2018 Vermont Long-Range Transmission Plan

vermont electric power company

VELCO

January 24, 2018
Vermont System
Planning Committee

2018 long-range planning

- Extensive collaboration throughout planning process
  - VSPC Forecast Subcommittee
  - Distribution utility input
- Used ISO-NE and VELCO TPL-001-4 bulk system assessments for years 1-10
- Supplemented to meet VT planning requirements
  - Analyzed sub-transmission system
  - Analyzed years 11-20 only for risks and trends due to long-range forecast uncertainties and inability to forecast public policy initiatives
    - Analyzed high load scenario calibrated to meet state goal of reaching 90% renewable energy by 2050
    - Analyzed high solar PV scenario—1000 MW by 2025 consistent with Solar Pathways
- Plan will be non-CEII* public document

**CEII: Critical Energy Infrastructure Information*

Plan development timeline

Jan to Jul 2017	Prepare a load/renewable energy forecast
May to Jul 2017	Prepare load flow cases and auxiliary files
Jun 2017	Consultation with distribution utilities
Jul VSPC quarterly meeting	Review high level scope with the VSPC
Jul to Nov 2017	Perform system analysis
Jul to Oct 2017	Identify deficiencies and develop solution options
Aug 2017	Engineering support (modeling data)
Sep and Oct 2017	Construction Controls support (Cost estimates)
Nov and Dec 2017	Prepare the draft report for VSPC review
Jan to Mar 2018	Obtain formal feedback from VSPC
Mar 2018	Incorporate VSPC comments
Apr to May 2018	Conduct public meetings for input to the report
Jun 2018	Incorporate comments from the public
Jun 2018 (by 7/1/18)	Publish plan

