Regional Update & 2021/2022 Winter Outlook

Vermont House Committee on Energy and Technology

Eric Johnson & Molly Connors

DIRECTOR, EXTERNAL AFFAIRS & EXTERNAL AFFAIRS REPRESENTATIVE

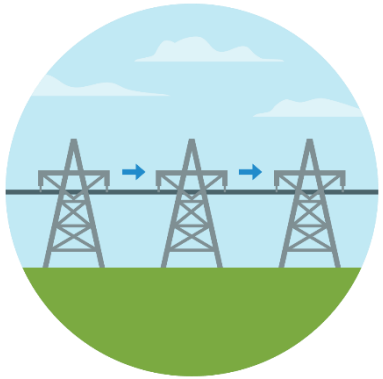
ISO New England (ISO) Has More Than Two Decades of Experience Overseeing the Region's Restructured Electric Power System

- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and **neutral** on technology

ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

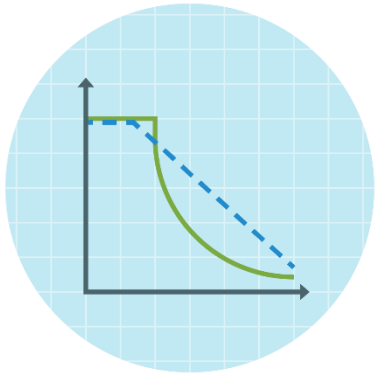
Grid Operation

Coordinate and direct the flow of electricity over the region's high-voltage transmission system



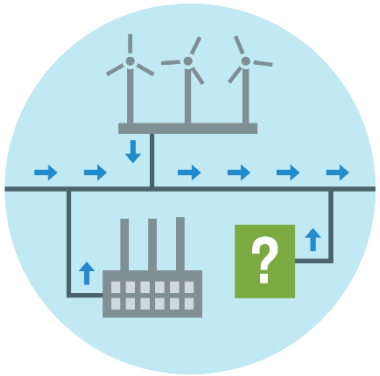
Market Administration

Design, run, and oversee the markets where wholesale electricity is bought and sold



