Cluster study potential

vermont electric power company

VELCO

Vermont System Planning Committee meeting

October 25, 2023

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:

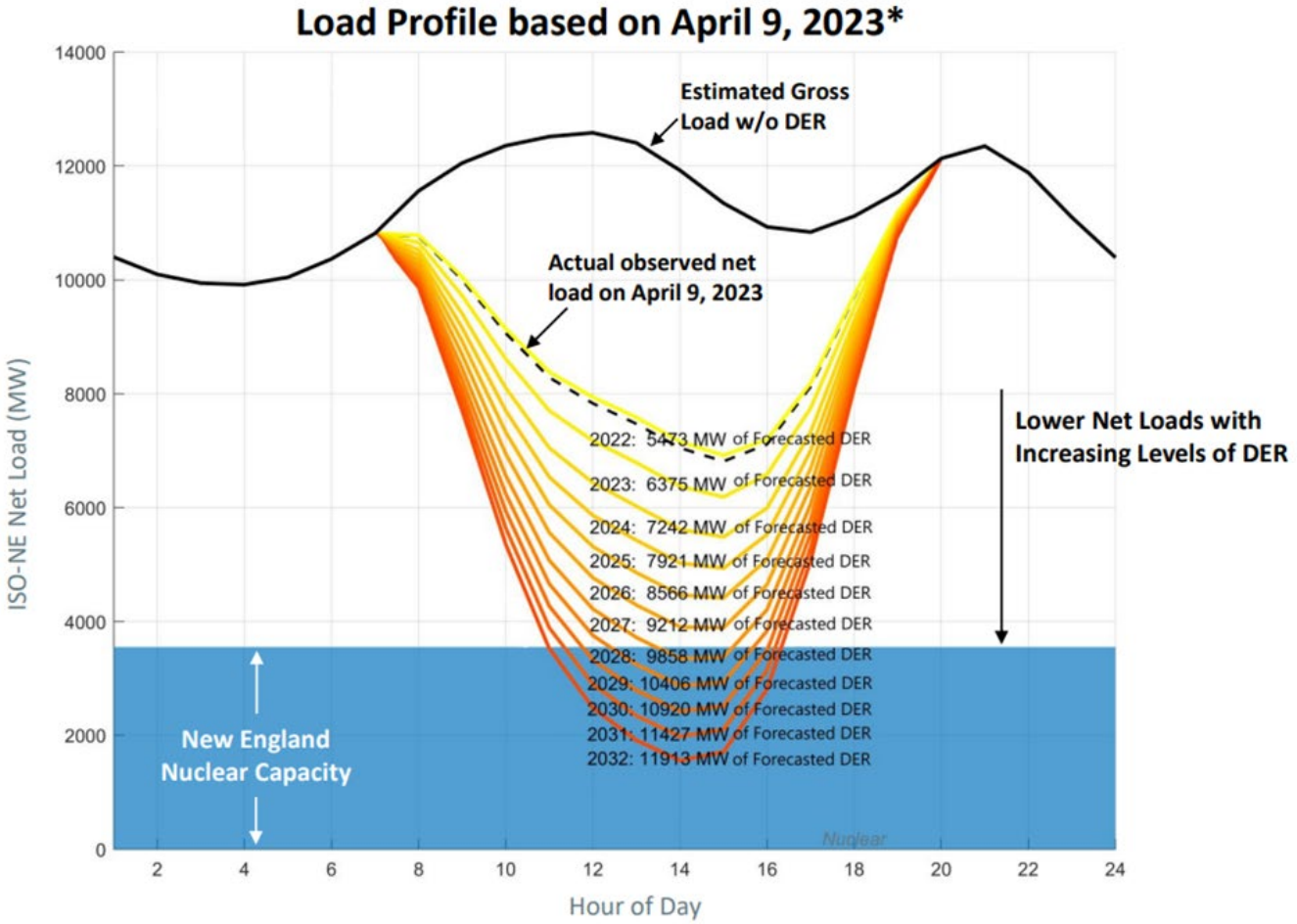
(1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources

