

2021 Vermont Long-Range Transmission Plan

vermont electric power company



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CIGRE Grid of the Future
Symposium
October 18, 2021

BACKGROUND

PLANNING AND GENERATION PROFILE

Why we prepare this plan

- Plan and associated public outreach required by Vermont statute and Public Utility Commission order
- To support full, fair and timely consideration of all cost-effective non-wires solutions to growth-related issues
- To inform utilities', regulators' and other stakeholders' consideration of policy and projects

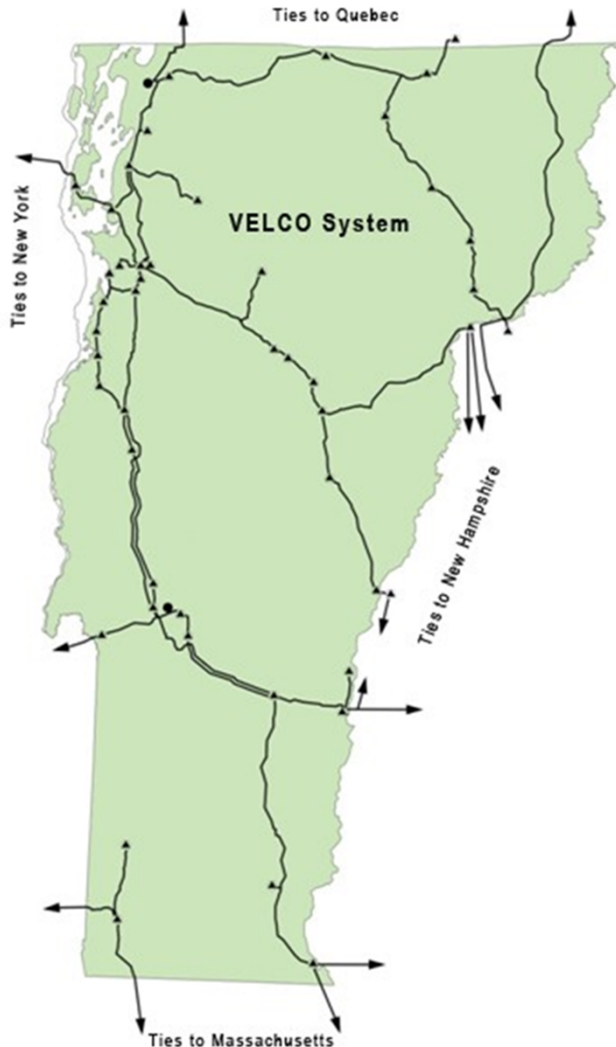


New additions in 2021 iteration of plan

- In-depth scenario analyses with greater collaboration
- Inclusion of climate trends in load forecast and consideration of long-term climate impacts to grid
- High-load scenario analysis assuming EV load control
- Ground-tested high-generation scenario analysis with more realistic assumptions
 - Allow some import amount from our controllable tie lines
 - Model larger (20 MW) FERC-jurisdictional generation projects
 - Consider distribution transformer limits

