46.6	46.6	46.6	39.8	39.5	39.2	778.9
VT	468.2	28.5	27.2	25.8	26.2	26.7	27.4	28.1	28.9	29.8	30.6	747.4
Regional - Annual (MW)	5472.7	902.2	867.0	678.8	645.2	645.7	646.4	548.4	513.2	507.5	485.5	11,912.7
Regional - Cumulative (MW)	5472.7	6374.9	7241.9	7920.7	8566.0	9211.7	9858.1	10406.5	10919.7	11427.2	11912.7	11,912.7

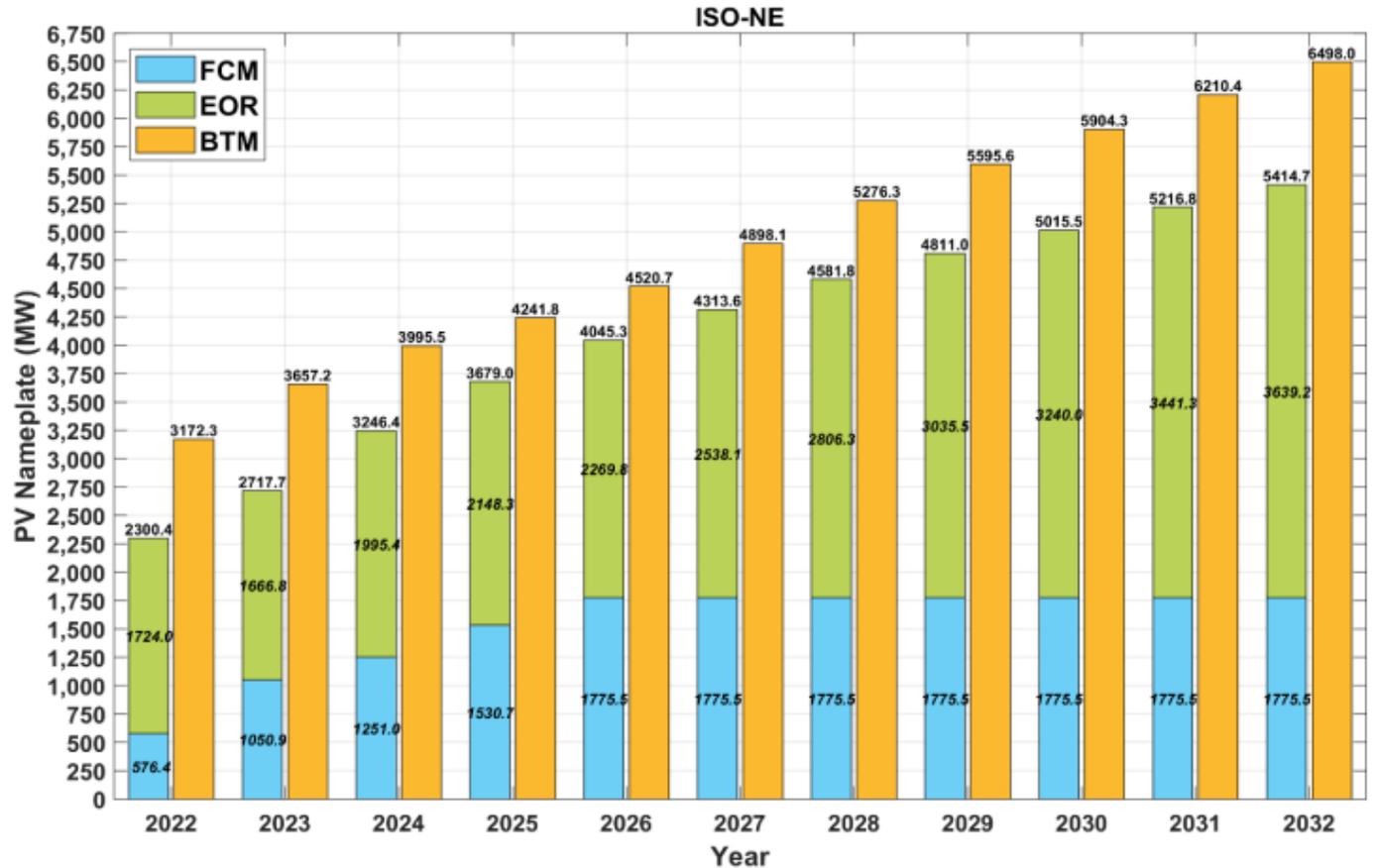
Notes:

- (1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources
- (2) The forecast values are net of the effects of discount factors applied to reflect a degree of uncertainty in the policy-based forecast
- (3) All values represent end-of-year installed capacities
- (4) Forecast does not include forward-looking PV projects > 5MW in nameplate capacity

