vermont electric power company

VELCO

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House Environment and Energy Committee

Transmission Grid Insights:
Enabling VT's Clean Energy Transition

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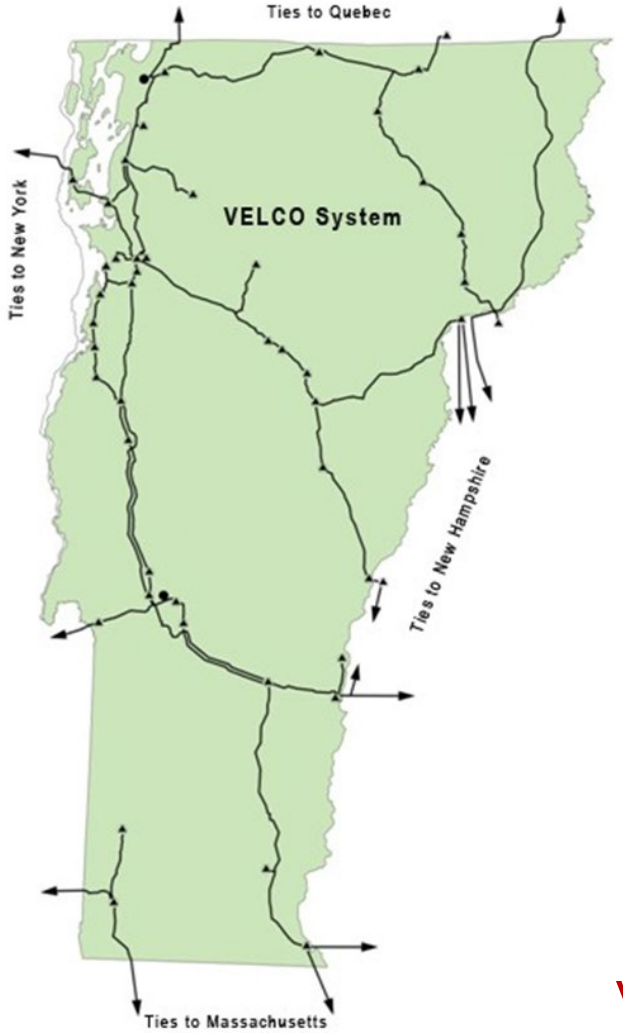
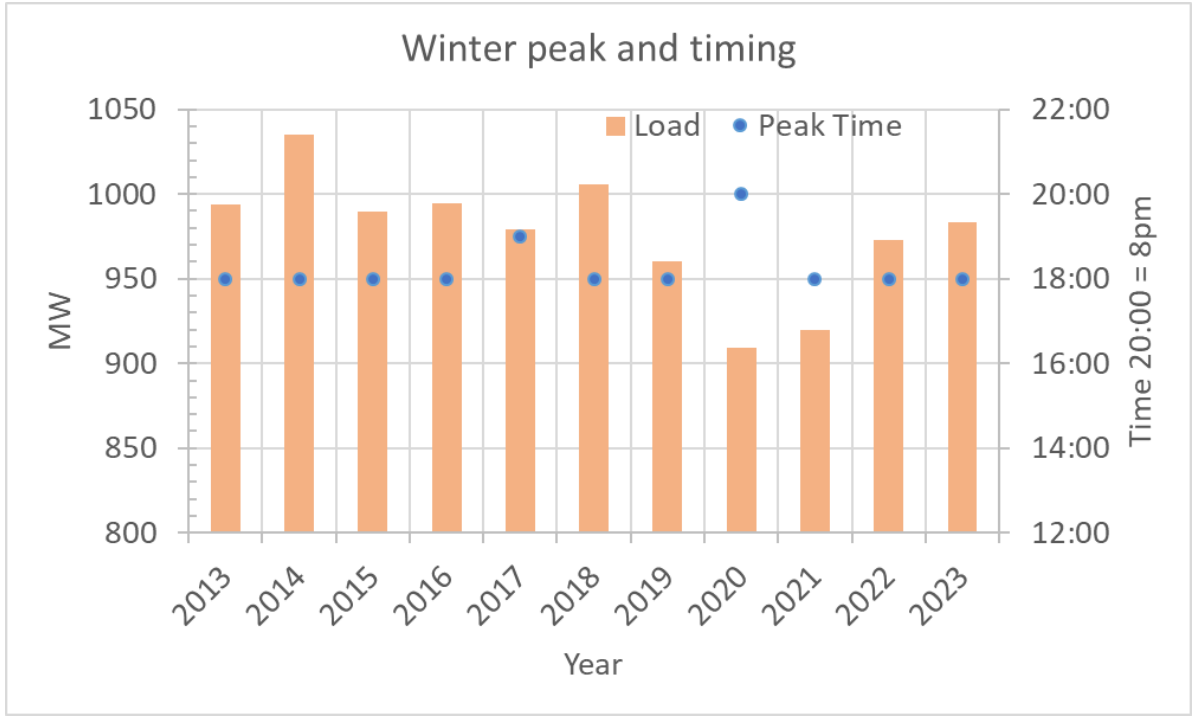
Incredible renewables progress