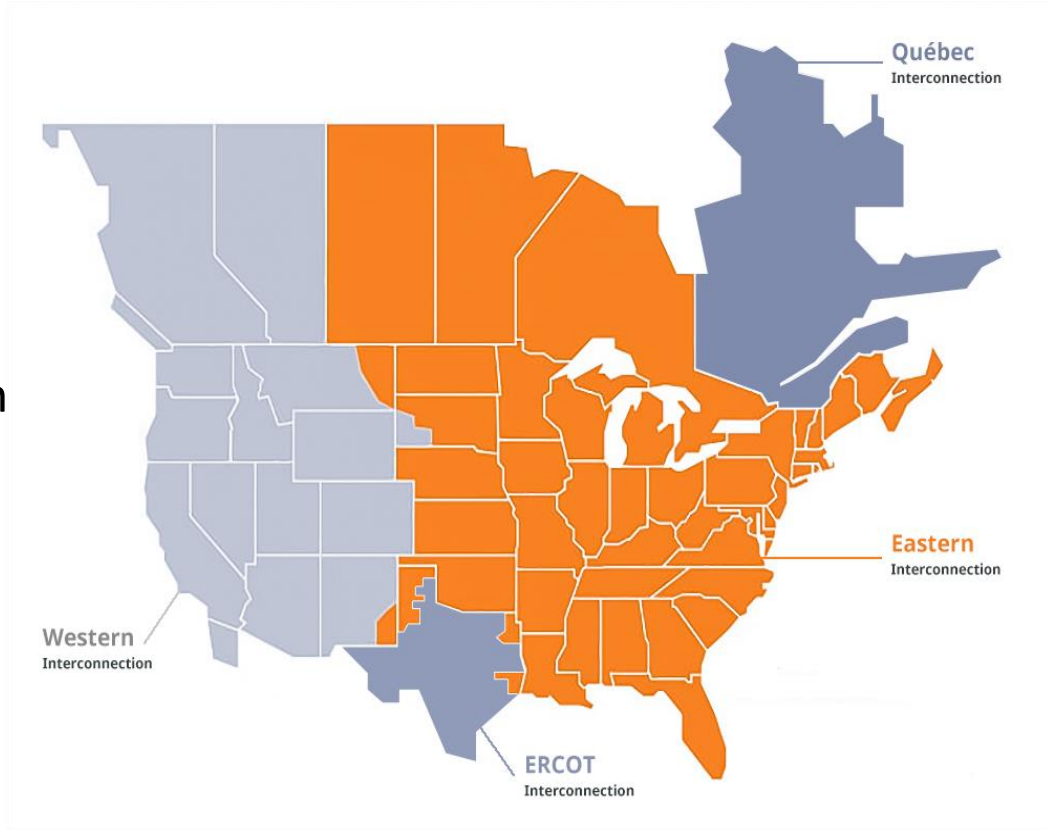
Power System Planning

Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years



New England's Power Grid Is Part of a Larger Electric Power System

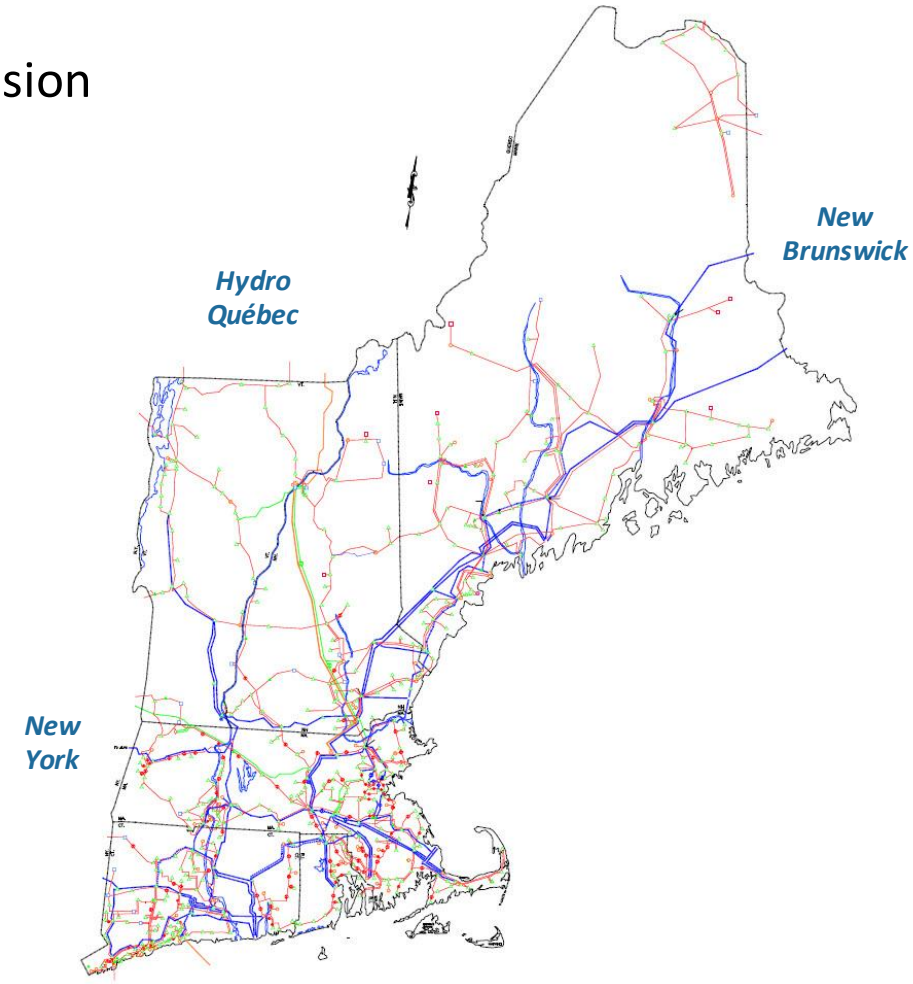
- Part of the **Eastern Interconnection**, one of four large power grids in North America
  - Interconnected through primarily alternating current (AC) transmission
- Tied to **Québec** only through direct current (DC) transmission
- 2003 blackout ushered in wide-area monitoring and **mandatory** reliability standards
- Subject to reliability standards set by **NERC** and **NPCC***



* North American Electric Reliability Corporation (NERC) and Northeast Power Coordinating Council (NPCC)

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
- **21%** of region's energy needs met by imports in 2020
- **$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



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 new **Vision** for the future represents our long-term intent and guides the formulation of our Strategic Goals*

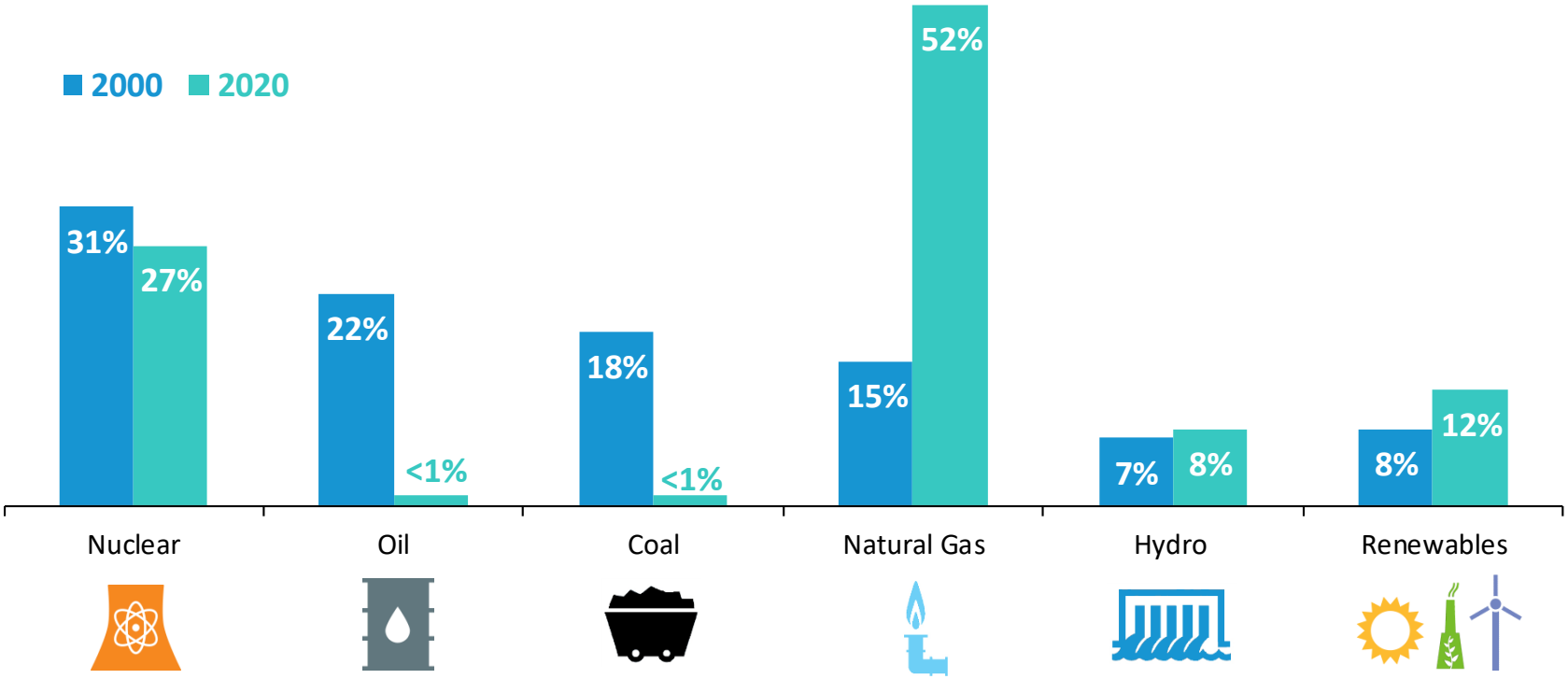
ACHIEVING STATE POLICY GOALS WILL FUNDAMENTALLY CHANGE THE RESOURCE MIX

This will ultimately affect the entire economy as states seek to use clean energy from the grid to electrify the heating and transportation sectors

New England's Power System Has Already Experienced Dramatic Changes in the Energy Mix

