

2024 Vermont Long Range Transmission Plan



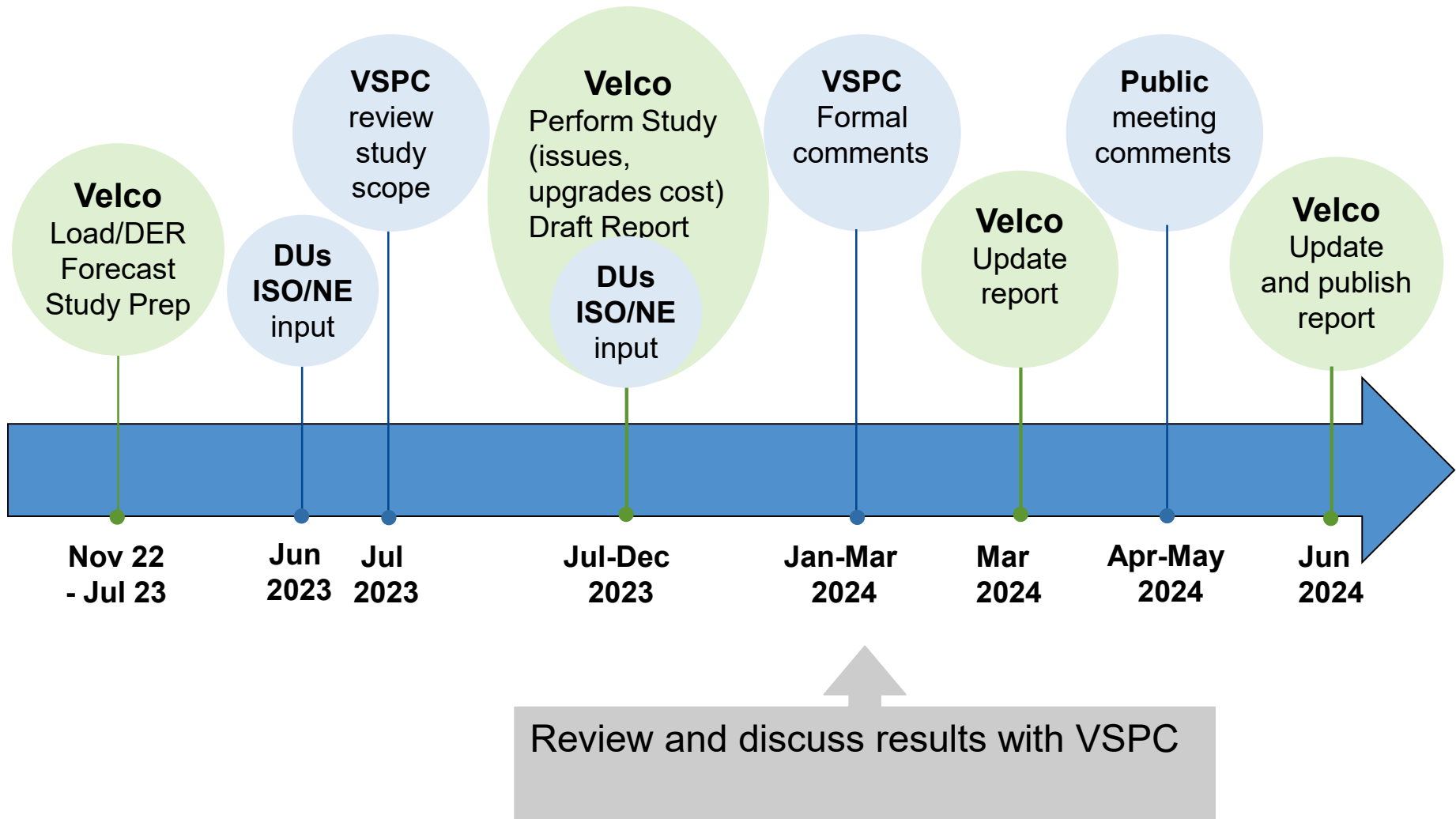
January 24, 2024

VELCO/VSPC planning meeting

Outline

- Study Plan
 - LRP Milestones
 - Data Inputs
 - Scenarios
- Study Results
- Next Steps

LRP Milestones



Data Inputs

- Itron
 - Load forecast based on existing and expected trends, policies
 - HP, EV, PV
- Distribution utilities (DU) and the Public Service Department (PSD)
 - Distributed generation (DG)
 - installed/proposed by fuel type
 - Aggregated by distribution substation
 - Distribution substations
 - Transformer voltage levels and rating
 - “Not to exceed” limits on generation
 - Resource plans
 - EV chargers and other controllable loads
 - distributed or grid-scale storage
- ISO/NE
 - Load flow cases and associated files
 - Contingency scenarios

Scenarios

- Peak Load
 - Policy/expected, Low
 - Summer, Winter
 - 2033, 2043
- Spring Daytime Load
 - Low load
 - DER 500 - 1300 in 100 MW increments (Tier II Standard)
 - Other BTM generation resources at full capacity

RESULTS

POLICY SCENARIO

Study Results – Policy

VT Overloaded Facilities – Peak Policy N-1

Overloaded Transformers	2033	2043	
	Number of Violations	Number of Violations	NTA in 2033
QUEEN CITY 115/34.5 kV	7	13	95 MW
ASCUTNEY 115/46 kV	1	8	Shed load
ST ALBANS 115/34.5 kV	7	8	Rerate
BARRE 115/34.5 kV	-	5	
WINDSOR 115/46 kV	-	13	
NORTH RUTLND 115/46 kV	-	5	
BENNINGTON 115/46 kV	-	6	

No transmission line overloads for N-1

Study Results – Policy

VT Overloaded T/L – Peak Policy N-1-1

Line	2033	2043
	Number of violations	Number of violations
Line 1	-	41
Line 2	-	22
Line 3	-	12
Line 4	-	8
Line 5	-	4
Line 6	-	4
Line 7	-	2
Line 8	-	2

