ISO New England's Ongoing Transmission Planning and Planning Improvement Efforts

New England Electricity Restructuring Roundtable

Robert Ethier

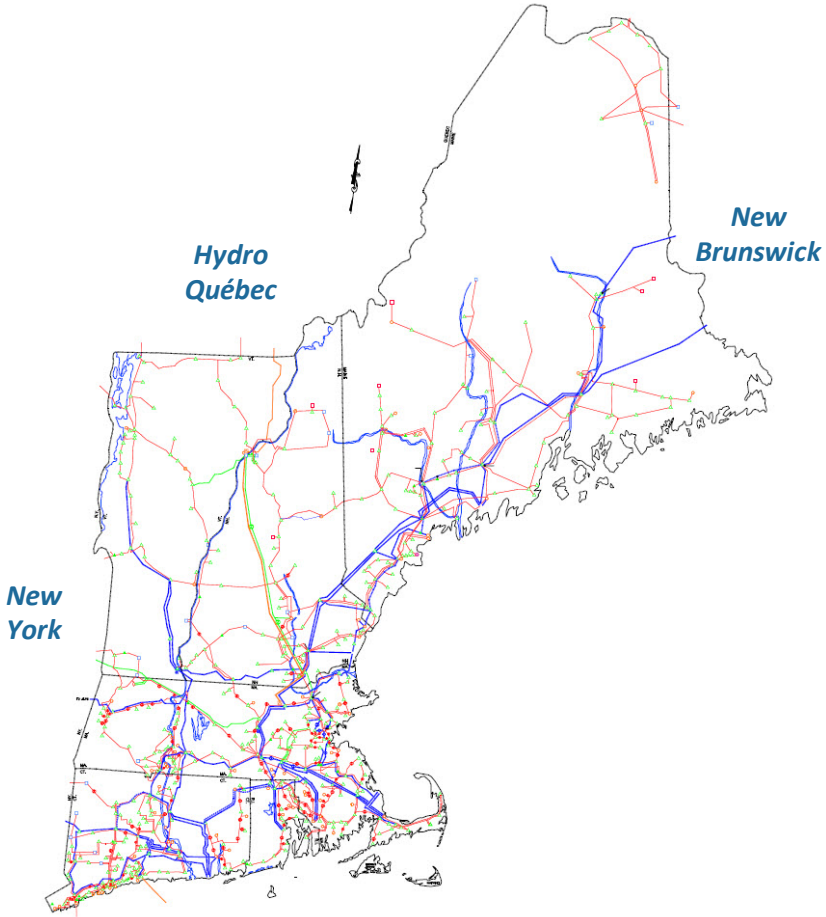
VICE PRESIDENT, SYSTEM PLANNING

Main Points

- Review the **historical context** for transmission planning in New England and **public policies** shaping the resource mix
- **Offshore wind** has the potential to add large amounts of supply from the east, close to load
- **Electrification** will reverse the recent trend of essentially flat growth in peak and overall electricity demand
- Transmission **planning horizons** are evolving to support the New England State's clean energy policies
- Innovations in the interconnection study space evaluate **clusters of offshore wind** in southern New England

New England's Transmission Grid Is the Interstate *and Interregional* Highway System for Electricity

- New England saw little investment in transmission infrastructure before electric industry restructuring
- $12 billion invested in the two decades since then to strengthen system ***reliability*** has enabled the ***clean energy transition*** by allowing older fossil generators (coal and oil) to retire
- The region has had success, historically, building ***transmission to access power from neighboring systems***, with potential for further expansion if more recent siting and legal challenges can be overcome
- Region is a ***net importer*** of electricity