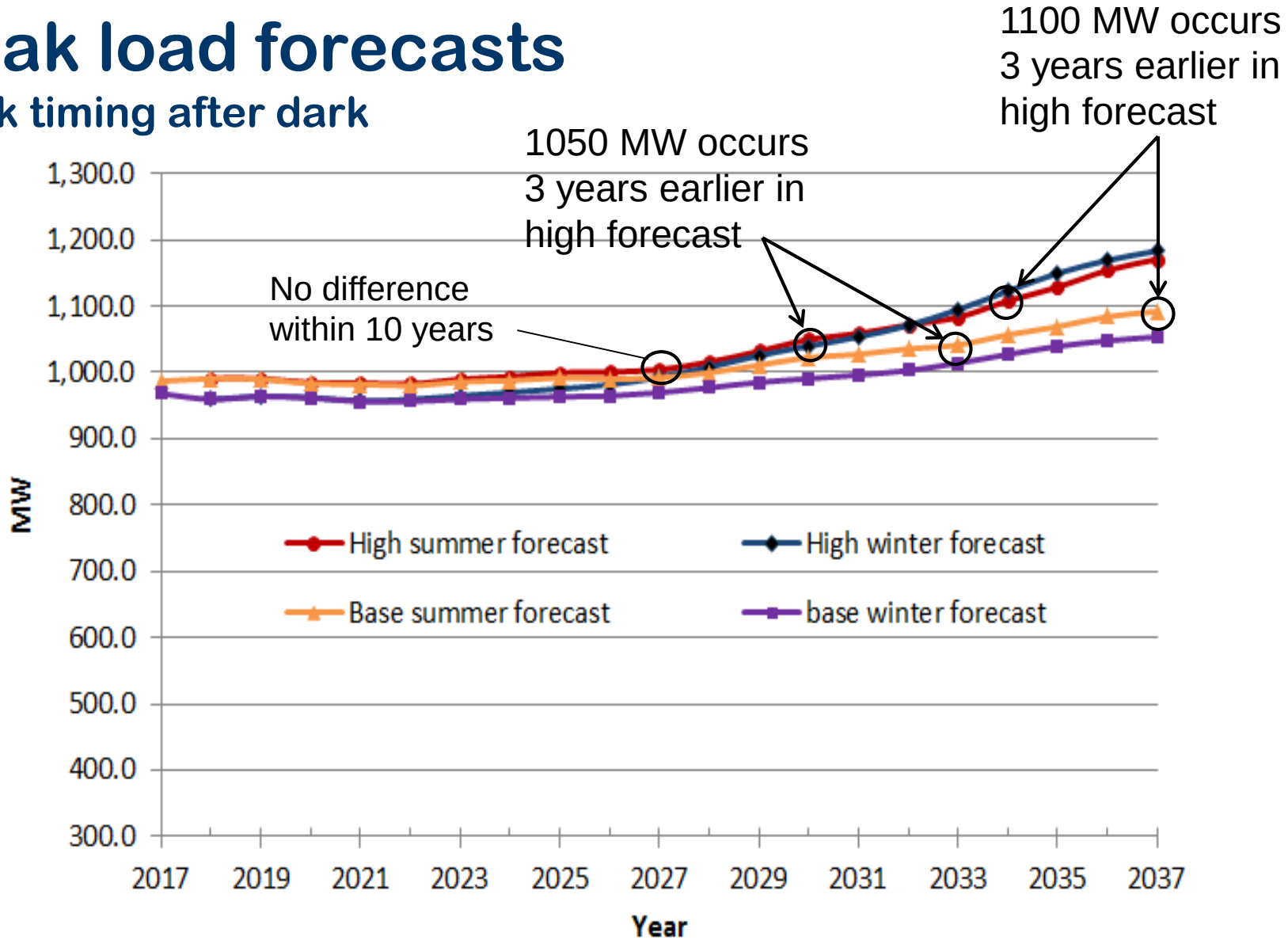
ASSUMPTIONS

Resources

- Highgate HVDC converter at 225 MW capacity (227 MW at border)
- McNeil as significant resource out of service
  - Also tested in service for local impact
- 70% of fast start generation in service
- Intermittent resources at expected seasonal output
  - Summer: solar 2.5%, wind 5%, hydro 10%
  - Winter: solar 0%, wind and hydro 25%
- New generation projects in service
  - Deerfield Wind (30 MW capacity), installed Dec 2017
  - Coolidge Solar PV (20 MW capacity), to be installed 2018
- Import from controlled tie lines
  - NY (Sand Bar and Blissville) at 0MW, and NH (Granite) at 100MW
- HVDC elective transmission upgrades modeled out of service