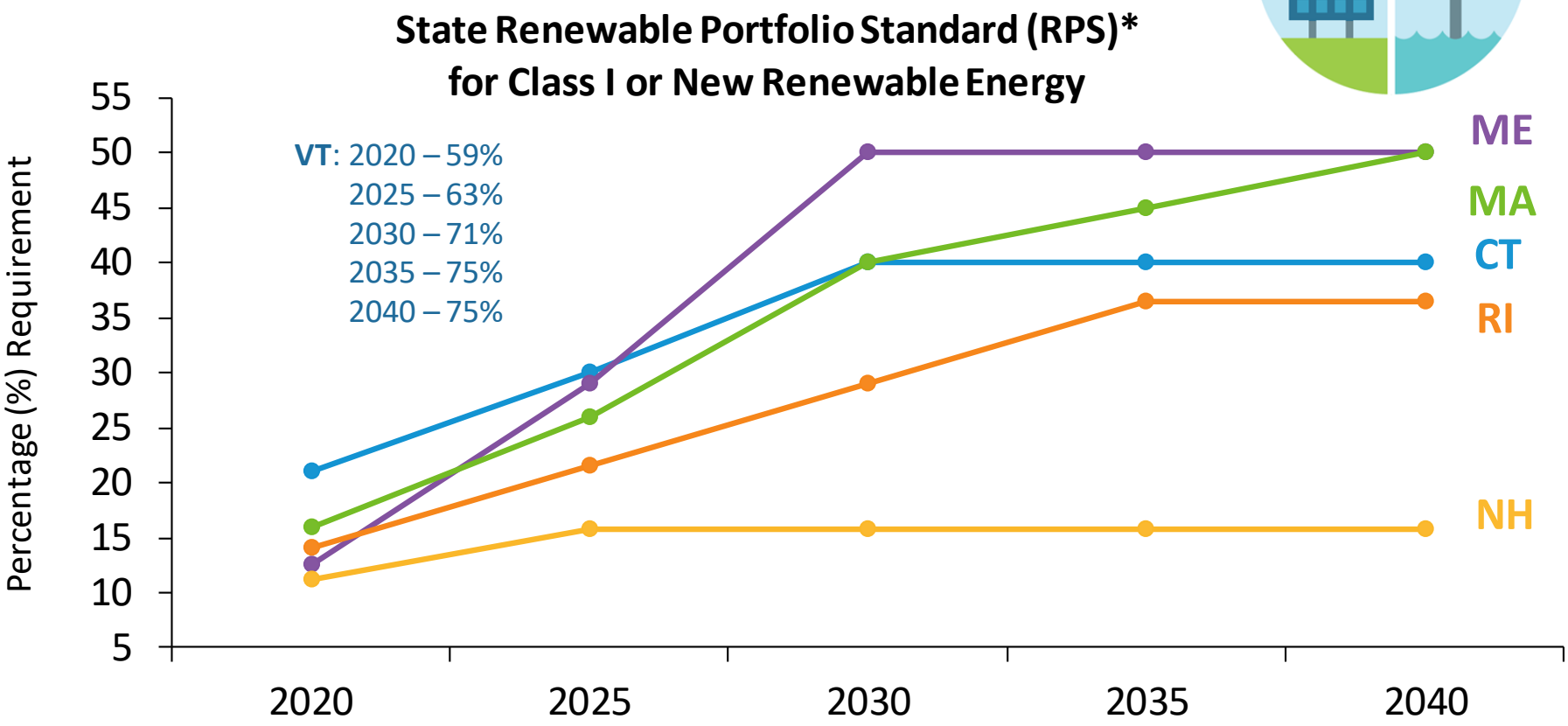
Economic and environmental factors have shifted the region's electricity production

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2020)



Source: ISO New England Net Energy and Peak Load by Source; data for 2020 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.

State Polices are Requiring Increasing Amounts of Renewable Energy



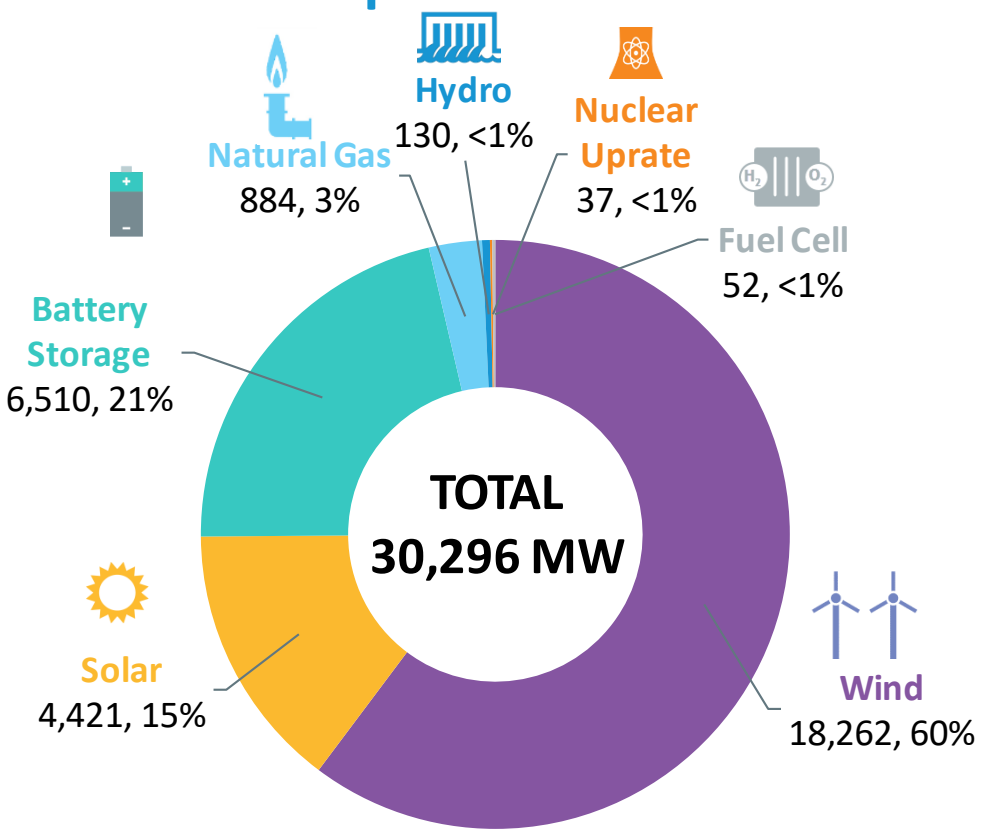
Notes: State RPS requirements promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Connecticut's Class I RPS requirement plateaus at 40% in 2030. Maine's Class I/IA RPS requirement increases to 50% in 2030 and remains at that level each year thereafter. Massachusetts' Class I RPS requirement increases by 2% each year between 2020 and 2024, 3% each year between 2025 and 2029, reverting back to 1% each year thereafter, with no stated expiration date. New Hampshire's percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006). New Hampshire's Class I and Class II RPS requirements plateau at 15.7% in 2025. Rhode Island's requirement for 'new' renewable energy plateaus at 36.5% i n 2035. Vermont's 'total renewable energy' requirement plateaus at 75% in 2032 and recognizes all forms of new and existing renewable energy.