Total length of overloaded lines: 75 miles

Study Results – Policy

Overloaded Subtransmission – Policy Peak N-1 and N-1-1

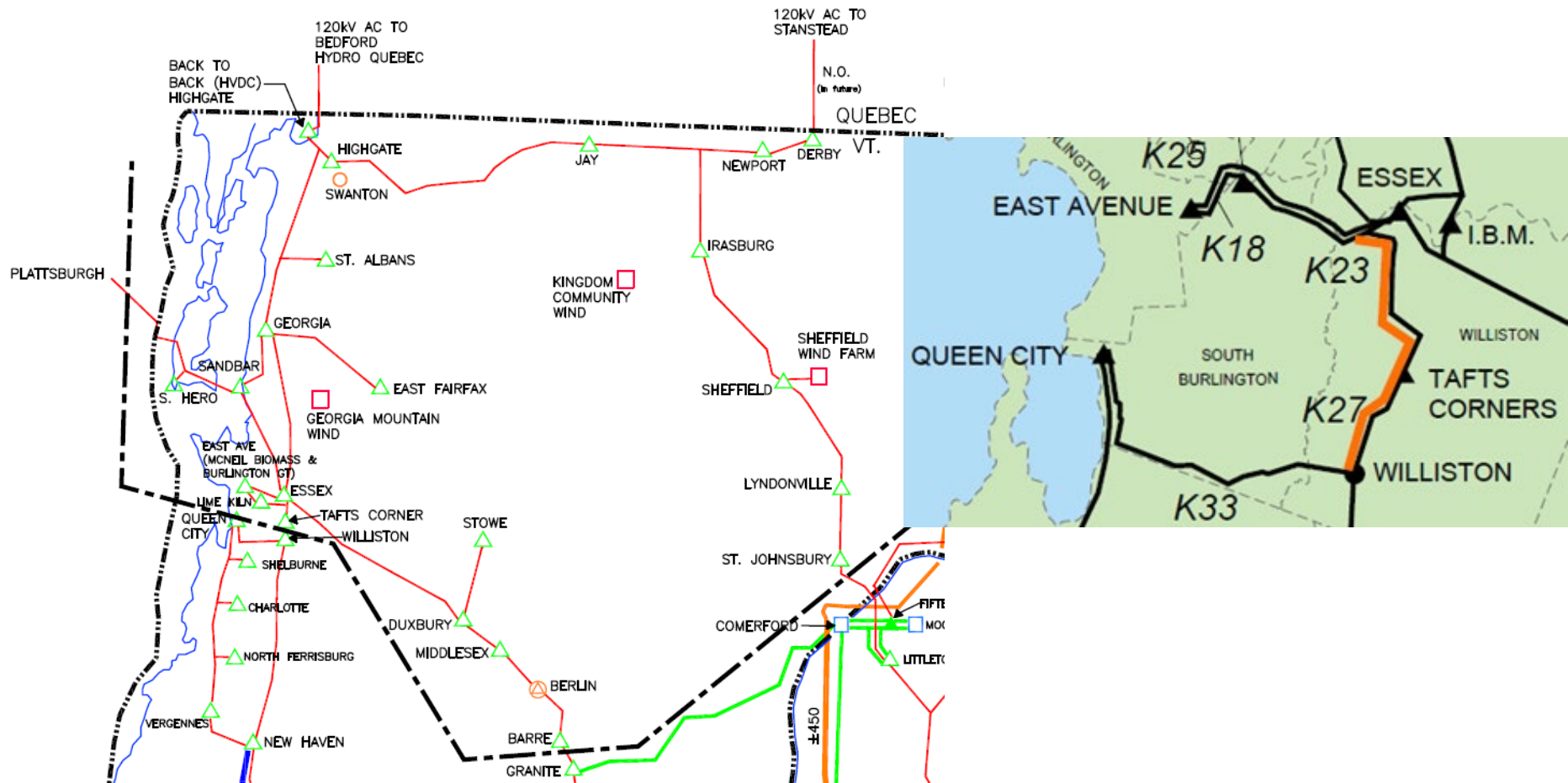
Summary

		N-1		N-1-1	
Year		2033	2043	2033	2043
Sub-transmission Transformers		1	1	1	1
Total length of overloaded lines (miles)	overload >100%	23	92	185	323
	overload >=110%	15	45	127	262

Assumed overloaded subtransmission lines would trip – caused or aggravated overloads on transmission facilities

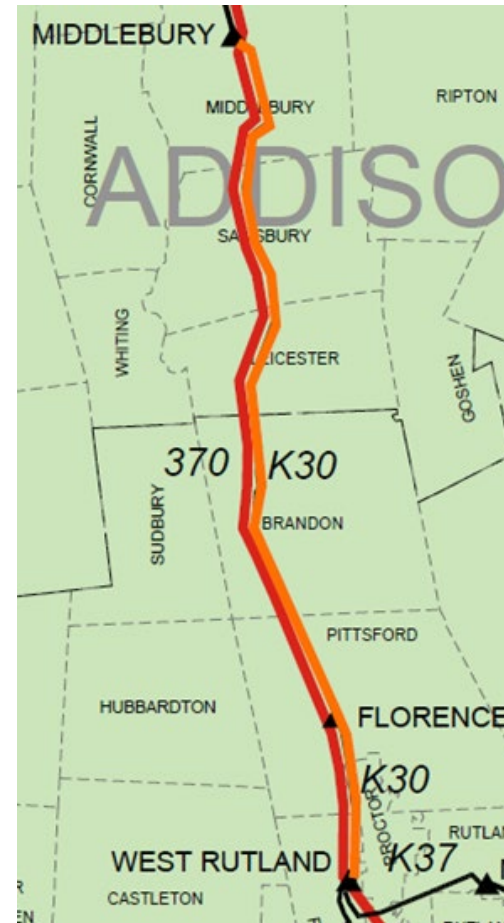
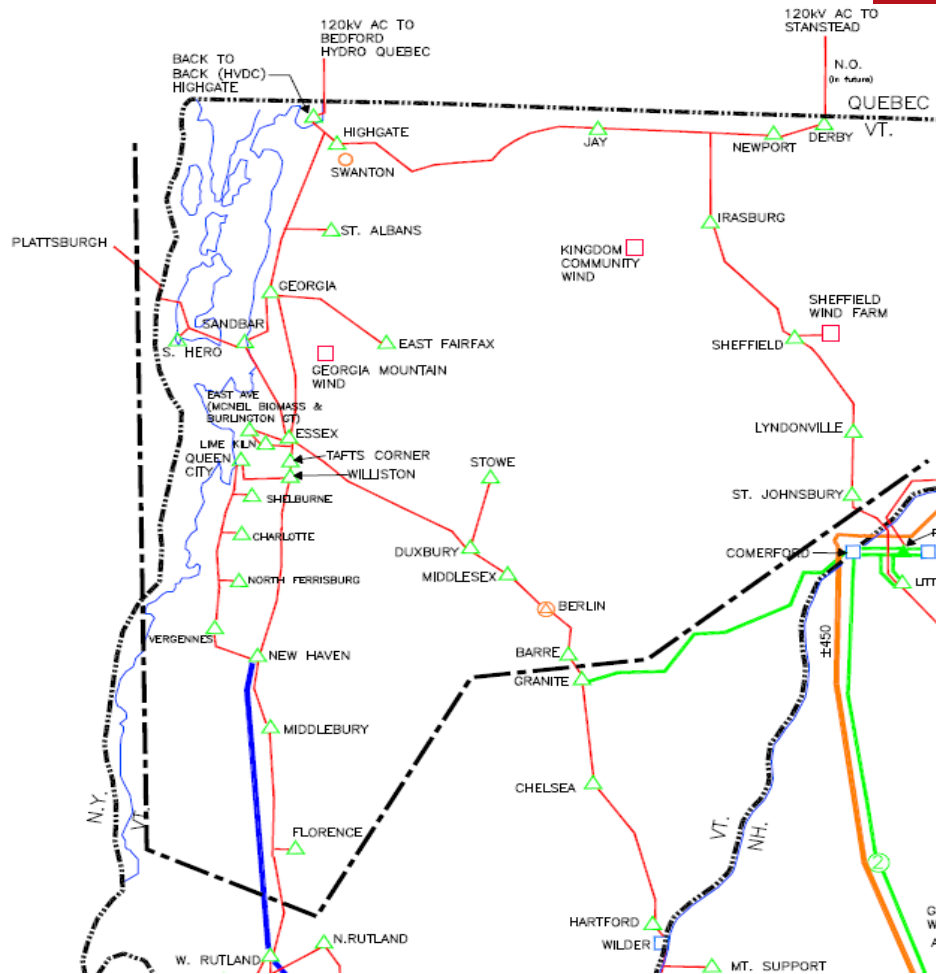
POLICY SCENARIO 2033