Peak load forecasts

Peak timing after dark

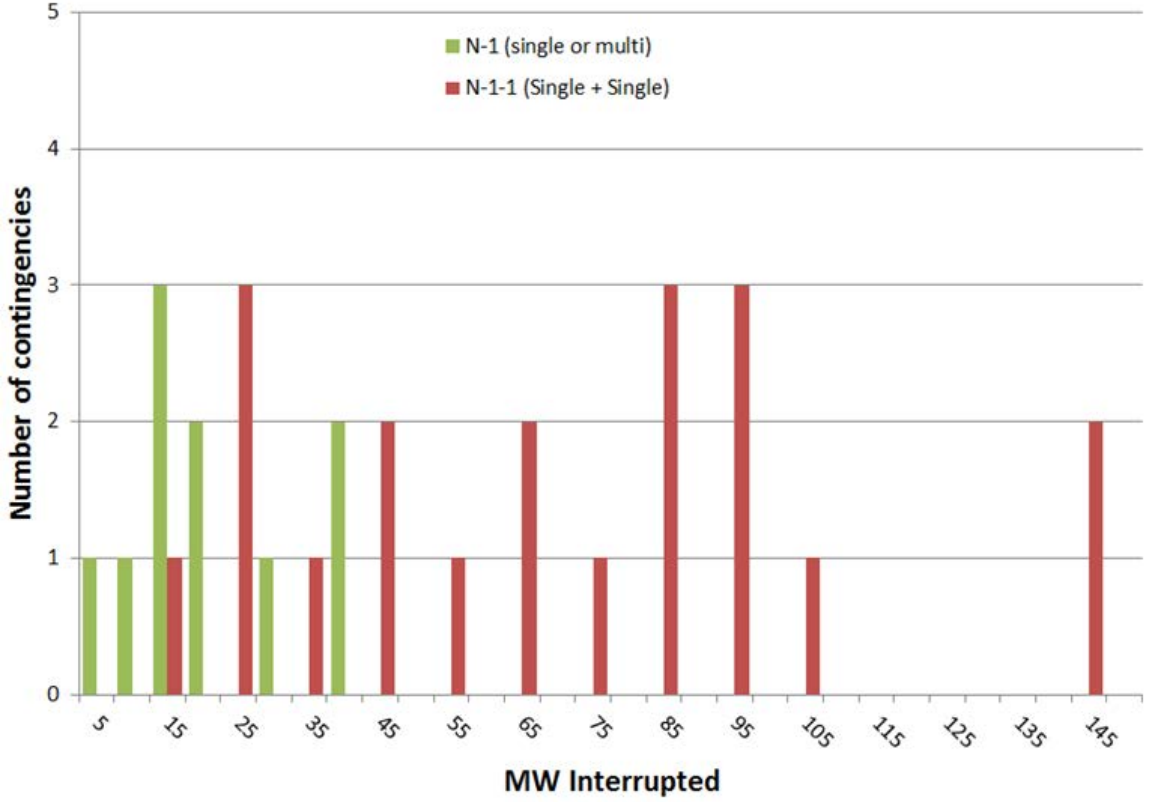


Any concerns that may occur during years 11-20 would be advanced by 3 years in the high load forecast, but still beyond 10-year horizon

RESULTS

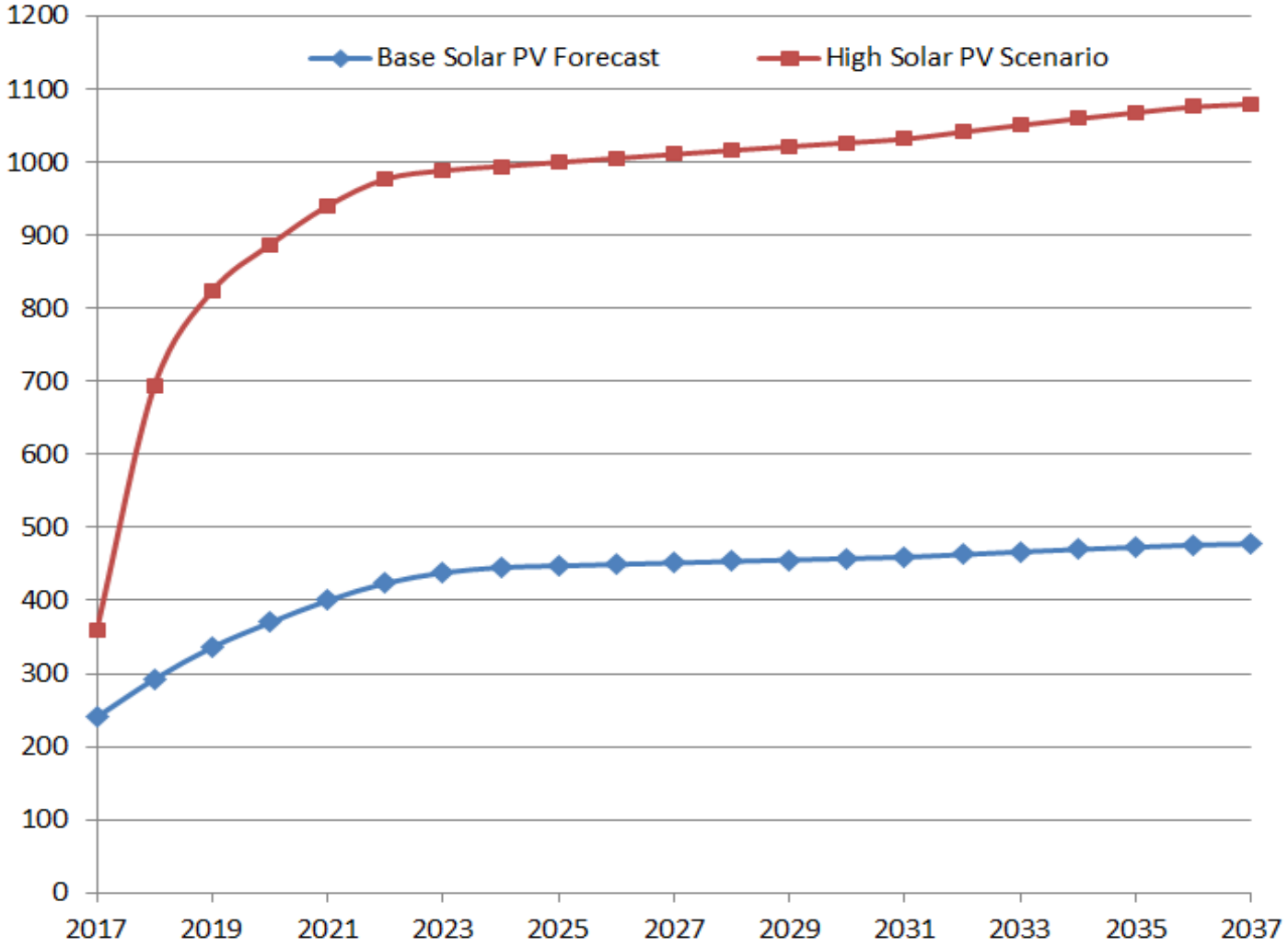
Peak load results within 10-year horizon