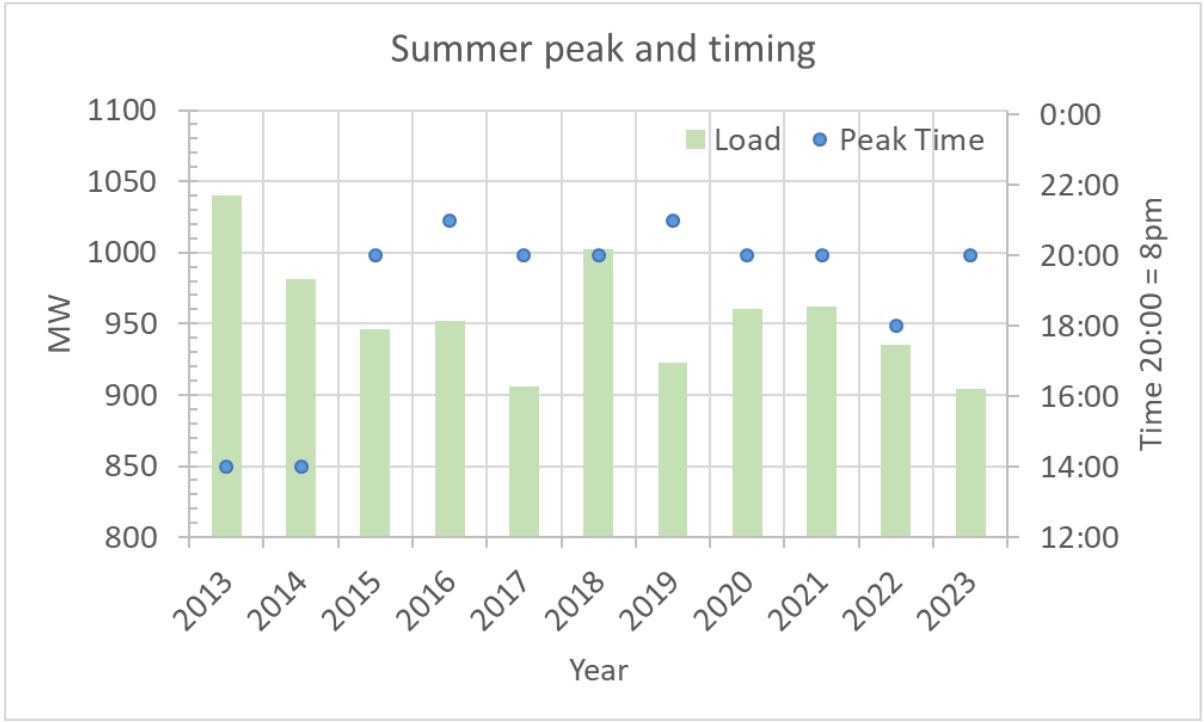


Type		MW
Fossil (fast start units)	Winter	173
	Summer	124
Hydro		152
Wind		151
Landfill gas		9
Biomass (wood)		72
Utility scale solar PV		20
Small scale solar PV		About 500 and growing
Small scale farm methane, wind, hydro		About 87 and growing
TOTAL IN-STATE GENERATION SUMMER NAMEPLATE CAPACITY		**~ 1115**

VT Peak net load about 1000 MW (winter and summer)

