

ISO New England Introduction & Regional Update



Senate Natural Resources and Energy Committee

House Environment and Energy Committee

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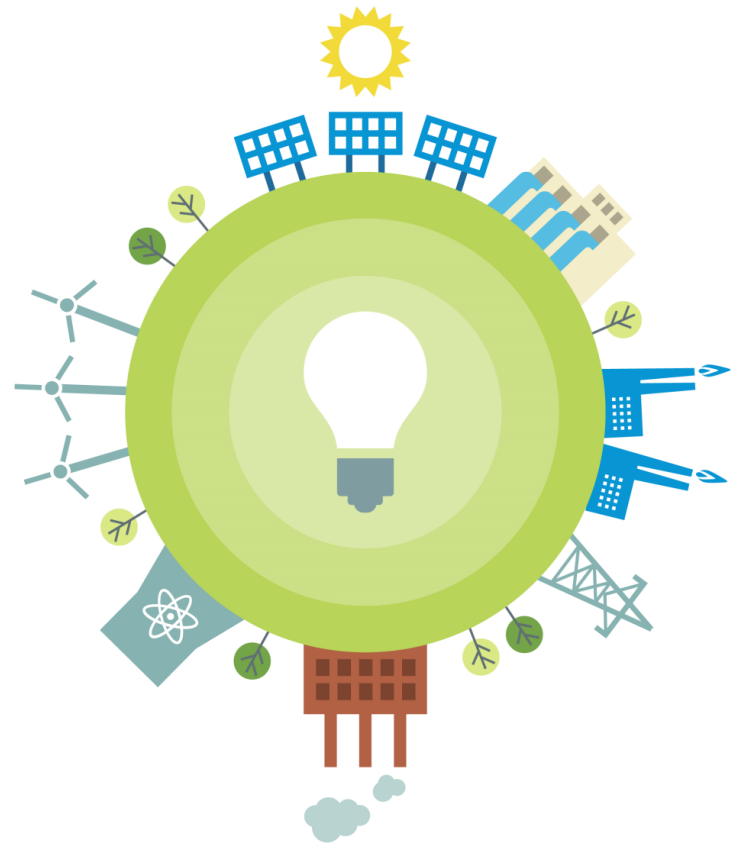
Sarah Adams

STATE POLICY ADVISOR



Overview of Presentation

- About ISO New England
- New England Power System & Markets
- Grid Transformation
- Transmission Developments
- Other Studies



ABOUT ISO NEW ENGLAND



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

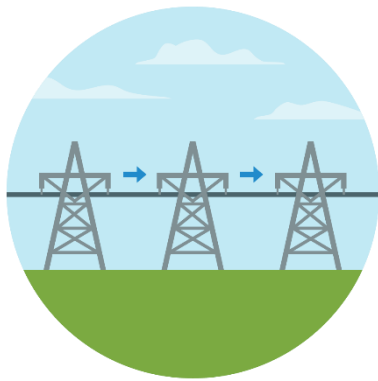
- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and **neutral** on technology



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

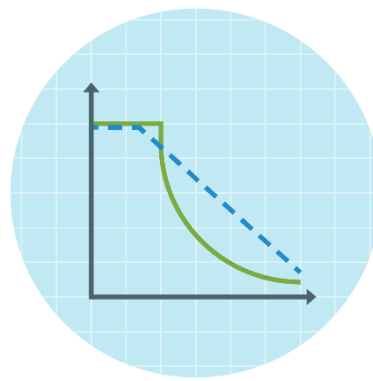
Grid Operation

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



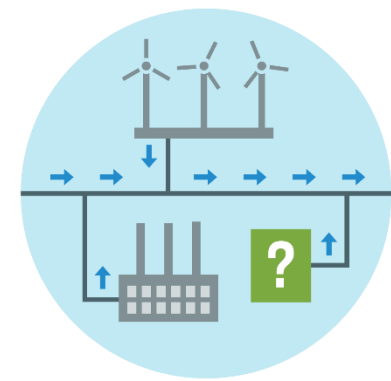
Market Administration

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

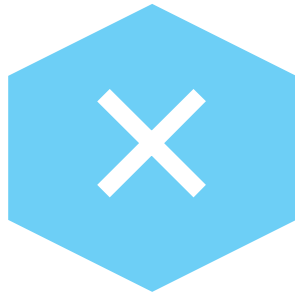


Power System Planning

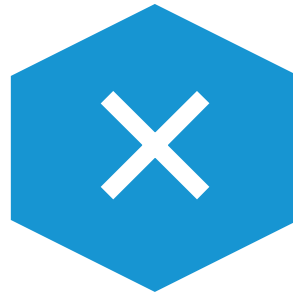
Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years



Things We Don't Do



Handle retail electricity
—the power you buy
from your local utility
or electric supplier



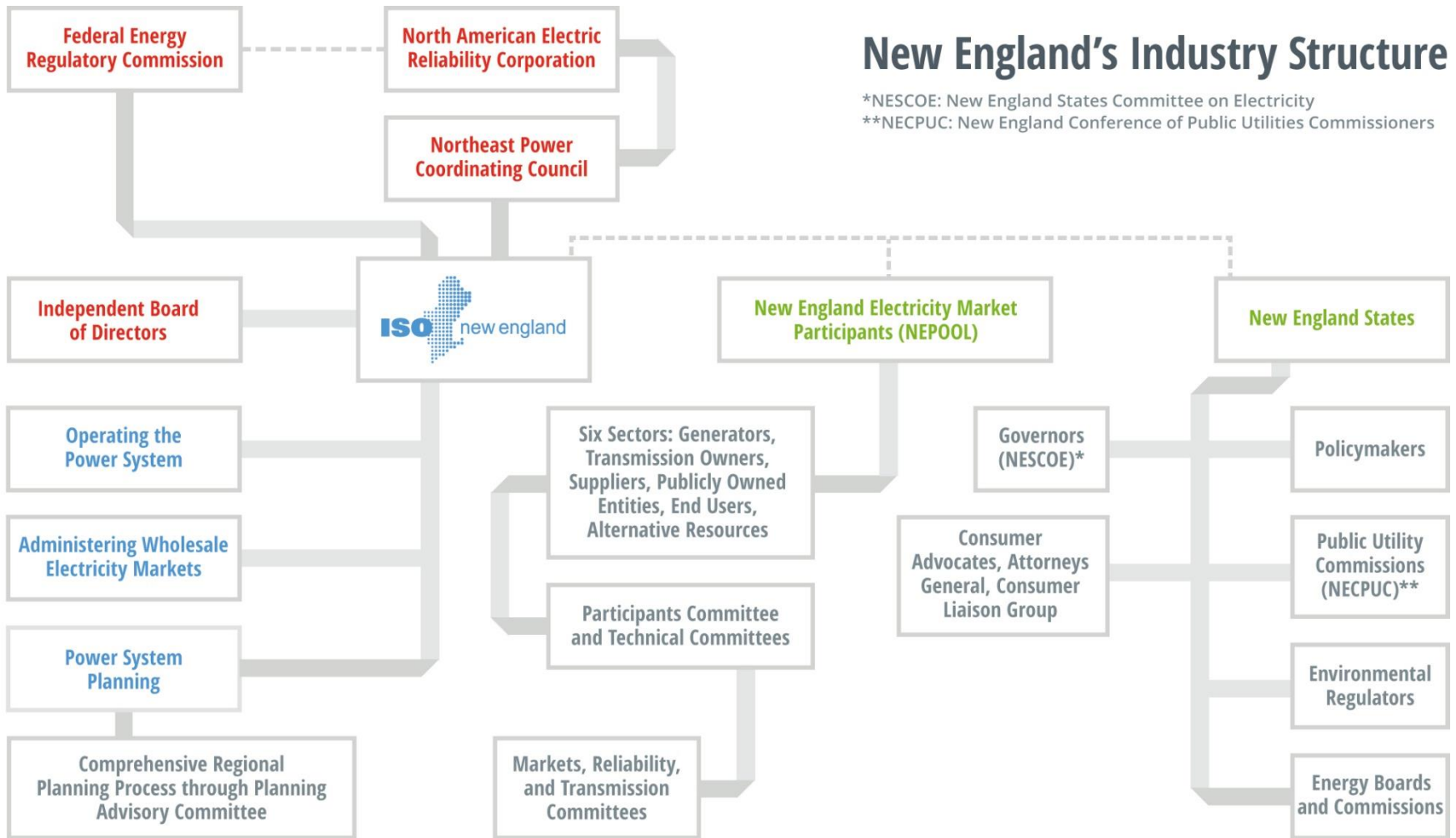
Own, maintain, or
repair the power grid's
infrastructure, such as
power plants, power
lines, and substations



Have a stake in
companies that
own the
infrastructure



Numerous Entities Including an Independent Board Provide Oversight of and Input on ISO's Responsibilities