Generation mostly renewable and

intermittent

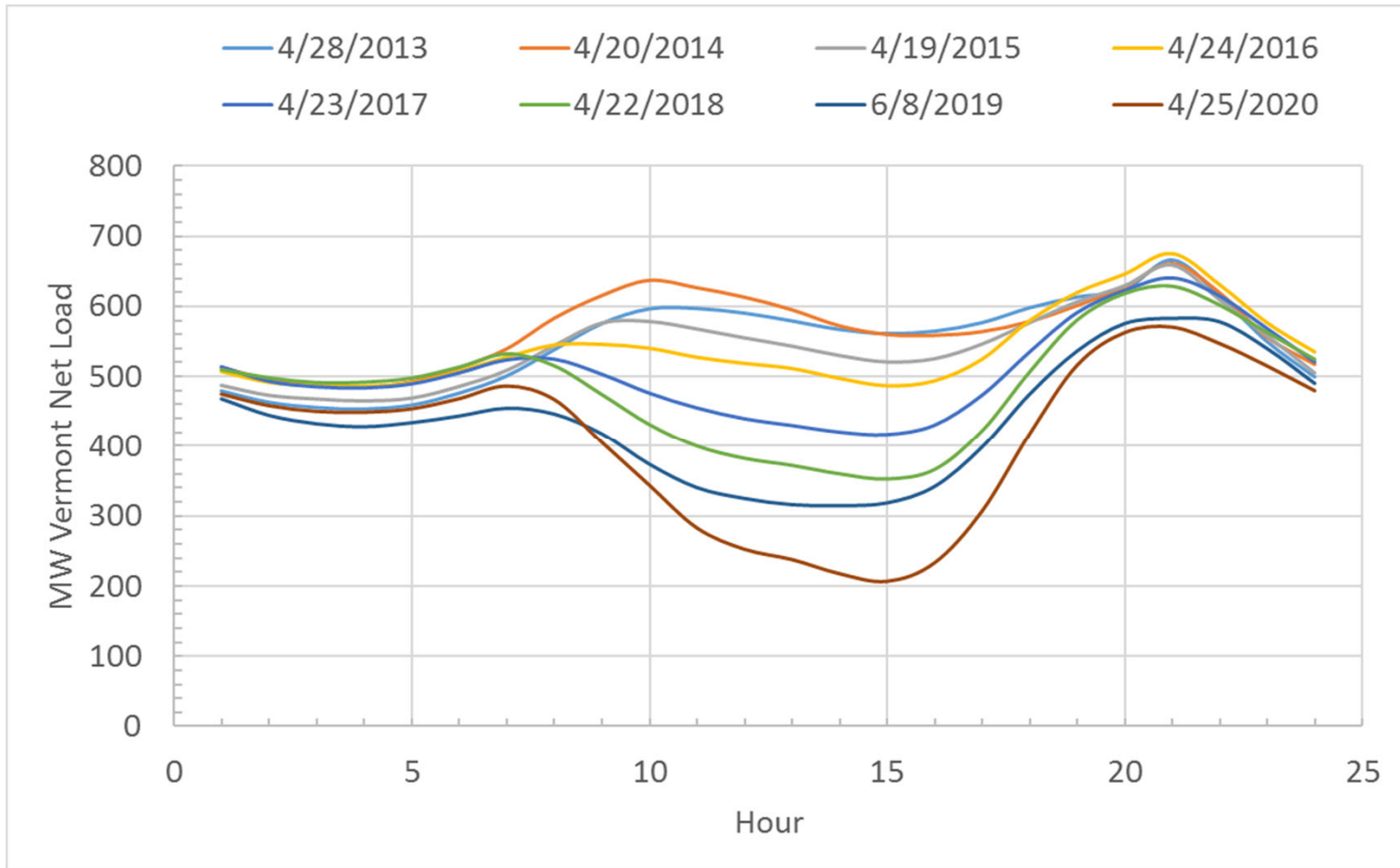


Type		MW
Fossil (fast start units)	Winter	188
	Summer	138
Hydro		152
Wind		151
Landfill gas		9
Biomass (wood)		72
Utility scale solar PV		20
Small scale solar PV		400 and growing
Small scale farm methane, wind, hydro		63 and growing
TOTAL IN-STATE GENERATION SUMMER NAMEPLATE CAPACITY		~ 1005

VT Peak load 1000 MW (winter and summer)