(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

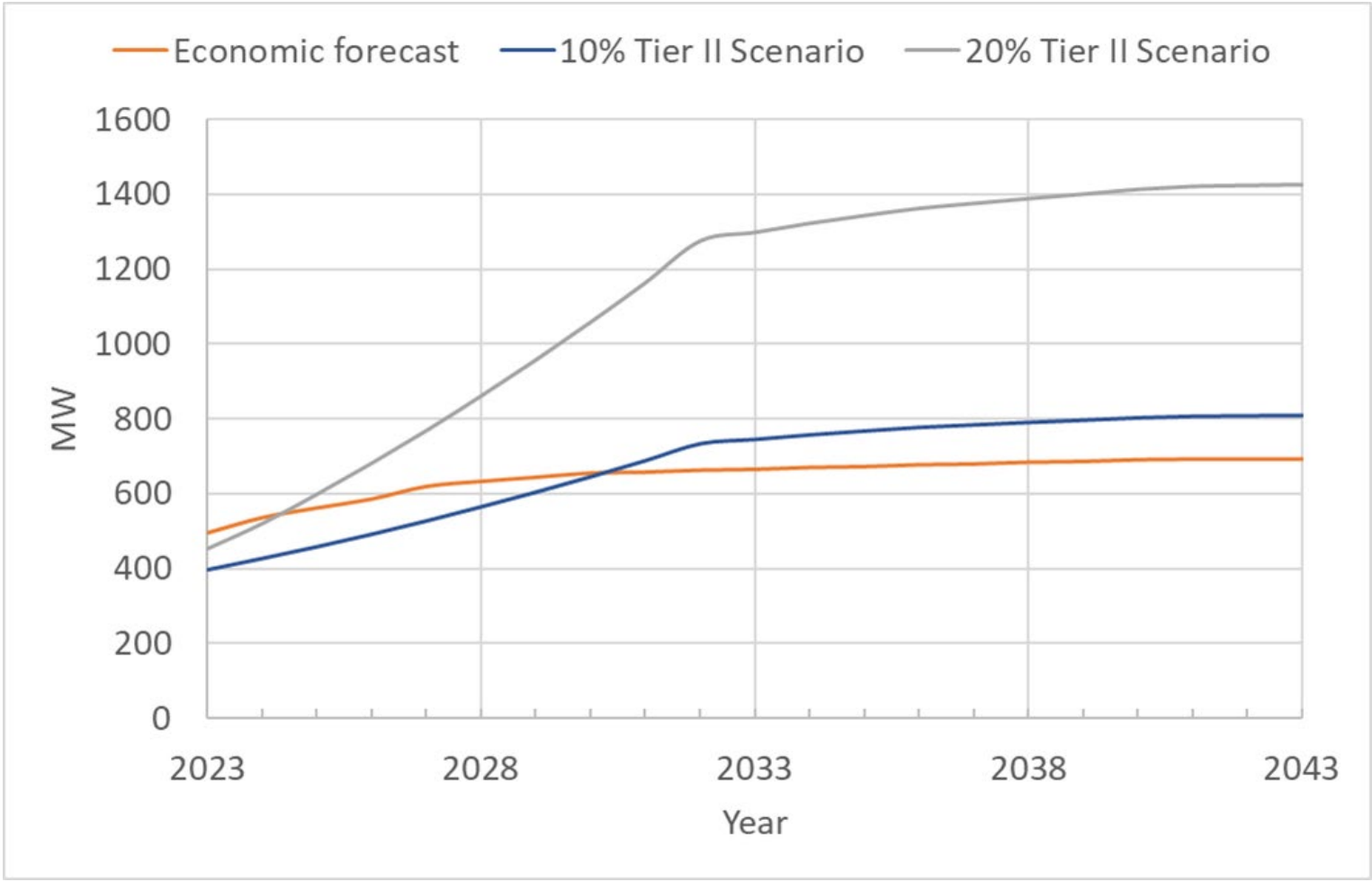
Projections of Daytime Minimum Loads in New England