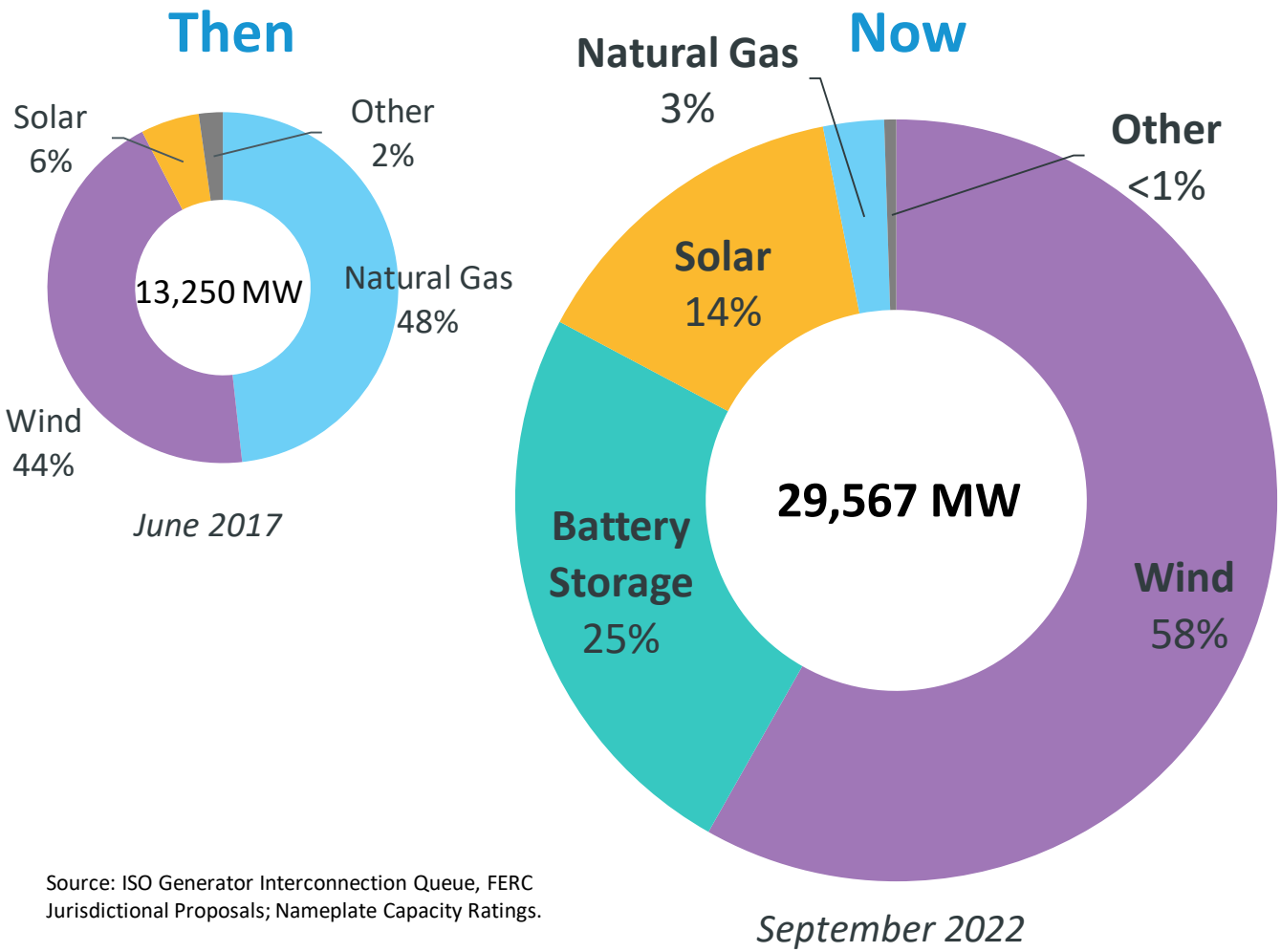


State Laws Target Deep *Reductions* in CO_2 Emissions and *Increases* in Renewable and Clean Energy

≥80% by 2050	Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels)
Net-Zero by 2050 80% by 2050	MA emissions requirement MA clean energy standard
90% by 2050	VT renewable energy requirement
100% by 2050 Carbon-Neutral by 2045	ME renewable energy goal ME emissions requirement
100% by 2040	CT zero-carbon electricity requirement
100% by 2030	RI renewable energy requirement

The ISO Generator Interconnection Queue Provides a Snapshot of the Future Resource Mix