Final 2023 PV Forecast – New England

Cumulative Nameplate by Category, MW_{ac}

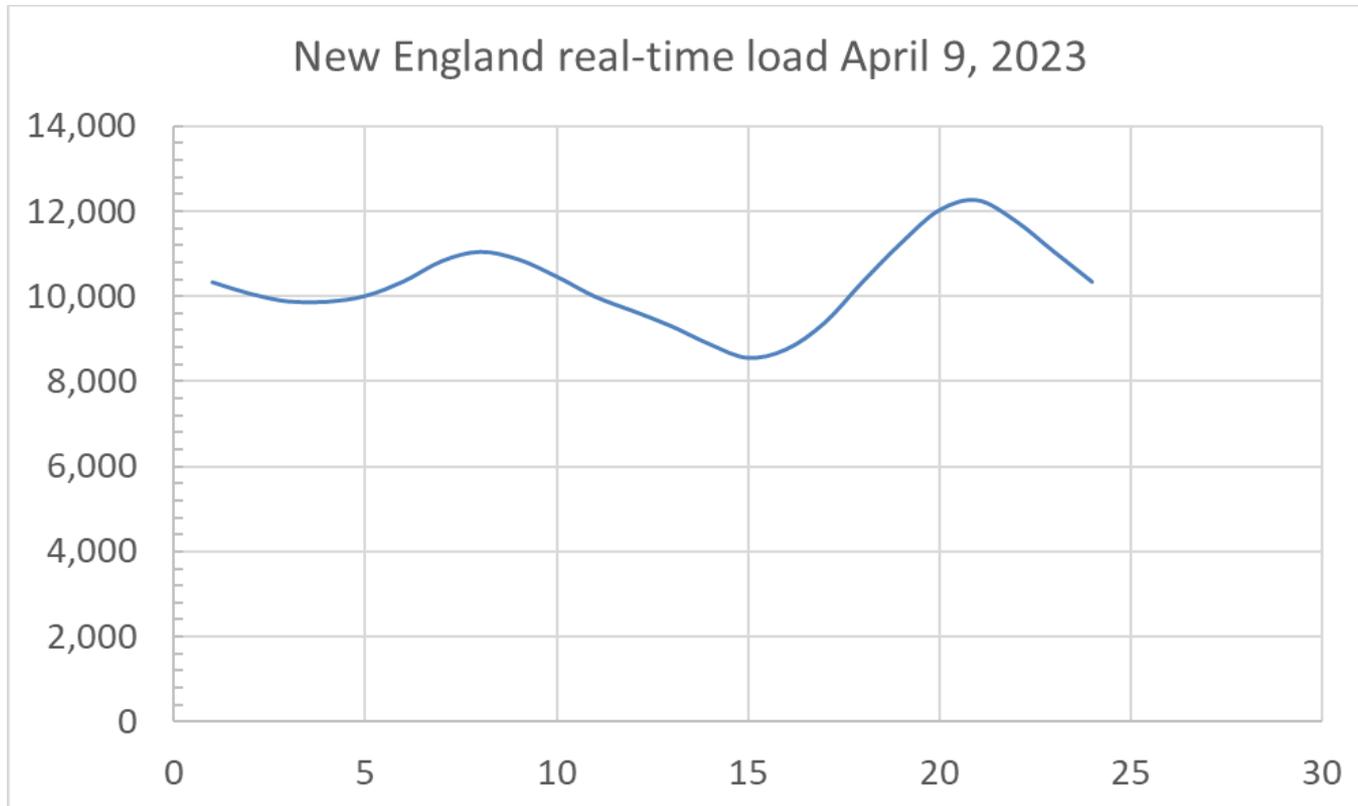
- FCM: Forward Capacity Market
- EOR: Non-FCM Energy Only Resource
- BTM: Behind-the-meter



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New England net loads projected to drop below 2,000 MW within 10 years



- ISO-NE under forecasts solar PV
- Forecast does not account for other types of DG
- Forecast does not account for solar PV sized 5 MW or more

ISO-NE requesting more DG data details

DER Surveys - New

- ISO-NE has started a new effort to collect higher fidelity data
- Data is still on an individual installation basis
- New DER surveys through the DGFWG contain substation level information as well