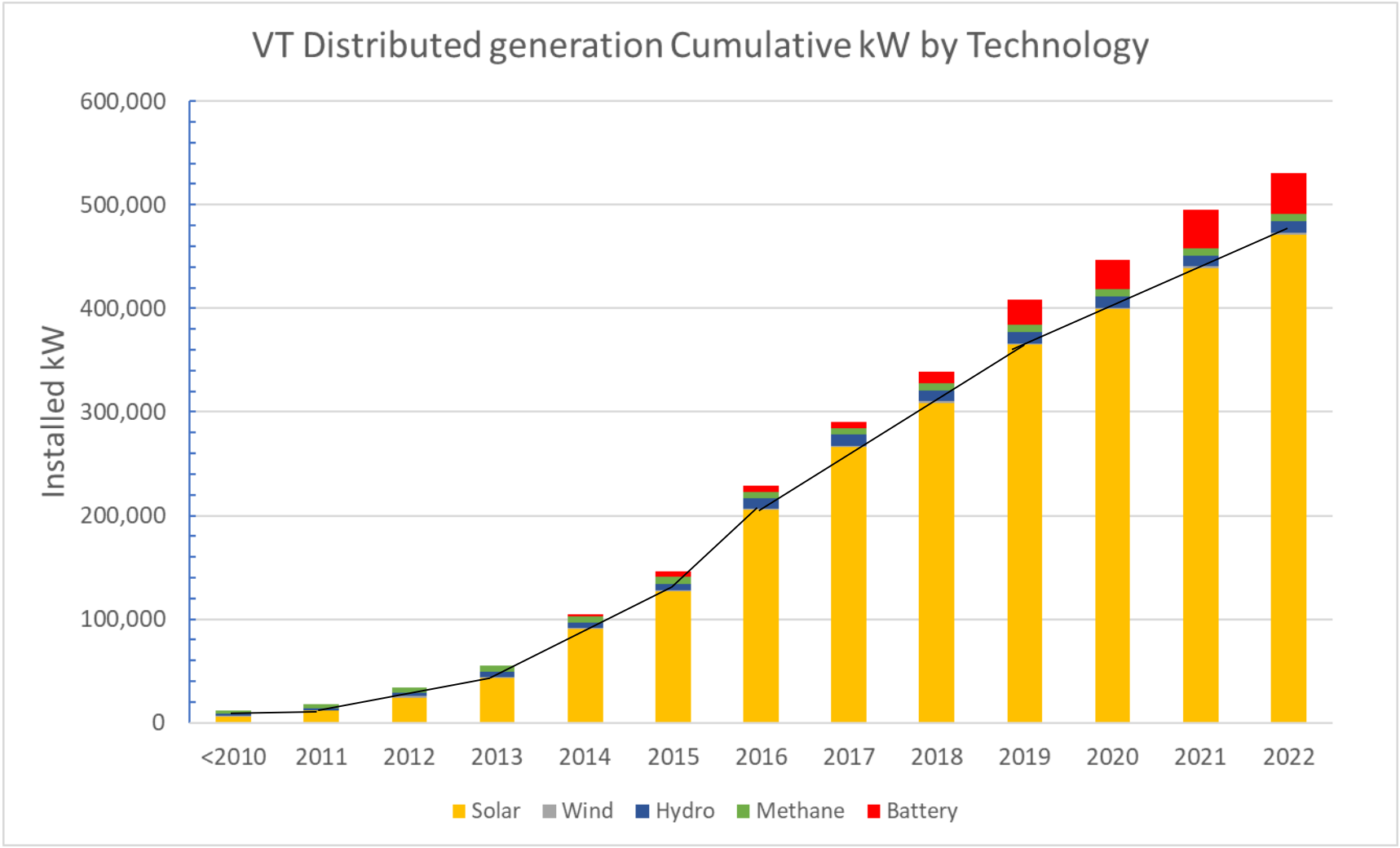


*New England saw its historical lowest net load on April 9, 2023 when the load was approximately 6,814 MW between 2 and 3 p.m.