Dramatic shift in types of proposed resources from natural gas to wind



Offshore Wind	
CT	2,400 MW
MA	11,763 MW
ME	12 MW
RI	704 MW

Onshore Wind	
ME	2,330 MW

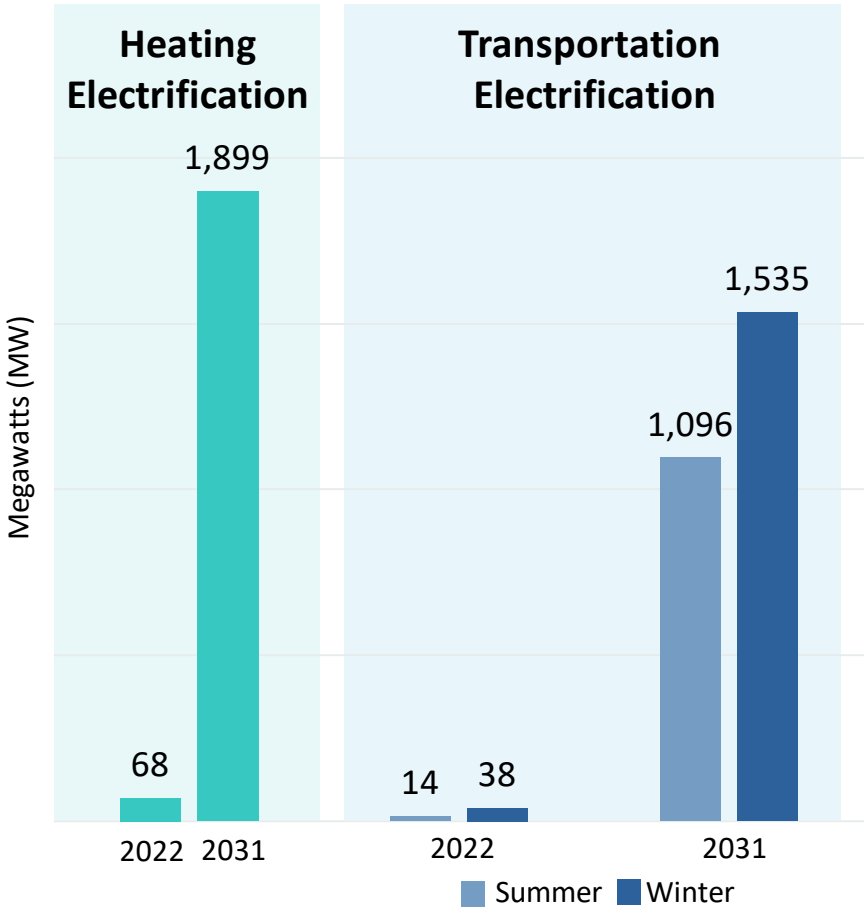
Source: ISO Generator Interconnection Queue, FERC Jurisdictional Proposals; Nameplate Capacity Ratings.

ISO's Electrification Forecast Shows Demand Growth

- The ISO began including **forecasted impacts** of heating and transportation electrification on state and regional electric energy and demand in the 2020 CELT report
- In New England by **2031**, the ISO forecasts that there will be:

  > 1.1 million air-source heat pumps

  > 1.5 million electric vehicles



Sources: : ISO New England 2022-2031 Forecast Report of Capacity, Energy, Loads, and Transmission (2022 CELT Report) (May 2022), Final 2022 Transportation Electrification Forecast, and Final 2022 Heating Electrification Forecast