Northern Vermont area of concern



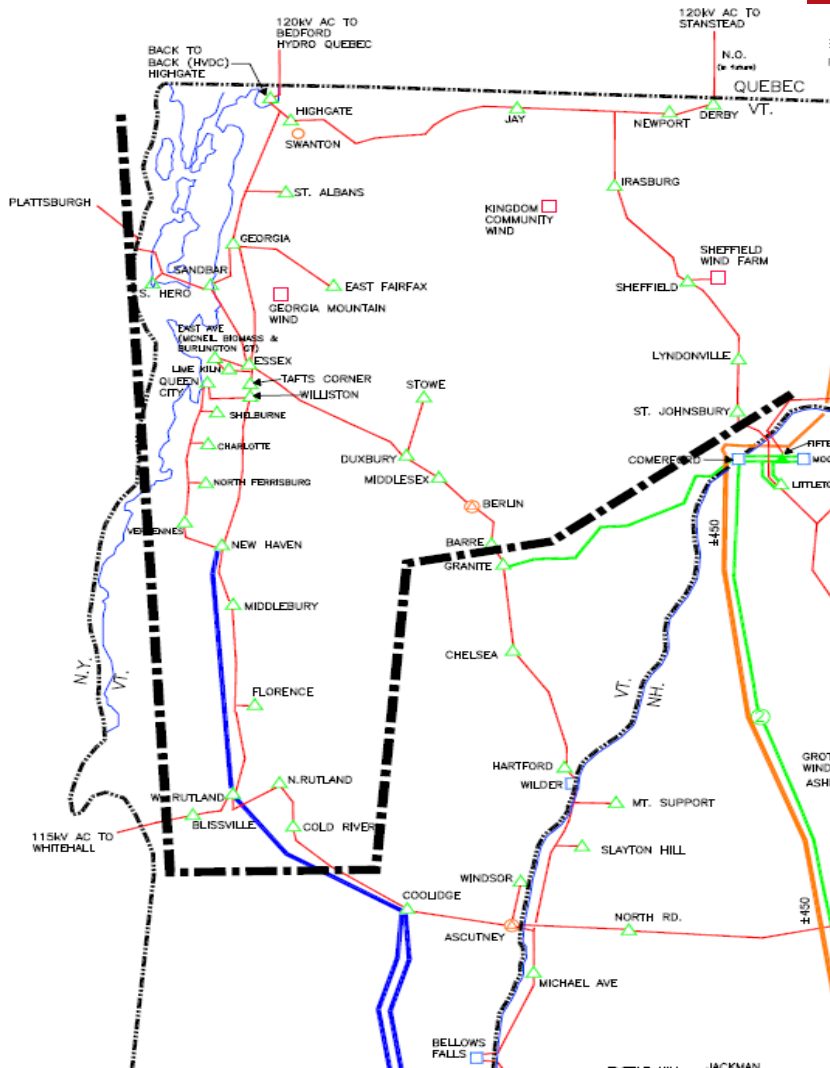
POLICY SCENARIO 2033

Northwest Vermont area of concern



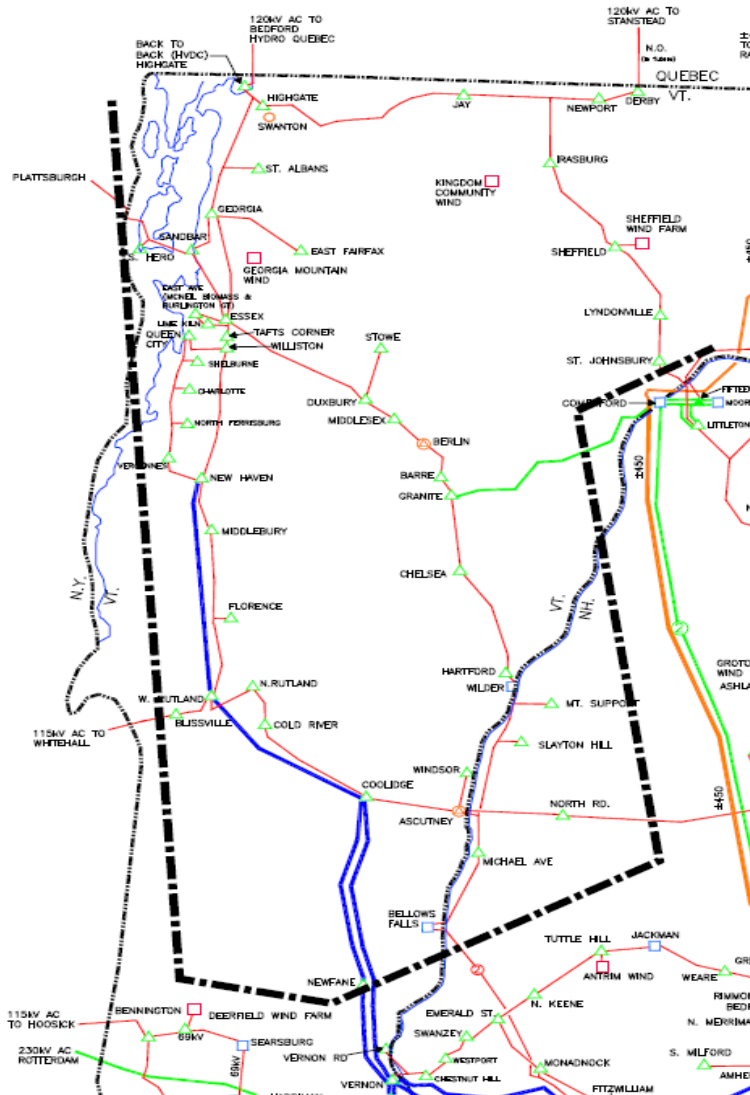
POLICY SCENARIO 2033

Central Vermont area of concern



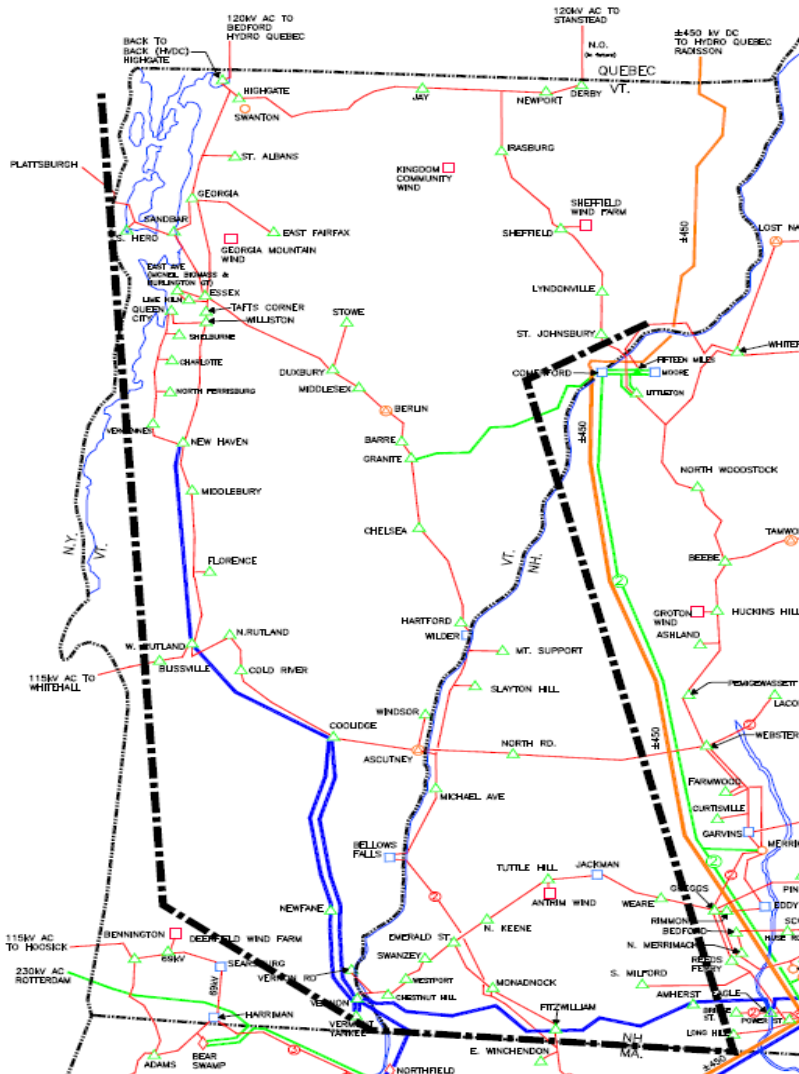
POLICY SCENARIO 2033

Southern Vermont area of concern



POLICY SCENARIO 2033

Vermont area of concern

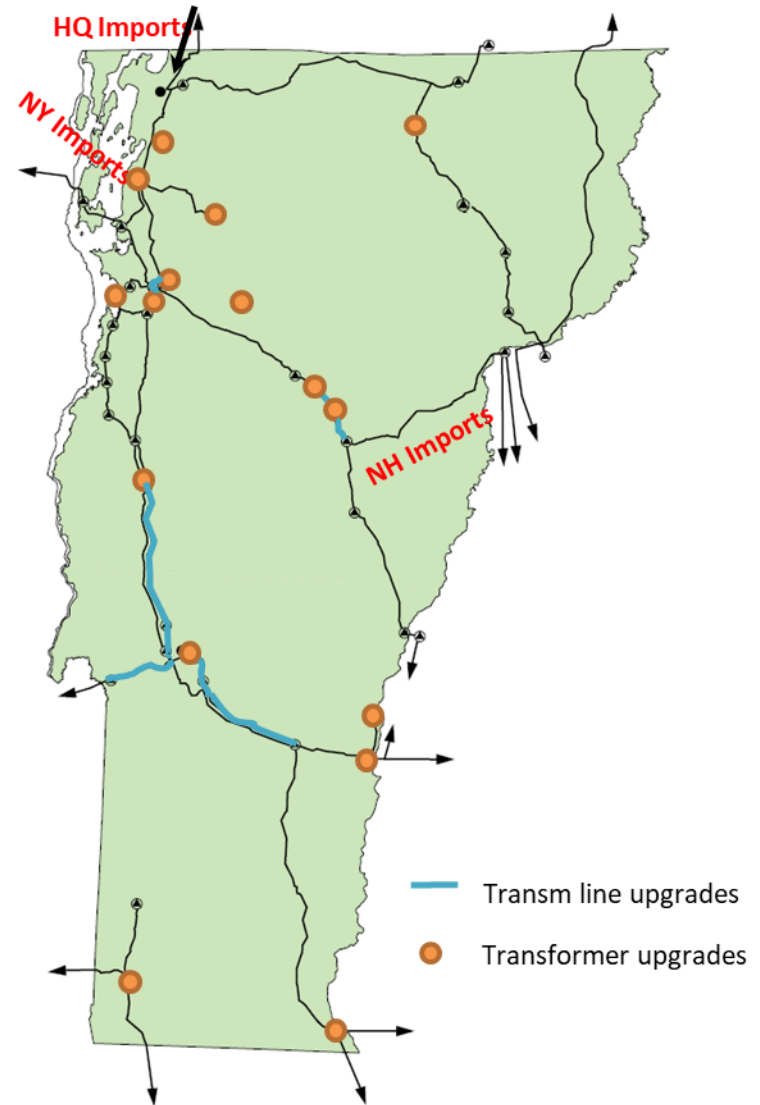


Bulk System result summary – Policy Scenario

SUMMARY OF BULK SYSTEM REGIONAL GROUPING & TRANSMISSION SOLUTIONS	LEAD & AFFECTED DISTRIBUTION UTILITIES	ESTIMATED TRANSMISSION PROJECT COST	SCREENED IN OR OUT OF FULL NTA ANALYSIS
Northern area <ul style="list-style-type: none"> Install a new 115 kV line between Essex and Williston N-1-1 contingency causing overload & voltage collapse exposure Affected transformers: Queen City, Tafts Corner, Barre Need date is 2032 based on winter expected forecast 	<i>Lead:</i> GMP <i>Affected:</i> All VT	\$100M Three X \$11M	In 75 MW of load reduction in northern area by 2033 Grows over time
Northwest area – includes northern area <ul style="list-style-type: none"> Rebuild West Rutland to Middlebury 115 kV line N-1-1 contingency causing thermal overload Affected transformer: Middlebury Need date is 2029 based on summer expected forecast 	<i>Lead:</i> GMP <i>Affected:</i> All VT	\$215M \$13M	In 80 MW of load reduction in northwest area by 2033 Grows over time