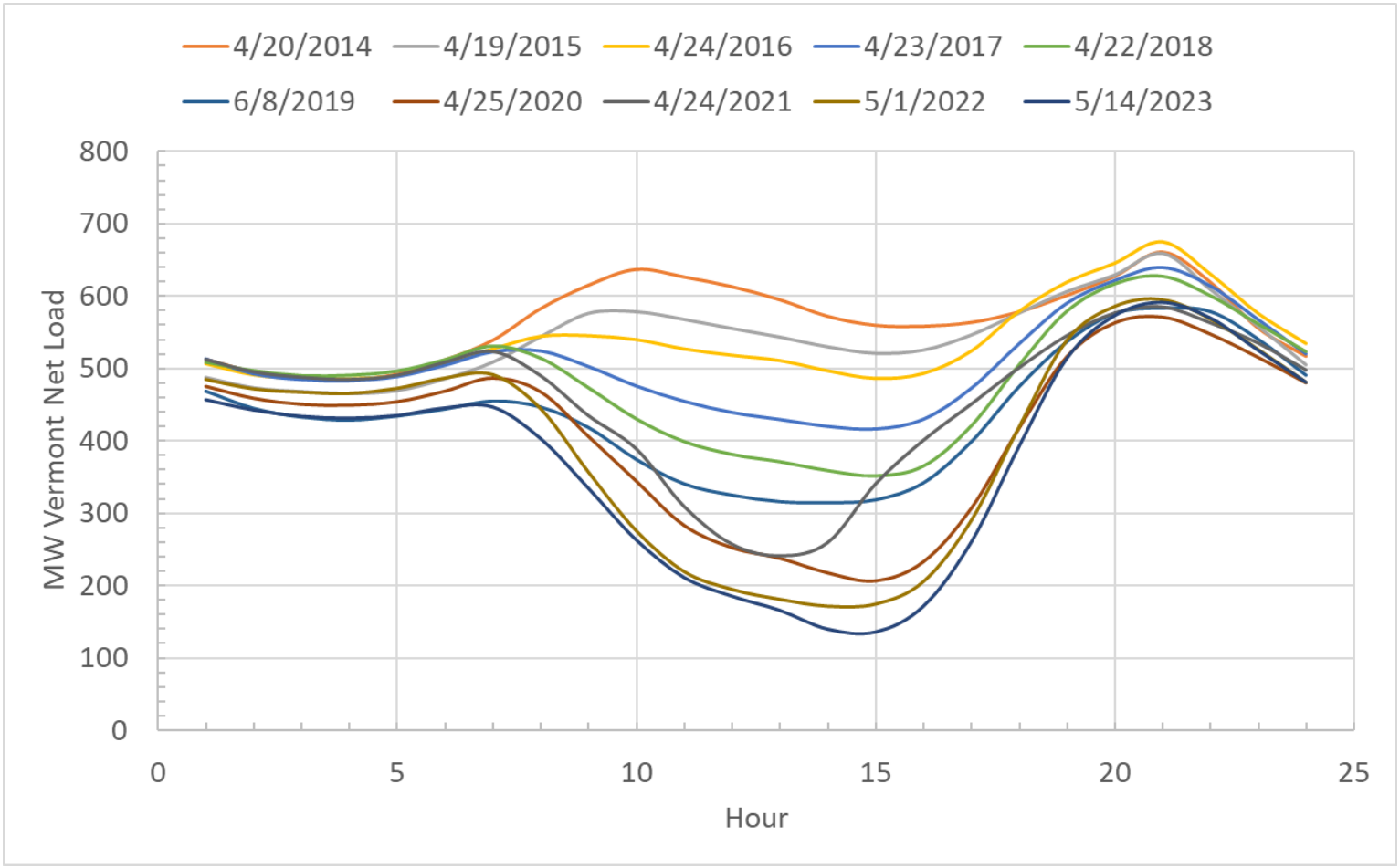
- ISO-NE under-forecasts solar PV
- Forecast does not account for other types of DG
- Forecast does not account for solar PV larger than 5 MW