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*

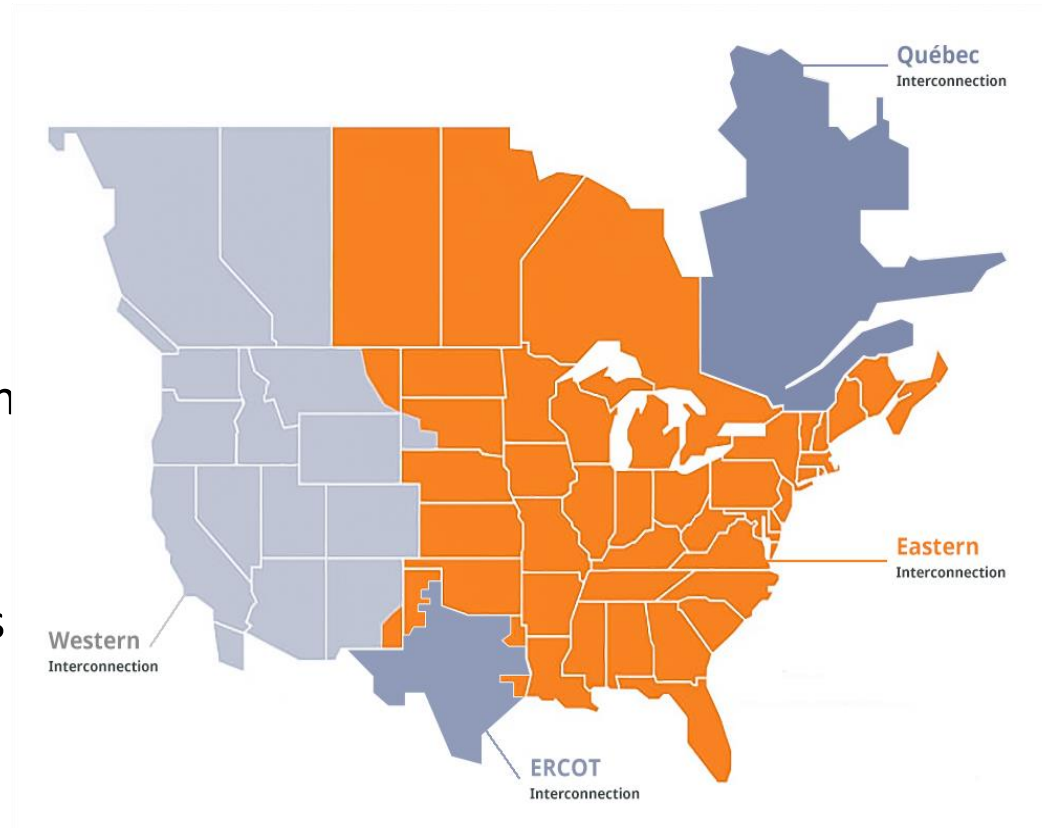


NEW ENGLAND POWER SYSTEM & MARKETS



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

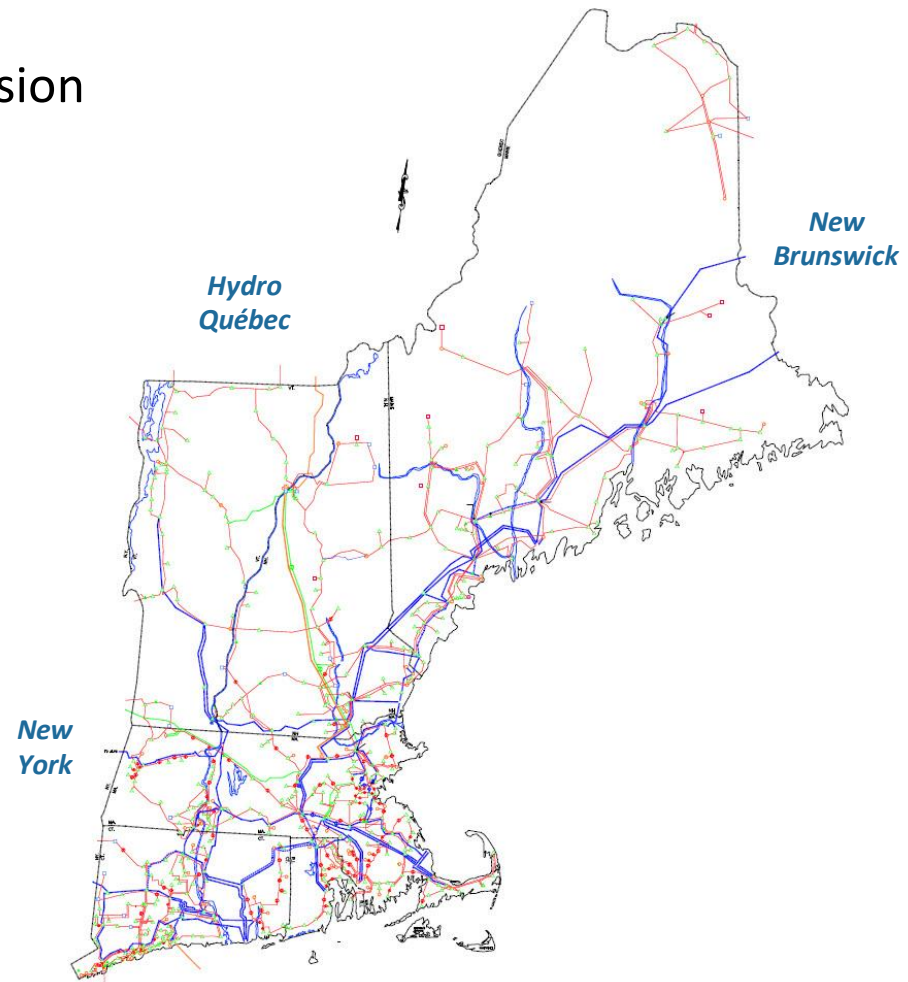
- Part of the **Eastern Interconnection**, one of four large power grids in North America
 - Interconnected through primarily alternating current (AC) transmission
- Tied to **Québec** only through direct current (DC) transmission
- 2003 blackout ushered in wide-area monitoring and **mandatory** reliability 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
- **16%** of region's energy needs met by imports in 2021
- **\$11.7 billion** invested to strengthen transmission system reliability since 2002; **\$1.3 billion** planned
- Developers have proposed multiple transmission projects to access **non-carbon-emitting resources** inside and outside the region



Generation and Demand Resources Are Used to Meet New England's Energy Needs

- **350** dispatchable generators in the region
- **31,500 MW** of generating capacity
- Over **30,000 MW** of proposed generation in the ISO Queue
 - Mostly wind, solar, and storage proposals
- Roughly **7,000 MW** of generation have retired or will retire in the next few years
- **765 MW** of active demand response and **2,032 MW** of energy efficiency with obligations in the Forward Capacity Market*
 - Demand resources have had further opportunities in the wholesale markets since 2018



* In the Forward Capacity Market, demand-reduction resources are treated as capacity resources.

Why Competitive Markets?

New England restructured its power industry and launched competitive wholesale electricity markets in the late 1990s based on several key principles



Competition among wholesale electricity buyers and sellers yield prices that accurately reflect a resource's true operating costs



Efficiency and transparency spur innovation and investment in new technologies and power resources to ensure power system reliability



Investment risk associated with developing new power resources shifts from consumers to private investors

Markets Select the Most Cost-Efficient Resources to Meet Current and Future Electricity Needs

Energy Market Values Vary with Fuel Prices, While Capacity Market Values Vary with Changes in Supply

Energy Market

The Day-Ahead and Real-Time Energy Markets are forward and spot markets for trading **electric energy**

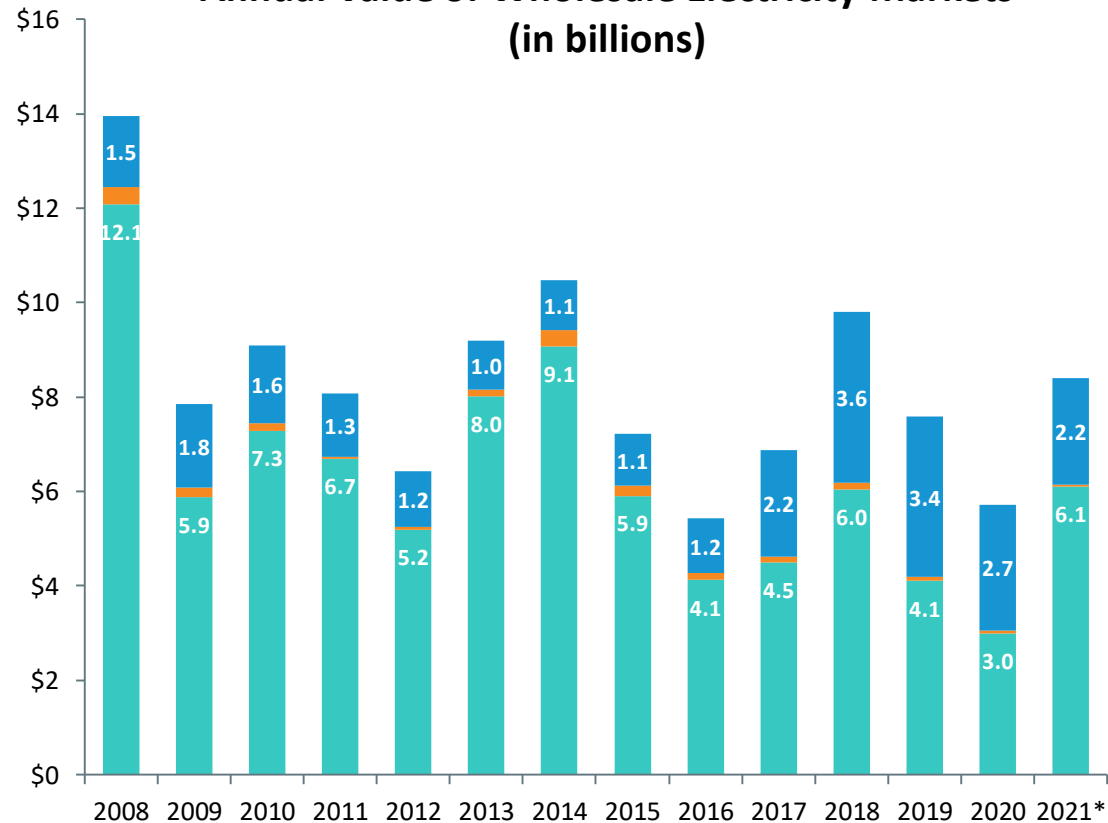
Ancillary Services

Resources provide **short-term reliability services**, as well as services needed to support the physical operation of the system (eg., regulation, voltage support)

