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The Four Pillars Needed for a Successful Clean Energy Transition, and the Critical Role of Transmission Infrastructure

2022 WIRES Summer Meeting

Gordon van Welie

PRESIDENT & CHIEF EXECUTIVE OFFICER

ISO New England's *Mission and Vision*

Mission: *What we do*

Through collaboration and innovation,
ISO New England plans the transmission system, administers the region's wholesale markets, and operates the power system to ensure reliable and competitively priced wholesale electricity

Vision: *Where we're going*

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy

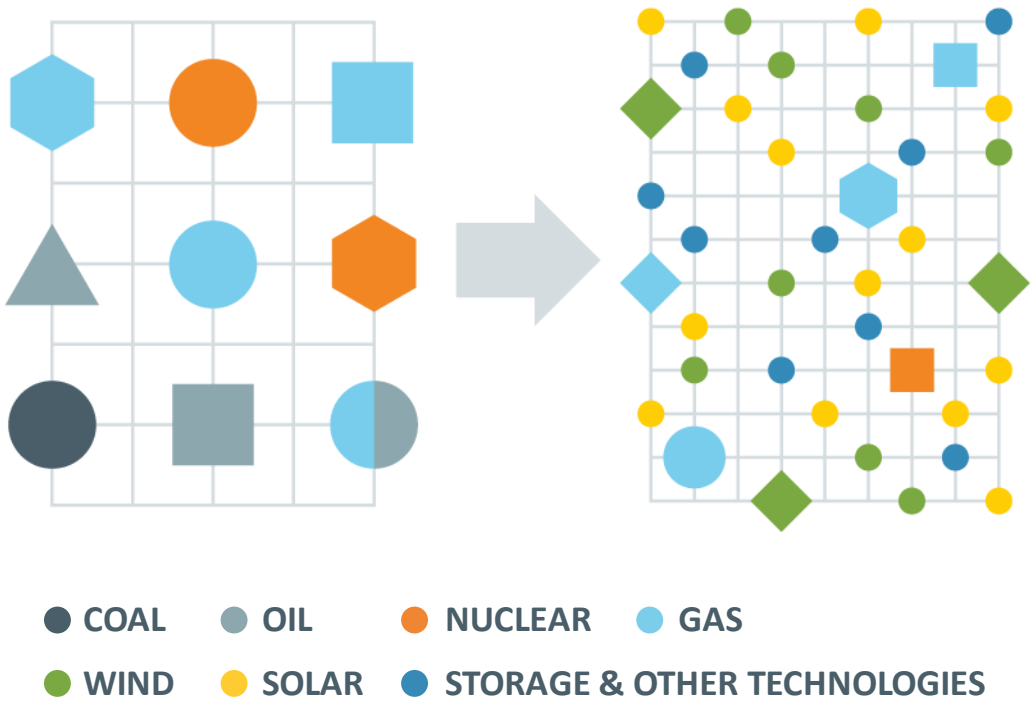
*The ISO's **Vision** for the future represents our long-term intent and guides the formulation of our Strategic Goals*

What Does the Future Grid Look Like?

There are two dimensions to the transition, happening simultaneously…

1. **A shift from conventional generation to renewable energy**

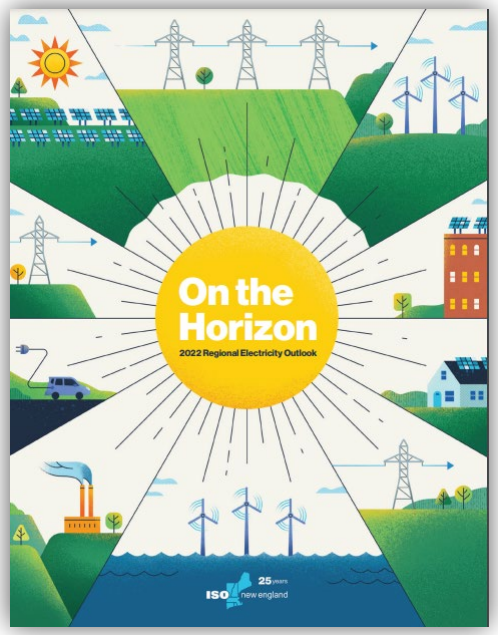
2. **A shift from centrally dispatched generation to distributed energy resources**



