The Transformation of the New England Power System: Infrastructure Needs and Market Implications

New England Council
Regional Energy Discussion

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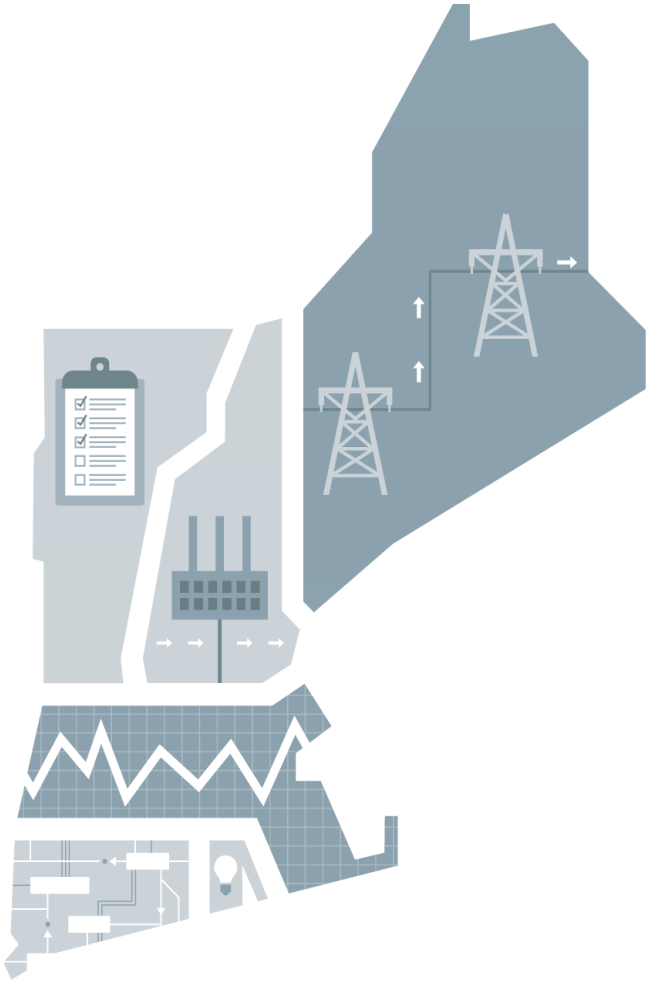
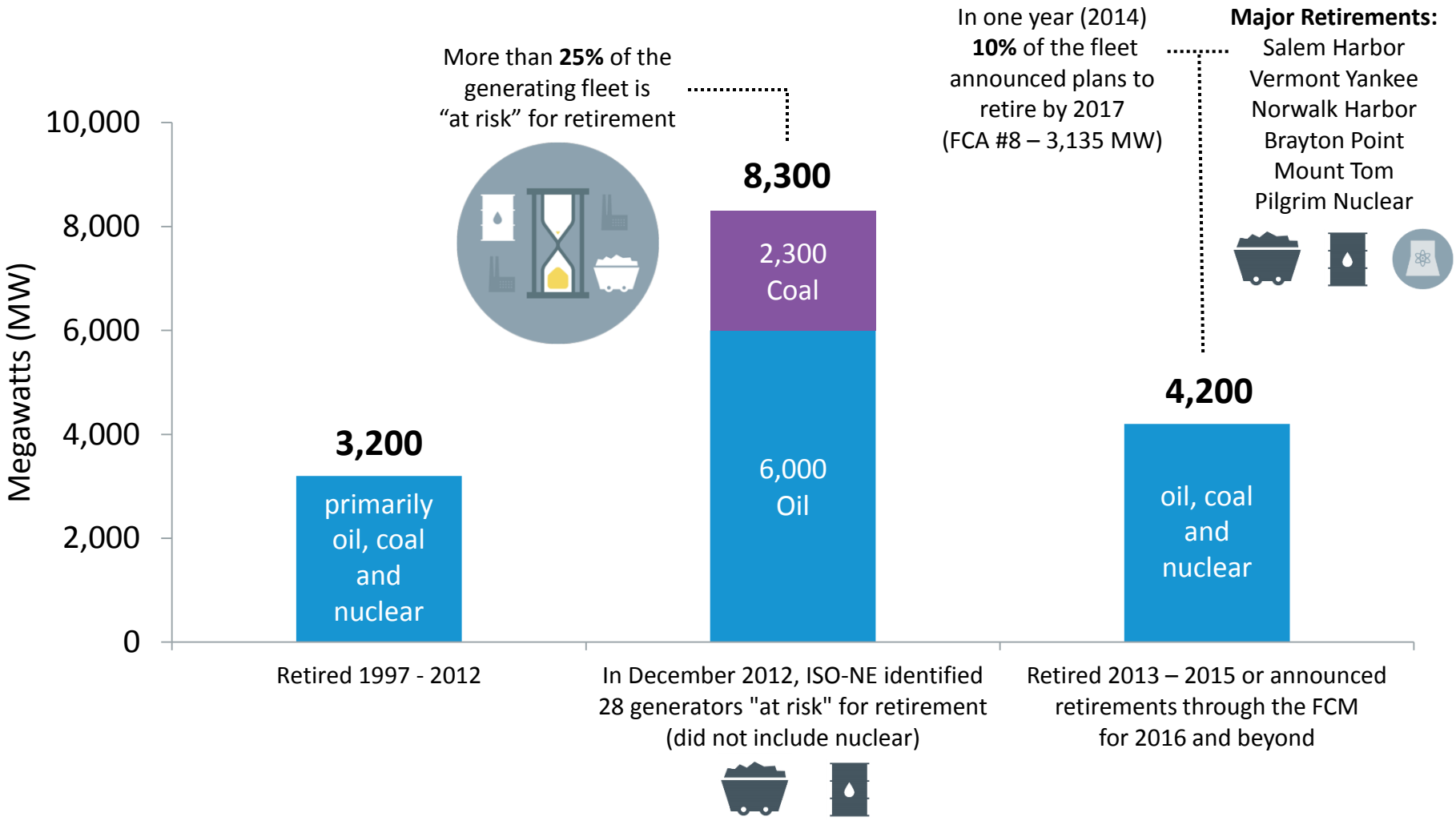
ISO New England Is Focused on Developing Solutions to the Region's Top Reliability Risks