Forward Capacity Market

Resources compete to sell **long-term reliability services** to the system in three years' time through annual Forward Capacity Auctions

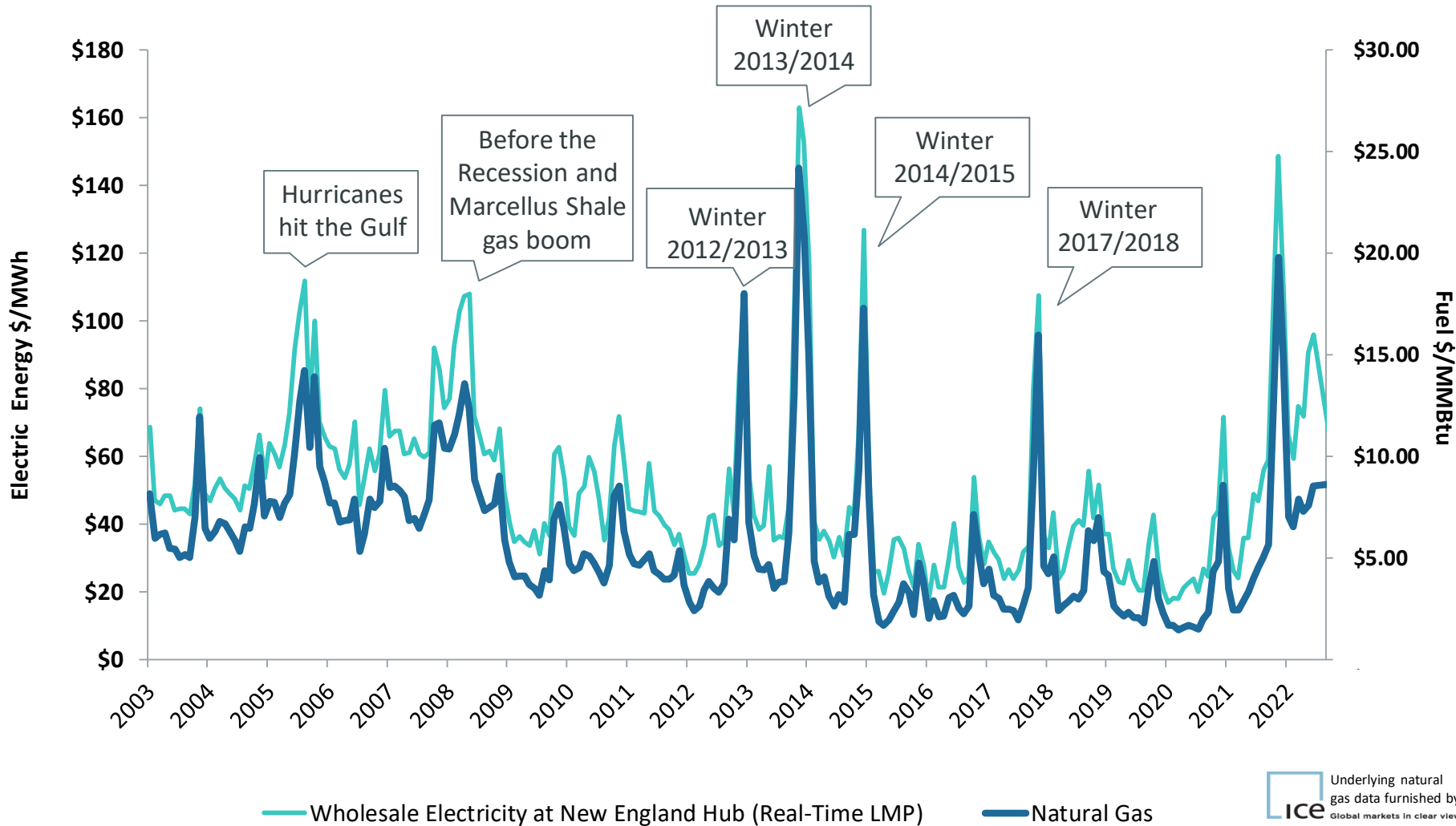
Annual Value of Wholesale Electricity Markets (in billions)



Source: [2021 Report of the Consumer Liaison Group](#); *2021 data is preliminary and subject to resettlement

Natural Gas and Wholesale Electricity Prices Are Linked

Monthly average natural gas and wholesale electricity prices at the New England hub



GRID TRANSFORMATION

Achieving state policy goals will fundamentally change the resource mix



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



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

ISO-NE Is a Summer-Peaking System

New England shifted from a winter-peaking system to a **summer-peaking** system in the early 1990s, largely because of the growth of air conditioning and a decline in electric heating

- Peak demand on a normal summer day has typically ranged from 17,500 MW to 22,000 MW
- Summer demand usually peaks on the hottest and **most humid** days and averaged roughly 25,600 MW since 2000
- Region's all-time summer peak demand was **28,130 MW** on **August 2, 2006**



The region could shift back to a **winter-peaking system** with the electrification of heating demand

- Region's all-time **winter** peak demand was **22,818 MW** on **January 15, 2004**



State Laws Target Deep Reductions in CO₂ Emissions and Increases in Renewable and Clean Energy

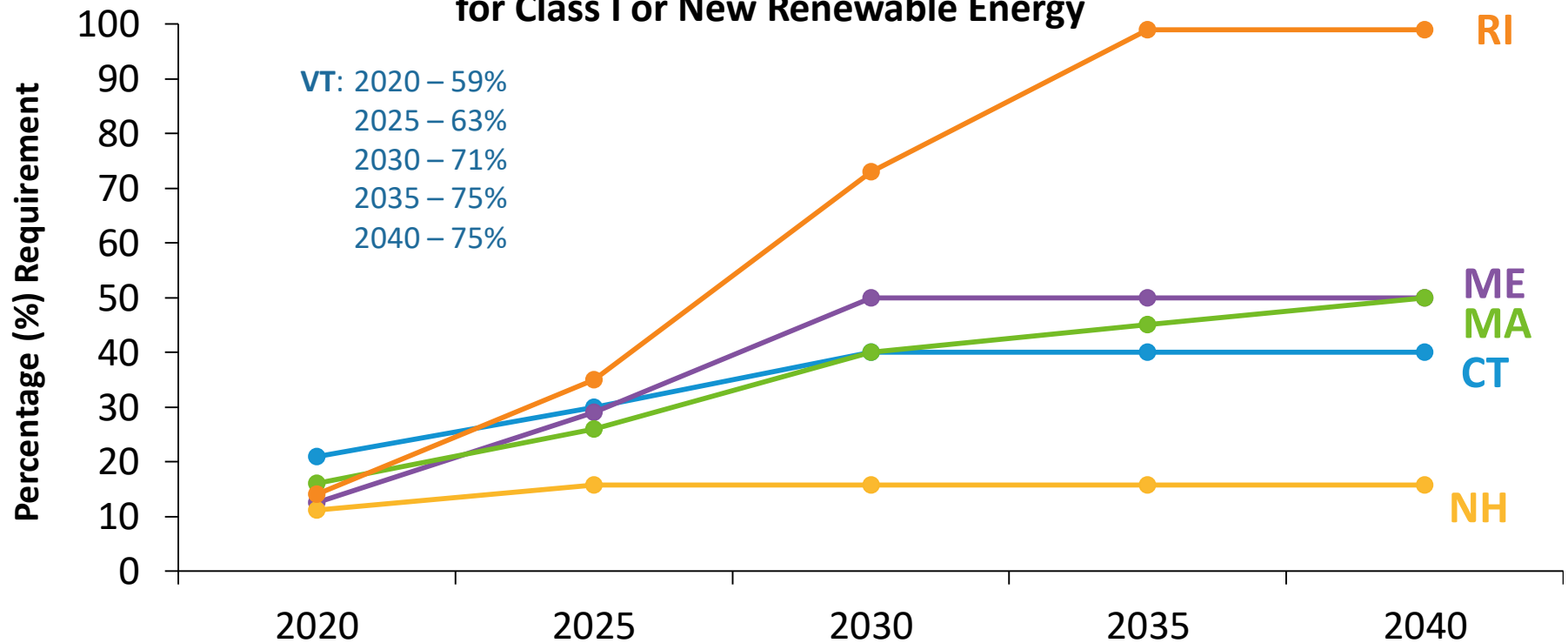
≥80% by 2050	Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels)
Net-Zero by 2050 80% by 2050	MA emissions requirement MA clean energy standard
90% by 2050	VT renewable energy requirement
100% by 2050 Carbon-Neutral by 2045	ME renewable energy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