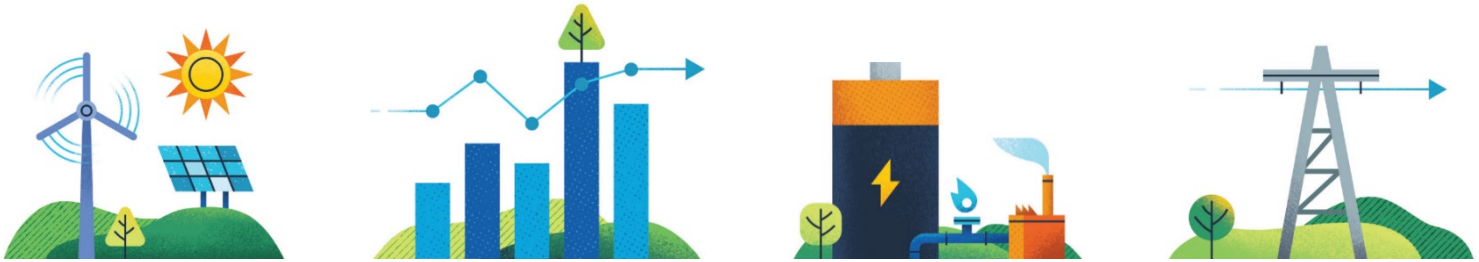
*Maintaining reliable power system operations becomes **more complex** with the shift to greater resources that face constraints on energy production*

There Are Four Pillars Necessary to Support a Successful Clean Energy Transition

1. **Significant amounts of clean energy** to power the economy with a greener grid
2. **Balancing resources** that keep electricity supply and demand in equilibrium
3. **Energy adequacy**—a dependable energy supply chain and/or a robust energy reserve to manage through extended periods of severe weather or energy supply constraints
4. **Robust transmission** to integrate renewable resources and move clean electricity to consumers across New England