- **Ensuring Resource Adequacy**
  - New England will need sufficient replacement resources to replace retiring resources. These resources must be able to perform under adverse weather conditions
- **Inadequate Natural Gas Infrastructure**
  - New England is challenged to meet electricity demands with existing natural gas infrastructure (currently during the winter, but in the future this may also become a summer problem)
- **Renewable Resource Integration**
  - Maintaining reliability as increasing levels of distributed generation and intermittent resources come online

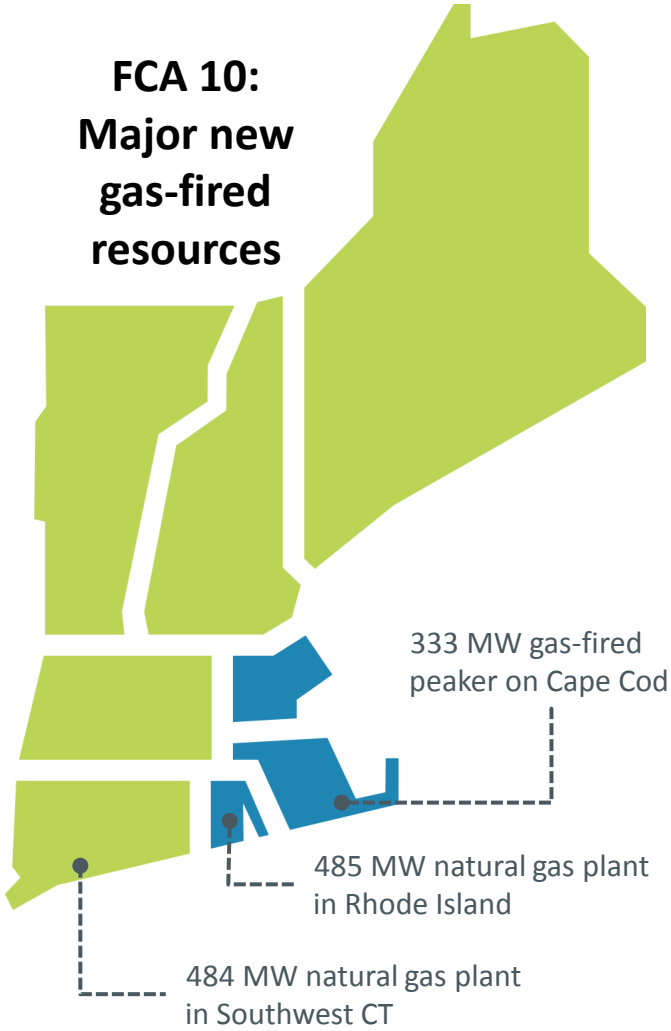


Large Non-Gas Generators Have Recently Retired or Announced Plans to Retire, and More Retirements Are Likely