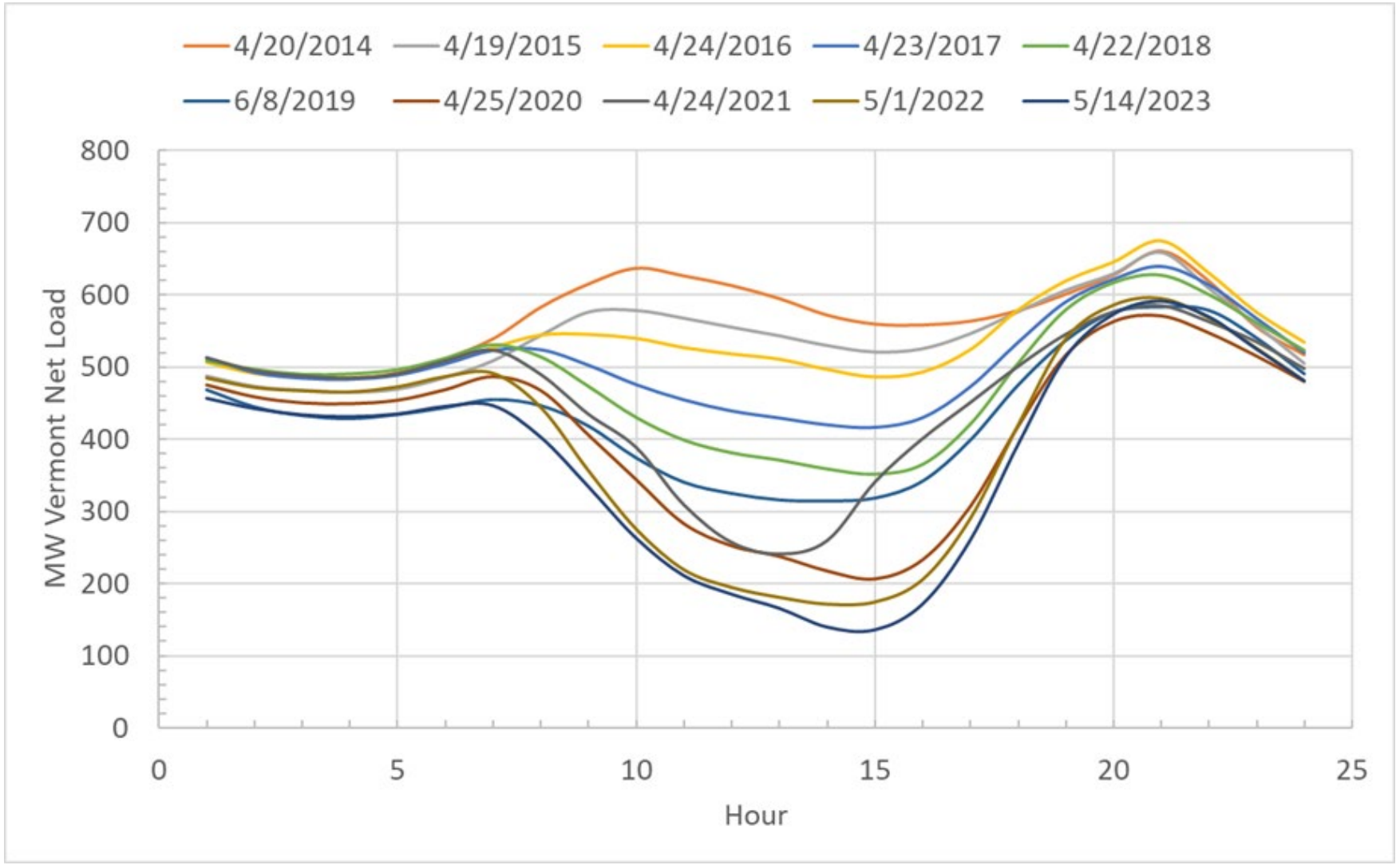
Timing of seasonal peaks is after dark



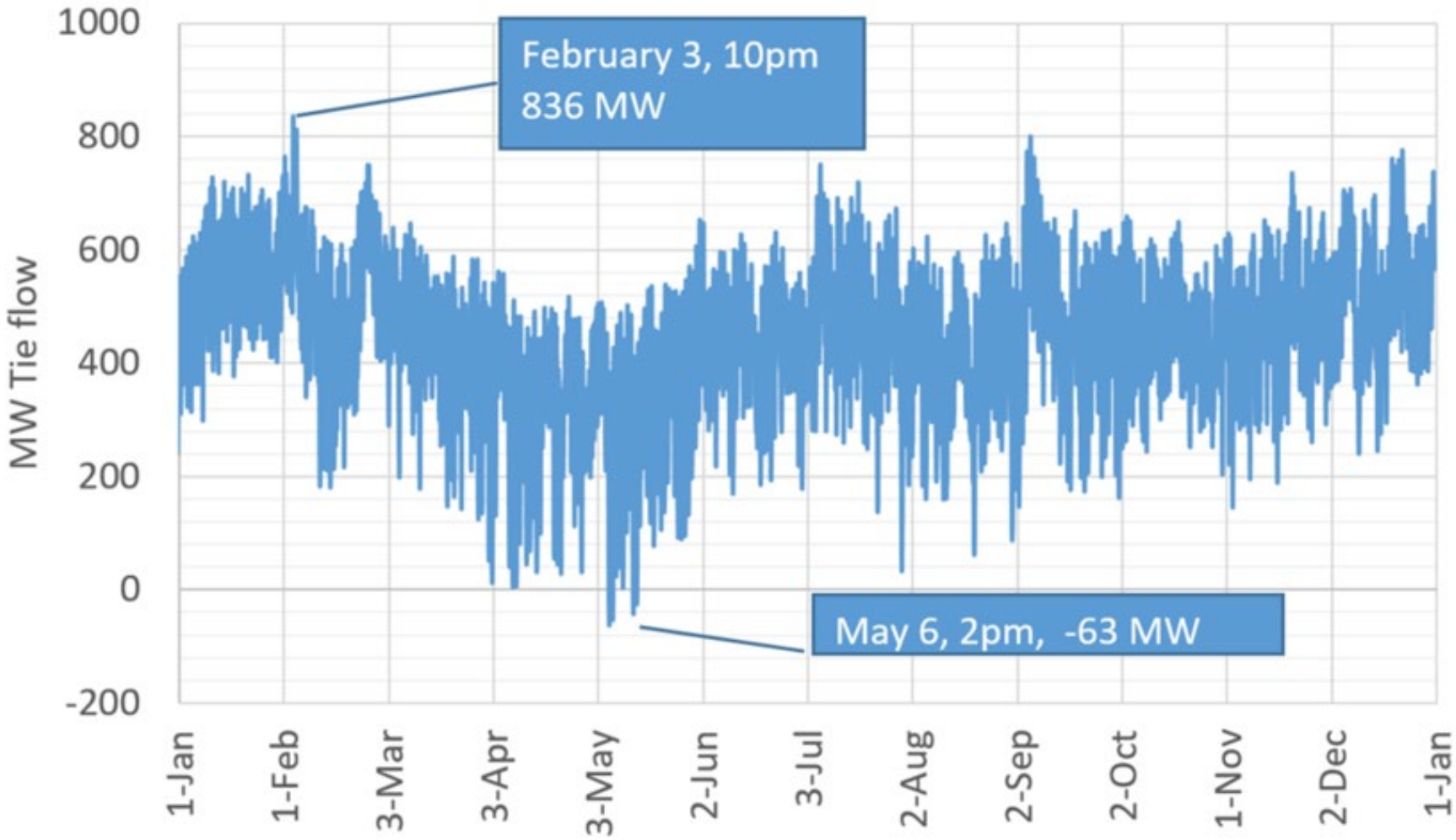


Solar PV has moved summer peak timing after dark (new solar PV has no impact on peak load)