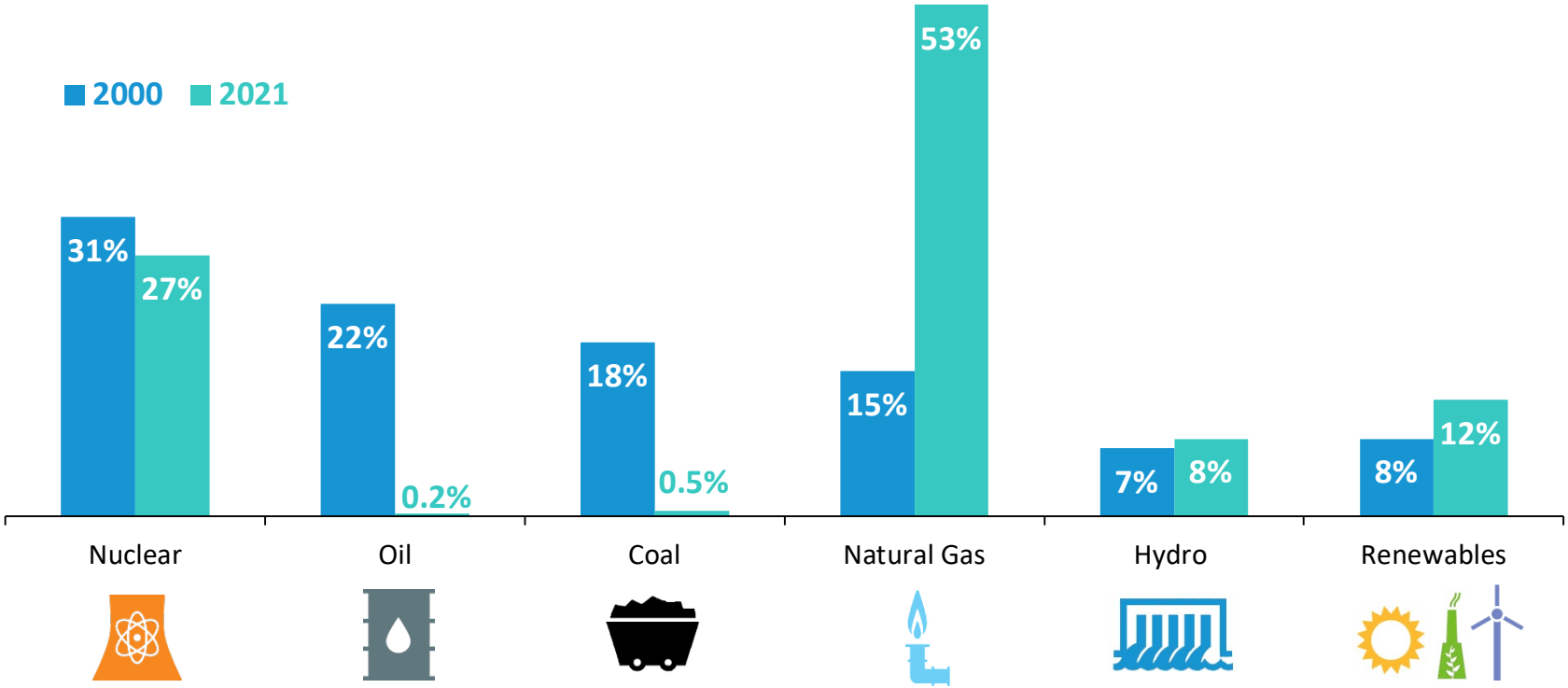
2022 Regional Electricity Outlook



LONG-TERM REGIONAL ENERGY ADEQUACY WILL DEPEND (IN PART) ON ADDITIONAL TRANSMISSION INVESTMENTS

Big Changes in New England's Energy Mix Have Already Occurred

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2021)



Source: ISO New England Net Energy and Peak Load by Source; data for 2021 is preliminary and subject to resettlement
Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.
This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.

Significant Retirements Have Already Occurred, with More on the Horizon

Since 2013, approx. **7,000 MW** of generation have retired or announced plans for retirement

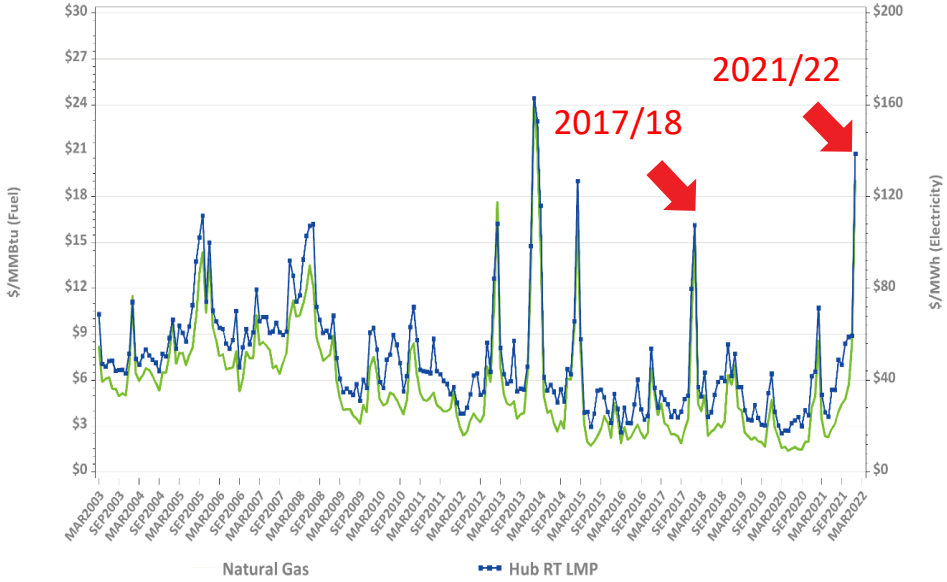
- Predominantly *coal, oil*, and *nuclear* resources
- 5,000 MW of remaining oil units are *at-risk* of retirement
- Generator retirements occur *on schedule*, but new resources are often delayed
- Due to *pipeline constraints*, the region has become dependent on *imported LNG* and *oil* to provide peaking energy supplies in the winter