Renewable Energy Is on the Rise

State policy requirements are a major driver



State Renewable Portfolio Standard (RPS)* for Class I or New Renewable Energy

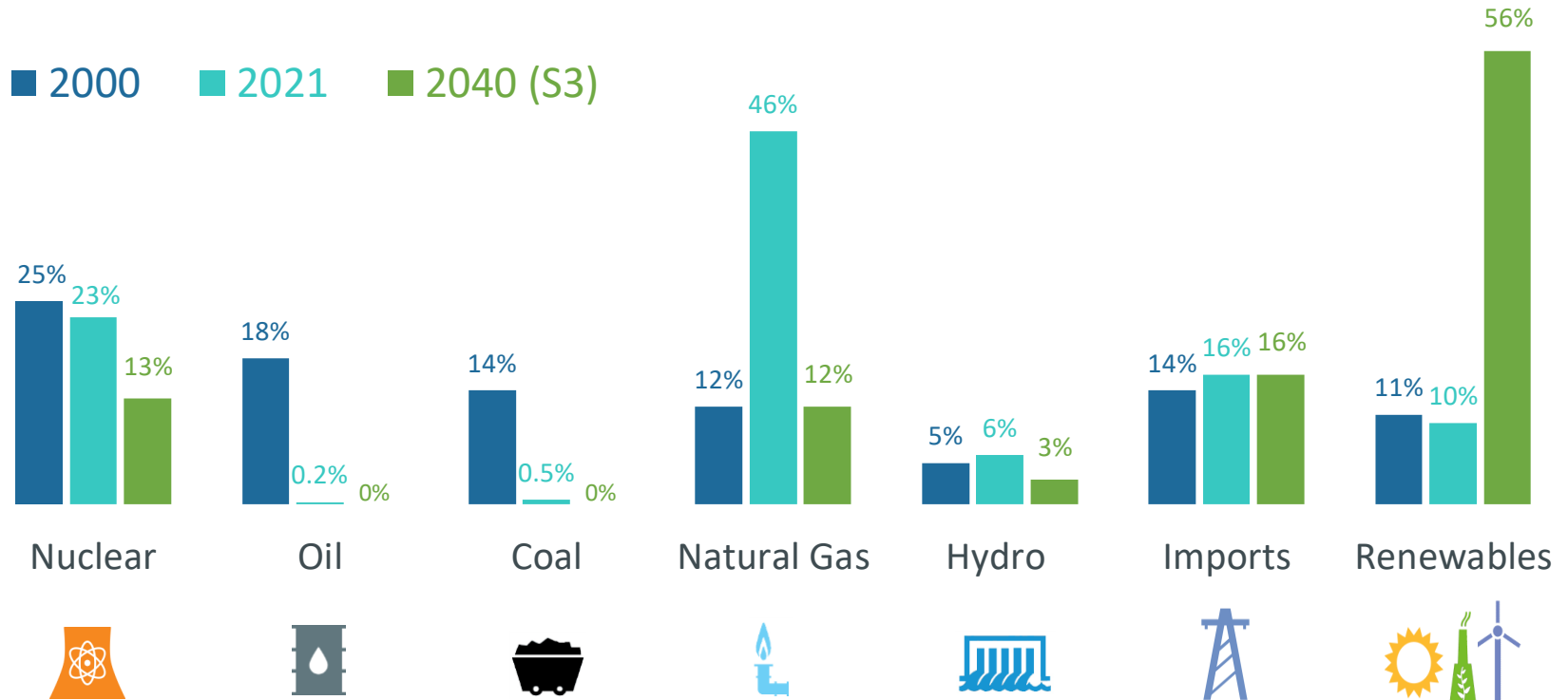


Notes: State RPS requirements promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Connecticut's Class I RPS requirement plateaus 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 reaches 100% in 2033. Vermont's 'total renewable energy' requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.

July 2022

Dramatic Changes in the Energy Mix Continue

Percent of Total Electric Energy Production by Source
(Past, Present, Future)

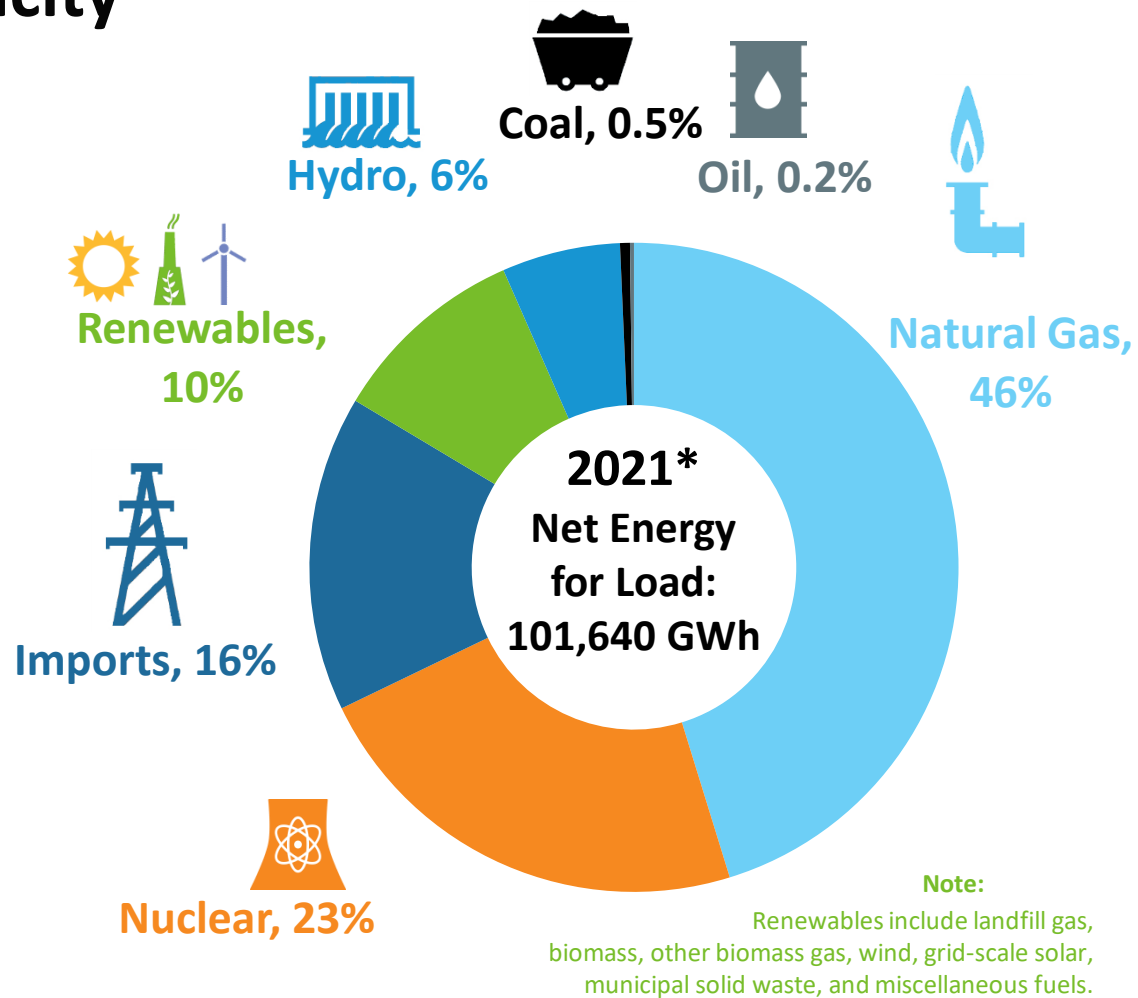


Source: ISO New England [Net Energy and Peak Load by Source](#); data for 2021 is preliminary and subject to resettlement; data for 2040 is based on Scenario 3 of the ISO New England [2021 Economic Study: Future Grid Reliability Study Phase 1](#).

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, behind-the-meter solar, municipal solid waste, and miscellaneous fuels.

Natural Gas, Nuclear, and Imports Supply Most of New England's Electricity

- In 2021, most of the region's energy needs were met by natural gas, nuclear, imported electricity (mostly hydropower from Eastern Canada), renewables, and other low- or non-carbon-emitting resources
- Region is transitioning away from older coal and oil resources

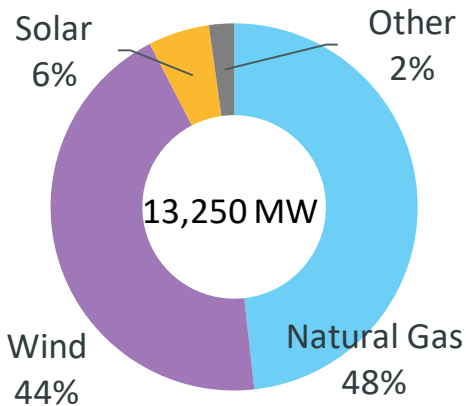


*Data is subject to adjustment. Source: 2021 Net Energy and Peak Load by Source
<https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/net-ener-peak-load>

The ISO Generator Interconnection Queue Provides Snapshots of the Future Resource Mix

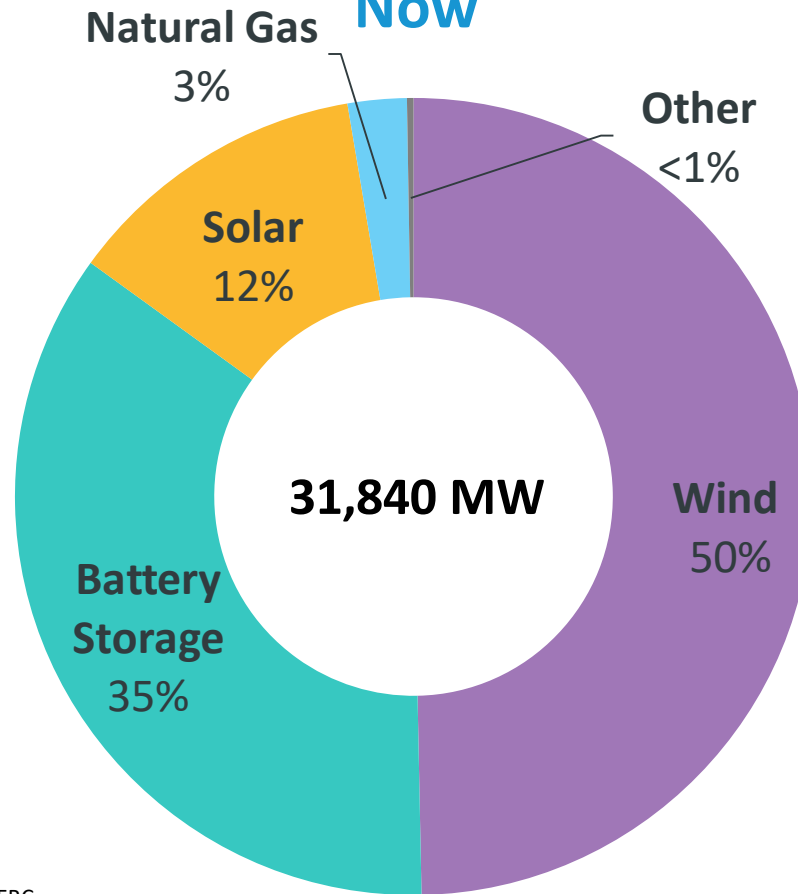
Dramatic shift in types of proposed resources from natural gas to wind