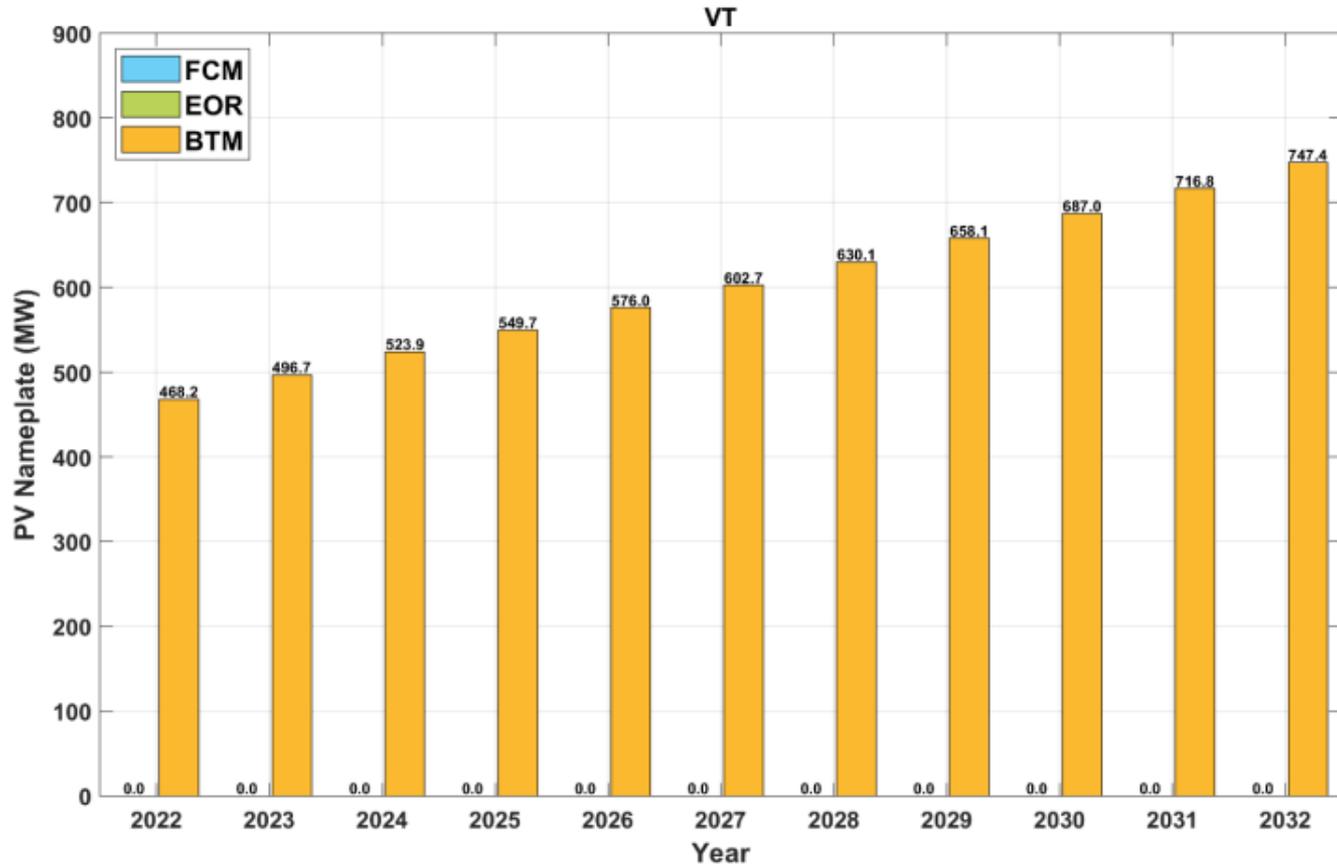
Non-Default 1547 Setting Categories:

1. ISO-NE Ridethrough Settings (PV that went in service after 8/1/2018)
2. NERC Underfrequency Settings (PV > 100 kW that went in service from 5/1/2016 to 7/31/2018)
3. IEEE 1547 2003 Setting (All PV that went in service from 1/1/2003 to 4/30/2016 and all PV ≤ 100 kW that went in service from 5/1/2016 to 7/31/2018)
4. Non-Default 1547 Settings (all non-PV or any PV that went in service prior to 2003)

Town	State	Status	In-Service Date	Technology Type	Installed Capacity (kW)	PV & Storage	Storage Only	Feeder	Feeder kV	Substation Name	Substation High kV	Substation Low kV	Substation Mid kV	Non-Default 1547
ABC Town	CT	In-Service	1/1/2003	PV	5.60			12346	13.80	Substation A	115	13.80	N/A	
ABC Town	CT	In-Service	6/15/2007	PV	4.00			12345	13.80	Substation A	115	13.80	N/A	
ABC Town	CT	In-Service	4/8/2018	PV	2.50			ABC123	13.80	Substation B	115	13.80	N/A	
ABC Town	CT	In-Service	5/16/2018	PV	10.00			ABC123	13.80	Substation B	115	13.80	N/A	
ABC Town	CT	In-Service	9/26/2019	PV	15.00			ABC124	13.80	Substation B	115	4.80	N/A	
ABC Town	CT	In-Service	2/13/2019	PV	2.00			ABC125	13.80	Substation B	115	13.80	N/A	
ABC Town	CT	In-Service	10/17/2020	PV	2.16			35789	13.80	Substation C	115	13.80	N/A	
ABC Town	CT	In-Service	3/23/2021	PV	3.75			35789	13.80	Substation C	115	13.80	N/A	
ABC Town	CT	In-Service	5/28/2022	PV	1.20			35788	4.80	Substation C	115	13.80	N/A	
ABC Town	CT	In-Service	12/17/2022	PV	1,000.00			35788	13.80	Substation C	115	13.80	N/A	