Source: [ISO New England Status of Non-Price Retirement Requests and Retirement De-list Bids] (January 2022)

Pipeline Constraints Make New England Dependent on LNG Imports, Resulting in Volatile Natural Gas and Electricity Prices, *and Higher Oil Usage*

Monthly Avg. Fuel Price and RT Hub LMP

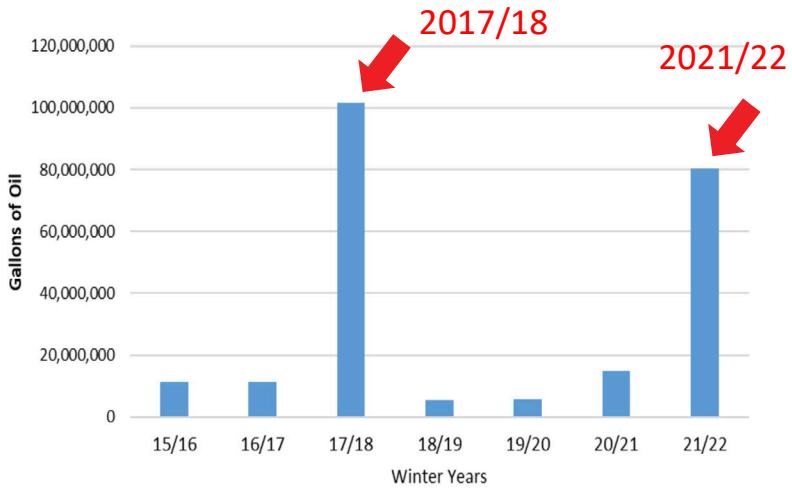
New England experienced 2nd highest January prices



Winter 2021/22 weather was moderate compared to 2017/18, but natural gas prices reached near-all-time highs

Total Winter Oil Burn Per Year

From 2015/16 to 2021/22



Winter 2021/22 fuel-oil burn of ~80 million gallons was three times the previous three winters combined

*The supply chains for LNG and oil become **uncertain** under extreme weather conditions, resulting in **reliability risks** for the electric system*

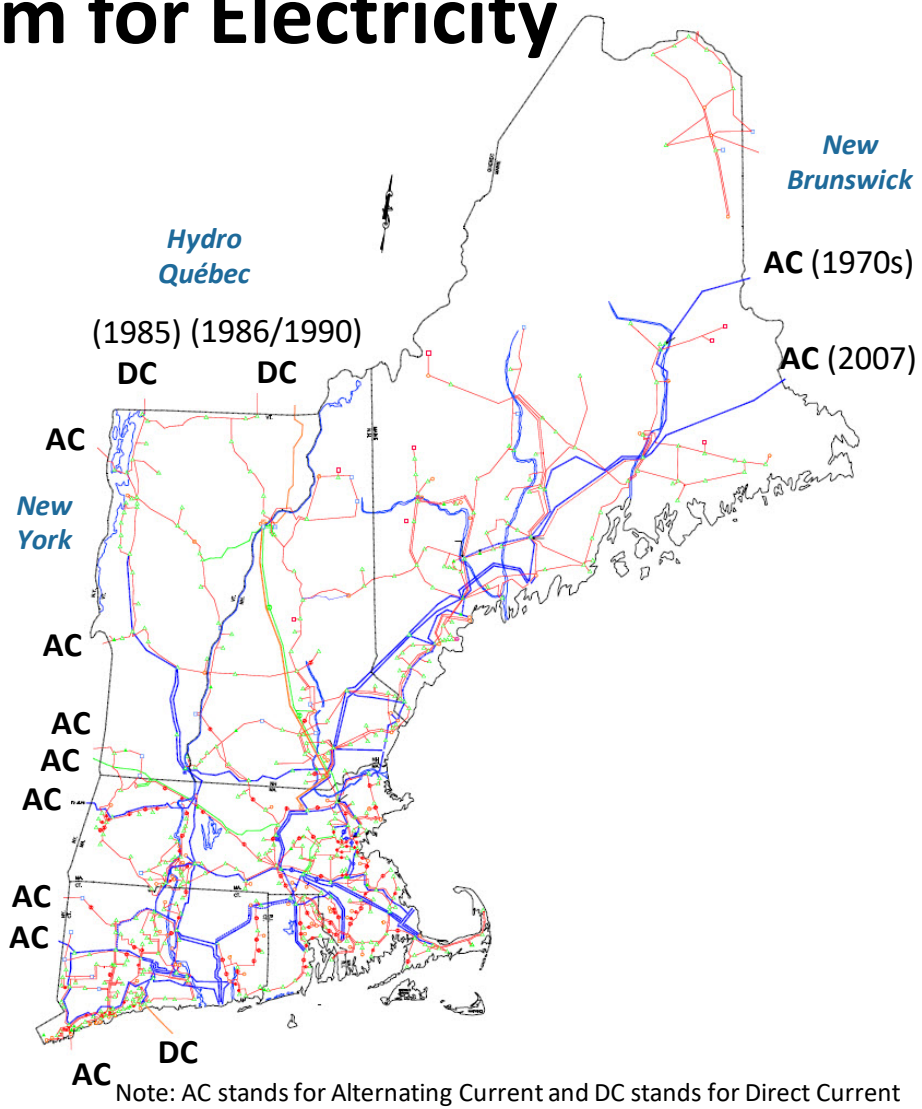
Transmission and Other Investments Are Needed for a Reliable, Clean Energy Future