States Are Targeting Increases in Renewable and Clean Energy and Deep Reductions in CO_2 Emissions

≥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 statewide GHG emissions limit MA clean energy standard
90% by 2050	VT renewable energy requirement
100% by 2050 Carbon-Neutral by 2045	ME renewable energy requirement ME emissions goal
100% by 2040	CT zero-carbon electricity goal
100% by 2030	RI renewable energy goal

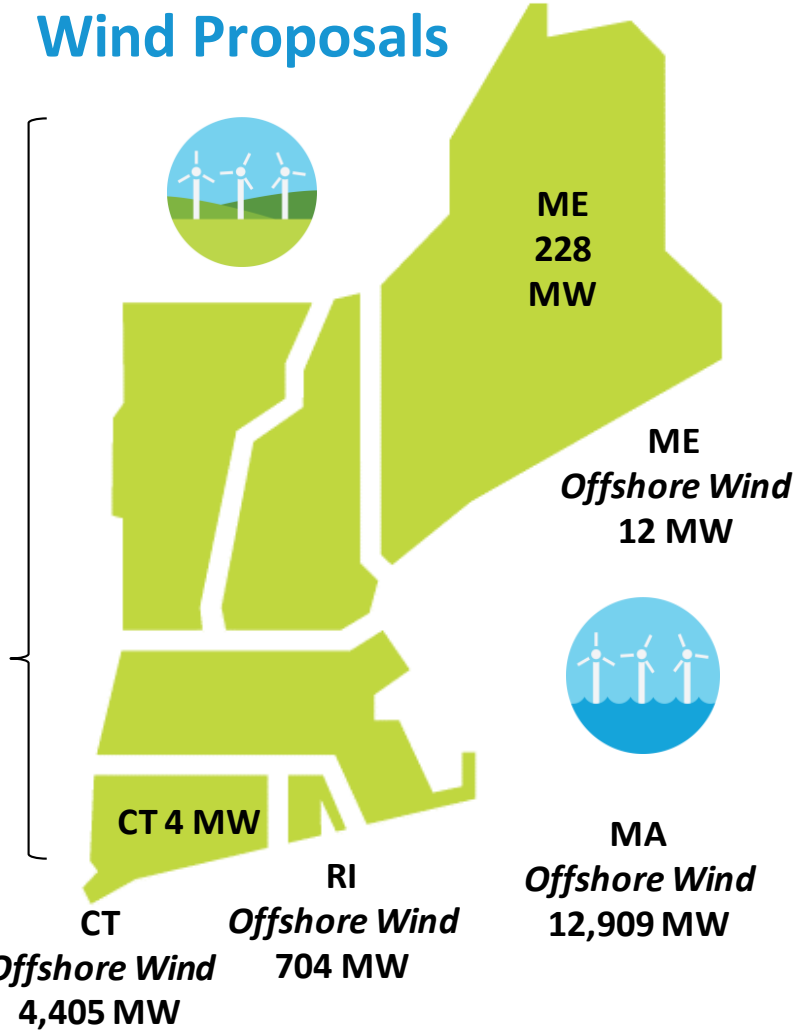
Wind Power Comprises Almost Two Thirds of New Resource Proposals in the ISO Interconnection Queue

All Proposed Resources



Source: ISO Generator Interconnection Queue (January, 2022)
FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings
Note: Some natural gas proposals include dual-fuel units (with oil backup).
Some natural gas, wind, and solar proposals include battery storage.