Final 2023 PV Forecast – Vermont

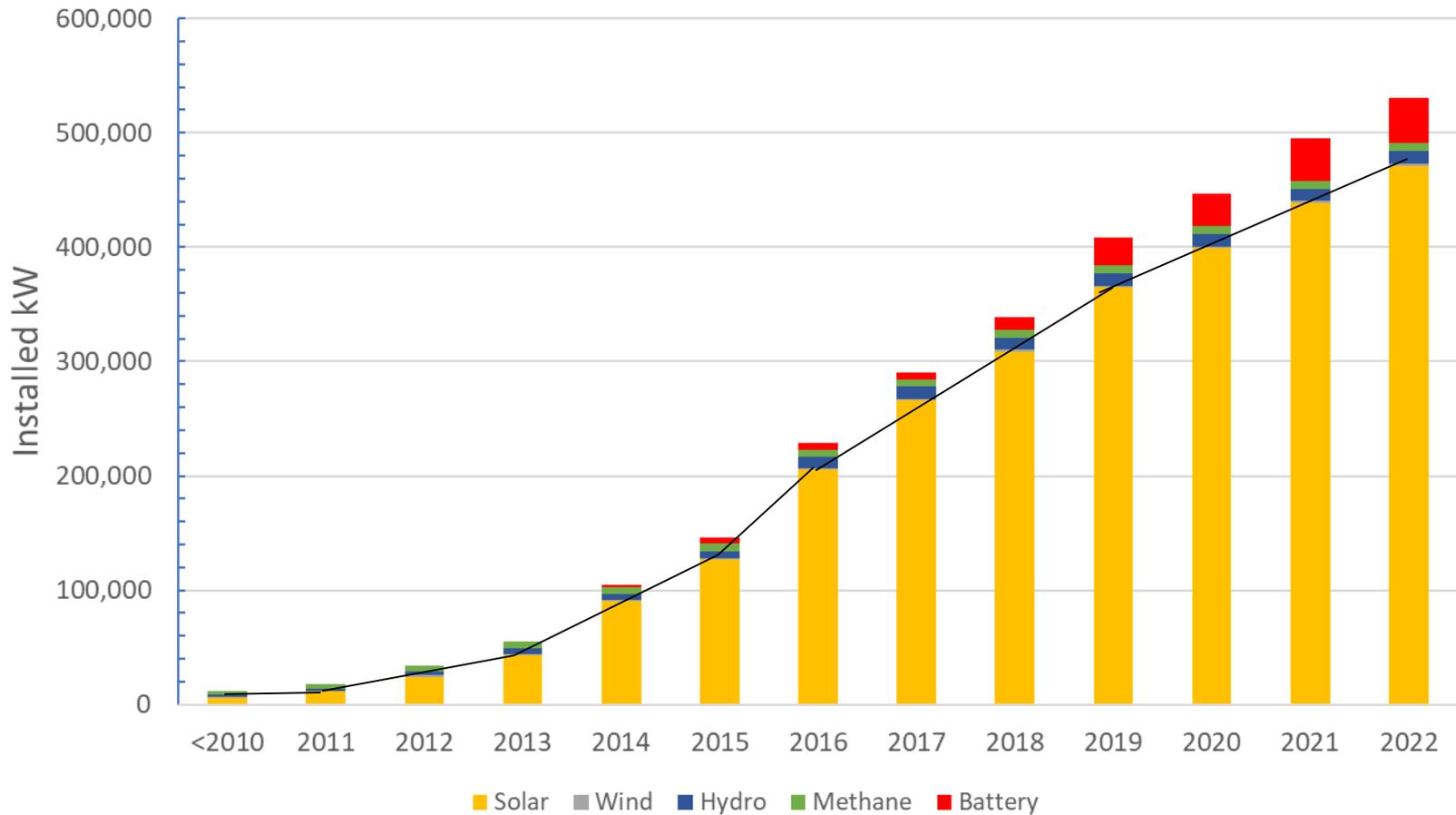
Cumulative Nameplate by Category, MW_{ac}



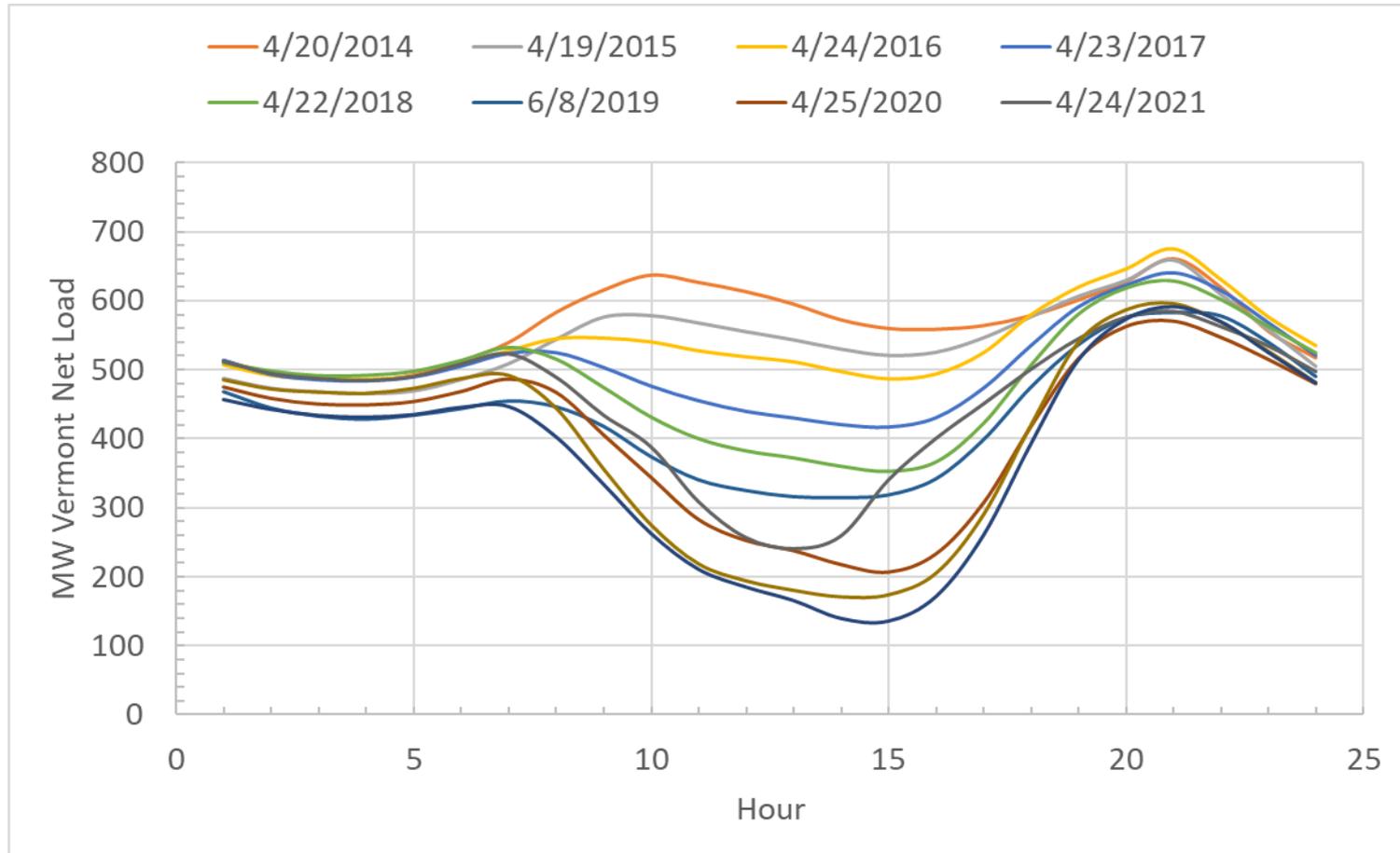
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VT Distributed generation Cumulative kW by Technology