Then



June 2017

Now



January 2023

Offshore Wind



CT	2,400 MW
MA	10,593 MW
ME	12 MW
RI	704 MW

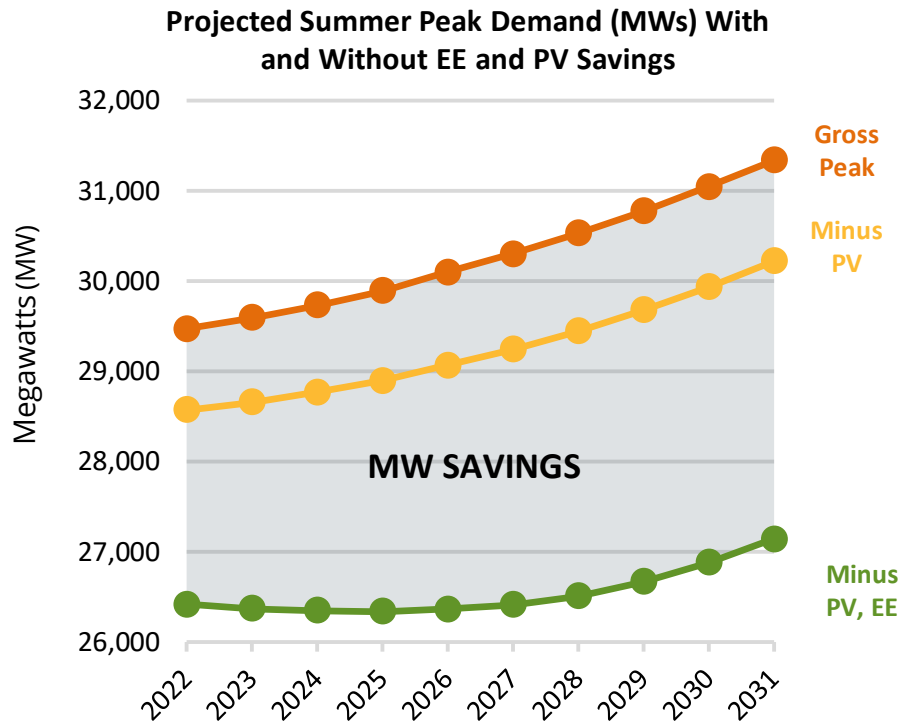
Onshore Wind



ME	2,110 MW
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Source: ISO Generator Interconnection Queue, FERC Jurisdictional Proposals; Nameplate Capacity Ratings.

Energy Efficiency and Behind-the-Meter Solar Resources Are Reducing Peak Demand



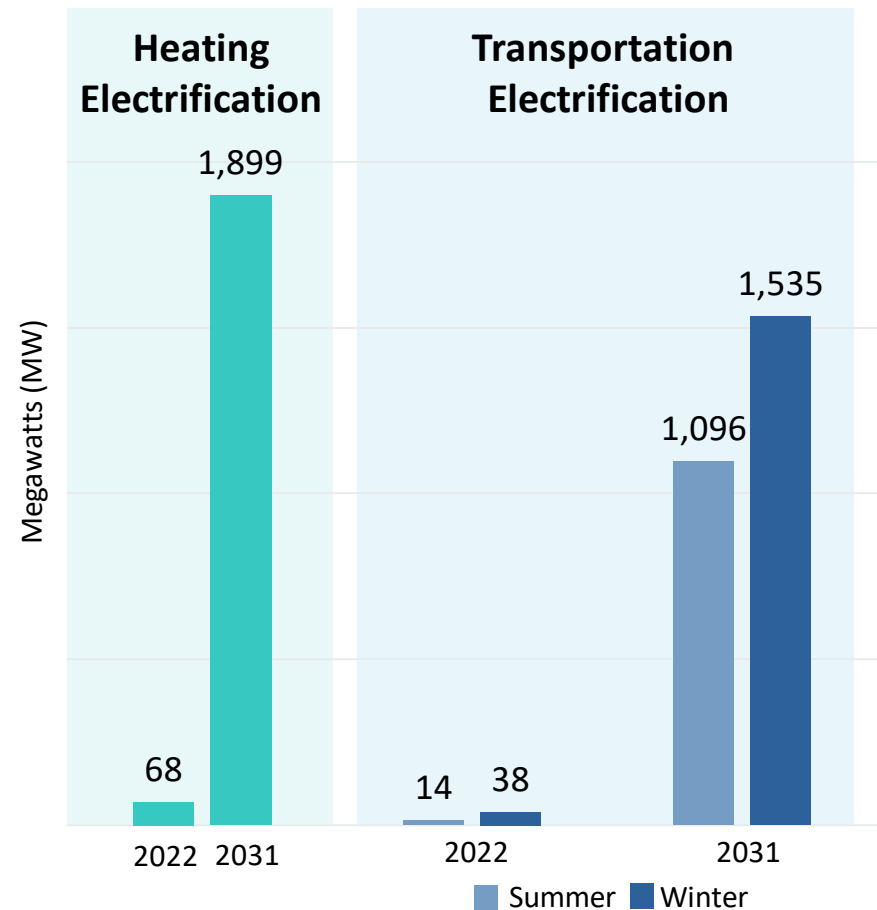
- The gross peak and load forecast
- The gross peak and load forecast minus existing and anticipated “behind-the-meter” (BTM) solar PV resources
- The gross peak and load forecast minus existing and anticipated BTM solar PV and energy efficiency

- **28,130 MW:** all-time summer peak demand, set on August 2, 2006
- Energy efficiency (EE) and behind-the-meter (BTM) solar are **reducing** annual growth in peak demand
- Annual growth rates for 2022–2031:
 - +0.7% without EE and BTM solar**
 - +0.3% with EE and BTM solar**
- Electrification of heating and transportation will increase load

Source: [ISO New England 2022 Forecast Data](#). Summer peak demand is based on the “90/10” forecast, which accounts for the possibility of above-average summer weather (temperatures of about 94° F).

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](#)

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



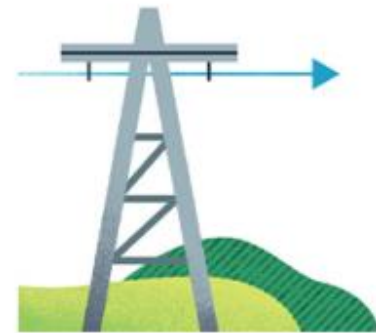
Significant amounts of **clean energy** to power the economy with a greener grid



Balancing resources that keep electricity supply and demand in equilibrium



Energy adequacy—a dependable energy supply chain and/or a robust energy reserve



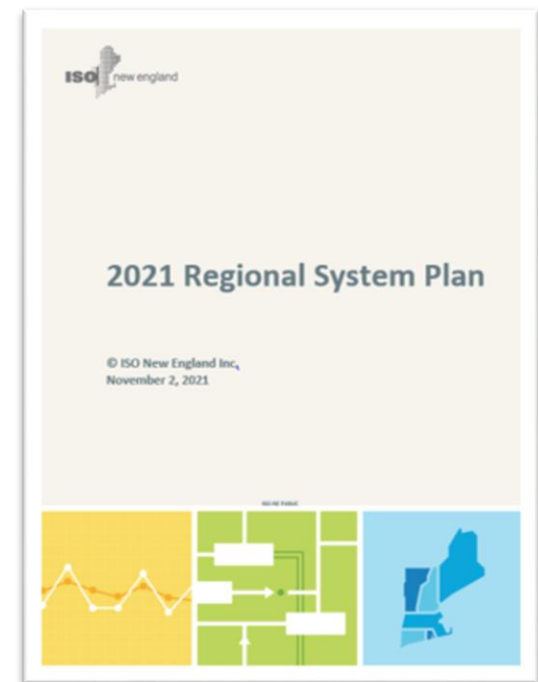
Robust transmission to integrate renewable resources and move clean electricity to consumers across New England

TRANSMISSION DEVELOPMENTS



Overview of Transmission Planning

- As the **Regional Transmission Organization**, the ISO is required to identify transmission infrastructure solutions that are essential for maintaining power system reliability in New England
- Through an **open stakeholder process**, the ISO is responsible for the development of long-range plans to address future system needs over the ten-year planning horizon
 - Summarized in a **Regional System Plan (RSP)**
- The transmission planning process is governed by a **FERC-approved tariff**
- The transmission planning process has been revised to comply with the Federal Energy Regulatory Commission's (FERC) **Order No. 1000**