2050 TRANSMISSION STUDY

Evaluating the transmission system in 2035, 2040, and 2050

2050 Transmission Study: A High-Level Study for the Years 2035, 2040, and 2050

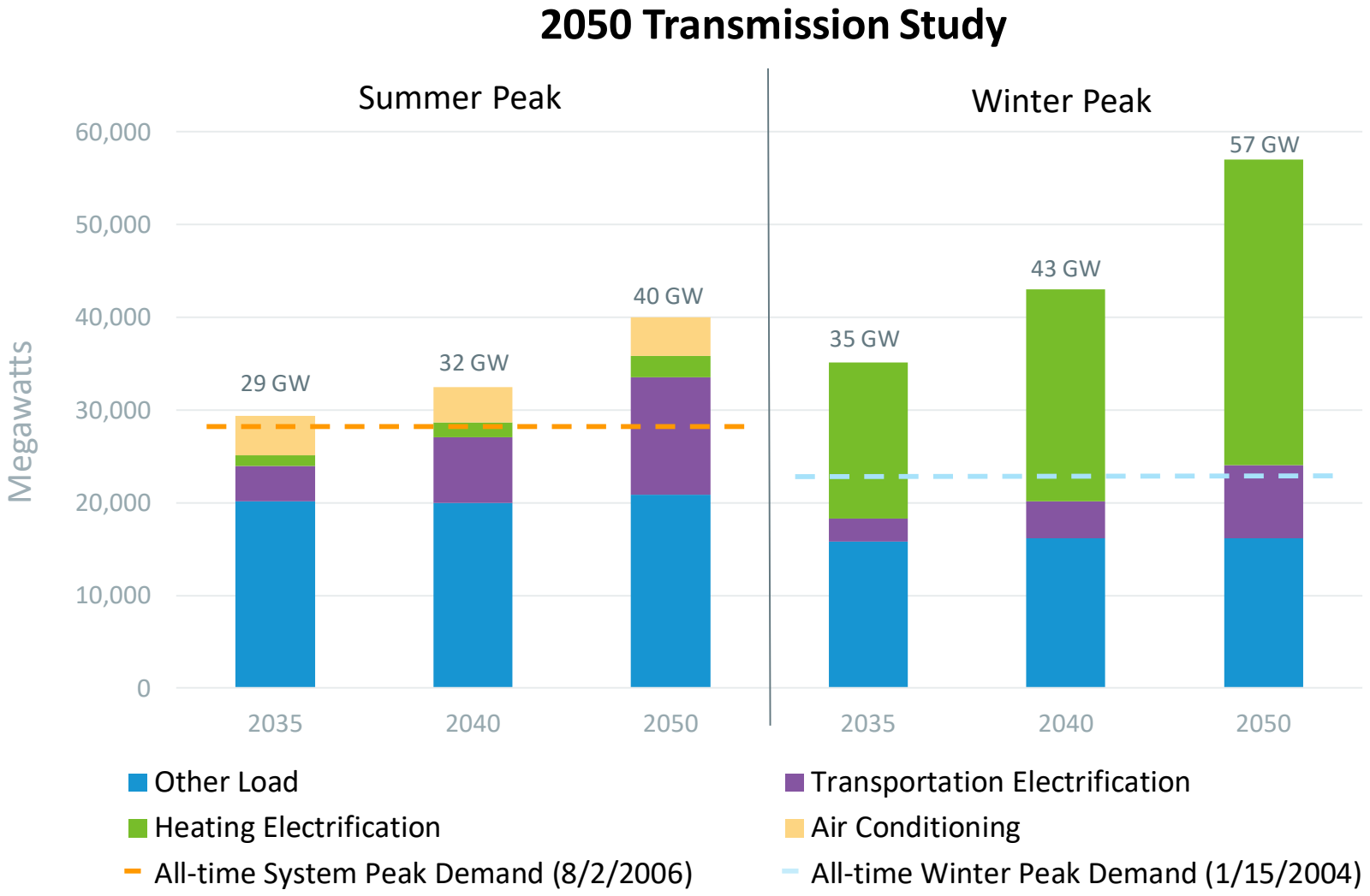
- Initial study scope and assumptions developed **in conjunction with the states**
- Aims to **inform the region** of the amount, type, and high-level cost estimates of **transmission infrastructure** that would be *needed to cost-effectively and reliably serve peak loads*, including electrified transportation and heating, in a clean-energy future
- Study looks **well beyond** the ISO's typical 10-year horizon for transmission planning
- It is ***not*** a plan to build specific projects

The most up-to-date information on the 2050 study is available at the Planning Advisory Committee and Longer-Term Transmission Studies webpages.