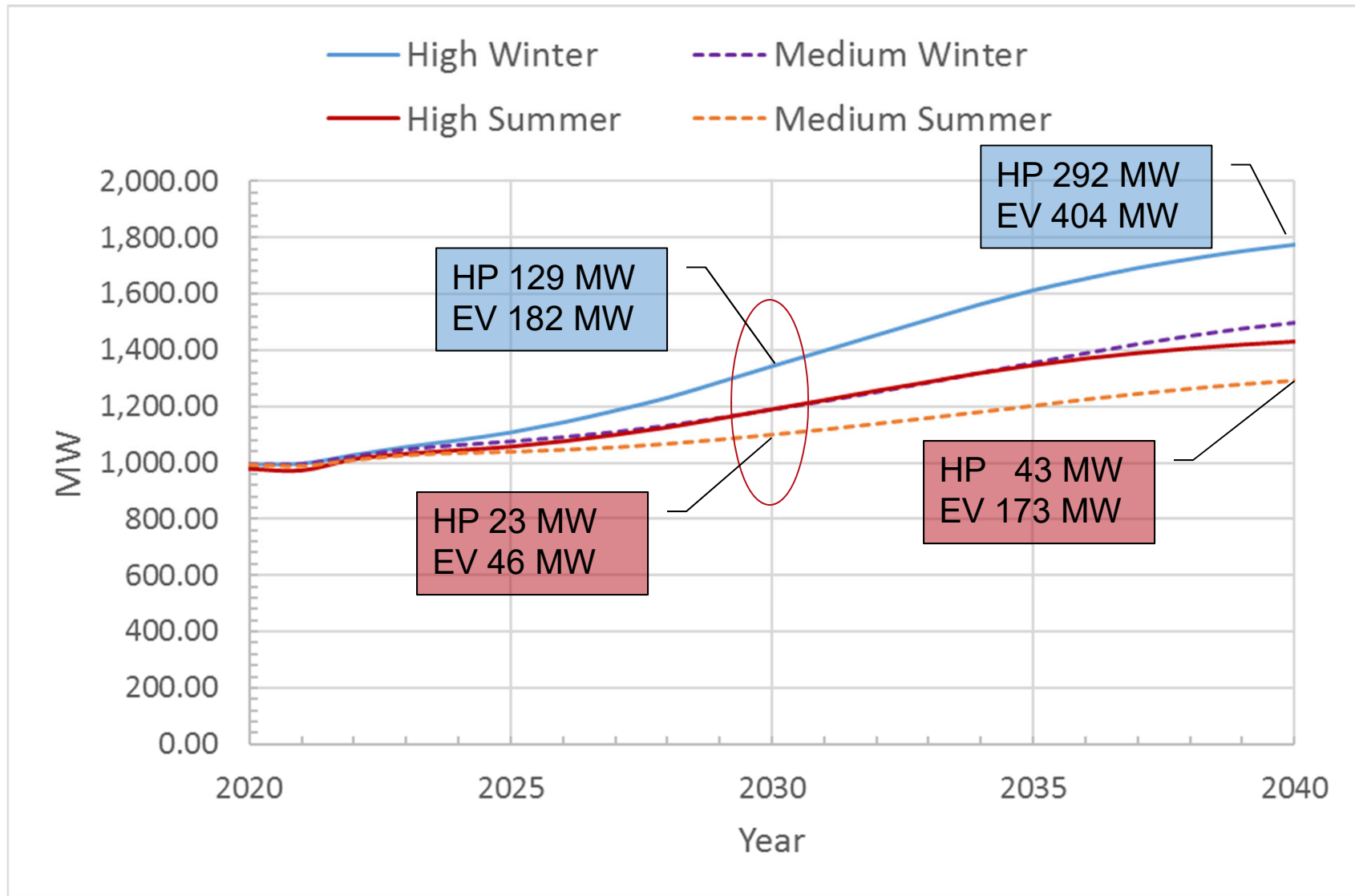
Solar PV impacts on net loads



FORECASTS

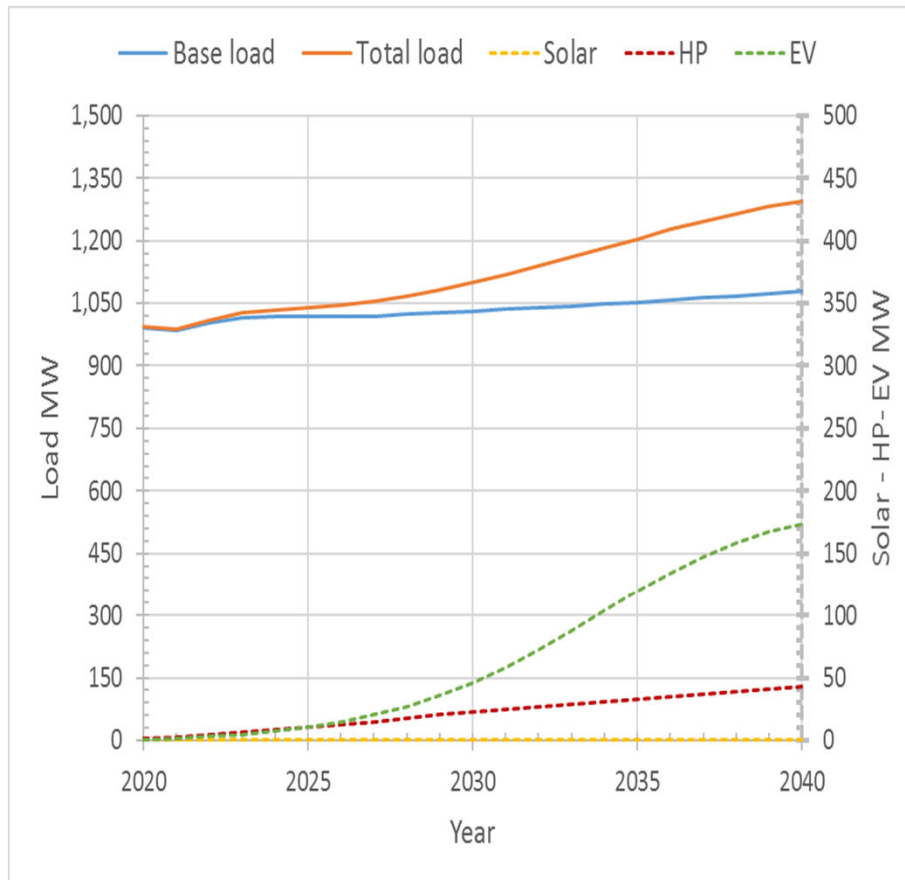
LOAD AND GENERATION

Load forecast scenarios

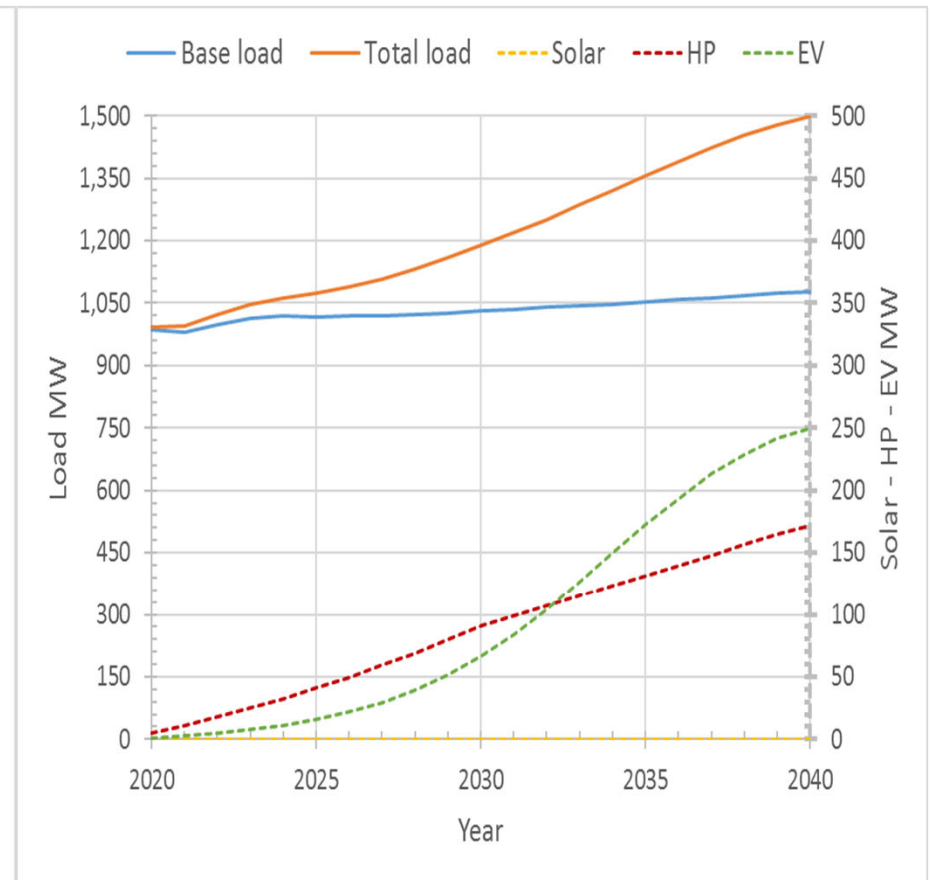


Summer and Winter Medium Peak Load Forecast Components

Summer Peak Load Forecast