Central area – includes northwest area <ul style="list-style-type: none"> Rebuild Coolidge - Cold River - North Rutland 115 kV line N-1-1 contingency causing thermal overload Affected transformers: North Rutland, Cold River, Windsor Need date is 2034 based on summer expected forecast 	<i>Lead:</i> GMP <i>Affected:</i> All VT	\$185M Three X \$13M	In Keep load below 2033 load level in central area Grows over time
Southern area – includes central area <ul style="list-style-type: none"> Rebuild NGRID Bellows Falls-Ascutney Tap 115 kV line and GMP Vernon Road to Newfane 46 kV N-1-1 contingency causing thermal overload Affected transformer: GMP Vernon Road 115/46 kV Need date is 2034 based on summer expected forecast 	<i>Lead:</i> GMP <i>Affected:</i> All VT, NGRID	No VELCO estimate	In Keep load below 2033 load level in southern area Grows over time
State of Vermont <ul style="list-style-type: none"> Install new 345 kV line between Vernon & Eversource Northfield, MA N-1-1 contingency causing thermal overload Affected transformers: Bennington Need date is 2034 based on summer expected forecast 	<i>Lead:</i> GMP <i>Affected:</i> All VT, Eversource	\$5M for VELCO portion \$13M	In Keep load below 2033 load level in Vermont Grows over time