- New England has made big investments in transmission for **reliability**
  - Investments to-date have substantially reduced *congestion* and *out-of-market costs* and allowed the *retirement* of older, less efficient generation
- Transmission is a **critical pillar** for a reliable, clean energy future:
  - However, adding transmission on its own will not be sufficient – **ensuring energy adequacy** is also critical and will depend on commitments to adequate, *long-duration, balancing-energy supplies*
  - The ISO's Future Grid Reliability Study highlights these energy-adequacy risks
  - In order to meet the region's *decarbonization goals*, action is needed to reduce dependence on imported LNG (because of the availability/cost risks), and thereafter, all fossil fuels
  - Reducing dependence on fossil fuels will depend heavily on accelerating the *integration of renewables* and *accessing balancing energy supplies* in neighboring regions and, in the meantime, the region needs to *retain enough existing infrastructure*, and *stabilize fuel supply chains*, until the clean energy is available in sufficient quantities

THE CLEAN ENERGY TRANSITION WILL DEPEND ON ADDITIONAL TRANSMISSION INVESTMENTS

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

- **9,000 miles** of high-voltage transmission lines (primarily 115 kV and 345 kV)
- **13 transmission interconnections** to power systems in New York and Eastern Canada
- **16%** of region's electrical energy needs met by electricity imports in 2021
- **$11.7 billion** invested to strengthen transmission system reliability since 2002; **$1.1 billion** planned
- Developers have proposed multiple transmission projects to access **non-carbon-emitting resources** inside and outside the region

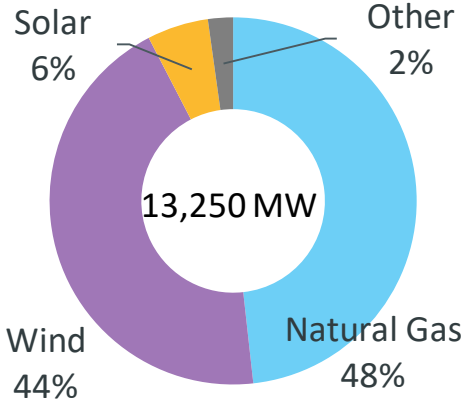


Note: AC stands for Alternating Current and DC stands for Direct Current

The ISO's Generator Interconnection Study Queue Is a Preview of the Future Resource Mix