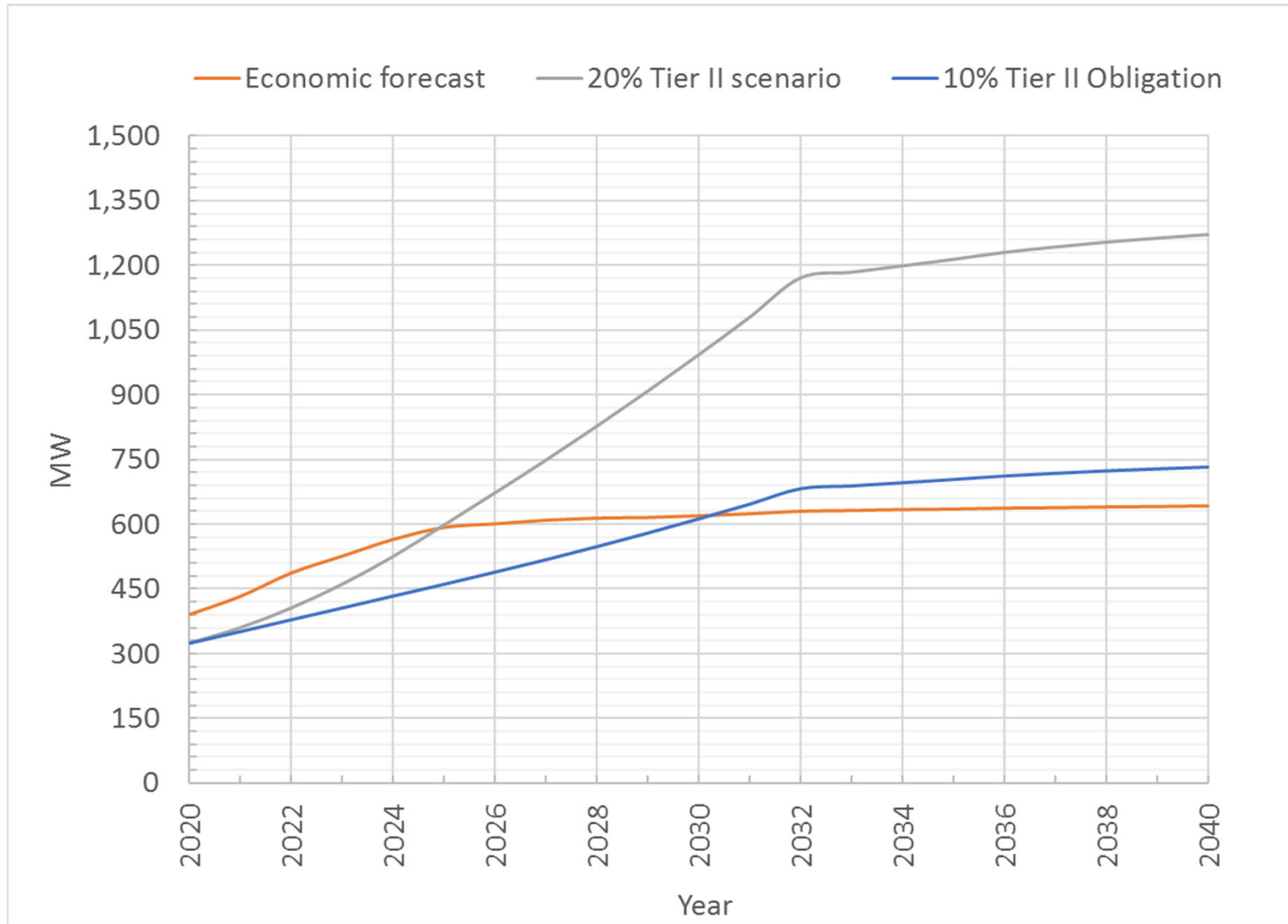
Winter Peak Load Forecast



Technology forecasts do not include effect of load control



Solar PV growth scenarios



RESULTS

ABILITY TO SERVE PEAK LOADS

No major upgrades needed to serve load within the 10-year horizon

Bulk system

- No peak load concerns. Issues addressed with tie line adjustments

Predominantly bulk system

- No peak load concerns. Issues addressed by tie line adjustments and operator actions
- Acceptable loss of load (5-150 MW). As a direct consequence of outage and operator actions.