Solar PV growth scenarios in the long-range plan

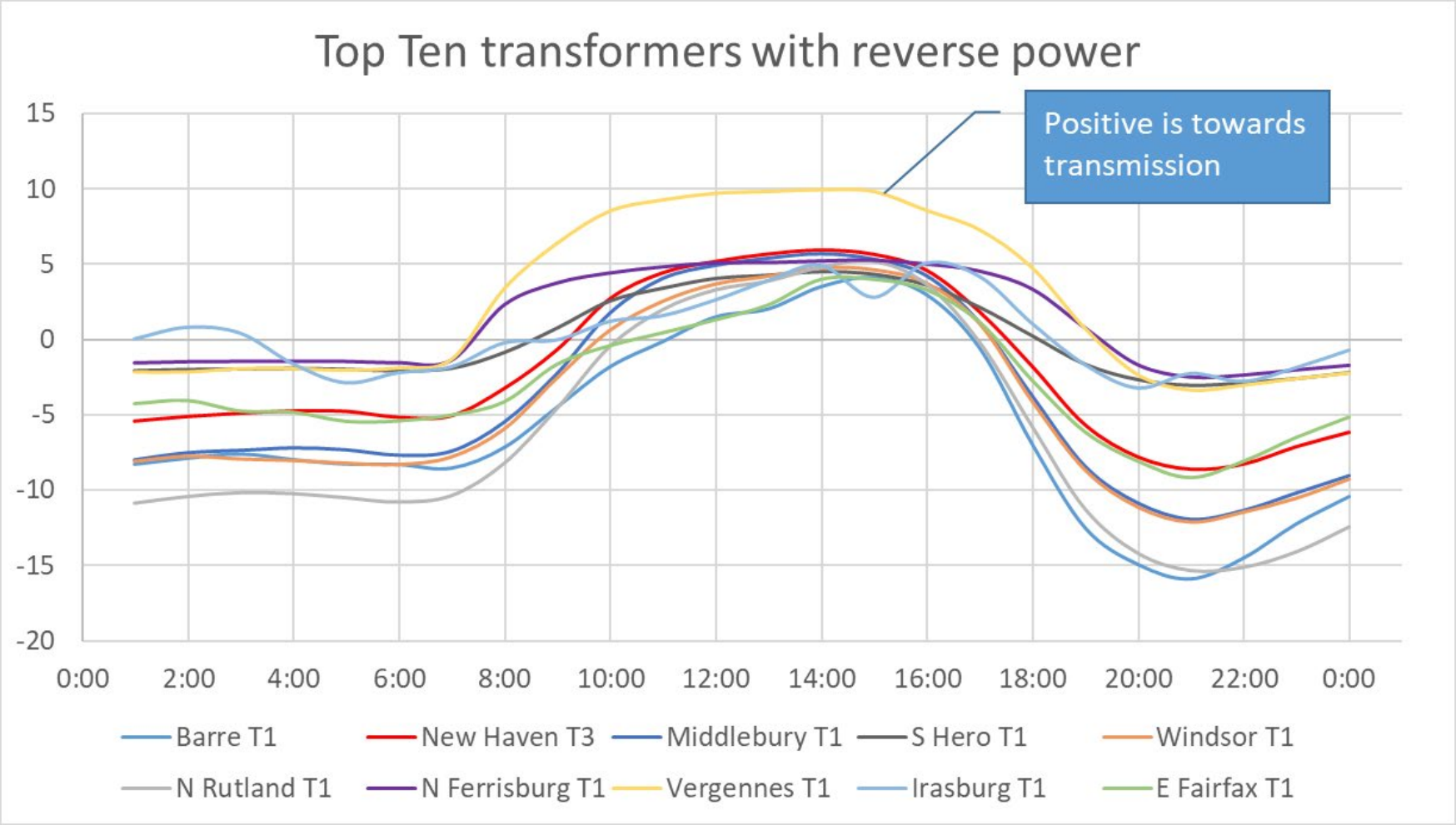



VT Distributed generation Cumulative kW by Technology
Installed kW
600,000
500,000
400,000
300,000
200,000
100,000
0
<2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Solar
Wind
Hydro
Methane
Battery