ISO-NE's Capacity Market Has Attracted New Peaking and Combined-Cycle Gas Generation to Load Centers

- **3,000 MW** of gas-fired generation have come forward in recent auctions (FCAs 7–10) with commitments to be available in 2017–2019
- A mix of existing and new resources cleared in FCA 10, including three new, gas-fired, dual-fuel power plants totaling **1,300 MW**
- FCA 10 also attracted new renewable resources, demand resources, and imports:
  - Solar: 40 MW
  - Wind: 27 MW
  - Hydro: 2 MW
  - Demand resources: 371 MW
  - Imports from New York/Canada: 1,361 MW



What Is the Outlook for Fuel Security?

ISO-NE sees environmental, market, and operational concerns

- The ISO currently **keeps the lights on during extremely cold periods with** a combination of the following fuels: **nuclear, coal, oil and LNG**
  - Very little pipeline gas is available to support gas generators under these conditions
- The first three fuels are declining rapidly, the fourth is limited, *and*, **more gas generation is being added**
  - Renewable resources are small, but valuable offsets to gas consumption (on average) *However, these resources may not be available during extreme weather conditions or able to respond to contingencies on the system*
- We expect **further coal and oil generator retirements** post 2019 due to low natural gas prices during most of the year, renewable energy additions, and upcoming environmental regulations
- Permitting of **dual-fuel capability** is becoming more difficult, and, when permitted, runtimes are restricted. The existing oil fleet has runtime restrictions
- Our operating situation is ***precarious*** during the winter time and we are concerned that beyond 2019 it may become ***unsustainable*** during extreme cold conditions

What Is the Solution to This Fuel Security Challenge?

- Will the ISO have to revert to reliability agreements with retiring generators (likely oil and coal generators) to maintain reliability?
- At what point do we have to condition qualification in the capacity market on the generators' fuel-supply arrangements?
- Do we have to revisit scarcity pricing in either the capacity market or energy market?

Power Plant Emissions Have Declined with Changes in the Fuel Mix

Reduction in Aggregate Emissions (ktons/yr)

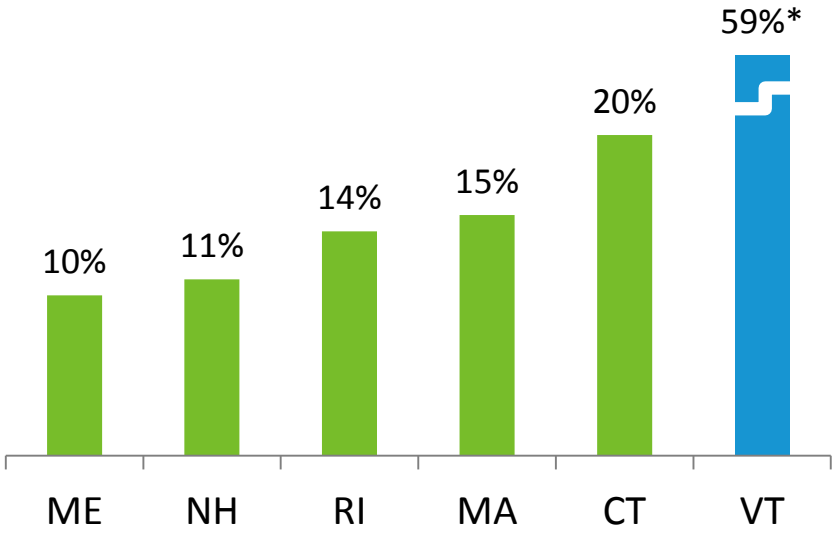
Year	NO_x	SO_2	CO_2
2001	59.73	200.01	52,991
2014	20.49	11.68	39,317
% Reduction, 2001–2014	**⬇ 66%**	**⬇ 94%**	**⬇ 26%**

Reduction in Average Emission Rates (lb/MWh)

Year	NO_x	SO_2	CO_2
1999	1.36	4.52	1,009
2014	0.38	0.22	726
% Reduction, 1999–2014	**⬇72%**	**⬇ 95%**	**⬇ 28%**