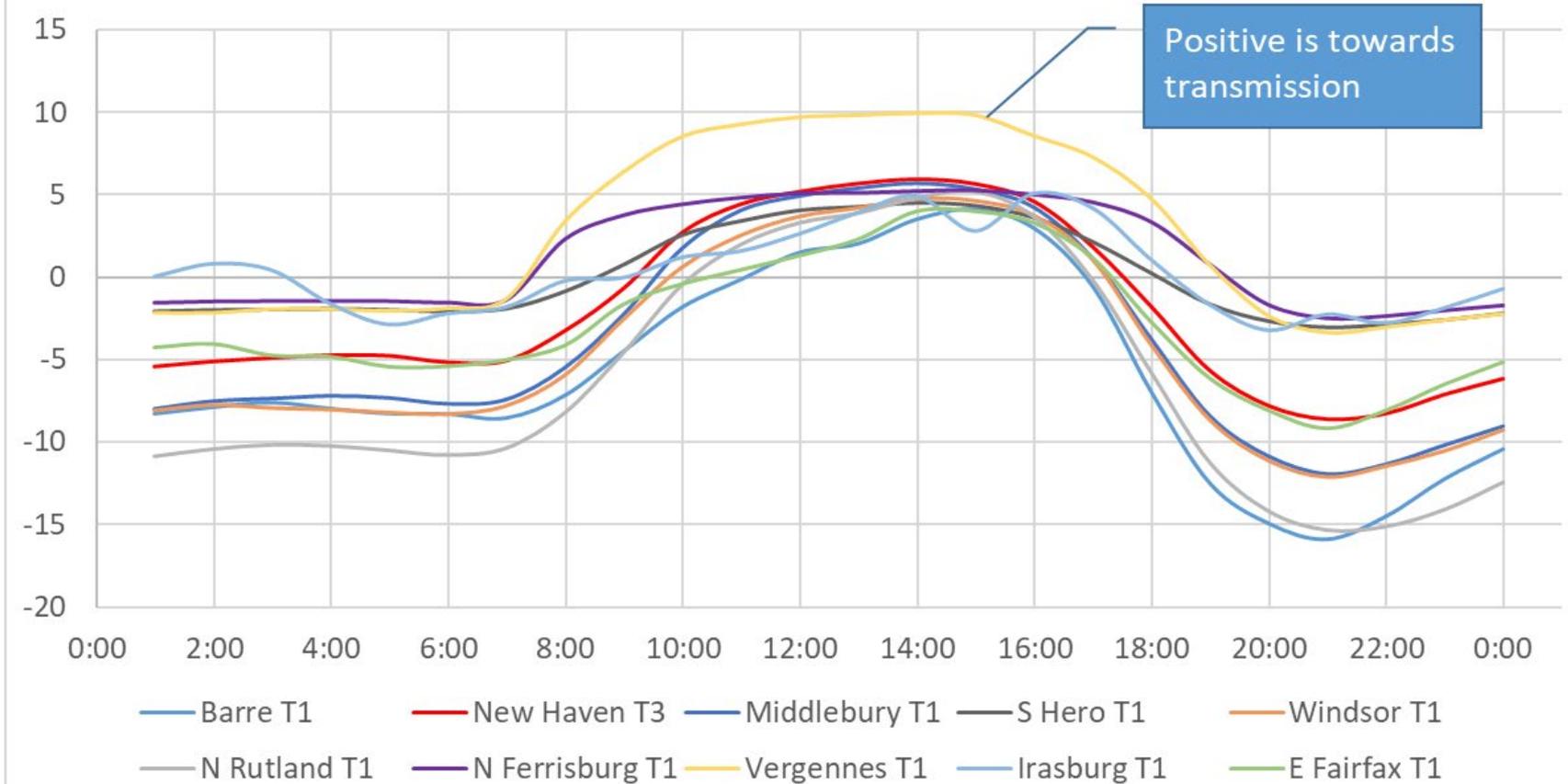


VT net loads projected to be negative within five years



- Affected by BTM “retired” hydro

Top Ten transformers with reverse power



VELCO needs more data

- Improve models with implementation of VELCO operating procedure OP-55G
- Improve visibility with real-time data from units 150 kW and greater
- Obtain control settings data per proposed change to Rule 5.500

DG interconnection and study requirements

Adoption of IEEE 1547 in New England



- Beginning in 2012, the ISO began providing support to stakeholders who were looking to adopt what was, at the time, a new iteration of the IEEE 1547 standard, IEEE 1547-2014a
- Beginning Jan 1, 2019 the ISO New England Source Requirement Document was in place for all states
 - Interim approach to IEEE 1547-2018
- Since that time, DERs have continued to proliferate and IEEE has updated its standard, IEEE 1547, again
- Eversource and National Grid have begun to adopt the latest version of IEEE 1547-2018 as amended by 1547a-2020
 - These utilities operate in Massachusetts, Connecticut, New Hampshire, and Rhode Island
 - **More than 60% of solar PV in New England is/will be installed in Massachusetts**
 - Additional details are available in the Appendix

New Jan 2023 source requirement document at:

<https://www.mass.gov/doc/tsrg-inverter-source-requirements-document/download>

ISO-NE tariff change: all distribution-connected projects should proceed through the state process