Wind Proposals



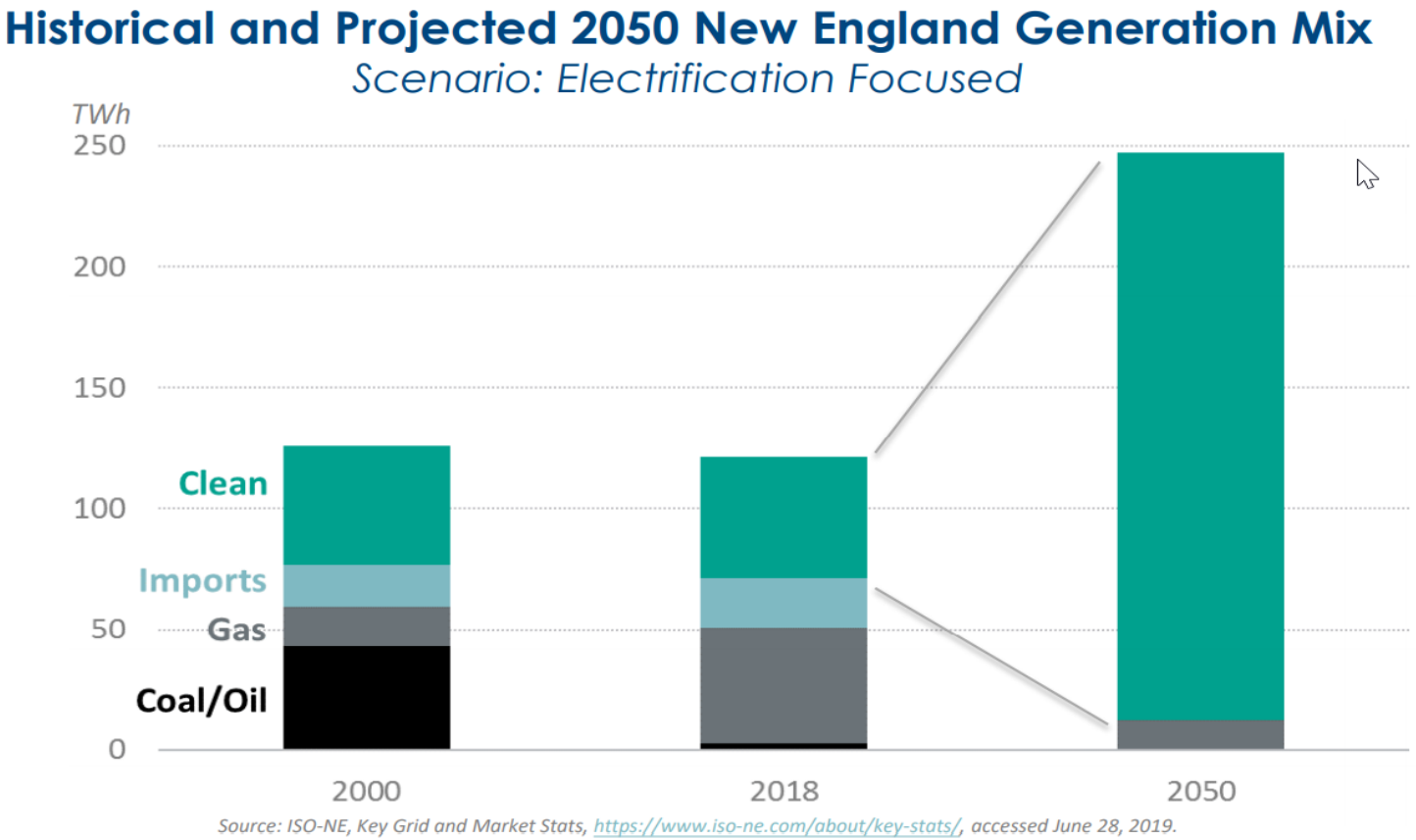
Overview of Studies Supporting Future Grid

- **Weather**: Operational Impacts of Extreme Weather Events
  - Rigorously model likelihood and impact
- **Transmission**: 2050 Transmission Study
  - What transmission is needed to support renewable/high load future
- **Operations**: Future Grid Reliability Study (Phase 1)
  - Examine operational effects of renewable-heavy grid
- **Markets**: Pathways to the Future Grid
  - Evaluate different market options to support a renewable-heavy grid
- **Reliability**: Transmission Planning for the Clean Energy Transition
  - How should near-term needs assessments evolve with renewables?

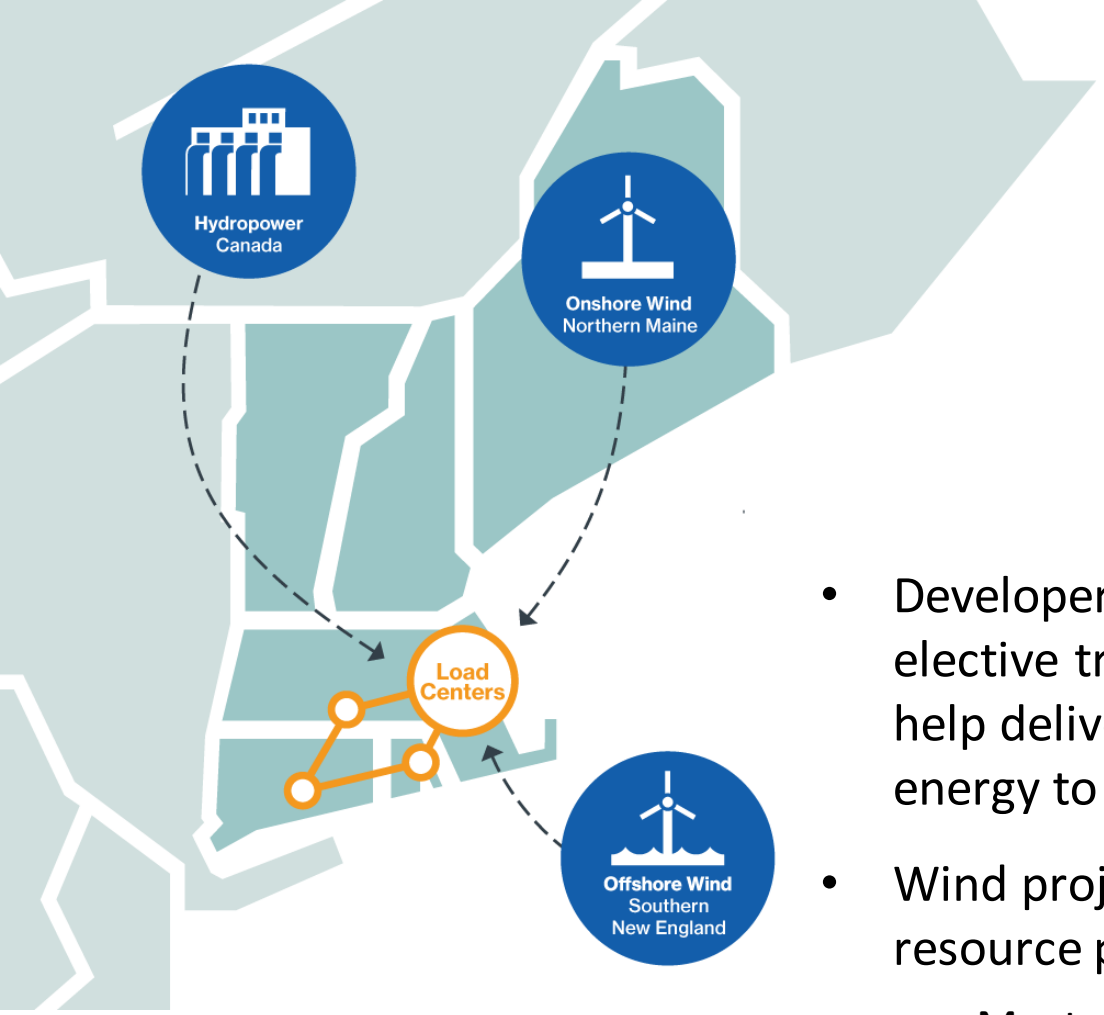
- **Other Studies**
  - Inverter-based resource modeling and integrated market simulator