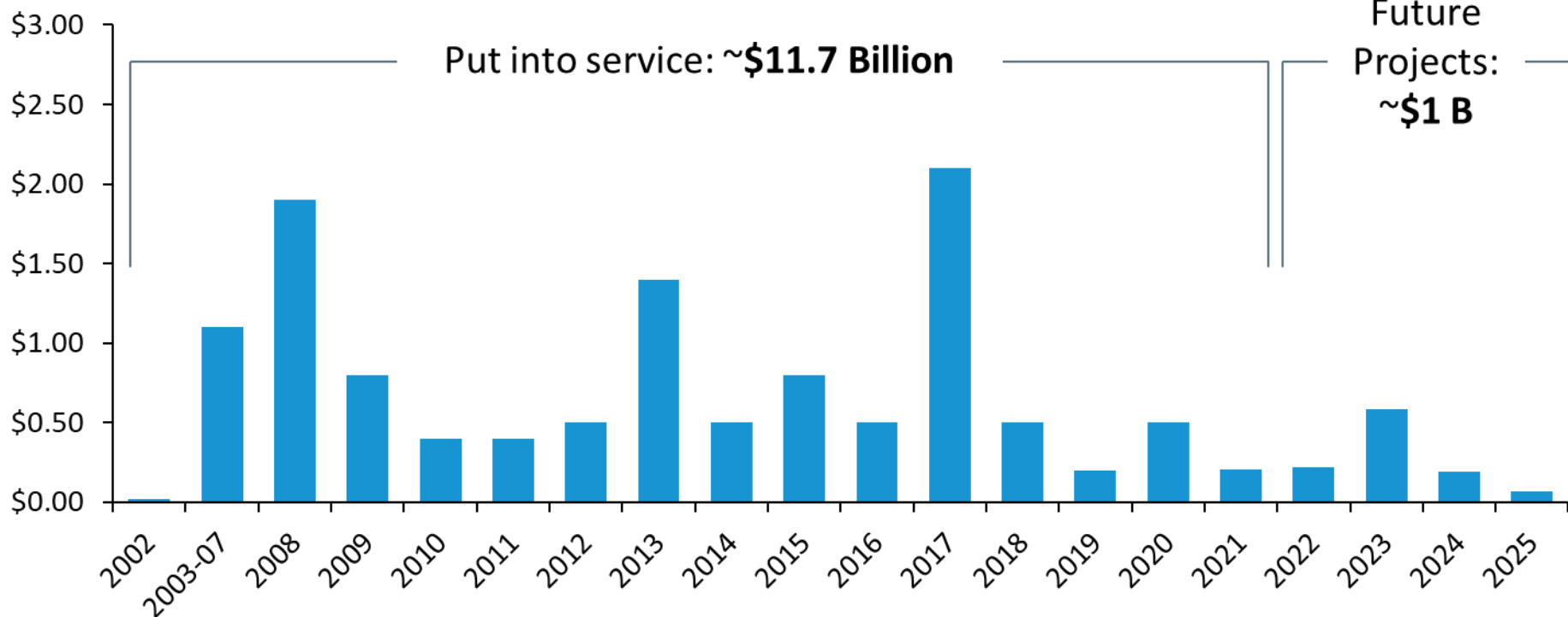


[ISO New England 2021 Regional System Plan](#)

New England Has Made Major Investments in Transmission to Ensure a Reliable Electric Grid

Transmission investment by year that projects are put into service (capital costs)

Billions of Dollars

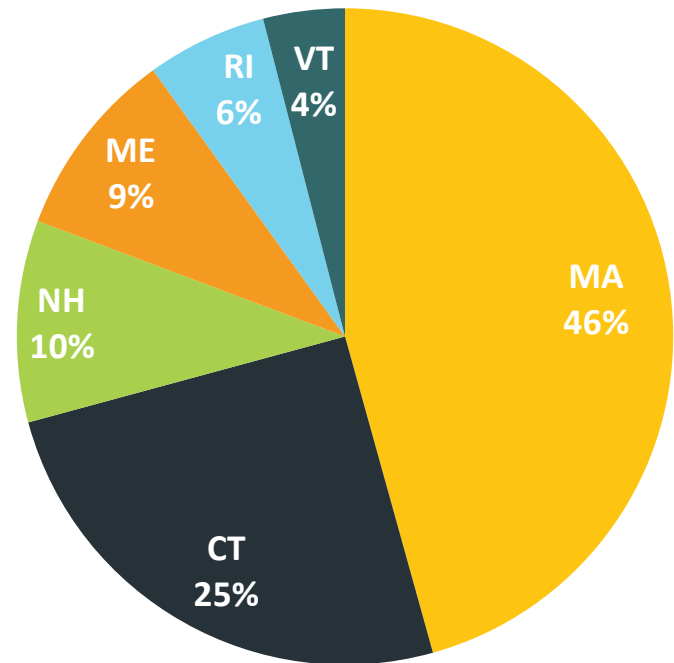


Source: ISO New England RSP Transmission Project Listing, June 2022
Estimated future investment includes projects under construction, planned and proposed.

How Are Transmission Costs Allocated?



- The New England electric grid is a **tightly interconnected** system; each state shares in the benefits of reliability and market efficiency upgrades
- The amount of electricity demand in an area determines its **share** of the cost of new or upgraded transmission facilities needed for reliability or market efficiency

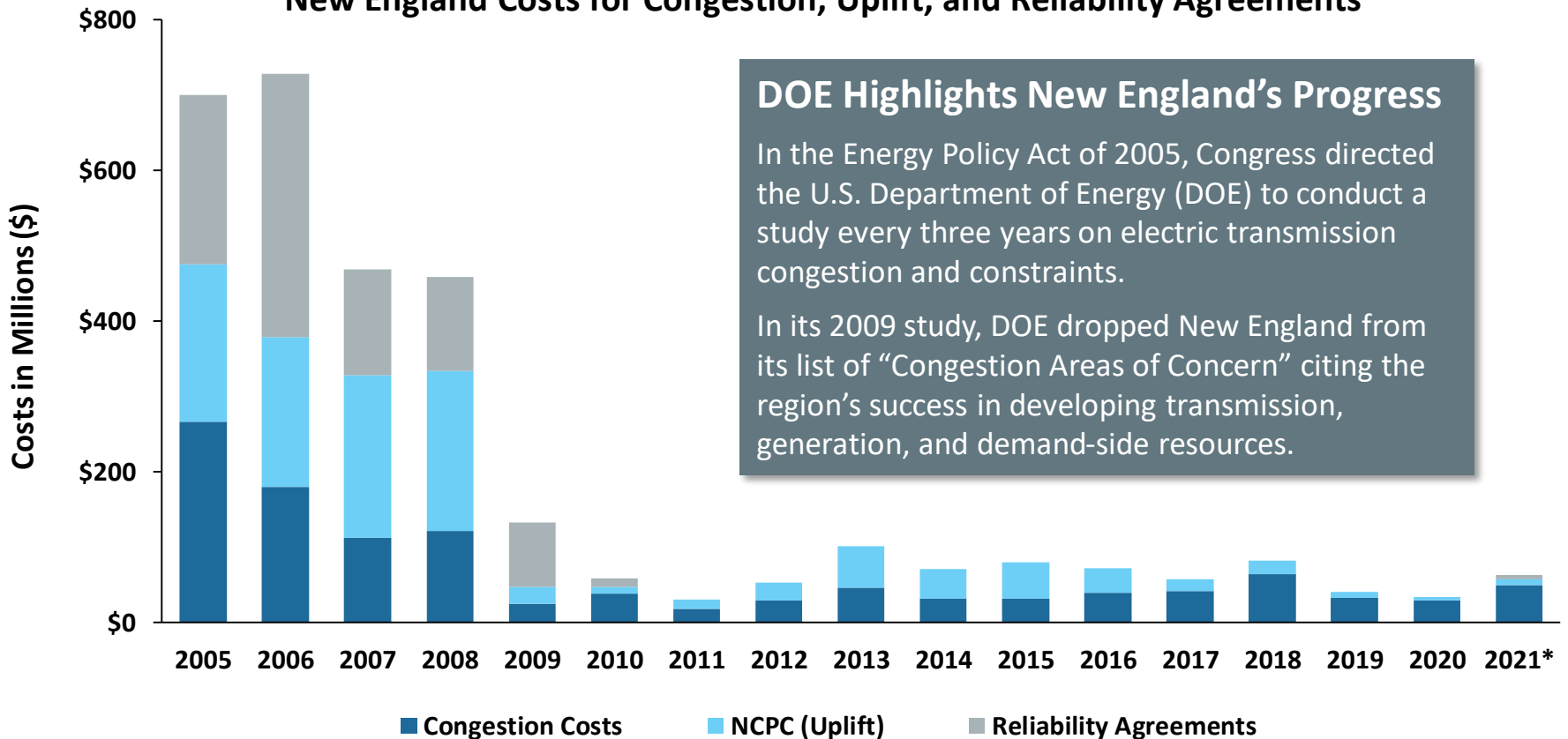


2021 Network Load by State



Transmission and Resource Developments Have Reduced Energy and Reliability Costs

New England Costs for Congestion, Uplift, and Reliability Agreements



DOE Highlights New England's Progress

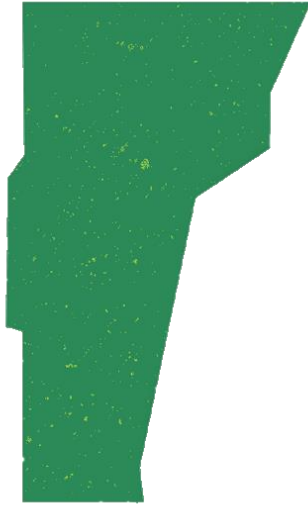
In the Energy Policy Act of 2005, Congress directed the U.S. Department of Energy (DOE) to conduct a study every three years on electric transmission congestion and constraints.