2050 Transmission Study Overview

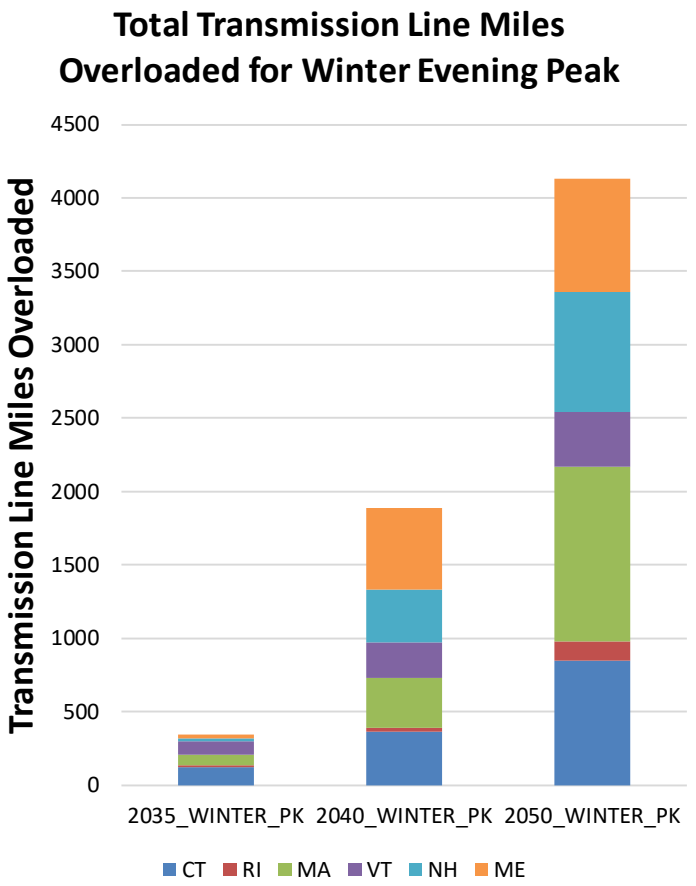
- The assumptions used for the 2050 Transmission Study represent numerous **paradigm shifts** for New England
  - Shift from a *summer-peaking* area to a *winter-peaking* area
  - Rapid growth in the development of *renewable* resources
  - Electrification of *heating* and *transportation* more than doubles the amount of peak power consumption by 2050
- Achieving a **load-generation balance** with the input assumptions requires:
  - The dispatch of *some fossil units* for energy balance in all snapshots
  - Additional resources beyond the input assumptions to meet the load in the Summer Evening and Winter snapshots
- Significant **new transmission** may be needed to reliably serve load under the assumptions analyzed in this study
  - With the current resource location assumptions, the *paths between North and South* would need significant upgrades to transfer surplus generation in Northern New England to generation-deficient Southern New England

New England System Peak Grows Substantially and Shifts to Winter-Peaking



Results Show Overloads on Half of Region's Transmission Lines

- Results show overloads on approximately 50% of New England's transmission line mileage by 2050
- Further analysis showed fewer overloads at a lower, 51 GW (winter peak) level, so that will be the focus of the primary solution set



Solution Development Progress

- Solution development has focused initially on Boston
  - As the major load center, it drives many transmission needs
- Challenges to solution development in Boston:
  - Underground cables with low ratings must both serve load and handle through-flow from one part of the Boston area to another
  - Due to the large number of overloads, adjustments to generation and phase shifters tend to solve one problem while worsening another
- Outside of dense urban areas, many concerns can likely be resolved through incremental upgrades (rebuilding/reconductoring existing lines)
- ISO-NE is currently evaluating bids from consultants to provide high-level cost estimates for conceptual transmission upgrades
  - To save time and study costs, minor/incremental upgrades will rely on per-mile cost assumptions rather than detailed estimates

Solution Development: Initial Takeaways

- Generator interconnection locations are critical
  - Interconnecting in southern New England rather than northern New England tends to reduce transmission needs because supply would not be competing for space to move along an already constrained North-South transmission corridor
- Additional 345/115 kV transformation capacity is required
  - Serving peak load from remote renewable resources requires long-distance transmission at high voltage, and then transformation to reach local substations
  - Generator interconnections directly to the 115 kV network may help, but often require upgrades on the 115 kV system instead