Solar PV impacts on spring time net loads



Vermont imports electricity nearly 100% of the time

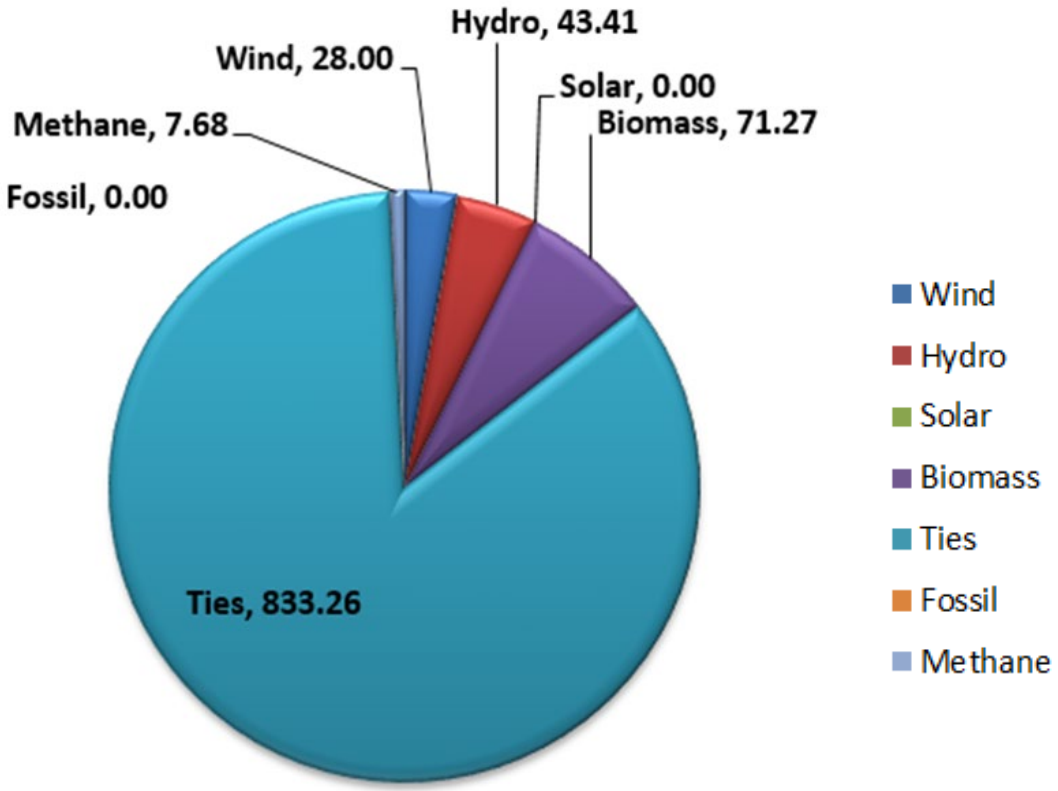


Historical imports

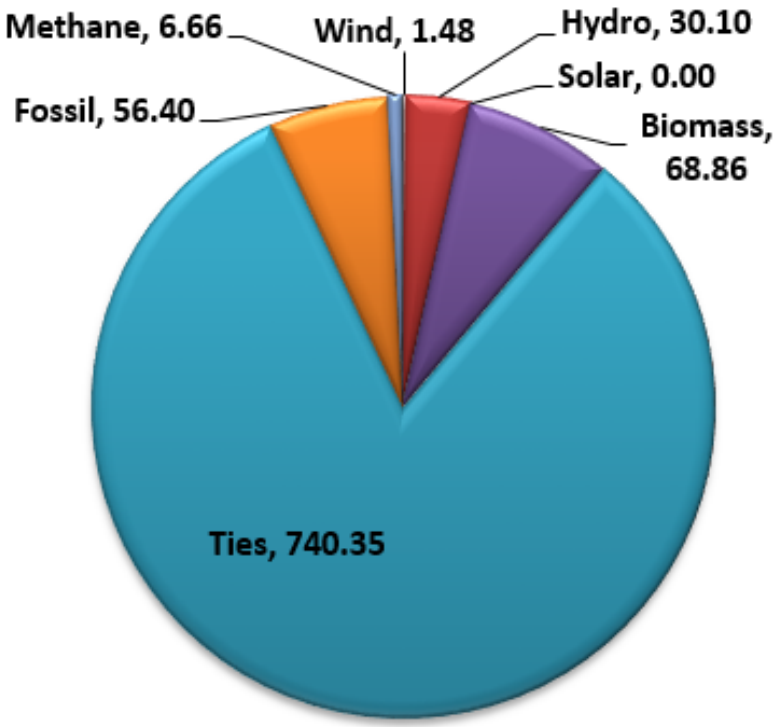
Year	Minimum	Maximum	Percent of time over 400 MW
2015	198	910	84%
2016	223	842	86%
2017	234	810	80%
2018	139	833	80%
2019	100	850	70%
2020	14	856	69%
2021	30	854	73%
2022	20	861	71%
2023	-63	836	64%