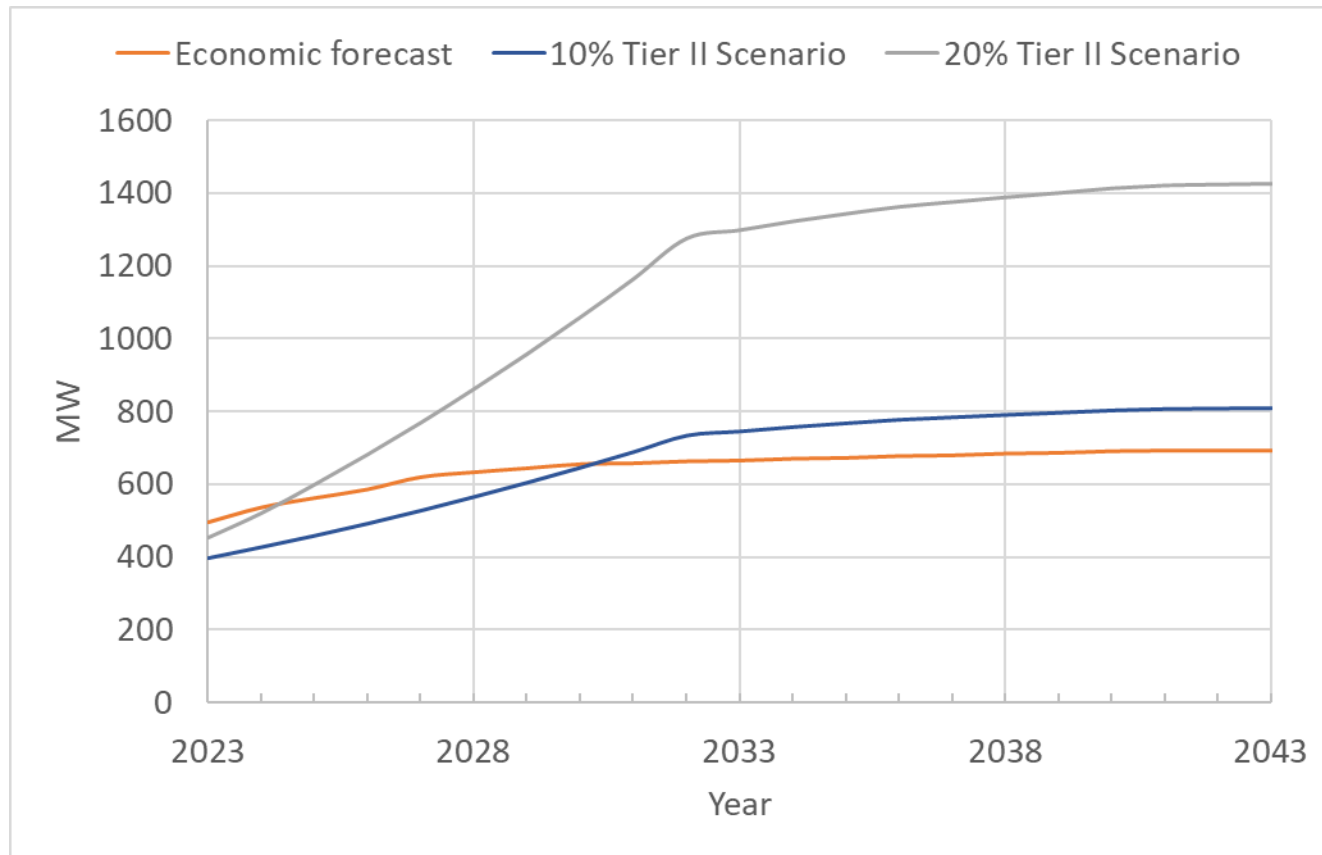
Policy Scenario 2043

- 75 miles length of overloaded lines
- 19 overloaded transformers
- 55K contingency scenarios studied
 - West Rutland- Florence 115 kV path overloads in 40 scenarios
 - Queen City 115 /34.5 kV transformer overload in 126 scenarios
- Total upgrades cost: \$840M



PV HOSTING CAPACITY

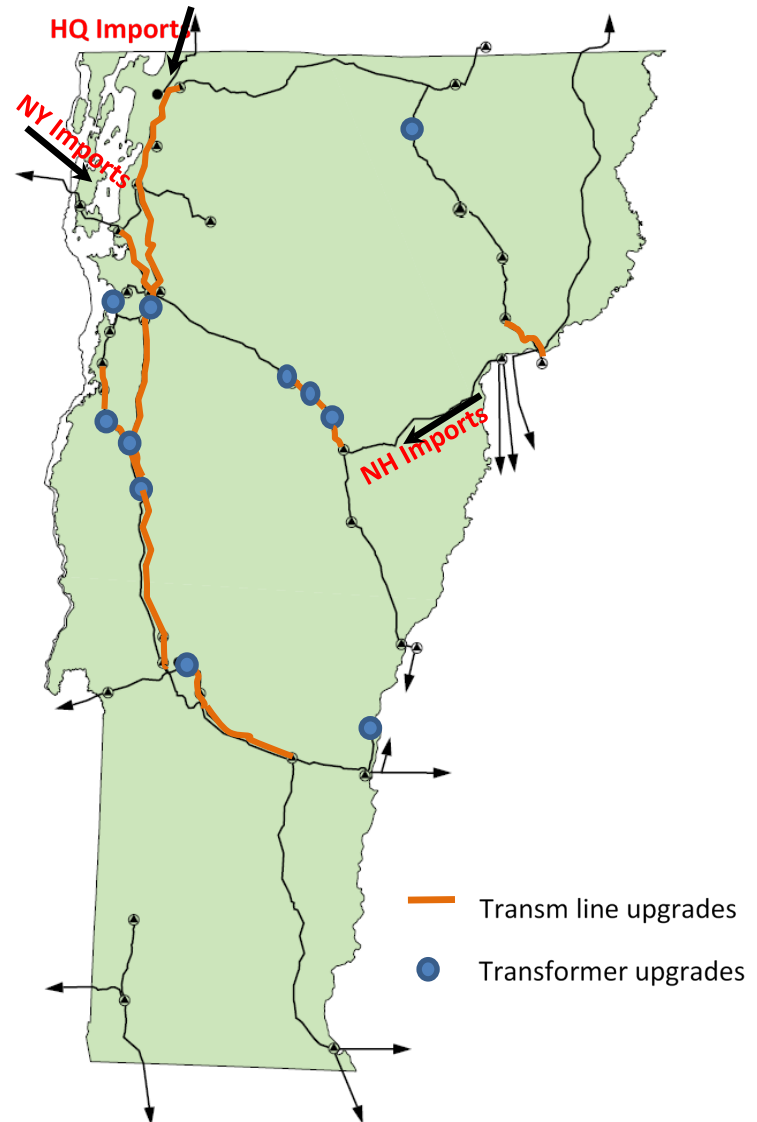
Solar PV forecast



Vermont Renewable Energy Standard, Tier II – Distributed Renewable Generation

Overloaded Transmission Facilities at 1300 MW DG

- 156 miles length of overloaded lines
- 10 overloaded transformers
- 1200 contingency scenarios studied
 - Essex- Tafts Corner- Willington 115 kV path overloads in 200+ scenarios
 - Vergennes 115 /34.5 kV transformer overload in 61 scenarios
- Total upgrades cost: \$1400M