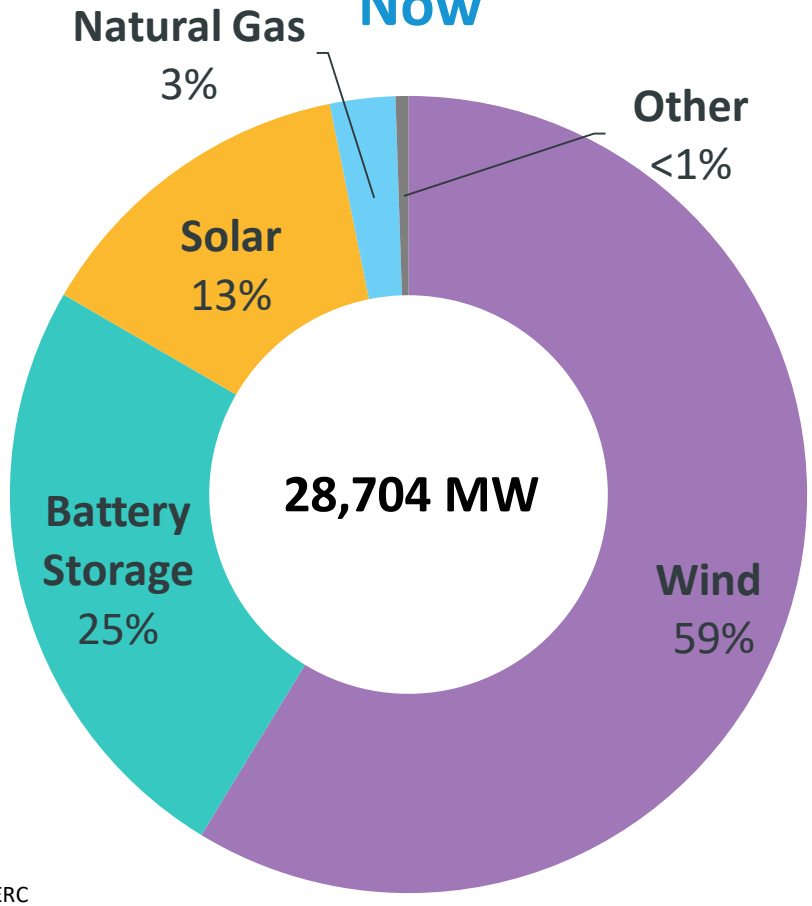
Dramatic shift in types of proposed resources from natural gas to wind