- No peak load concerns at bulk and predominantly bulk levels
  - Bulk issues addressed by tie line adjustments
  - Predominantly bulk issues addressed by lower loads and Rutland Area Reliability Plan
  - Acceptable loss of load exposure



SUB-TRANSMISSION POTENTIAL RELIABILITY ISSUES GROUPED BY LOCATION							
Location	**Year Needed (Projects needed in past listed as 2017 in this table)**	**90/10 Load Forecast for Year (MW)**	**Contingency**	**Reliability Concern**	**N-1 Criteria Violation**	**Affected DUs**	**Lead DU**
Ascutney	2025	992	Transformer Subtransmission	Low Voltage	Lafayette – Bridge St. – Bellows Falls	GMP / PSNH	GMP
Ascutney	2025	992	Transformer Subtransmission	Thermal	Highbridge – Ascutney	GMP / PSNH	GMP
Blissville	2025	992	Transformer	Low Voltage	Blissville area	GMP	GMP
Blissville	2030	1023	Transformer	Thermal	Blissville – Hydeville	GMP	GMP
Rutland	2017	< 970 Winter	Subtransmission End open	Low voltage	Snowshed (winter)	GMP	GMP
Montpelier	2031	1028	Transmission	Thermal	Marshfield – Danville GMP – Danville WEC	GMP	GMP
Montpelier	2017	< 987	Subtransmission End open	Low Voltage	Ryegate / Newbury	GMP	GMP
Montpelier	2017	970 Winter	Subtransmission End open	Low Voltage	Moretown – Irasville – Madbush (winter)	GMP / WEC	GMP
Montpelier	2017	< 970 Winter	Subtransmission End open	Thermal	Northfield – W Berlin (winter)	GMP / WEC	GMP
Burlington	2017	< 987	Transformer Subtransmission	Thermal	Gorge – McNeil	GMP / BED	GMP
St. Albans	2017	< 987	Subtransmission End open	Thermal	Welden St. – East St. Albans	GMP	GMP
St. Albans	2025	992	Transformer Transmission	Low voltage	Sheldon	GMP	GMP

High solar PV scenario



Study of spring load (A saturday in April 2025)

- System conditions tested
  - Substation loads at 620 MW, losses pre small-scale solar PV at 30 MW
  - Plattsburg-Sand Bar flow at 0 MW, Comerford-Granite flow at 100 MW
  - Highgate at 225 MW capacity (227 MW at border)

Generation	Amount	Generation	Amount
Utility-scale wind	151 MW	Landfill methane	11 MW
Utility-scale hydro	155 MW	Coolidge solar PV	20 MW
Utility-scale biomass	70 MW	Diesels and GTs	0 MW

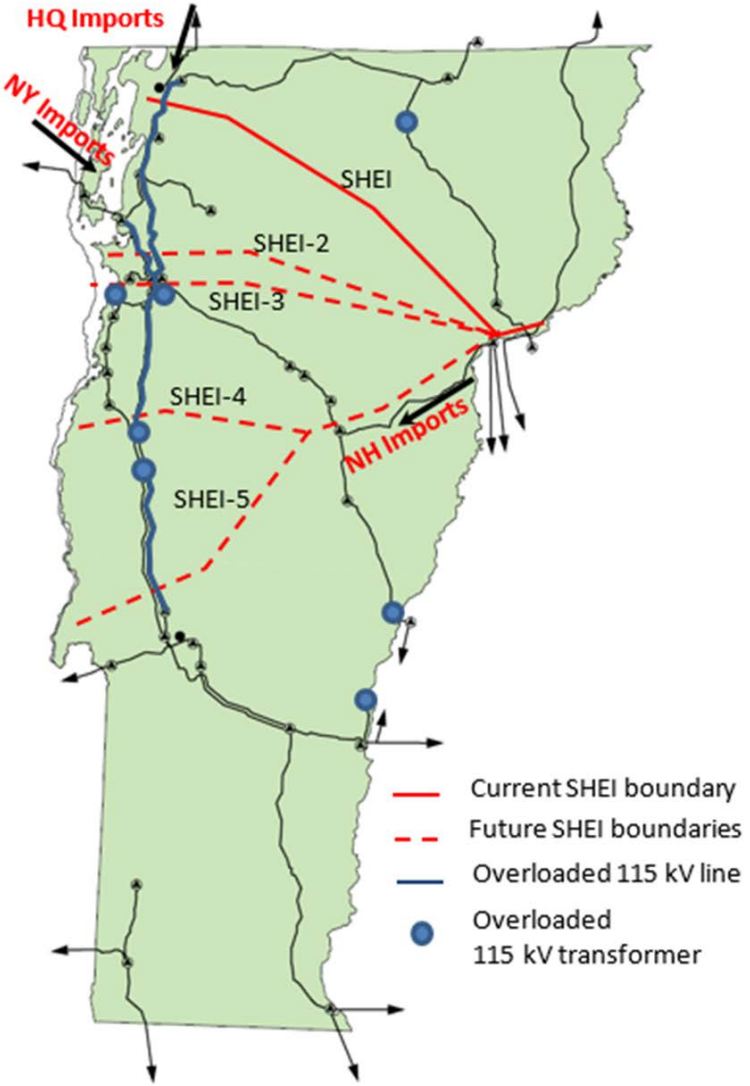
- Results of base solar PV (448 MW) forecast
  - System losses increased by 8 MW
  - Greater SHEI impacts
    - Voltage collapse within SHEI and additional sections of K42 line overloaded
    - Overloads south of Georgia depending on Plattsburg-Sand Bar tie flow

