2050 Transmission Study

Study Overview and Preliminary Results

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2050 Transmission Study Objectives

- The ISO has coordinated with the New England States Committee on Electricity (NESCOE) to develop objectives and assumptions for the 2050 Transmission Study
- Where will the transmission system be deficient in serving load in 2035, 2040, and 2050?
- What transmission upgrades would resolve these deficiencies?
- Approximately how much will these upgrades cost?
- Input assumptions include
  - Higher loads due to transportation & heating electrification
  - Retirement of many existing generating resources
  - Addition of large amounts of renewable generation
  - Increased transfers between New England and neighboring areas
- Fulfills a NESCOE recommendation from the October 2020 "New England States' Vision for a Clean, Affordable, and Reliable 21st Century Regional Electric Grid"

Study History and Current Status

- November 2021: Presented a Scope of Work to the Planning Advisory Committee (PAC), including study goals, methodology, and preliminary assumptions
- March 2022: Presented an overview of results to PAC, showing where today's transmission system will be deficient by 2050, and made full results available for review
- April 2022: On April 28, will be presenting sensitivity analysis results and a high-level overview of the solutions development process to PAC
- Remainder of 2022: Identify transmission solutions to address deficiencies, and developing approximate costs
- ISO-NE has coordinated with NESCOE throughout the study process

Questions Beyond the Scope of the 2050 Transmission Study

- Resource adequacy and production cost analysis
  - How much capacity, and of what types, will we need to serve load?
  - The future generation mix is an input assumption, not an end product
  - Other studies (such as the NEPOOL Future Grid Reliability Study) address these questions
- Renewable generation deliverability during off-peak hours
  - How often, and for how long, will renewable resources be curtailed?
- Operational analysis of hours around peak conditions
  - How often, and for how long, will these overloads occur?
- Voltage and transient stability analysis
  - How does the future system react in the seconds after a disturbance?
- Local distribution systems
  - How will distribution systems serve increased load?

Snapshots Examined

- The 2050 study examines specific snapshots in time rather than system performance during every hour of the year
- For comparison, the forecasted 2031 summer peak is 27,520 MW
- New England is summer-peaking today, but winter-peaking for all three study years

Power Consumption by Snapshot (MW)				
Year	Summer Daytime Peak	Summer Evening Peak A (Overall Peak)	Summer Evening Peak B (Northern NE Peak)	Winter Evening Peak
2035	29,375	26,749	25,741	35,116
2040	32,447	32,968	31,968	43,046
2050	40,004	38,601	38,492	56,997

Note: The future load and resource assumptions are based on the "All Options" pathway in the "Energy Pathways to Deep Decarbonization" report.

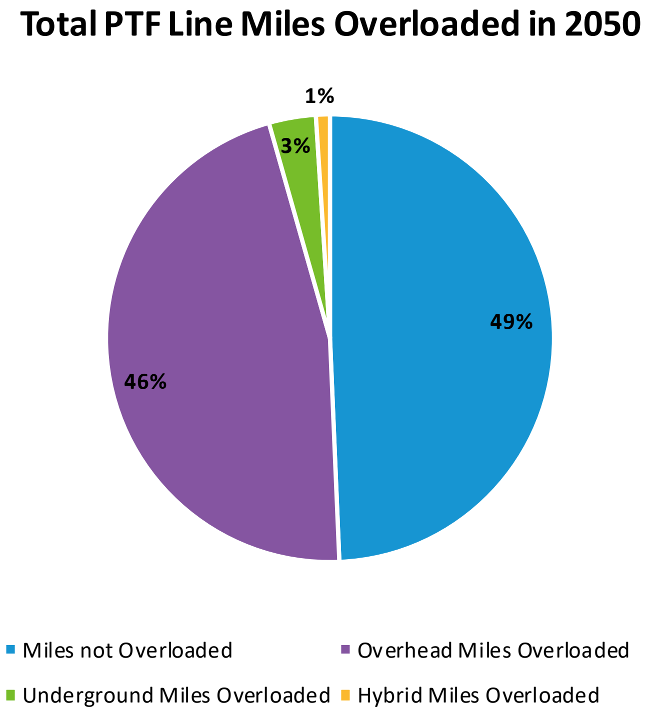
Resource Assumptions

- To serve this load, the 2050 study includes:
  - Large increases in solar, wind, and battery storage capacity
  - Increased import capacity from New York and Quebec, including a 1000 MW HVDC line from Quebec interconnecting at the Coolidge 345 kV substation (Ludlow, VT)

Resource Type	Today (MW)	2035 (MW)	2040 (MW)	2050 (MW)
Solar (Rooftop and Ground-Mounted)	5,639	23,714	31,475	56,665
Onshore Wind	1,424	3,006	3,006	3,006
Offshore Wind	30	9,449	16,633	31,954
Battery Storage	61	2,729	3,237	7,040