VT net loads projected to be negative within five years



- Affected by BTM “retired” hydro

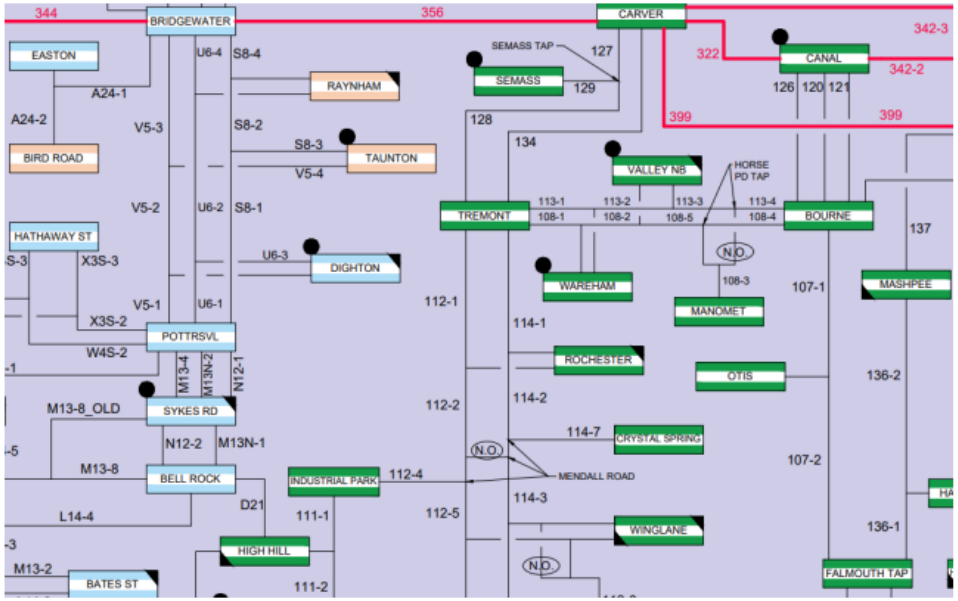

Top Ten transformers with reverse power
Positive is towards transmission
15
10
5
0
-5
-10
-15
-20
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Barre T1
New Haven T3
Middlebury T1
S Hero T1
Windsor T1
N Rutland T1
N Ferrisburg T1
Vergennes T1
Irasburg T1
E Fairfax T1

More data needed for system reliability

- 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

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



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

ISO-NE extracts data from notification forms for tracking

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

Form Data

- 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
Airport 12.5 kV	2.10
Barre South End 12.47 kV	2.20
Bay St 12.5 kV	2.20
Berlin 12.47kV	2.20
Bethel 12.47 kV	4.93
Brandon 12.47 kV	2.20
Brudies Rd 12.5 kV	4.98
Burton Hill 12.5 kV	1.89
Castleton 12.5 kV	4.40
Charlotte 12.5 kV	6.98
Chester 12.5 kV	2.18
Coventry Landfill Plant	2.20
Digital 12.5 kV	9.36
Dorset Street 12.5 kV	1.55
East Middlebury 12.5 kV	4.20
East Rutland 12.5 kV	2.00
East Ryegate 12.4 kV	1.32
East St Albans 12.5 kV	2.00
Essex 19G3 12.5 kV	4.69
Essex 19G5 12.5 kV	2.20
Ferrisburg 12.5 kV	7.00
Georgia 12.5 kV	5.00
Gilman 12.5 kV	2.10
Hardwick 12.5 kV	3.72
Hewitt Road 12.47kV	5.15

Substation totals	MW
Hinesburg 12.5 kV	3.16
Hydeville 12.47 kV	2.20
Jackson Corners 12.5 kV	3.49
Jamaica 12.5 kV	2.20
King Street 12.5 kV	1.25
Leceister 12.5 kV	2.00
Londonderry 12.47kV	4.95
Lyons Street 12.47kV	3.50
McNeil 13.8kV	2.50
Middlebury 12.47 kV	7.96
Mountain View 12.4 kV	2.20
Morrisville 3 12.5 kV	2.10
Morrisville 5 12.5 kV	2.20
Nason Street 12.5 kV	**10.86**
North Brattleboro 12.5 kV	2.00
North Elm Street 12.47 kV	4.95
North Rutland 12.5 kV	6.47
North Springfield 12.5 kV	5.00
Pawlet 12.47kV	4.10
Pittsford Village 12.5 kV	7.88
Poultney 12.5 kV	2.05
Pownal 12.5 kV	4.20
Quechee 12.5 kV	4.99
Richmond 12.5 kV	3.65

Substation totals	MW
Rochester 12.47kV	3.00
Salisbury 12.47kV	4.95
Sand Hill Rd 12.5 kV	6.50
Sharon 12.5 kV	6.80
Shelburne 12.5 kV	2.12
GMP Sheldon 12.5 kV	4.95
VEC Sheldon Springs Hydro	2.20
Silk Road 12.5 kV	6.56
South Hero 12.5 kV	4.98
South Rutland #1 12.5 kV	**12.76**
South Shaftsbury 12.5kV	2.20
Stamford 12.47kV	2.20
Stratton 12.5 kV	2.16
Underhill 12.5 kV	1.51
Vergennes 12.5 kV	6.86
Wallingford 12.5 kV	2.20
Waterbury 12.5kV	2.00
Websterville 12.5 kV	**14.99**
West Milton 12.5 kV	6.90
Westminster 12.5 kV	1.79
Weybridge 12.5 kV	4.20
White River Jct 12.5 kV	2.17
Wilder 12.5kV	4.13
Windsor 12.5kV	3.80

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