Source: 2014 ISO New England Electric Generator Air Emissions Report, January 2016

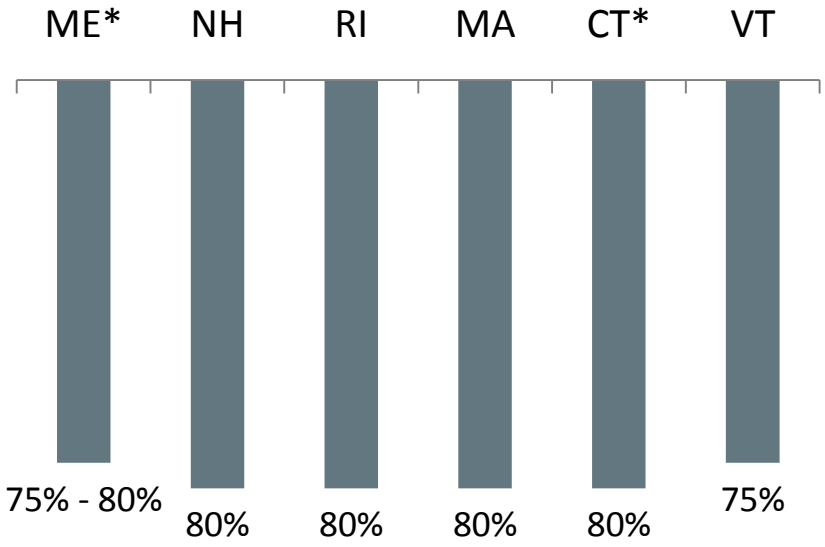
States Have Set Goals to *Increase* Renewable Energy and *Reduce* Greenhouse Gas Emissions



State Renewable Portfolio Standard (RPS) for Class I or New Renewable Energy by 2020

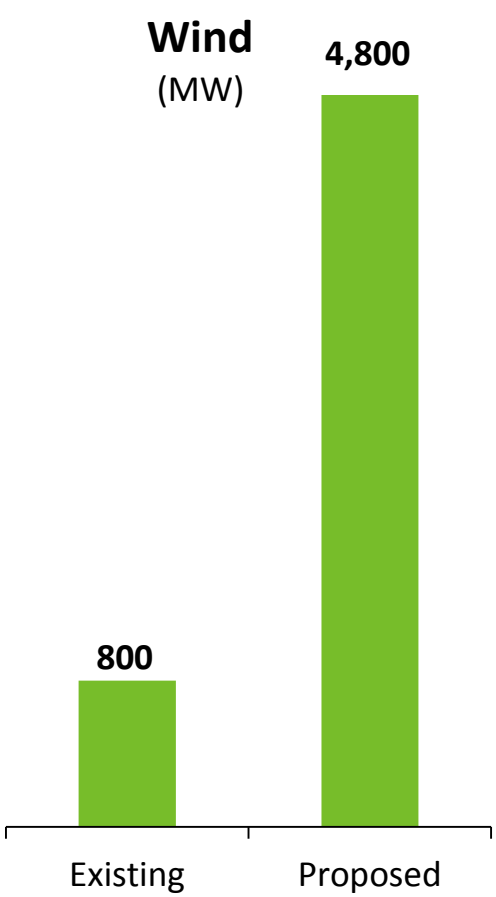
* Vermont's standard recognizes all forms of new and existing renewable energy, and is unique in classifying large-scale hydro as renewable.

Percent Reduction in Greenhouse Gas (GHG) Emissions Below 1990 Levels* by 2050 (economy wide)