LOAD CONTROL:

(GENERATION/STORAGE/
DEMAND RESPONSE)

Load reductions to address peak load issues

Policy Peak N-1-1, 2043 Winter

- Load Reduction^(*) in MW

Location	Load Reduction (MW)
COLD RIVER	60
QUEEN CITY	55
VERNON ROAD	30
MCNEIL	26
EAST FAIRFAX	25
WINDSOR	25
IRASBURG	20
DORSET	15
STRATTON	15
BARRE	10
DIGITAL	10
KENDALL FARM	10
MIDDLEBERRY	10
SNOWSHED	10
ESSEX	9
SHELBURNE	9
MTN VIEW	8
SOUTH END	8

Location	Load Reduction (MW)
MANCHESTER	7
MILTON	7
E RUTLAND	6
ETHAN ALLEN	6
MALLETS BAY	6
NASON STREET	6
TAFTS CORNER	6
EAST AVENUE	5
LAFAYETTE	5
SAND ROAD	5
TOWNLINE	5
CHARLOTTE	4
E ST ALBANS	4
BETHEL	3
IROQUOIS	3
BRANDON	2
HINESBRG	2
RICHMOND	2

(*) this could be demand response, load reduction, DER, Battery production, Microgrid solutions etc...

Load reductions to address peak load issues

Policy Peak N-1-1, 2043

- Total Load Reduction^(*) Needed in MW

	Winter Peak	Summer Peak
GMP	394	365
VEC	20	10
BED	25	25
Total	439	400

(*) this could be demand response, load reduction, DER, Battery production, Microgrid solutions etc...

Load additions to address excess DG issues

PV Hosting Capacity (DER=1300MW)

- Load Increase in MW^(*)

Location	Voltage	Load Increase in MW
HIGHGATE	115	60
SANDBAR	115	60
ESSEX	115	50
GEORGIA	34.5	50
EAST FAIRFAX	34.5	35
NASON	34.5	30
IRASBURG	46	20
WINDSOR	46	15
NEW HAVEN	46	15
VERGENNES	34.5	15
ST JOHNSBURY	34.5	15
MIDDLESEX	34.5	15
STOWE	34.5	15
SHEFIELD WND	34.5	15
EAST AVENUE	34.5	15
TAFTS CORNER	12.5	15
COLD RIVER	46	10
MIDDLEBURY	46	10
BARRE	34.5	10
CHARLOTTE	12.5	10

(*) Solution could be energy storage, generation curtailment, demand response, etc...

Load additions to address excess DG issues

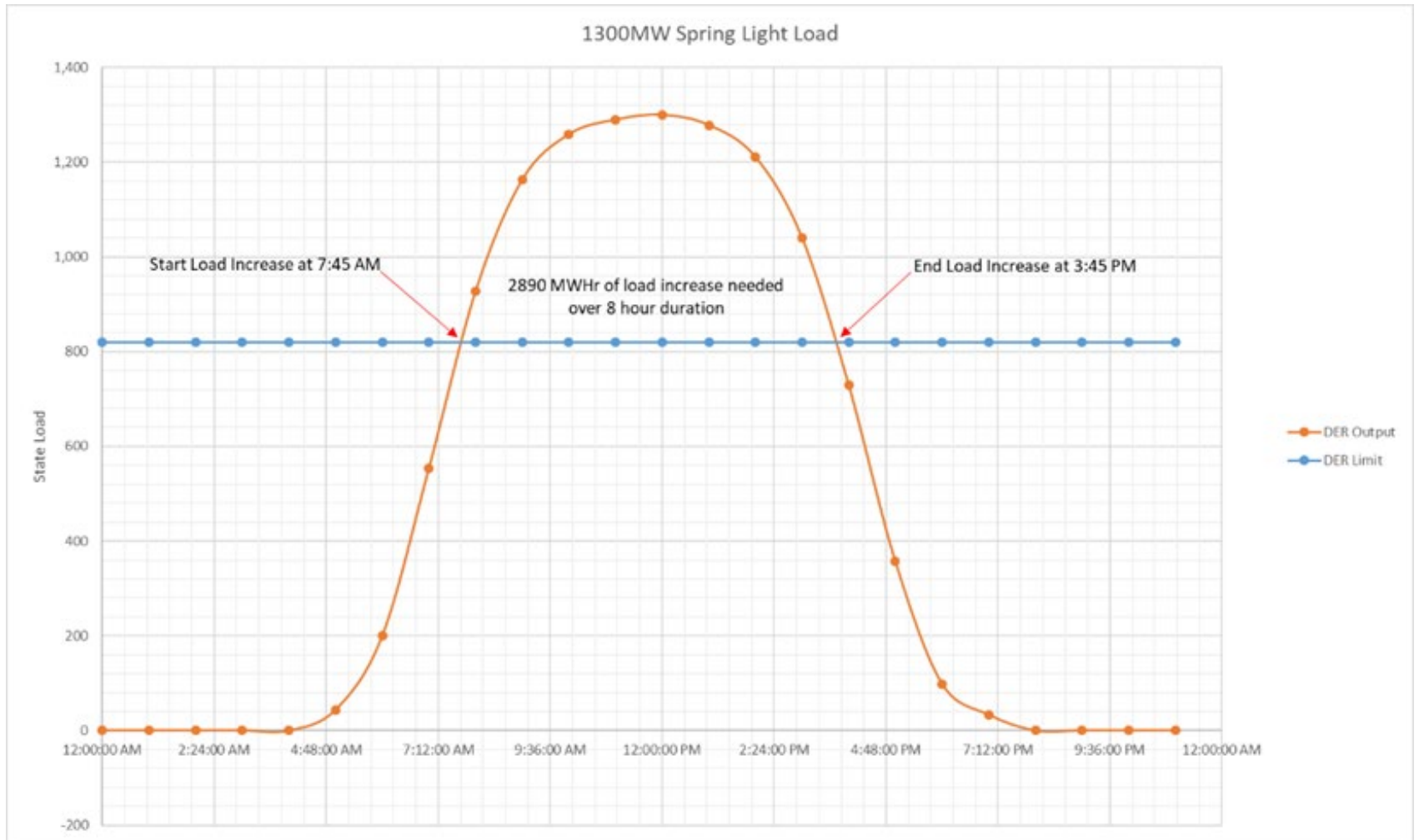
PV Hosting Capacity (DER=1300MW)