Next Steps

- Continue transmission solution development for the "primary" 2050 solution set
- Determine subsets of upgrades required for 2035 and 2040
- Expand solutions set to fully address the original 57 GW winter peak snapshot
- Work with selected consultant to develop cost estimates
- Next update to NESCOE/PAC likely to occur in Q4 2022
  - Updates on solution development
  - Solution alternatives for 2050 in selected areas of New England

2050 Transmission Study: Two Phases

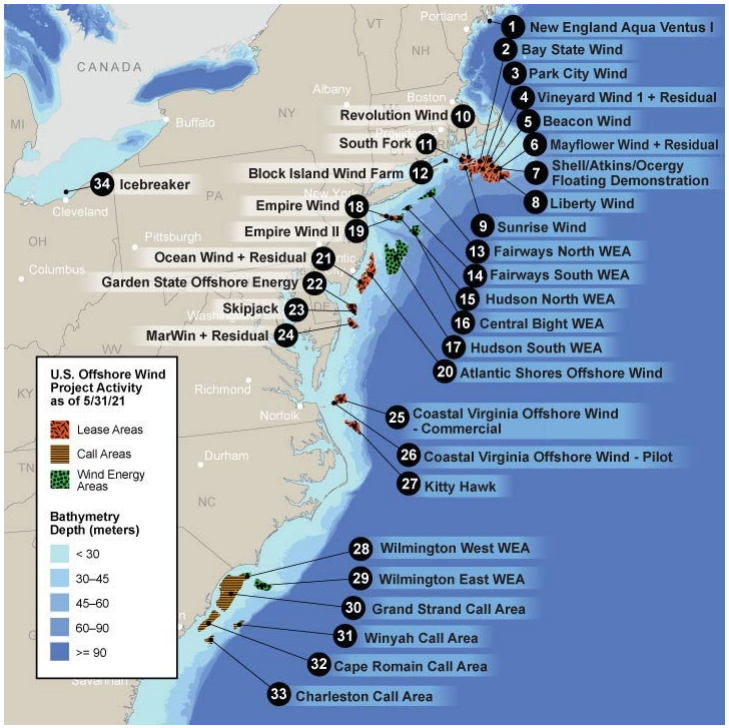
- **Extended-Term/Longer-Term Transmission Planning**
  - In 2022, FERC approved the first phase of changes to Attachment K of the OATT, creating a process that *allows the New England States to request* the ISO to perform planning analyses that may extend beyond the 10-year planning horizon that would provide visibility into the transmission investment needed to further state energy policy objectives
    - The current 2050 transmission study meets these criteria
  - The second phase of changes is intended to provide a process for the states to move public policy-related transmission investments forward along with the associated cost-allocation methodology
    - The process is intended to allow conversion of longer-term transmission studies into developable projects
  - Stakeholder discussions on Phase 2 are planned to begin in late 2022/early 2023, with a potential FERC filing in Q2/Q3 2023
    - Ongoing processes at FERC may further inform this effort

OFFSHORE WIND INTERCONNECTION EFFORTS

Regional Offshore Wind Transmission Study and Cape Cod Cluster Studies

ISO-NE Is Participating in the Atlantic Offshore Wind Transmission Study with the US DOE National Labs

- **US DOE Study Objectives**:
  - Evaluate coordinated transmission solutions to enable offshore wind deployment along the U.S. Atlantic Coast, addressing gaps in previous analyses
  - Compare different transmission technologies and topologies, quantify costs, assess reliability and resilience, and evaluate key environmental and ocean co-use issues
  - Produce timely results to inform decision making and offer feasible solutions, data, and models that may benefit stakeholders in their own planning processes.
- Research is being conducting by the National Renewable Energy Laboratory and Pacific Northwest National Laboratory
- Report expected by Fall 2023