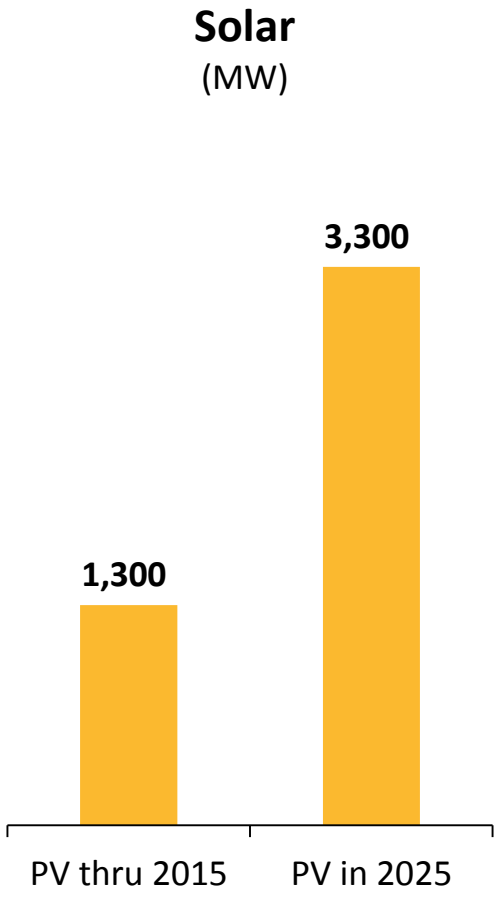


* Connecticut's goal is tied to 2001 levels. Maine's goal is tied to 2003 levels.

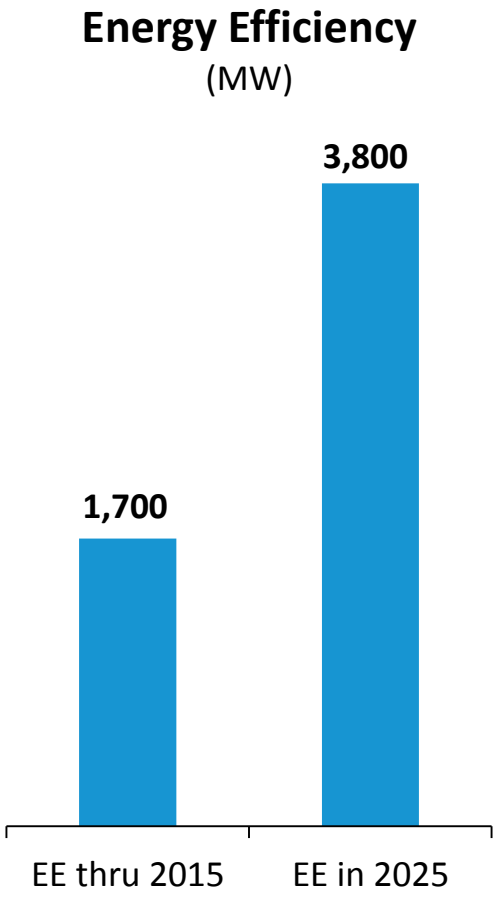
Renewable and EE Resources Are Trending Up



Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW) as of September 2016.



Final 2016 ISO-NE PV Forecast, AC nameplate capacity from PV resources participating in the region's wholesale electricity markets, as well as those connected "behind the meter."

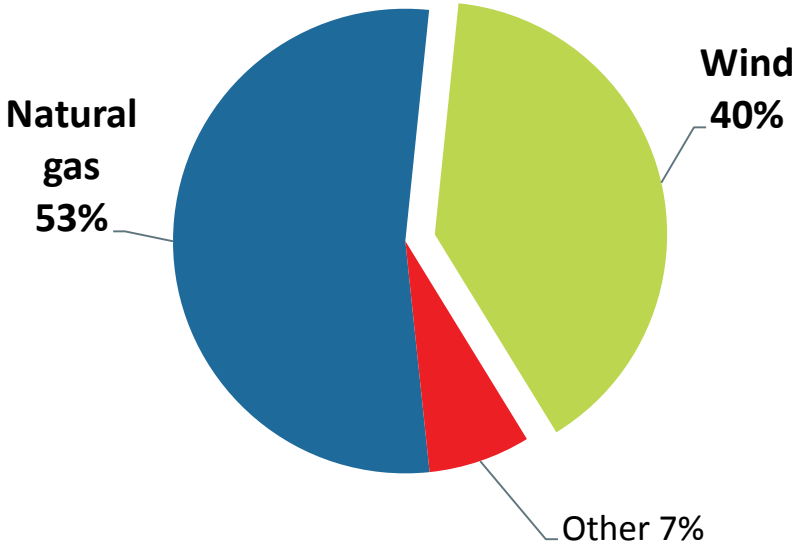


2016 CELT Report, EE through 2015 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2025 includes an ISO-NE forecast of incremental EE beyond the FCM.