Vermont generation performance at the peak hour

- 2022/23 winter peak day (2/3/23, 6:00 PM)
- Net Load was 983.62 MW

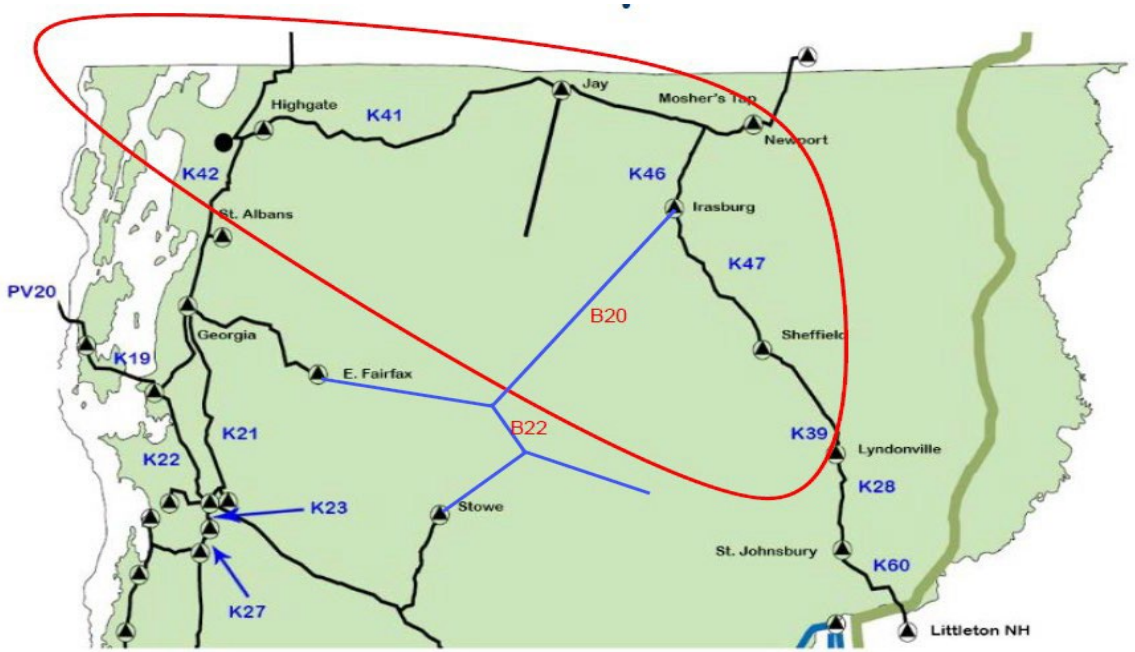


- 2023 summer peak day (9/6/23, 8:00 PM)
- Net Load was 903.85 MW



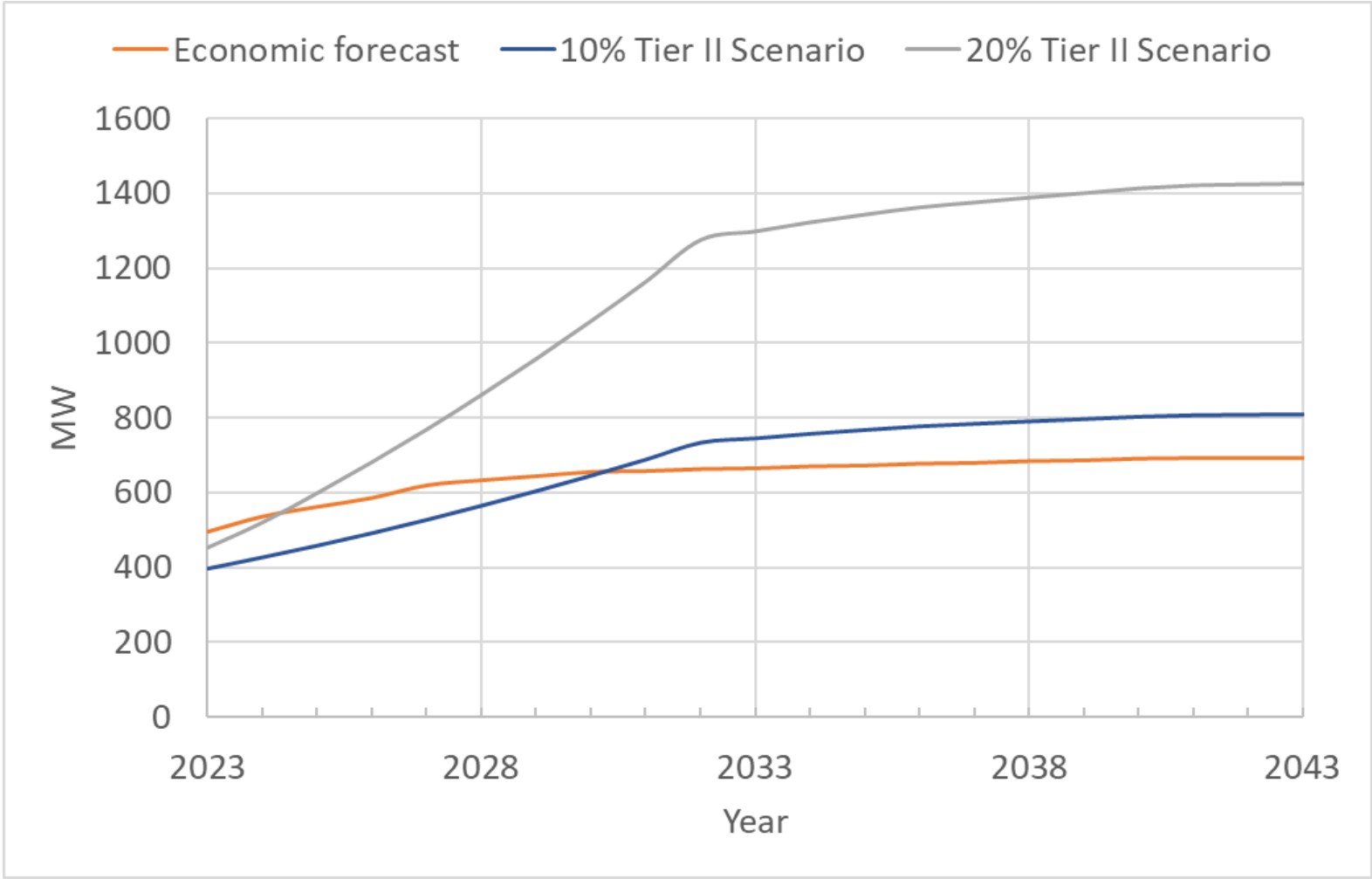
Sheffield Highgate Export Interface (SHEI)

- Large amount of generation
  - 225 MW Highgate HVDC
  - 65 MW Kingdom Community Wind
  - 40 MW Sheffield Wind
  - Solar, hydro, biomass
- Small amount of load
  - 60 MW max, 25 MW min



- Export from Northern Vermont is limited by ISO-NE
  - Voltage constraint is the most restrictive
  - Thermal and stability follow
  - ISO-NE limits generation in real time using market rules
- Current efforts to increase the export limit
  - Correcting stability models in a few months
  - Complete the Franklin County Line Upgrade in two years