Subtransmission issues

- Flagged some issues to be evaluated by distribution utilities

High-load scenario

- Minimal effect within 10 years
- After 10 years, requires non-transmission solutions to avoid transmission upgrades: load management, energy efficiency, storage, generation, ...

Time Series Power Flow - Description

- DC OPF dispatch and AC reliability PF
 - Provides counter-factual look at system across time
 - Performs 8760 offline power flow simulations
 - Close collaboration with UVM and EGA for 3+ years
- Relies on historical weather and load data
 - 3 km weather granularity for renewable generators
 - Presently based on 2017 data
- Expanding capabilities
 - Vary load and generation hour to hour
 - Frequency and duration of issues for contingencies
 - Plan to incorporate load management

Time Series Power Flow - Results

- Annual and daily peak remains after dark
 - 8 pm in summer, 6 pm in winter
 - Some daily spring peaks in morning, same as today
- Continued dependence on transmission
 - Import up to 1025 MW
 - Export up to 325 MW
- Subtransmission low voltage

Location	Total hrs.	# of events	Avg. duration	Max duration
Stowe	4743	679	7	96
Morrisville	3614	746	5	96
Blissville	1477	434	3.5	11
Websterville	144	56	2.5	6

Time Series Power Flow - Results (cont.)

- Subtransmission thermal overloads

Location	Total hrs.	# of events	Avg. duration	Max duration
McNeil – McNeil Tap	691	70	10	17
E. Arlington – Manchester	423	98	4.5	16
Websterville – S. Barre	402	145	3	8
Maple Ave – Charlestown	394	76	5	11
Mountainview – Berlin	313	124	2.5	7

- Transmission/transformer thermal overloads

Location	Total hrs.	# of events	Avg. duration	Max duration
Sand Bar – Essex	128	70	2	7
Vernon Road Transformer	16	16	2.5	4

RESULTS

ABILITY TO ACCOMMODATE DISTRIBUTED GENERATION (DG)

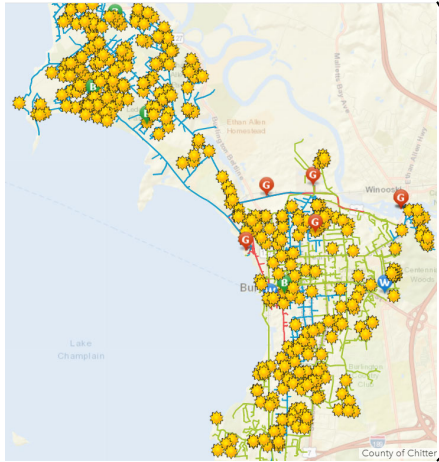
Location matters

- Current geographical distribution will cause additional overloads and voltage concerns
- Optimizing DG distribution avoids major upgrades