- The ISO is proposing updates to the rules determining the appropriate interconnection process for distribution-connected generating facilities
 - Proposing that all distribution-connected generation proceed through the state interconnection process
 - The application of the I.3.9 process to state jurisdictional interconnections will be unchanged
 - Consistency of reliability review throughout the region
 - Visibility and transparency to the ISO and to stakeholders
 - Single coordinated approach to organizing interconnections in the relevant state

ISO New England's Section I.3.9 Process: Applicability

- The ISO's Section I.3.9 process applies to the interconnection of the following DG resources:
 - **New or increased generation ≥ 5 MW**
 - These projects must include PPA forms in their Section I.3.9 submittals to the ISO
 - **New or increased generation > 1 MW and < 5 MW**, where the ISO has determined such interconnection(s) will have a *cumulative impact* on the regional transmission system
 - Generator Notification Forms (GNF) are submitted to the ISO for projects of this size, unless the ISO identifies that a PPA is required
- As the Regional Transmission Organization (RTO) for New England, the ISO is responsible for reviewing and approving proposed system changes because these changes may impact the **stability, reliability, or operating characteristics** of the New England power system

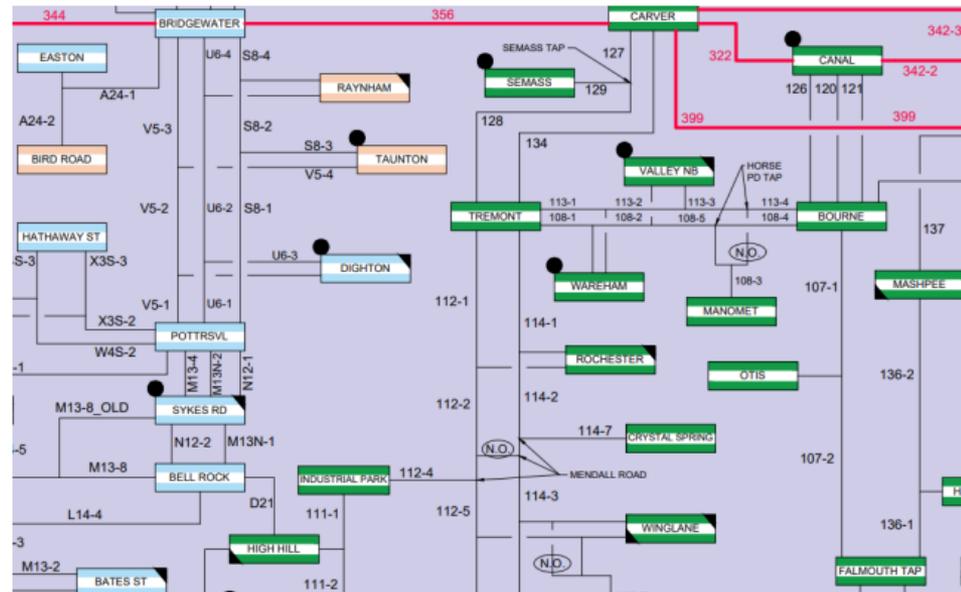


ISO New England's Role in Identifying Cumulative Impacts to the Regional Power System