Results of high solar PV scenario

- Same system condition as base solar PV forecast analysis, but small-scale solar PV increased to 1000 MW
- Will introduce significant operational challenges
  - Very large flows pre-contingency
  - System losses increased by 45 MW
  - Transmission overloads extend south of SHEI* towards Rutland
    - Even with Plattsburg-Sand Bar tie flow at 0 MW
    - May run out of angle range on Sand Bar phase angle regulator to maintain flows low enough to prevent overloads under some conditions
    - Any reduction in Northern Vermont generation will be annulled by NY-VT tie flows
  - Low voltage on bulk system and high voltage on subsystem
    - Managing pre- and post-contingency voltages will require dynamic voltage support

**SHEI: Sheffield-Highgate Export Interface*

Bulk and predominantly bulk concerns in high solar scenario



- SHEI is current constraint interface
- SHEI-1 to SHEI-5 are expansions of constraint

SHEI: Sheffield-Highgate Export Interface

Batteries to address overloads of subsystem transformers serving distribution

Bus Name	Capacity (MW)	Energy (MWh)*
NORWICH UNIV	0.5	2
MOORE_D	0.5	2
HEWITT RD_D	5.5	22
LEICESTER_D	2.0	8
MIDDLEBRY_D1	10.0	40
MIDDLBURY_D2	7.5	30
QUECHEE	1.5	6
NORWICH_D	2.5	10

** All batteries are assumed to have four hours of energy*

Batteries to address bulk, predominantly bulk and subsystem concerns

Location	MW	MVAr	MWh
Essex 115	150	-	600
Lowell 46	15	12	60
Crossroads 46	35	25	140
Pleasant St 46	5	4	20
Bethel 46	47.5	33.5	190
Hartford 46	8	6	32
Ryegate 46	10.5	3	42
White River Jct 46	30	25	120
Windsor V4 46	16	12	64
Leicester 46	1.5	1	6
Smead Road 46	45	34	180
Agrimark Tap 46	1.5	0	6
Fairfax Falls 34	8.5	6	34
Johnson 34	6	4	24
Websterville 34	3	2	12
Ryegate 34	12	10	48
McNeil Tap 34	20	15	80
Tafts Corner 34	15	12	60
Queen City 34	10	8	40

Conclusions

- Low load/high generation concerns will replace peak load/low generation concerns
  - No bulk or predominantly bulk concerns to be within 10 years
  - High load scenario has minimal effects
  - Flagged several potential subsystem issues to be further evaluated by DUs
- Base solar PV results showed more severe SHEI concerns and expansion of constraints south of Georgia
- High solar PV scenario will cause significant challenges
  - May be managed with careful planning, upgrades, demand-side management, storage, and other strategies
  - Rough/conceptual cost estimate if solved entirely by upgrades
    - $360M for wires solutions or $1000M for battery storage solutions
  - Not all renewable energy needs to be developed within Vermont
  - Need the right tools, policies, technology and processes to achieve long-term renewable energy goals