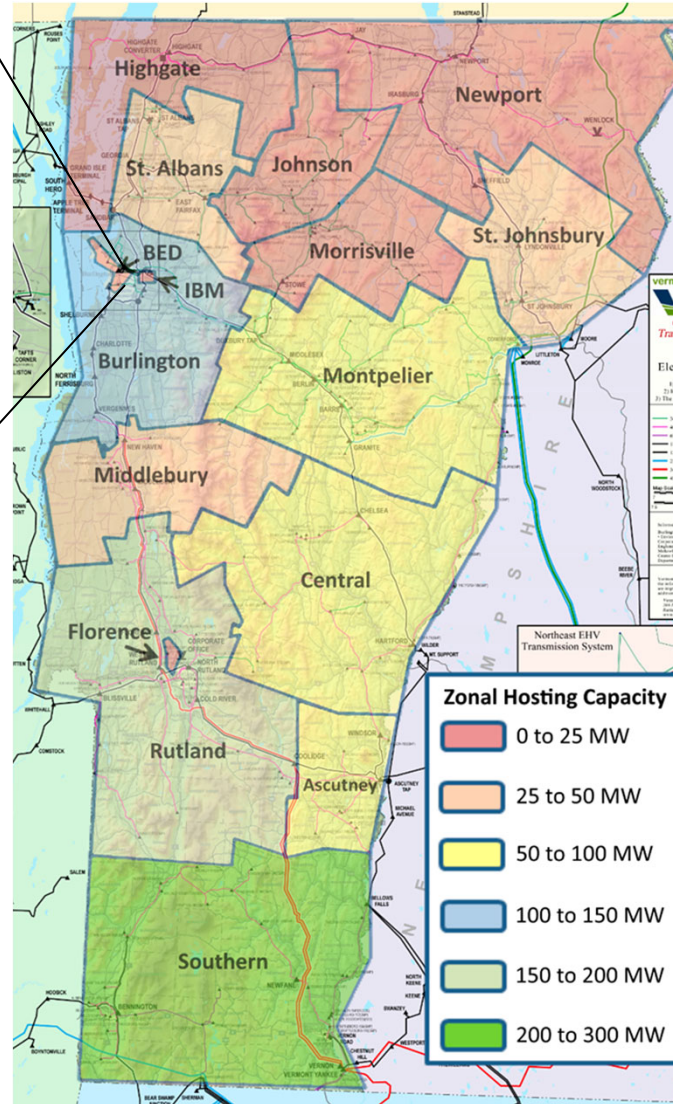


— Transm line upgrades - - - Represents newly observed overloads in 2021 analysis
● Transformer upgrades

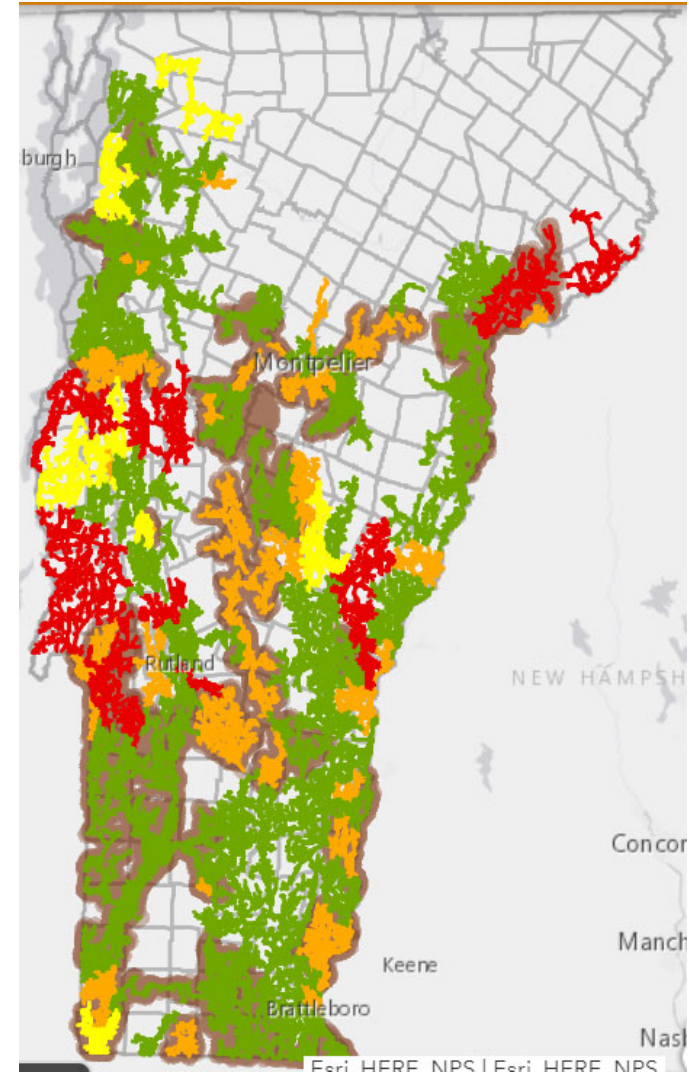
BED additional solar PV Map



Transmission total DG zonal limits



GMP additional solar PV Map



CONCLUSIONS

ACTIONS TO ENABLE ENERGY TRANSITION

Key Takeaways of 2021 LRTP

- Load growth due to EVs and heat pumps (no growth within ten years in the 2015 and 2018 plans)
 - Able to accommodate high growth with load management
- No load related transmission deficiencies in first 10 years
- Diversity necessary to support continued solar PV growth
 - Storage
 - Grid upgrades
 - Curtailment
 - Grid support from inverters
 - Load management
 - Statewide coordinated planning
- Vermont will continue to depend on transmission
- Collaboration and innovation needed to achieve renewable goals