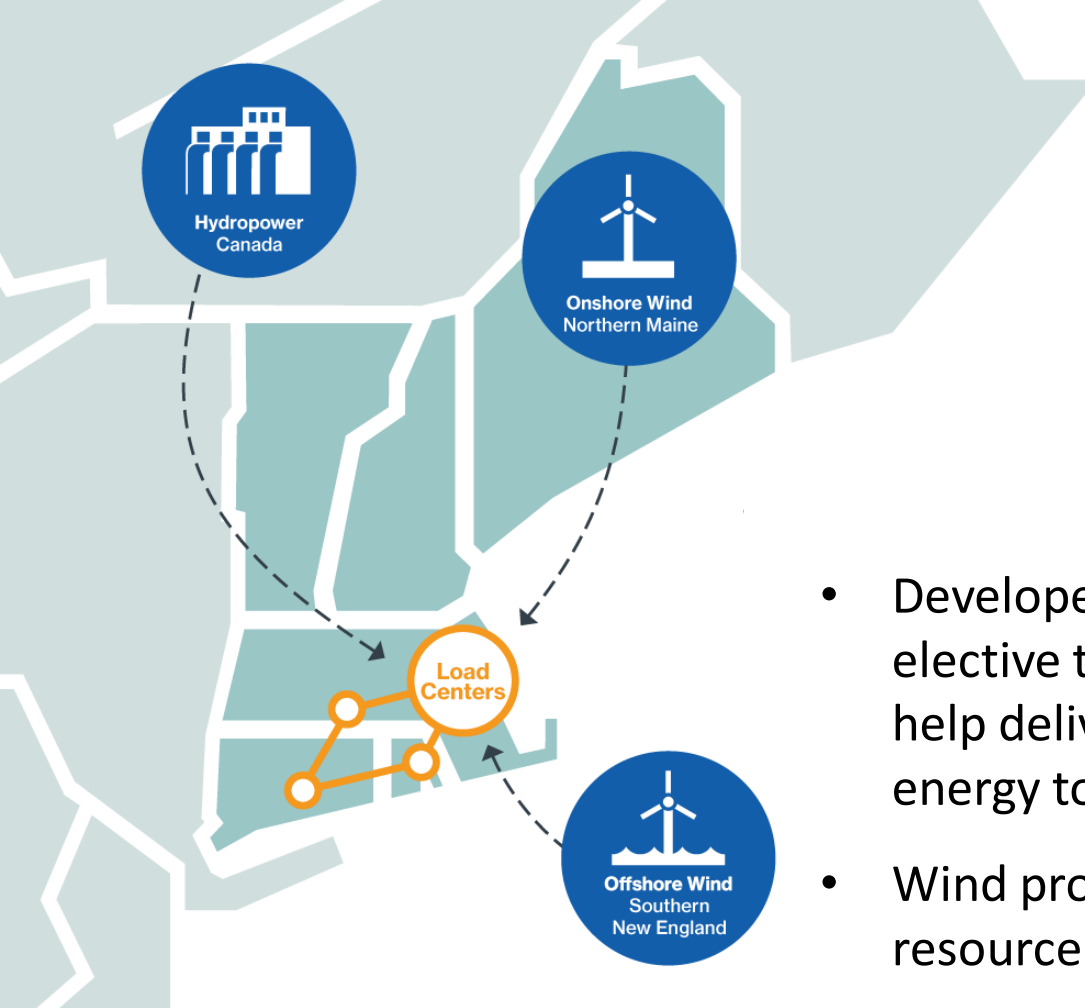
In its 2009 study, DOE dropped New England from its list of "Congestion Areas of Concern" citing the region's success in developing transmission, generation, and demand-side resources.

Note: Congestion is a condition that arises on the transmission system when one or more restrictions prevents the economic dispatch of electric energy from serving load. Net Commitment-Period Compensation is a payment to an eligible resource that operated out of merit and did not fully recover its costs in the energy market. Reliability Agreements are special reliability contracts between the ISO and an approved generator whereby the generator continues to operate, even when it is not economical to do so, to ensure transmission system reliability. Sources: Regional System Plans, ISO-NE Annual Markets Reports. *2021 data subject to adjustment.

Vermont 2032 Needs Assessment

- The ISO issued a [Notice of Initiation of the Vermont Needs Assessment](#) in November
 - The last Needs Assessment for the Vermont study area was the NH/VT 2023 Needs Assessment (completed in 2014)
- The ISO regularly conducts studies in key areas pursuant to the [Open Access Transmission Tariff](#) based on several triggers:
 - Assess compliance with reliability standards and criteria consistent with the long term needs of the system
 - Assess the adequacy of the transmission system capability, such as transfer capability, to support local, regional and interregional reliability
 - Examine short circuit performance of the system
- The Vermont Needs Assessment will evaluate the performance and identify reliability-based needs in the Vermont Area for the year 2032
- The ISO anticipates posting the draft Vermont 2032 Needs Assessment of Work report in Q3/Q4 of 2023





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

Source: [ISO Interconnection Queue](#) (November 2022)

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

- Developers are proposing 5 elective transmission upgrades (ETUs) to help deliver over **10,000 MW** of clean energy to New England load centers
- Wind projects make up almost **55%** 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

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
- Solution development work will be ongoing throughout 2023

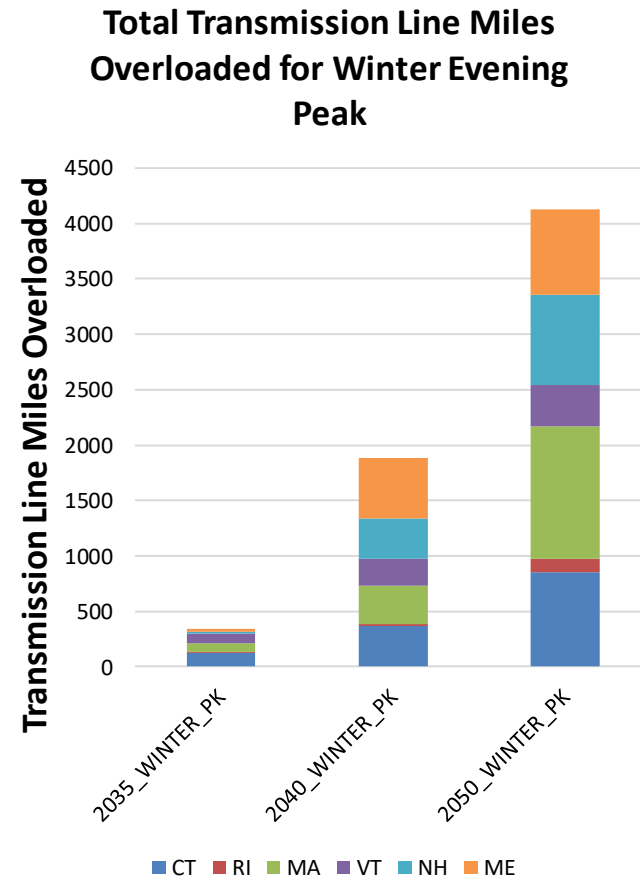


The most up-to-date information on the 2050 study is available at the [Planning Advisory Committee](#)

2050 Transmission Study

Key Takeaways

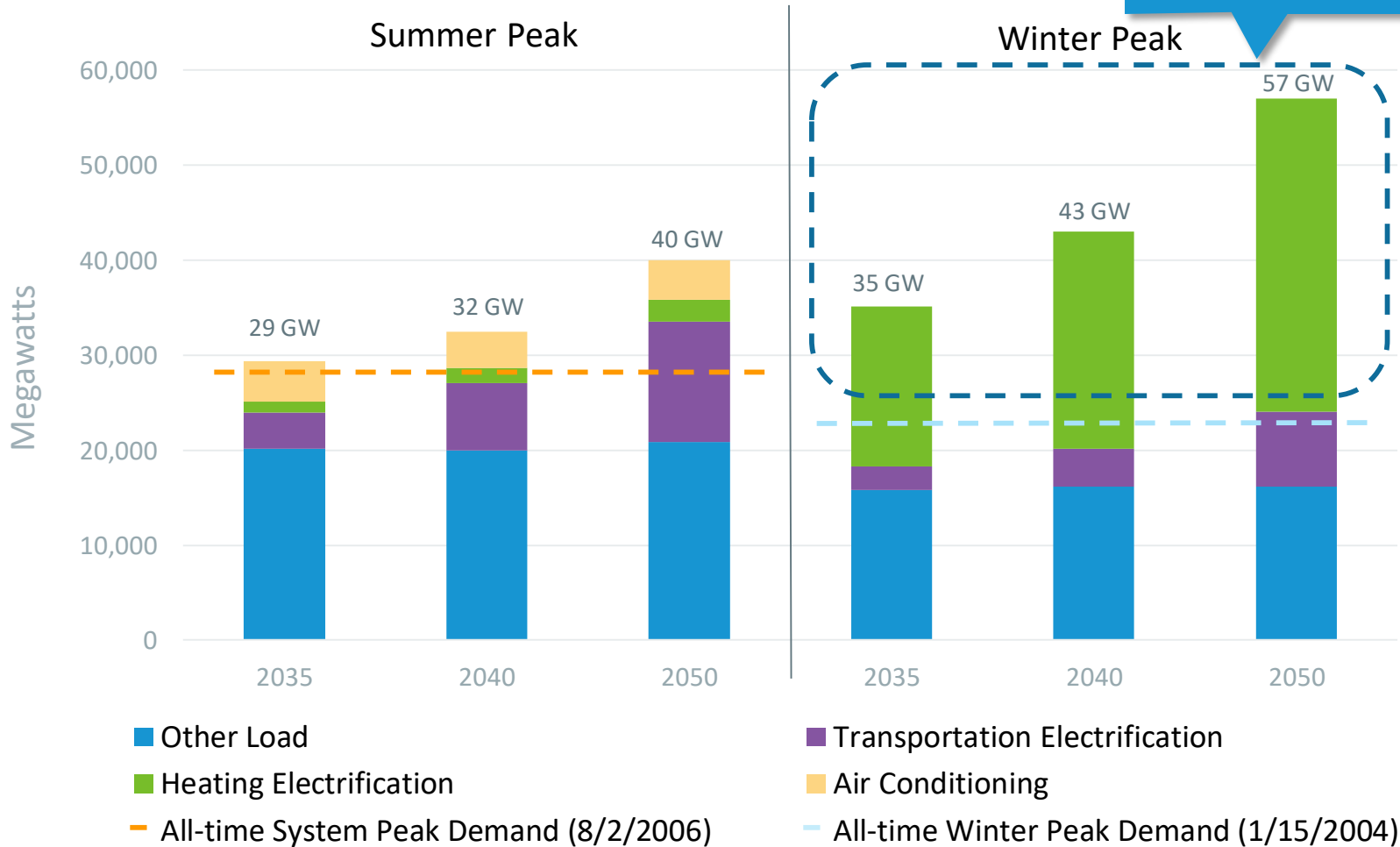
- The assumptions used for the 2050 Transmission Study represent numerous **paradigm shifts** for New England
 - Shift from a *summer-peaking* area to a *winter-peaking* area
 - Rapid growth in the development of *renewable* resources
 - Electrification of *heating* and *transportation* more than doubles 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** 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