Electrification Could Double Regional Electricity Demand by 2050: Brattle Group

This will need to be supplied by clean energy resources to meet state objectives



Source: *Achieving 80% GHG Reduction in New England by 2050*, September 2019, The Brattle Group



Lines represent types of ETUs private developers have proposed in recent years

Source: ISO Interconnection Queue (January 2022)

Developers Are Proposing Large-Scale Transmission Projects to Deliver Clean Energy to Load Centers

- Developers are proposing 13 elective transmission upgrades (ETUs) to help deliver almost **6,000 MW** of clean energy to New England load centers
- Wind projects make up **60%** of new resource proposals in the ISO Queue
  - Most are offshore wind proposals in southern New England, but some are onshore wind proposals in northern New England and **would require transmission** to deliver the energy to load centers

Source: ISO New England Status of Non-Price Retirement Requests and Retirement De-list Bids (January 2021)

Since 2013, Roughly 7,000 MW of Generation Have Retired or Announced Plans for Retirement in the Coming Years

- Include predominantly coal, oil, and nuclear resources
- Another **5,000 MW** of remaining coal and oil are at risk of retirement
- These resources have played an **important** role in recent winters when natural gas supplies are constrained in New England

Critical Inputs to a Reliable Power System with High Penetration of Renewables

Robust Transmission System

- $12B invested over two decades
- Active planning for the *Clean Energy Transition*, including a look-ahead to 2050 at the request of the New England States

Robust Fleet of Balancing Resources

- Market design improvements are needed to ensure *retention* and *entry* of resources that can balance renewable energy on a routine basis

Robust Energy Supply Chain

- Region needs "on call" **stored energy** to fill ***gaps*** when there is no sun or wind
- **Electrification** of heating and transportation will *increase* this gap until clean energy is available on a large scale

WINTER 2021/2022 OUTLOOK

Winter 2021/2022 Outlook

- New England's demand for electricity is expected to peak at **19,710 megawatts** (MW) during average winter conditions of 10°F, and **20,349 MW**, if temperatures reach below average conditions of 5°F
- The National Oceanic and Atmospheric Administration is predicting **a milder than average winter in New England**
- ISO New England **expects to have the resources needed** to meet consumer demand throughout the winter season, if this forecast holds

Pipeline Gas Availability

- Natural gas pipeline constraints occur when there is **simultaneous demand** for natural gas for heating homes and operating electric generating plants
- **Heating customers are served first** and the remaining gas is available for electric generators
- Region uses other fuels (**oil or LNG**) when pipeline gas is unavailable or prohibitively expensive

Availability of Other Fuels

- Current storage levels of oil and LNG are **lower** than in recent winters, while prices are high globally
- The region has **yet to find** a robust solution to bolster the supply chain for these fuels during inclement weather
- Pandemic-related supply chain issues and adverse weather could **limit deliveries** to the region this winter
- Emissions restrictions could limit the availability of dual-fuel and oil-fired plants

Weather

- NOAA is predicting **above-average temperatures**
- A mild season **does not eliminate risk** of prolonged cold snaps, as evidenced in recent winters
- Prolonged cold snaps **heighten risk** of the probability that the ISO would need to implement emergency procedures

High-Level Scenario Analysis: Winter 2021/2022

If this winter is similar to…

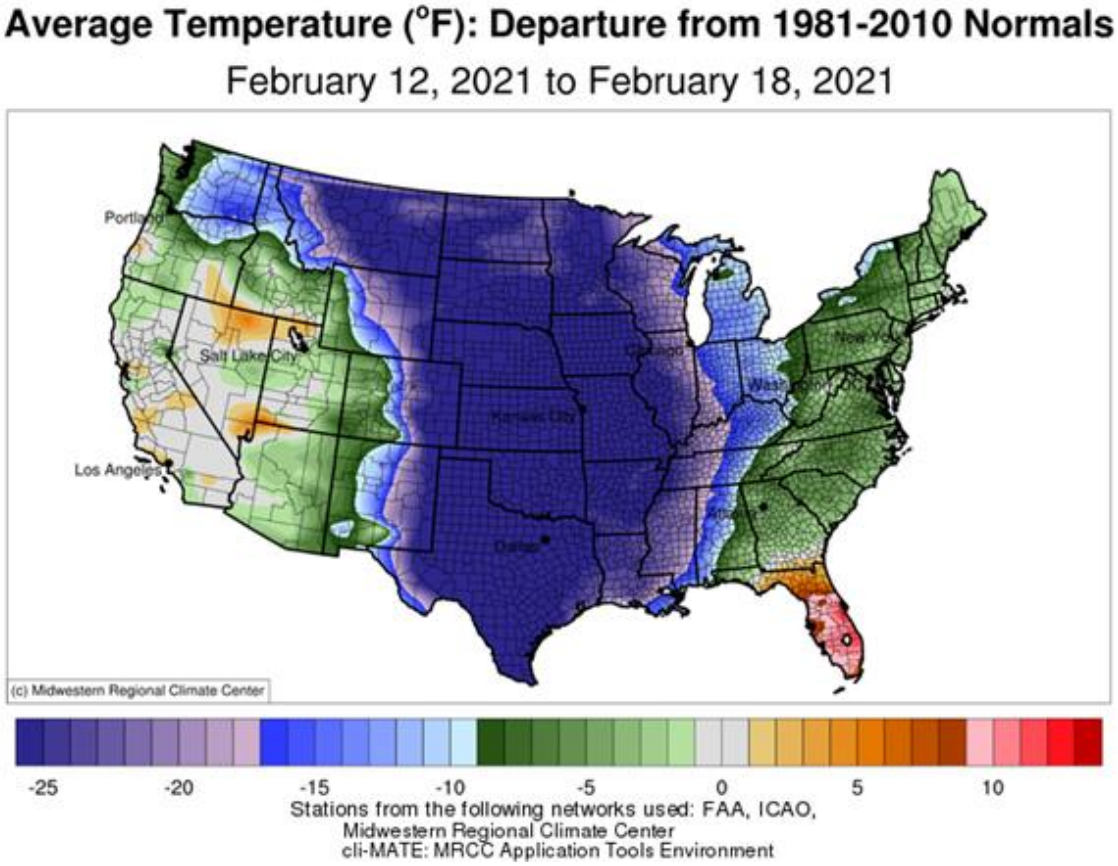
Winter 2020/21 *(Mild weather)*	**Winter 2017/18** *(Two-week cold snap)*	**Winter 2013/14** (below-normal temps and several cold stretches)
The ISO anticipates that the system can be operated reliably *without* the need for emergency procedures	The ISO anticipates that the system can be operated reliably, but *may require* **limited emergency procedures**	The ISO anticipates that it *may require* implementation of **all available emergency procedures**