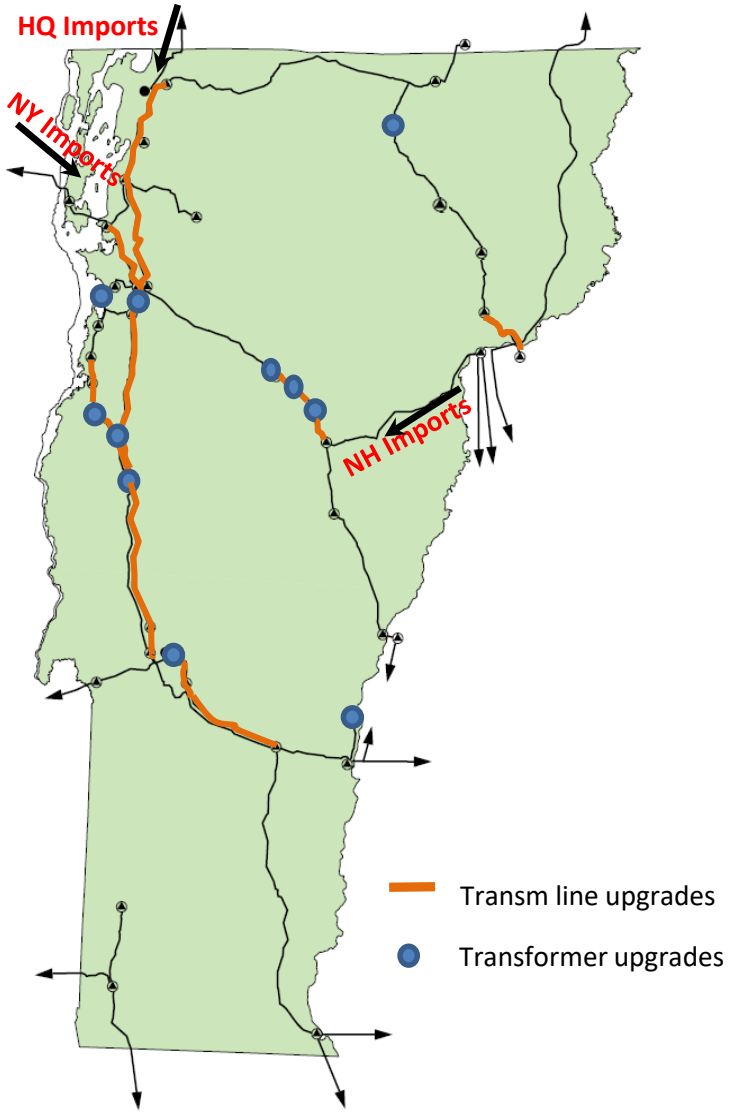
Solar PV forecast



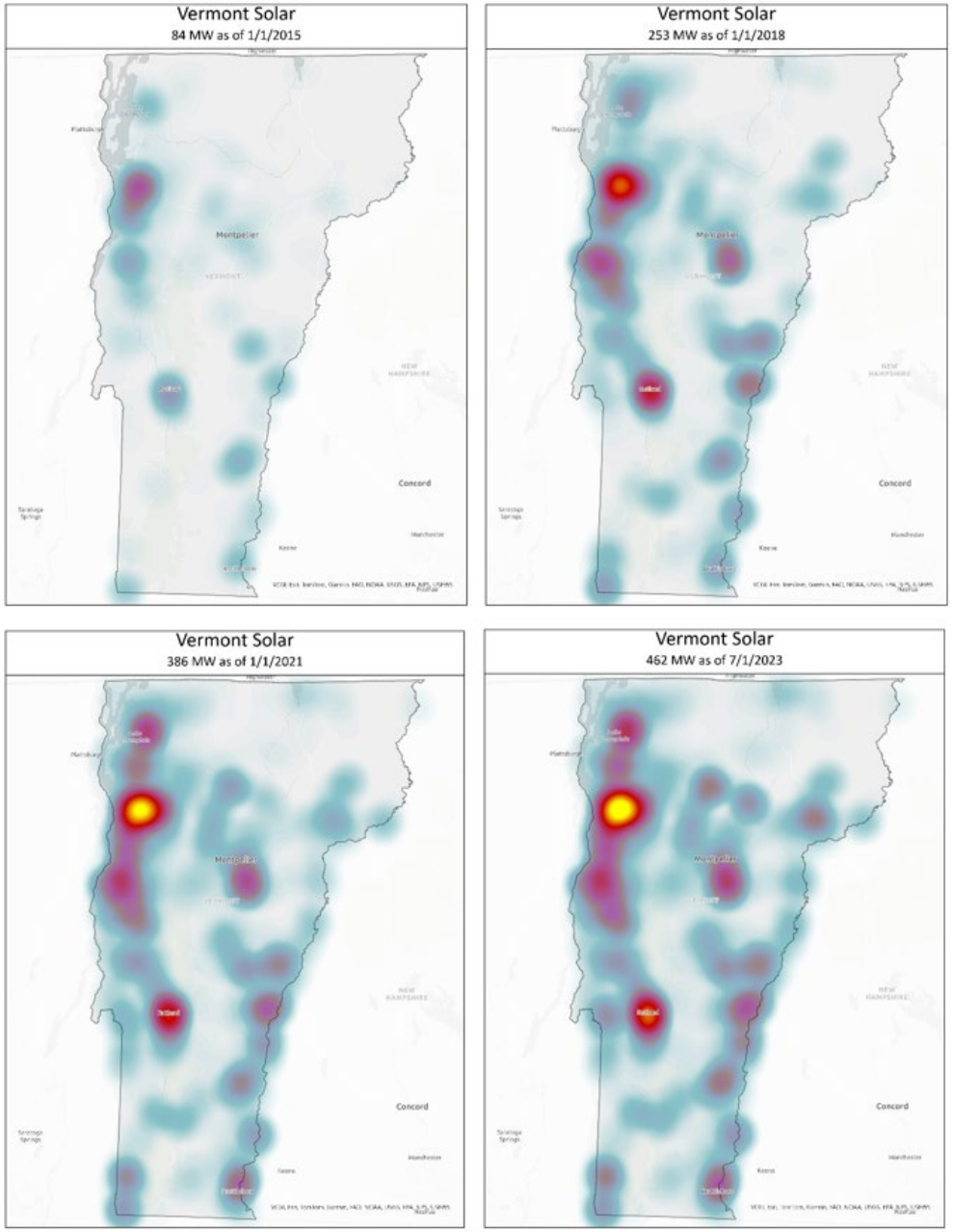
Vermont Renewable Energy Standard, Tier II – Distributed Renewable Generation