- From the Transmission Operating Agreement, Section 3.03(b):
 - The Participating Transmission Owner or its distribution company Affiliate, as applicable, shall notify the ISO of situations where the interconnection of multiple generators to distribution facilities that are not OATT Interconnection Distribution Facilities may have cumulative impacts affecting the facilities used for the provision of regional transmission service and shall, in such situations, consult with the ISO in its performance of such studies. The ISO will determine whether such interconnections will have a cumulative impact on facilities used for the provision of regional transmission service.
- In the case of non-OATT interconnections, the ISO's review of cumulative impact is conducted as part of the Section 1.3.9 process
 - *Participating Transmission Owner's early engagement with ISO New England helps to ensure successful preparation for the 1.3.9 review*

20 MW saturation threshold for level 3 studies

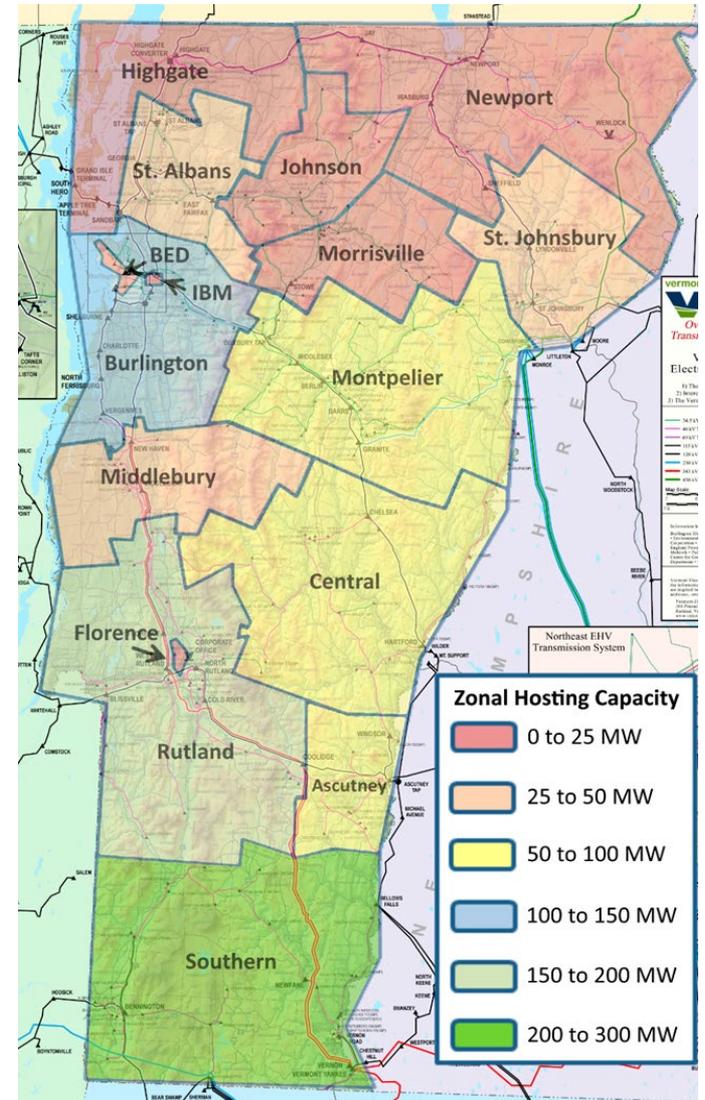
- Projects that fall under the I.3.9 process are aggregated and studies may be needed
 - All individual projects 5MW or greater
 - Aggregates of 20MW or more at a single station, or between electrically proximal stations
- Different types of studies may be needed
 - Steady State
 - Short Circuit
 - Stability
 - EMT



Total DG > 1 MW by zone – without legacy hydro

20 MW threshold exceeded in several zones

Zone totals	MW
St Johnsbury	4.30
Newport	4.09
Highgate	12.13
St Albans	31.22
Johnson	0.00
BED	2.50
Burlington	56.15
IBM	0.00
Morrisville	8.02
Montpelier	29.64
Middlebury	23.51
Florence	0.00
Rutland	51.21
Central	26.02
Ascutney	10.97
Southern	34.54



Total DG > 1 MW at transmission substations – without legacy hydro

20 MW threshold exceeded at 3 subs

Substation totals	MW
Ascutney	7.17
Barre	22.88
Bellows Falls	1.79
Bennington	16.46
Berlin	3.45
Blissville	12.75
Charlotte	6.98
Chelsea	3.00
Cold River	14.96
Comerford	1.32
East Avenue	2.50
East Fairfax	1.51
Essex	22.29
Georgia	11.90
Hartford	18.09
Highgate	7.15

Substation totals	MW
Irasburg	4.09
Middlebury	21.31
New Haven	9.35
Newfane	9.31
North Ferrisburg	7.00
North Rutland	16.35
Queen City	1.55
Shelburne	2.12
South Hero	4.98
St Albans	17.81
St Johnsbury	4.30
Stowe	10.02
Taft's Corner	9.36
Vergennes	6.86
Vernon Rd	6.98
Windsor	8.73



ISO-NE extracts data from notification forms for tracking Form Data

VSPC presentation

https://www.vermontspc.com/library/document/download/7957/ISO%20New%20England_Marszalkowski_7_12_2023_VSPC%20Presentation_DataCollection.pdf

- Forms have some built in logic to help standardize data entries
- Data is able to be downloaded from the forms in an easily exportable way
- Data is then added to tracking sheets in bulk