All three scenarios for this winter:
Assume no significant generation or transmission outages and *limited fuel replenishment*

If the region has ***adequate fuel replenishment*** this winter the ISO anticipates that the system can be operated reliably without the need for emergency procedures

New England Is Not Texas, but Risks Remain

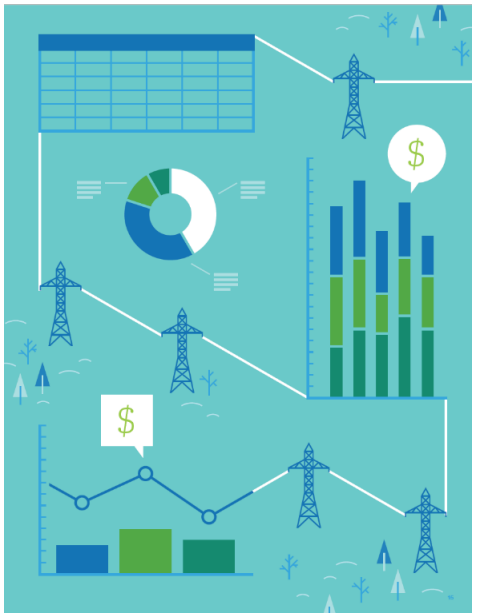
- New England generators and transmission lines are **better winterized**, but this region remains vulnerable during *extreme* and *extended* cold weather
- **Transmission** to neighboring power systems is beneficial; however, a *large-scale weather event* is likely to impact New York and Canada, limiting their ability to export power to New England.



Source: Midwest Regional Climate Center

Preparations and Actions during Winter

- Before and during the winter, ISO New England:
  - Evaluates region's winter supply outlook
  - Meets with generators, industry stakeholders, and governmental officials to review forecasts
  - Prepares short-term forecasts on a rolling 21-day basis to identify potential energy shortfalls
  - Can take emergency actions to prevent grid collapse
  - May request energy conservation over hours or days to minimize need for emergency actions



A CLEANER FUTURE, BUT CHALLENGES REMAIN

Energy Security Challenges

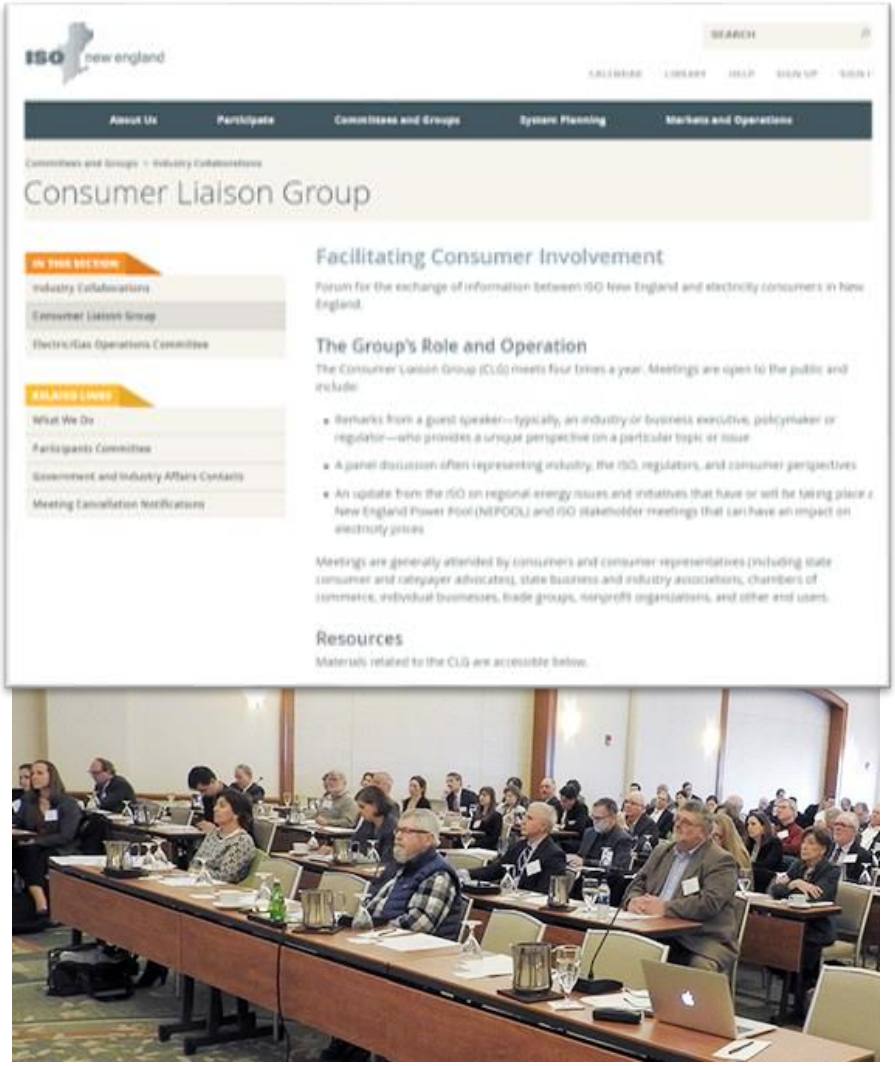
- Insufficient in-region energy storage, limited access to hydro storage in Quebec, and continued dependence on a fragile fuel supply chain for gas and oil will continue to inject uncertainty into the supply picture
- Offshore wind and increased imports from Canada will help, but remain years away and face development challenges
- Balancing resources will continue to be needed as we become more dependent on wind and solar resources