Overloaded Transmission Facilities at 1300 MW DG

- Study assumptions
  - Spring light load (650 MW)
  - No future transmission upgrades
  - No reduction of imports
  - No reduction of existing renewables
- 156 miles length of overloaded lines
- 10 overloaded transformers
- Total upgrades cost: $1.4B
  - Conservative/order of magnitude
  - We will likely not resolve all overloads
  - Cluster studies required
- Solution will be a hybrid solution
  - Real-time import adjustments
  - Real-time generation curtailments
  - Storage/Load management, etc.
  - Transmission

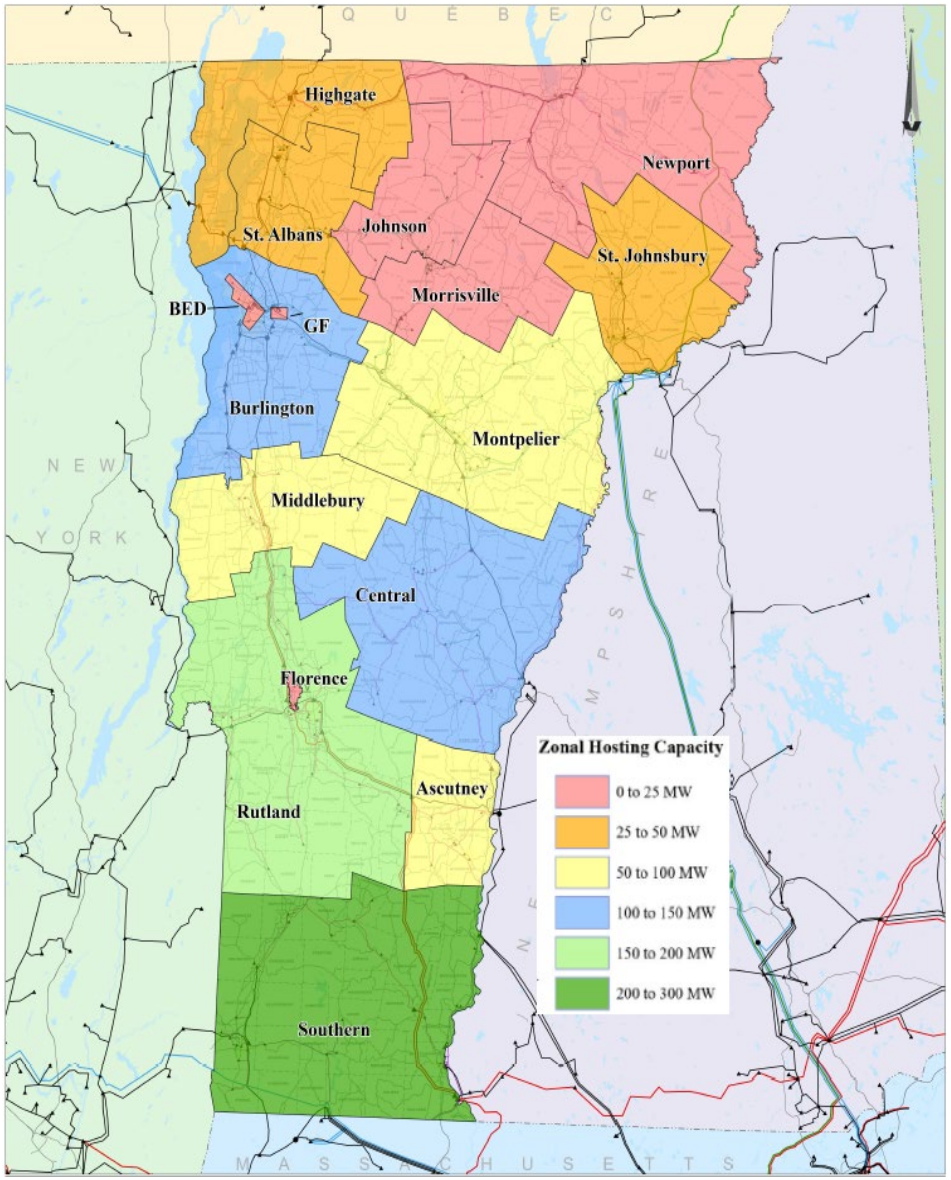


Location of Solar PV Growth



Location Matters

- 5% overload allowed
- 1053 MW Maximum solar
  - Considering transmission and subtransmission constraints



Takeaways for greater renewable integration

- Vermont will continue to depend on transmission
- Solar PV has been successful at reducing daytime peak
  - New solar PV will not reduce future peaks
- Diverse set of measures necessary to support continued solar PV growth
- Collaboration, data sharing and innovation needed to achieve reliability, affordability & sustainability goals
  - Storage
  - Grid upgrades
  - Curtailment
  - Grid support from inverters
  - Load management
  - Statewide coordinated planning

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