Vermont Station locations and PSSE bus numbers are at the distribution level

PPA number	Date of application (Date on Cover Letter)	Date of PPA approval letter	Project Name	Town	State	Address	Project Applicant	Maximum Net Power Injection (MW)	Requested Effective Date	Calendar Year of Requested Effective Date	Planning Year of Requested Effective Date. EX: Planning Year 2017 runs from June 1, 2016 to May 31, 2017	Interconnection bus name and voltage level	Substation name	Final bus number to be associated with the project (RED highlight indicates PTF bus)
ABC-22-G01	4/10/2022	5/14/2022	ABC Solar	Town ABC	MA	116 ABC Road	ABC Developer	1.900	7/1/2023	2023	2024	13.8 kV ABC distribution feeder 320 W3	ABC	999999
ABC-22-G02	4/10/2022	5/14/2022	DEF Solar, LLC	Town ABC	MA	146 DEF Rd	DEF Developer	2.500	9/1/2023	2023	2024	13.8 kV DEF 17K A3 Bus	DEF	999999
ABC-22-G03	4/10/2022	5/14/2022	DEF Solar, LLC	Town ABC	MA	146 DEF Rd	DEF Developer	2.500	9/1/2023	2023	2024	13.8 kV DEF 17K A3 Bus	DEF	999999



Total DG > 1 MW at distribution substations – without legacy hydro

Near or over the 5 MW threshold.

Substation totals	MW	Substation totals	MW	Substation totals	MW
Airport 12.5 kV	2.10	Hinesburg 12.5 kV	3.16	Rochester 12.47kV	3.00
Barre South End 12.47 kV	2.20	Hydeville 12.47 kV	2.20	Salisbury 12.47kV	4.95
Bay St 12.5 kV	2.20	Jackson Corners 12.5 kV	3.49	Sand Hill Rd 12.5 kV	6.50
Berlin 12.47kV	2.20	Jamaica 12.5 kV	2.20	Sharon 12.5 kV	6.80
Bethel 12.47 kV	4.93	King Street 12.5 kV	1.25	Shelburne 12.5 kV	2.12
Brandon 12.47 kV	2.20	Leceister 12.5 kV	2.00	GMP Sheldon 12.5 kV	4.95
Brudies Rd 12.5 kV	4.98	Londonderry 12.47kV	4.95	VEC Sheldon Springs Hydro	2.20
Burton Hill 12.5 kV	1.89	Lyons Street 12.47kV	3.50	Silk Road 12.5 kV	6.56
Castleton 12.5 kV	4.40	McNeil 13.8kV	2.50	South Hero 12.5 kV	4.98
Charlotte 12.5 kV	6.98	Middlebury 12.47 kV	7.96	South Rutland #1 12.5 kV	12.76
Chester 12.5 kV	2.18	Mountain View 12.4 kV	2.20	South Shaftsbury 12.5kV	2.20
Coventry Landfill Plant	2.20	Morrisville 3 12.5 kV	2.10	Stamford 12.47kV	2.20
Digital 12.5 kV	9.36	Morrisville 5 12.5 kV	2.20	Stratton 12.5 kV	2.16
Dorset Street 12.5 kV	1.55	Nason Street 12.5 kV	10.86	Underhill 12.5 kV	1.51
East Middlebury 12.5 kV	4.20	North Brattleboro 12.5 kV	2.00	Vergennes 12.5 kV	6.86
East Rutland 12.5 kV	2.00	North Elm Street 12.47 kV	4.95	Wallingford 12.5 kV	2.20
East Ryegate 12.4 kV	1.32	North Rutland 12.5 kV	6.47	Waterbury 12.5kV	2.00
East St Albans 12.5 kV	2.00	North Springfield 12.5 kV	5.00	Websterville 12.5 kV	14.99
Essex 19G3 12.5 kV	4.69	Pawlet 12.47kV	4.10	West Milton 12.5 kV	6.90
Essex 19G5 12.5 kV	2.20	Pittsford Village 12.5 kV	7.88	Westminster 12.5 kV	1.79
Ferrisburg 12.5 kV	7.00	Poultney 12.5 kV	2.05	Weybridge 12.5 kV	4.20
Georgia 12.5 kV	5.00	Pownal 12.5 kV	4.20	White River Jct 12.5 kV	2.17
Gilman 12.5 kV	2.10	Quechee 12.5 kV	4.99	Wilder 12.5kV	4.13
Hardwick 12.5 kV	3.72	Richmond 12.5 kV	3.65	Windsor 12.5kV	3.80
Hewitt Road 12.47kV	5.15				

Notes

- ISO-NE may request transmission level 3 studies soon
- ISO-NE has required level 3 studies for a single < 5 MW project
 - Detailed models required for all nearby projects
- ISO-NE Needs Assessment may show stability concerns in VT
- Need to update Rule 5.500 to include cluster study requirement
- VELCO is updating its interconnection requirement document to include DER interconnection considerations per NERC recommendation for FAC-001 standard
- VELCO recommended that the VT interconnection guidelines require installers to send inverter settings to the utilities after commissioning
- Recommending utilities send inverter data to VELCO now to prepare for eventual level 3 studies
 - Starting with distribution substations highlighted in red on the previous slide