Infrastructure Will Be Needed to Deliver Energy from Proposed Resources

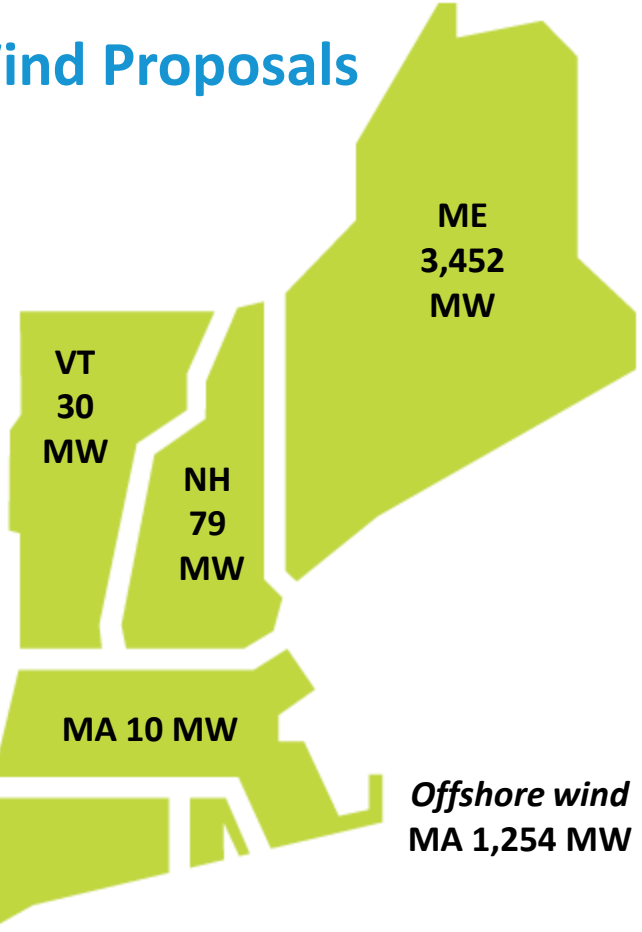
All Proposed Generation

Developers are proposing to build over 12,000 MW of generation, including almost 6,500 MW of gas-fired generation and more than 4,800 MW of wind



Source: ISO Generator Interconnection Queue (September 2016)
FERC Jurisdictional Proposals Only

Wind Proposals



Source: ISO Generator Interconnection Queue (September 2016)
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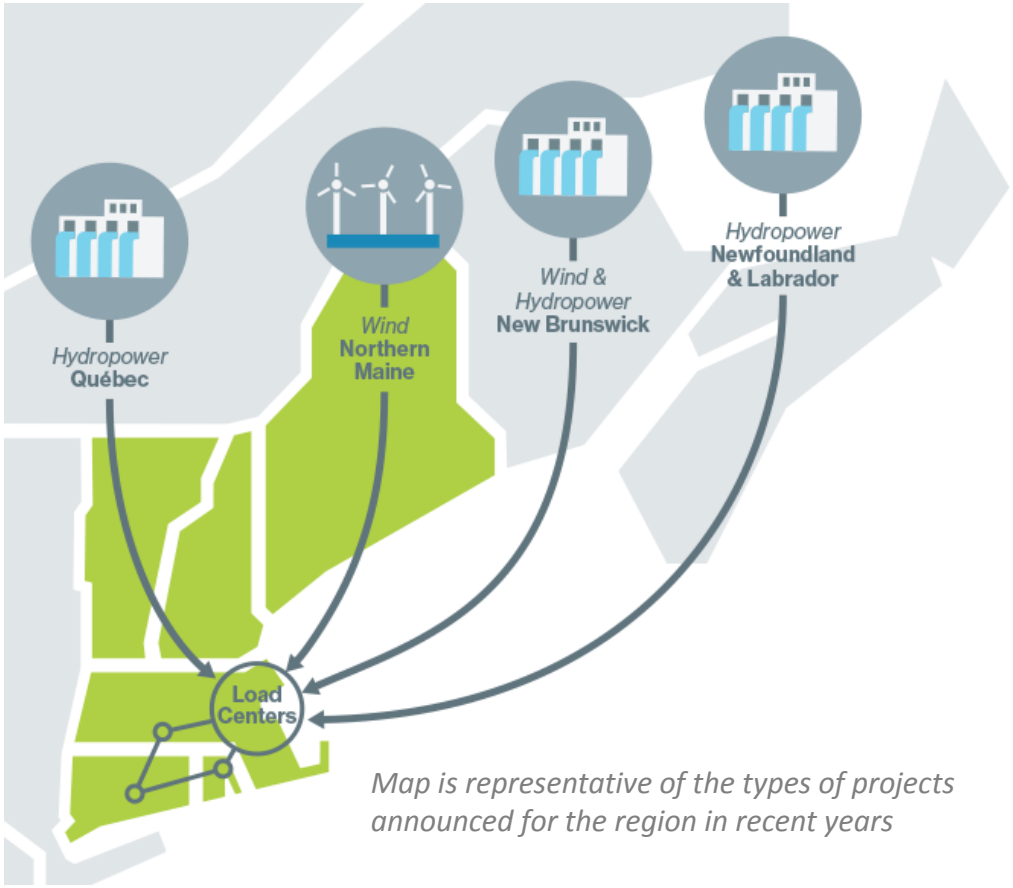
Developers Are Proposing to Move Renewable Energy to New England Load Centers