- Total Load Increase in MW^(*)

	Load Increase (MW)
VELCO	125
GMP	250
VEC	70
BED	20
STOWE	15
Total	480

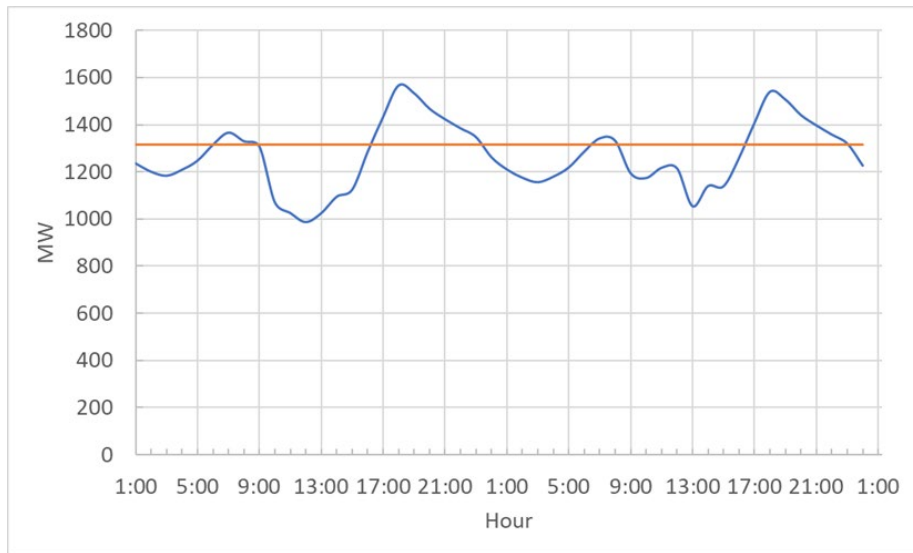
(*) Solution could be energy storage, generation curtailment, demand response, etc...

The details matter

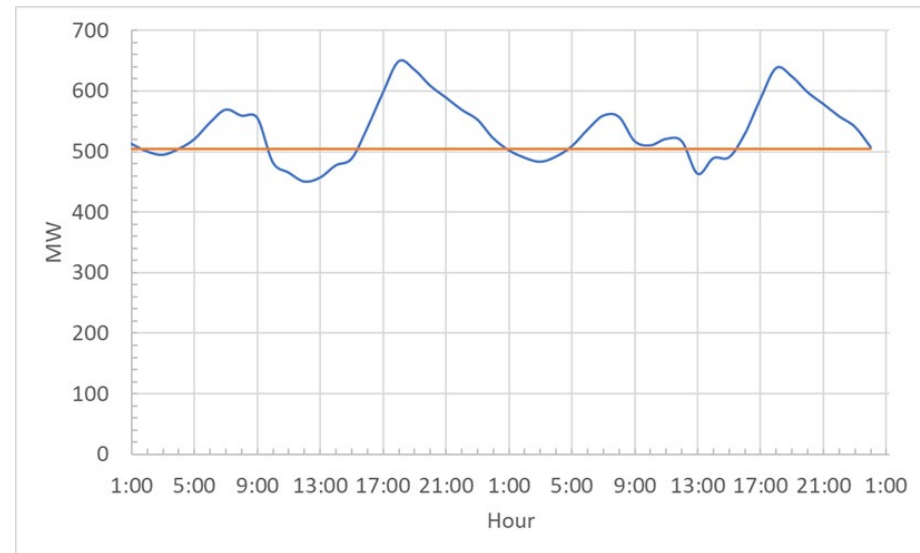


The details matter – 2043 example

State wide load control



Entire Load control in northern area

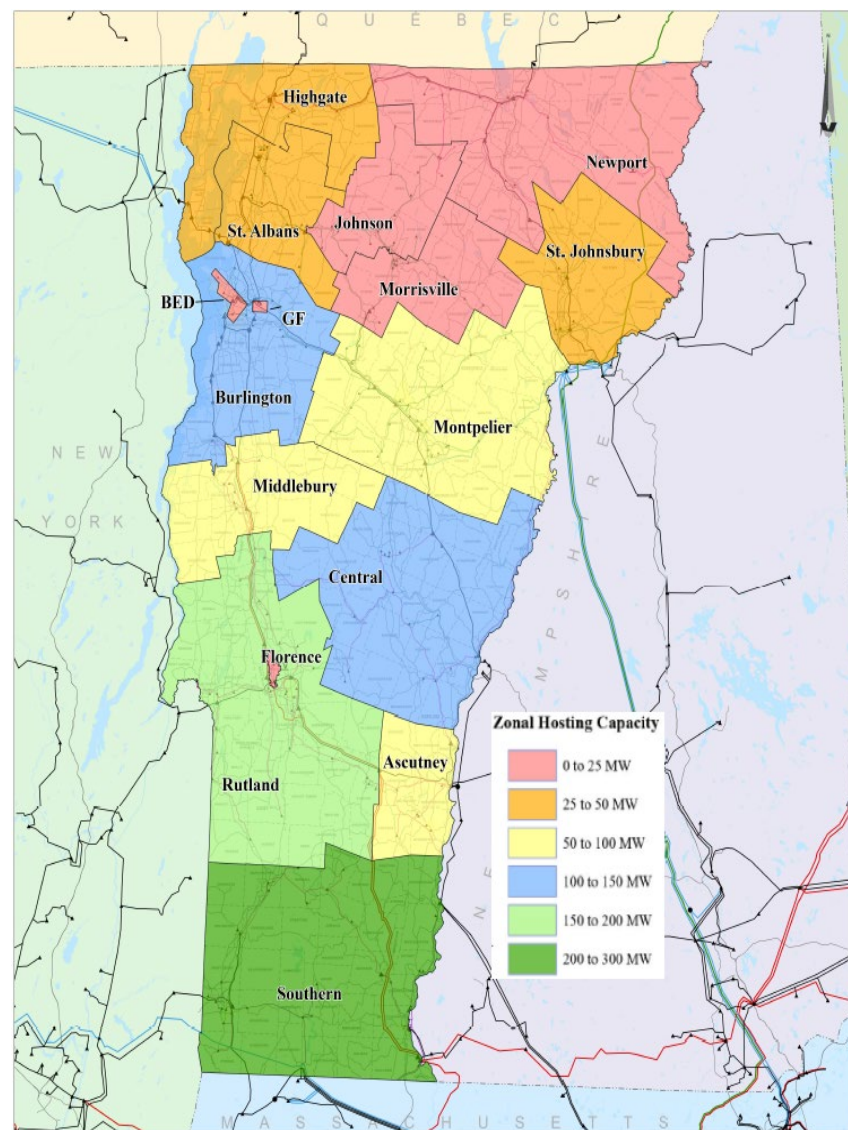


Orange line is the critical load level over which a violation occurs

OPTIMIZED SOLAR DG

- Used operational limits and solar DG location
- Maximum solar DG
 - 1175 MW (considering Transmission)
 - 1052 MW (considering Transmission and subtransmission)