Future Grid Initiative

- A regional energy strategy is central to achieving the region's climate goals while maintaining a reliable supply of electricity
- ISO New England, the New England states, and industry stakeholders have launched the Future Grid Initiative
- This broad, collaborative effort will define and quantify the trajectory of the region's power system, including quantifying the nature of the services needed to ensure a reliable clean energy transition

Join Us for a 2022 Consumer Liaison Group Meeting

- Consumer Liaison Group (CLG) meetings are:
  - A **forum** for sharing information between ISO New England and electricity consumers in the region
  - **Developed** by the CLG Coordinating Committee and **facilitated** by ISO New England
  - **Free** and **open** to the public
- 2022 Meetings
  - Thursday, March 10
  - Thursday, June 9
  - Thursday, September 15
  - Wednesday, November 30



More information on the CLG is available at: https://www.iso-ne.com/committees/industry-collaborations/consumer-liaison/

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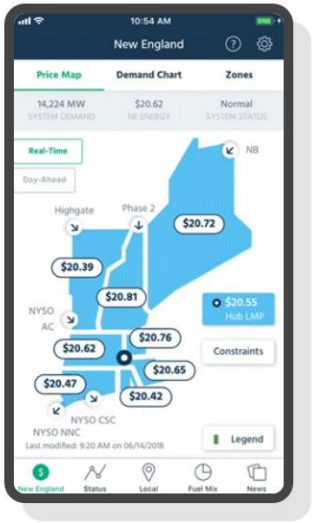
ISO to Go is a free mobile application that puts real-time wholesale electricity pricing and power grid information in the palm of your hand



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APPENDIX

Additional Information on the ISO's Efforts Supporting the Region's Transition to the Future Grid

Modeling and Assessing Operational Impacts of Extreme Weather Events

Considering how to study New England's reliability risks from severe weather events

- The 2021 events in Texas have caused the ISO to further evaluate whether our region is adequately assessing and preparing for low-probability, high-impact reliability risks (tail risks)
- The ISO initiated the project with NEPOOL and state officials this fall
- Through 2022 and 2023, the ISO and stakeholders will discuss approaches to modeling tail risks related to extreme weather events
- This process will:
  - Initially focus on understanding the modeling approaches to quantify such risks
  - Subsequently focus on understanding if and how the region should protect against the risks
- The ISO will work with Electric Power Research Institute on this project

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:
  - Incorporate clean-energy and distributed-energy resources and;
  - Meet state energy policy requirements and goals, including economy-wide decarbonization

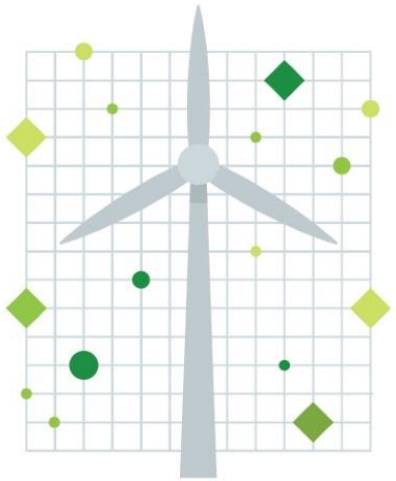
- Looks **well beyond** the ISO's 10-year horizon for transmission planning
- It is ***not*** a plan to build specific projects

The most up-to-date information on the 2050 study is available at the Planning Advisory Committee

Future Grid Reliability Study (Phase 1)

Stakeholder-led Assessment of the Region's Power System in 2040

- Examines the implications of a **substantially-changed** New England grid, where clean, intermittent resources comprise a majority of the generation mix
  - Studies whether the ISO can operate the grid reliably under status-quo market mechanisms
  - Considers what products and attributes are missing



- NEPOOL requested this study; stakeholders, including the New England States Committee on Electricity (NESCOE), **developed the scenarios**
- A full report is expected in March 2022

The most up-to-date information on the FGRS study is available at https://www.iso-ne.com/committees/key-projects/new-englands-future-grid-initiative-key-project

Pathways to the Future Grid

Exploring Potential Market Frameworks To Support the Power Grid's Evolution

- The ISO will model three potential market designs that could help the region **decarbonize** the New England electric system
  - Net Carbon Pricing
  - Forward Clean Energy Market (FCEM)
  - Hybrid of the two (FCEM and Net Carbon Pricing)
- Under all cases, region-wide emissions from the electricity sector will **be 80% below 1990 levels in 2040**
  - NEPOOL requested this study, with stakeholders weighing in on the market designs
- Results anticipated in **April 2022**

The most up-to-date information on the Pathways study is available at
https://www.iso-ne.com/committees/key-projects/new-englands-future-grid-initiative-key-project

Transmission Planning for the Clean Energy Transition

- The ISO has **pilot-tested** a variety of transmission planning assumptions for 2030, exploring the question: **What new concerns and phenomena need to be analyzed?**
- Based on results, the ISO will finalize and document new study conditions for **load, solar generation, and wind generation** to use going forward in its planning studies
- The ISO will continue **further analyses into 2022** on renewable energy modeling and inter-area coordination of renewable energy integration, including:
  - Detailed Distributed Energy Resource (DER) modeling
  - DER protection settings
  - Criteria for the acceptable level of DER tripping following transmission system events
- Draft and final reports documenting the analysis performed in the TPCET Pilot Study are expected to be published **by the end of 2021**

The most up-to-date information is available at the Planning Advisory Committee

Also needed: Tools to Support Future Grid Studies

Models, simulators, and other tools that are adaptive to evolving technologies and system conditions are needed to support future-grid studies

- **Inverter-Based Resource Integration and Modeling Assessment**
  - A multi-year project (2021-2023) to assess and adopt advanced, innovative analysis techniques that capture the **unique performance characteristics of inverter-based resources** (e.g., solar and wind)
- **Integrated Market Simulator Development**
  - A multi-year project (2021-2023) to develop a new platform to produce accurate, timely, long-term wholesale electricity market-simulation results
  - Will enable the ISO **to better and more cost-effectively quantify** the potential outcomes of future market design changes or potential changes in system supply and demand conditions
  - Will aid the ISO's **research and development** projects and cost impact studies