Map is representative of the types of projects announced for the region in recent years

- As of **September 1, 2016**, fourteen elective transmission projects had been proposed in the ISO Interconnection Queue, totaling more than **9,000 MW** of potential transfer capability, including:
  - **Large-scale hydro** resources from eastern Canada, and
  - **Onshore wind** resources from northern New England
- Projects seek to address public policy goals, not reliability needs
- In addition, **offshore wind** resources are emerging in southern New England

Source: ISO Interconnection Queue (September 2016)
http://www.iso-ne.com/system-planning/transmission-planning/interconnection-request-queue

New England Has Two Overarching Policy Goals – *Are They Compatible?*

1. Achieving reliability through **competitive wholesale markets**, and

2. Achieving **reductions in carbon emissions**

Goal 1 rests on the premise that efficient merchant investors have the opportunity to recover their costs and a return on equity through the market

If carbon reductions require 'out of market' financial support, do we sacrifice Goal 1 to achieve Goal 2?

Achieving a Mostly Renewable Power System Raises Complex Policy and Market Design Questions

- **Decarbonizing the entire economy** will increase the need for a highly reliable electric power system as heating and transportation sectors are electrified
- **Very high renewable penetration** will dramatically reduce energy market revenues for all resources
  - Renewable resources have low to zero marginal costs, and, with policy incentives (e.g., tax credits, RECs), can offer into the wholesale market at negative prices
- How do you pay for the ***backup system*** that will be needed when renewable resources cannot produce electricity?
  - Through the capacity market, or cost of service for all resources?
- How does the region pay for the ***environmental attributes*** that policymakers desire?

NEPOOL Has Launched a New Initiative Called Integrating Markets and Public Policy (IMAPP)

- In August, NEPOOL launched a stakeholder process with the goal of identifying **potential adjustment(s)** to the wholesale electricity market(s) to accommodate and achieve the New England states' **public policy objectives**
- The region's competitive wholesale electricity markets are designed to maintain **reliability** through the selection of the most economically-efficient set of resources
- The states have **environmental** and **renewable energy** goals that are beyond the objectives of the wholesale electricity markets

Overview of the IMAPP Schedule

- NEPOOL's goal is to develop a **"framework document"** by December 2 to provide guidance to the ISO regarding potential changes to the wholesale power markets
- This is an extremely important effort and we are encouraged by the attention of both NEPOOL and the New England states to this initiative
- In 2017, ISO New England will work with the states, NEPOOL and the FERC to determine the most effective path forward

Note: For information on the individual proposals, visit the NEPOOL website or the ISO's Wholesale Markets and State Public Policy Initiative webpage.

ISO-NE Will Continue to Work with Stakeholders to Manage the Transformation of the Power System

- **New England's wholesale markets provide a framework to ensure resource adequacy and reliability**
  - Competitive wholesale electricity markets have resulted in high levels of reliability, produced significant efficiencies and have driven billions of dollars of investment in New England's power system
  - However, the competitive market framework is vulnerable, and the transformation of the power system is presenting new risks
- **New England needs additional energy infrastructure**
  - Growing levels of renewable generation will require a fleet of flexible resources, with an equally flexible fuel system, to reliably balance the variability of renewable resources
- **Thoughtful balance of public policy goals and wholesale market operations can achieve effective results**
  - New England has a history of achieving environmental goals within the framework of wholesale energy markets

Questions

For More Information…

- Subscribe to the ***ISO Newswire***
  - *ISO Newswire* is your source for regular news about ISO New England and the wholesale electricity industry within the six-state region
- 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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