UTILITY	INSTALLED SOLAR PV AS OF 2023 ¹ (MW)	ADDITIONAL SOLAR PV (MW)	OPTIMIZED SOLAR PV DISTRIBUTION (MW)
BED	9	0	9
GMP	404	525	929
VEC	34	34	68
VPPSA	26	6	32
SED	3	0	3
WEC	6	6	12
TOTALS	482	571	1053



Next Steps

- VSPC to provide comments – 60 days after receiving draft plan
- Discuss with affected parties
- Schedule

February 2, 2024	VSPC to receive draft plan
February 16, 2024 10am -11am	VSPC Q&A Webinar
April 2, 2024	VSPC comments due
April – May 2024	Public Input Period
July 1, 2024	2024

Thank you

Criteria and Assumptions

Load Forecast by Zone

Date	Season	Forecast	Ascutney	Greater Burlington	Central	Florence	Highgate	Johnson	Middlebury	Montpelier
2033	Win	Pol	88.0	249.7	91.3	19.6	47.3	20.2	43.6	158.2
		Low	74.8	189.9	80.7	19.6	43.2	17.6	39.1	130.7
	Sum	Pol	82.9	225.2	68.9	18.7	47.9	14.4	40.3	120.3
		Low	75.1	190.1	64.0	18.7	46.2	13.1	38.2	104.8
2043	Win	Pol	98.0	305.9	101.8	19.6	52.7	22.2	47.6	180.0
		Low	85.7	249.0	91.5	19.6	48.6	19.7	43.3	154.1
	Sum	Pol	91.6	264.7	76.2	18.7	53.0	15.7	43.8	135.9
		Low	84.3	232.0	71.7	18.7	51.3	14.5	41.8	121.5

Date	Season	Forecast	Morrisville	Newport	Rutland	StAlbans	Southern	St Johnsbury	BED	GF	System
2033	Win	Pol	44.5	56.1	134.6	84.9	182.5	38.0	88.4	42.0	1389
		Low	39.1	50.0	119.7	76.1	157.2	34.4	69.9	42.0	1184
	Sum	Pol	38.5	46.8	107.1	86.5	131.8	30.3	83.0	52.8	1195
		Low	35.8	44.0	99.9	82.4	118.0	28.8	72.5	52.8	1085
2043	Win	Pol	48.7	61.9	145.5	95.6	200.5	41.0	105.7	42.0	1569
		Low	43.5	56.0	131.4	86.9	176.7	37.5	88.0	42.0	1374
	Sum	Pol	41.7	51.2	115.7	96.2	145.4	32.6	94.8	52.8	1330
		Low	39.2	48.6	109.0	92.3	132.6	31.2	85.0	52.8	1226

Criteria and Assumptions

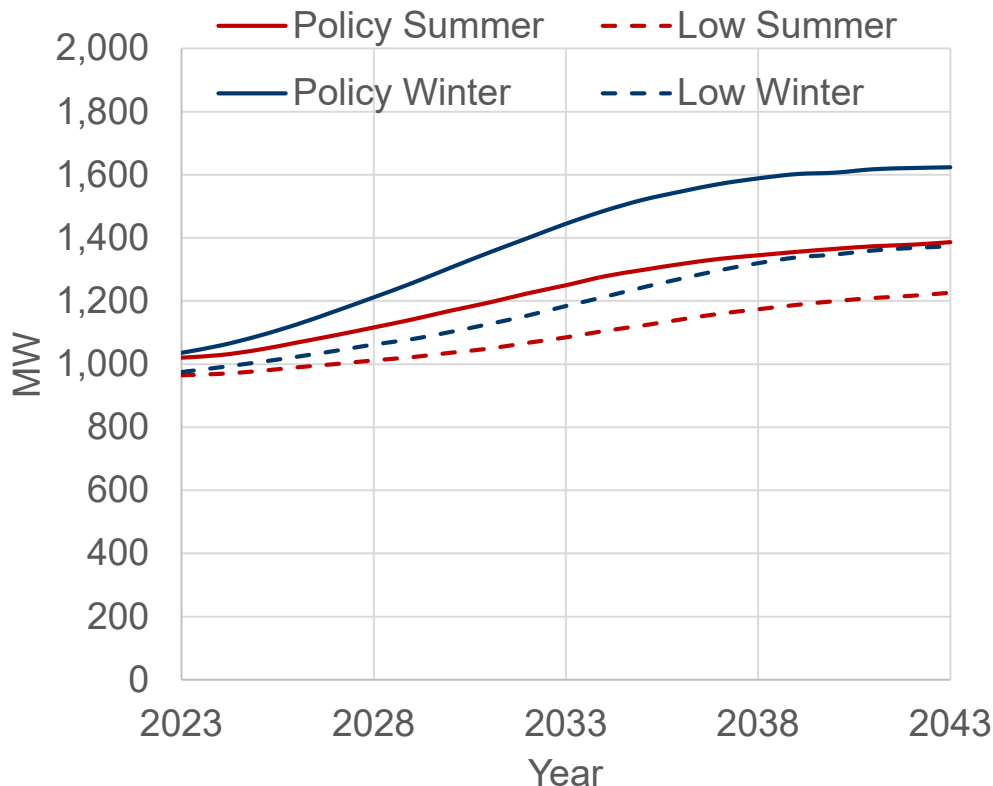
Peak load forecasts

- **Policy (Expected forecast)**

- Annual sales of HP increase to 17.9k by 2029
- Non-fleet EVs grow to 90% of vehicles by 2043
- Fleet EVs 100% electrification between 2038 and 2045

- **Low**

- Annual sales of HP remain at 10.5k
- Non-fleet EVs grow to 60% of vehicles by 2043
- Fleet EVs constant at 2032 level through 2043



Criteria and Assumptions

- Transfers
 - NY-NE: 0 MW (Peak)
 - NY-NE: 100 MW (Daytime off peak, import)
 - Highgate: 225 MW at the border
 - North-South: 2,000 MW
 - West-East: 2,000 MW
- System Topology
 - ISO-NE identified upgrades included
 - Projects with a Vermont section 248 approval included
 - No projects past 2028
 - Elective Transmission Upgrades not included
 - 1000 MW HVdc at Coolidge substation
 - 400 MW HVdc at New Haven substation
- Resources
 - Battery energy storage not modeled to determine size/location requirements
 - McNeil out of service (peak), In-service (Daytime off peak)
 - Summer: Hydro 10%, wind 5%; winter: hydro and wind 25%
 - Peak: solar PV off, Daytime: DG on at unity power factor

Criteria and Assumptions

- NERC planning standard TPL-001-5
 - Category P0 (No outages)
 - Category P1 (Outage of one element such as line, trsf, gen)
 - Categories P2 to P7 (Outage of two or more elements)
- ISO-NE Planning Procedure No.3
 - N-0, N-1, N-k, N-1-1
- DU line outage
 - Entire line, breaker to breaker
 - Line end open
 - Radial lines
 - Pick up radial line, close N.O. switch
- Planning Software Used: TARA and PSS/E