Then



June 2017

Now



July 2022

Offshore Wind

CT	2,400 MW
MA	11,403 MW
ME	12 MW
RI	704 MW

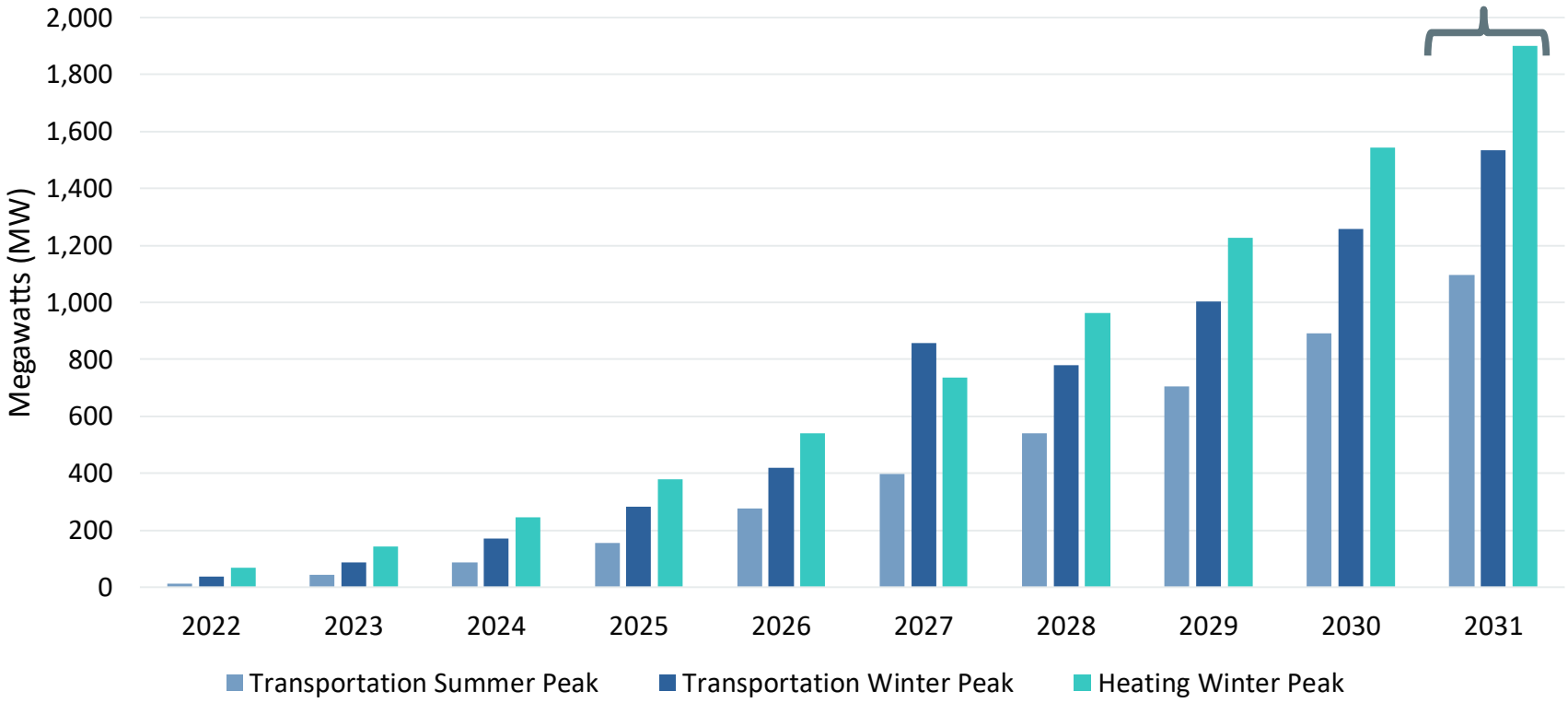
Onshore Wind

ME	2,330 MW

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

ISO Forecasts Electricity Demand Growth from Electric Vehicles and Heating Sectors Over the Next Decade

> 1.5 M EVs
1.1 M air-source heat pumps



Percentage of Net System Peak in 2030: Transportation – summer: 4%; Transportation – winter: 7%; Heating – winter: 8%. Sources: ISO New England 2022-2031 Forecast Report of Capacity, Energy, Loads, and Transmission (2022 CELT Report) (May 2022), 2022 Forecast Data.