2050 Transmission Study

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



OTHER STUDIES



Overview of Studies Supporting Future Grid

- **Weather:** [Operational Impacts of Extreme Weather Events](#)
 - Rigorously model likelihood and impact of extreme weather events
- **Transmission:** [2050 Transmission Study](#)
 - Determine transmission needs 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](#)
 - Explore how near-term needs assessments should evolve with renewables



Modeling and Assessing Operational Impacts of Extreme Weather Events

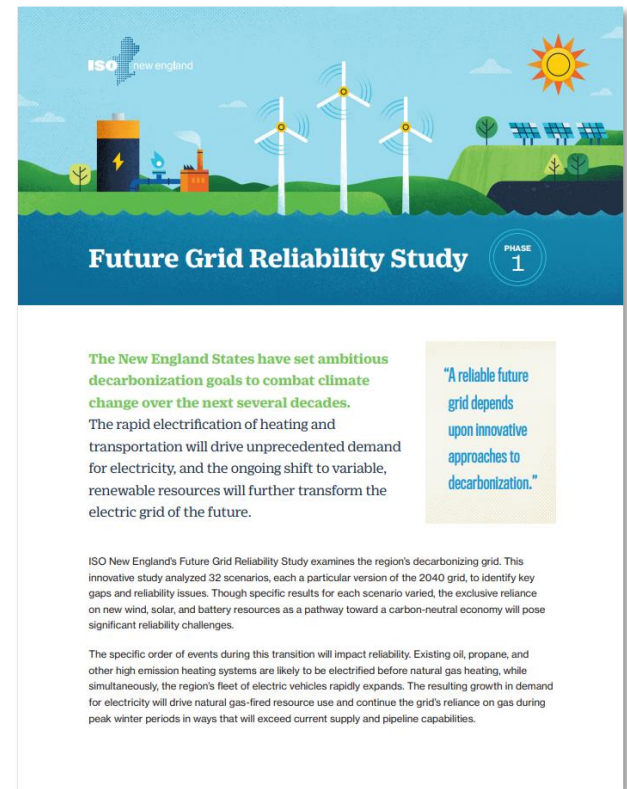
Considering how to study New England's reliability risks from severe weather events

- The ISO is working with Electric Power Research Institute (EPRI) to conduct a [probabilistic energy security study](#) for the New England region in the operational timeframe (10 years) under extreme weather events
 - The project is collaborative opportunity for industry leaders and regional stakeholders to learn how extreme weather events in the future may affect the evolving power system and to prompt thinking about how best to prepare
 - **Step 1 (Extreme Weather Modeling)** analysis was completed in May
 - **Step 2 (Risk Model Development and Scenario)** preliminary results were [presented](#) at the January Reliability Committee meeting
 - **Step 3 (Perform Energy Adequacy Assessment)** initial results expected in March
 - The results of the study will help inform the region's larger energy security/energy adequacy discussion
- The ISO expects final Study results in 2023



2021 Economic Study: Future Grid Reliability Study Phase 1

- On July 29, the ISO released the [2021 Economic Study: Future Grid Reliability Study Phase 1](#)
- The study, requested by NEPOOL stakeholders, evaluates how a 2040 grid could perform when the system has significantly more renewables and a greater amount of electrification of the transportation and heating sectors
- The ISO hosted a webinar on **October 21** to discuss the findings of the Study
 - The webinar recording will be available on the ISO website.



ISO NEW ENGLAND PUBLICATIONS AND RESOURCES

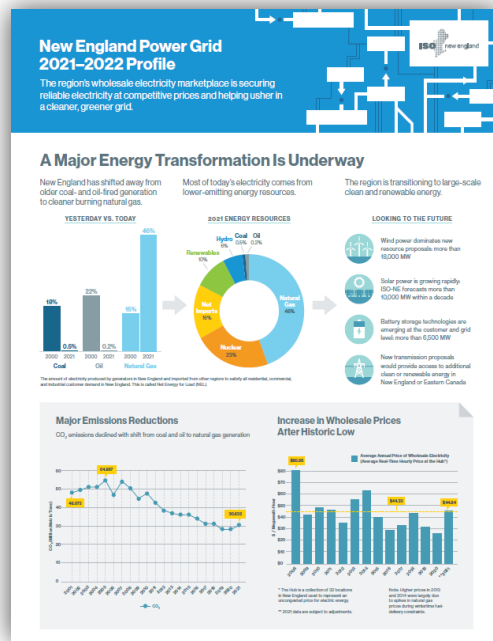


ISO New England Information Resources



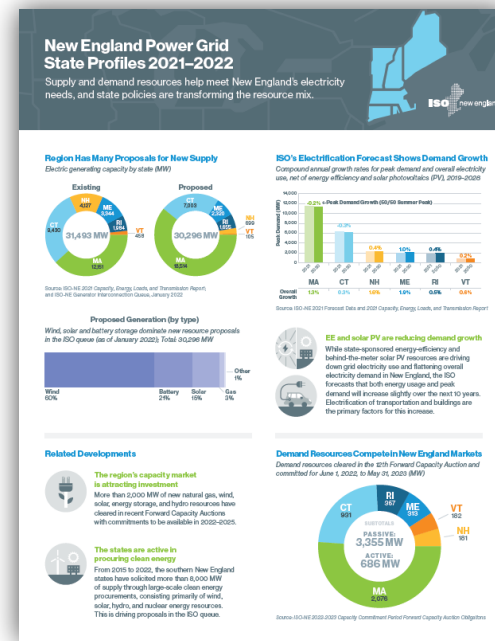
2022 Regional Electricity Outlook

Provides an in-depth look at New England's biggest challenges to power system reliability, the solutions the region is pursuing, and other ISO New England efforts to improve services and performance



New England Power Grid Profile

Provides key grid and market stats on how New England's wholesale electricity markets are securing reliable electricity at competitive prices and helping usher in a cleaner, greener grid



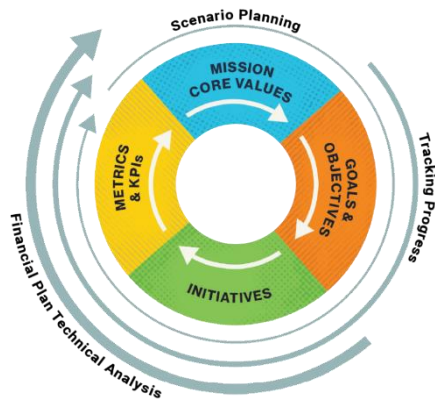
New England State Profiles

Provides state-specific facts and figures relating to supply and demand resources tied into the New England electric grid and state policies transforming the resource mix in the region

ISO New England's Strategic Plan



- On **October 26**, the ISO released [Vision in Action: ISO New England's Strategic Plan](#)
- The plan provides insight into how the ISO intends to fulfill its three critical roles during the clean energy transition
- In addition to discussing the ISO's key goals and initiatives, the plan offers perspectives on trends shaping the power industry
- ISO CEO Gordon van Welie presented an overview of the plan at the Nov 1 Open Board Meeting



Consumer Liaison Group Provides a Forum for Consumers to Learn about Regional Electricity Issues

- A forum for sharing information between the ISO and electricity consumers in New England
- The CLG Coordinating Committee consists of 12 members who represent various stakeholder groups
- Quarterly meetings are free and open to the public, with in-person and virtual options to participate
- 2023 Meetings
 - Thursday, March 30
 - Thursday, June 8
 - Thursday, September 21
 - Wednesday, December 6



2021 CLG Annual Report is posted at: https://www.iso-ne.com/static-assets/documents/2022/03/2021_report_of_the_consumer_liaison_group_final.pdf

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

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Log on to ISO Express

[ISO Express](#) provides real-time data on New England's wholesale electricity markets and power system operations



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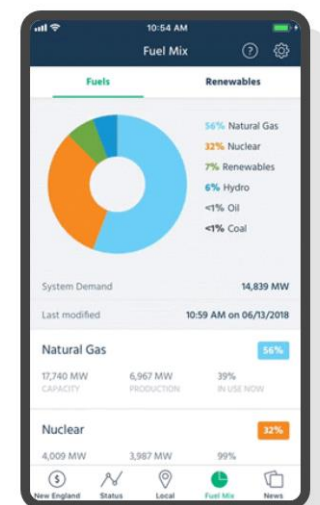
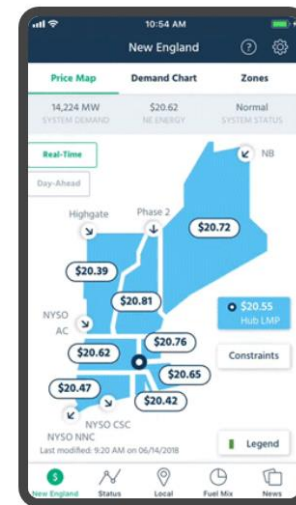


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Download the ISO to Go App

[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



Questions