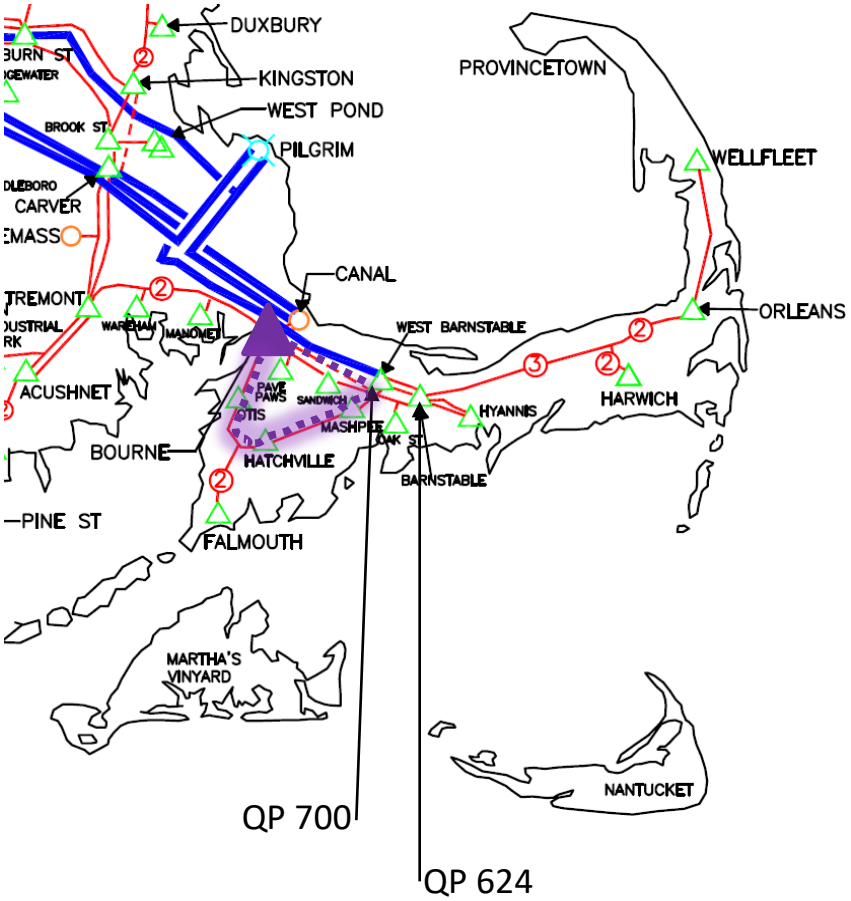


The locations of the current U.S. Atlantic Coast offshore wind projects being considered or developed as of April 30, 2021. *Image from the Offshore Wind Market Report: 2021 Edition*

Source: https://www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html

First Cape Cod Offshore Wind Cluster Study (2020)

ISO Initiated the First Cape Cod Resource Integration (CCRIS) Study to Maximize Interconnection of Offshore Wind



- **1,600 MW** of offshore wind on Cape Cod have completed System Impact Studies and can interconnect immediately
- The ISO initiated the Cape Cod Resource Integration Study (CCRIS) to identify infrastructure upgrades to enable the interconnection of an additional 1,200 MW of offshore wind
- The First CCRIS determine that with the addition of a new 345 kV line on Cape Cod (Bourne – West Barnstable), **a total of 2,800 MW of offshore wind can interconnect on Cape Cod**
- The Cluster System Impact Study has filled and the study is progressing towards completion

Second Cape Cod Resource Integration Study (2021)

Builds on the First CCRIS by addressing issues identified for offshore wind additions greater than 2,800 MW in the Cape Cod area

- Approximately 1,200 MW of offshore generation is seeking to interconnect to Cape Cod and near Pilgrim Substation.
- Together the First and Second CCRIS **seek to interconnect ~4,000 MW of offshore wind.**
- Preliminary findings indicate that that the CETU for the Second CCRIS will be a radial 1,200 MW HVDC line from offshore wind lease areas directly to Boston
- The ISO anticipates concluding the Second CCRIS in the fourth quarter of 2022

Questions