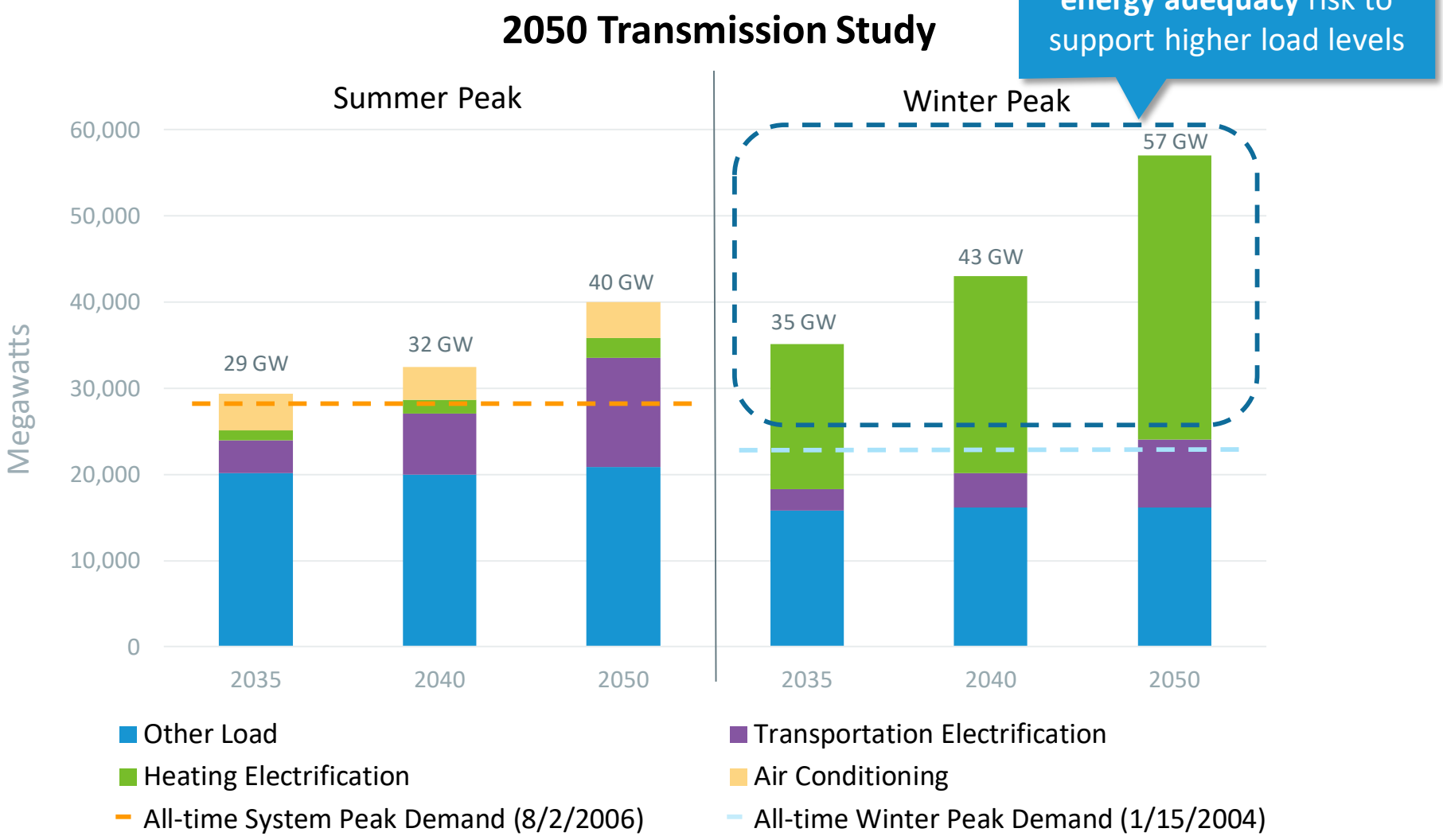
2050 Transmission Study: A High-Level Study for the Years 2035, 2040, and 2050

- 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 webpage.

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

Region needs to address **energy adequacy** risk to support higher load levels



2050 Transmission Study: Key Takeaways

- 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** will 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

2050 Transmission Study: Next Steps

- Begin development of possible **transmission solutions**
  - Ongoing collaboration with the New England states through NESCOE
  - Update stakeholders through the Planning Advisory Committee

Related development:

- **Longer term planning changes**
  - In February 2022, FERC approved the region's proposal to incorporate a supplementary, transmission planning mechanism for the ISO to perform *state-requested*, scenario-based transmission analysis as a permanent feature of the ISO's tariff
  - These changes provide an *additional option* for transmission analysis for the New England states to further their energy policy goals

Conclusions

- New England needs a plan to **ensure energy adequacy** to fully support the region's **transition to clean energy** resources and the **electrification** of transportation and heating sectors
- New England needs to ensure that we *retain enough existing infrastructure*, and *stabilize fuel supply chains*, until the clean energy is available in sufficient quantities
- New England has **vast renewable energy potential**
  - Large-scale onshore and offshore wind development
  - Additional hydropower from Québec
  - Elective transmission projects (e.g., renewables in Northern Maine)
- **Massive transmission investments** will ultimately be required to achieve the states' clean energy goals
  - Siting and cost-allocation hurdles need to be overcome for the clean energy transition to be successful in New England