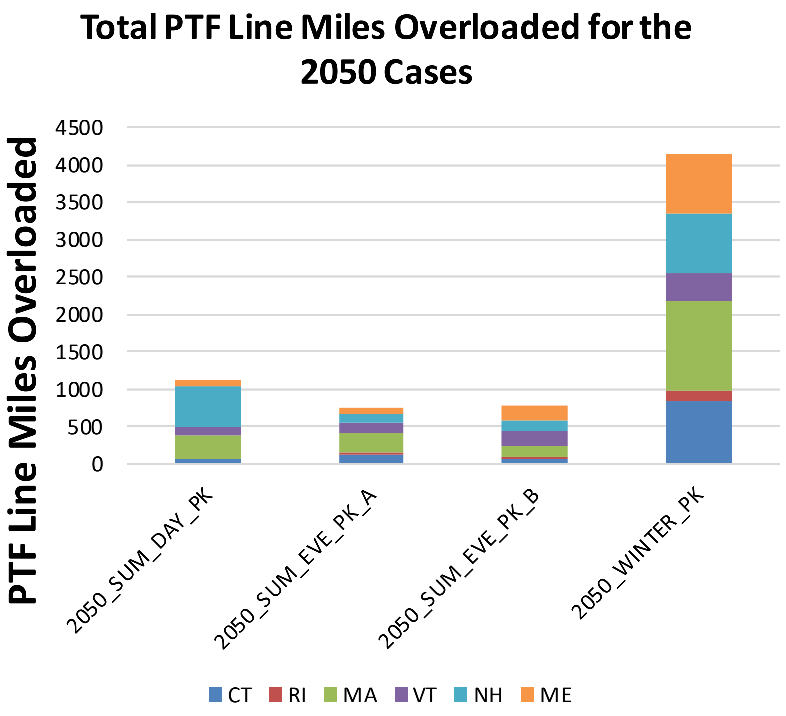
All numbers indicate nameplate capacity in MW. Today's numbers are according to the 2021 CELT report.

Percentage of Line Mileage Overloaded in 2050



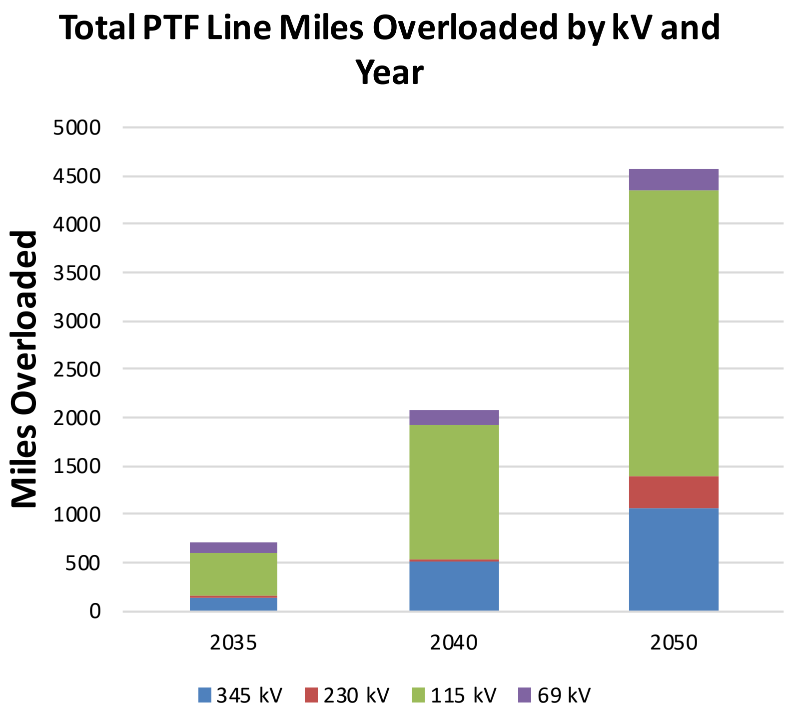
- Approximately half of the total Pool Transmission Facility (PTF) line miles in New England (~4,500 miles out of ~9,000 miles) are overloaded in 2050
- Approximately 90 PTF transformers (of about 150 total) are also overloaded in 2050

2050 Results by Snapshot



- In 2050, the vast majority of overloads occur in the Winter Evening Peak
- Input assumptions show a winter-peaking system by 2035, and winter peak grows more quickly due to heating electrification
- Overloads spread throughout all six New England states
  - New Hampshire and Maine have relatively high amounts due to high North-South transfers driven by new resource assumptions

Overloads by kV Level



- 345 kV system is generally associated with the transfer of power across New England
- 115 kV system is generally associated with serving local loads
- The largest increase in overloaded miles between 2040 and 2050 is on the 115 kV system
- 2050 load-serving issues are mainly associated with a large increase in heating electrification

Sensitivity Analysis

- Winter evening peak: How many overloads could be eliminated by reducing winter peak loads, especially in 2050?
  - Studies a reduced winter peak load of 51 GW rather than 57 GW
- Summer daytime: Can some overloads be avoided through redispatch of generating resources?
  - Surplus generation is available in the summer peak snapshot
  - Reducing generation in northern New England, and increasing generation in southern New England, will offload north-south paths
- Results of these sensitivity analyses will be discussed at PAC on April 28, 2022

Key Takeaways

- The winter peak in 2050 is the most challenging snapshot
  - Shift from a summer peaking system to a winter peaking system
  - Electrification of heating and transportation more than doubles the amount of peak power consumption by 2050
  - Reducing winter peak loads could substantially reduce the cost of transmission upgrades
- Vermont’s 115 kV transmission system shows some overloads due to increased peak loads, but the Vermont 345 kV system does not show major concerns

Key Takeaways, cont.

- North-South paths will need significant upgrades to transfer surplus generation from northern New England (especially New Hampshire and Maine) to generation-deficient southern New England
  - Overloads are beyond what could be fixed with rebuilding existing lines; new transmission lines will likely be required
- Ongoing work will develop possible solutions to the deficiencies identified, and determine approximate upgrade costs

Questions