



# Managing Reliability During the Rapid Transformation of New England's Electric Power System

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*Town of Acushnet Advisory Committee*

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# ISO New England (ISO) Has 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



# Reliability Is the Core of ISO New England's Mission

*Fulfilled by three interconnected and interdependent responsibilities*

Managing  
comprehensive  
regional **power**  
**system planning**



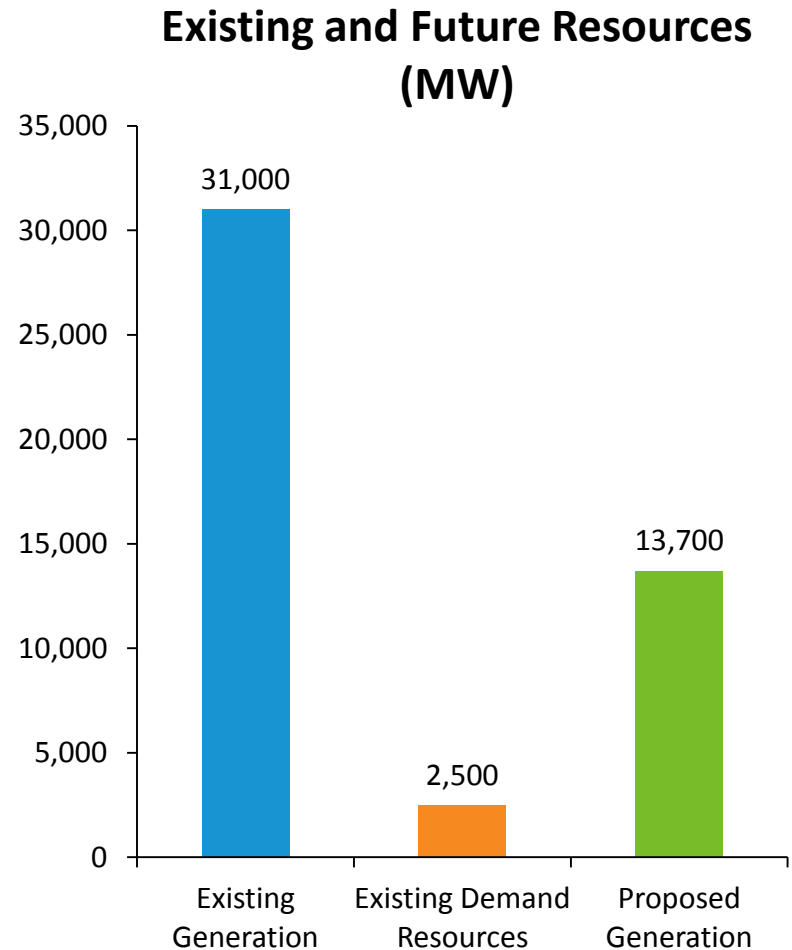
Overseeing the day-to-day  
**operation** of New England's  
electric power generation and  
transmission system

Developing and  
administering the region's  
competitive **wholesale**  
**electricity markets**



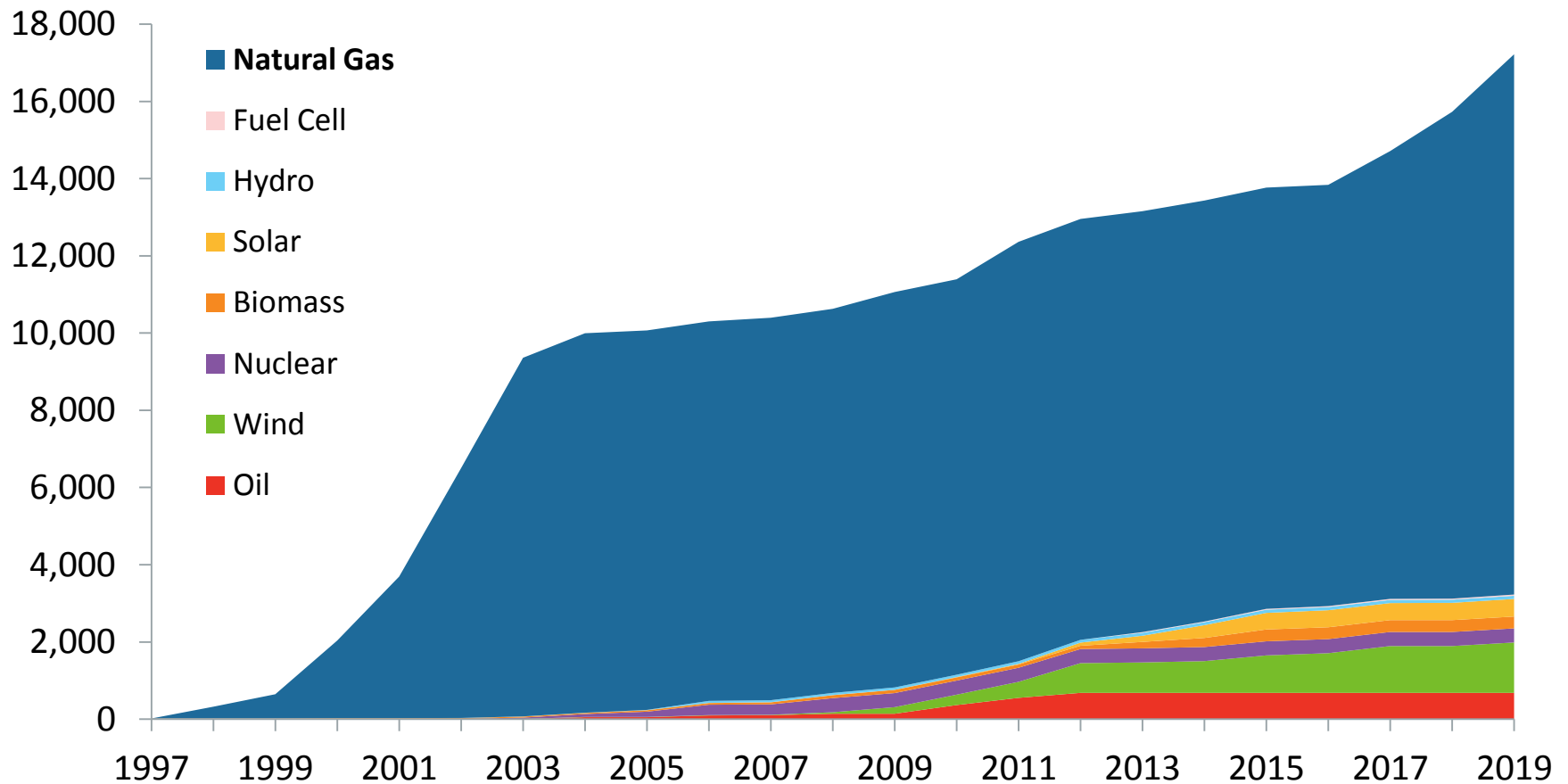
# A Range of Generation and Demand Resources Are Used to Meet New England's Energy Needs

- **350** generators in the region
- **31,000 MW** of generating capacity
- **13,700 MW** of proposed generation in the ISO Queue
- **4,200 MW** of generation has retired or will retire in the next five years
- **600 MW** of active demand response and **1,900 MW** of energy efficiency with capacity supply obligations



# Natural Gas Is the Dominant Fuel Source for New Generating Capacity in New England

Cumulative New Generating Capacity in New England (MW)

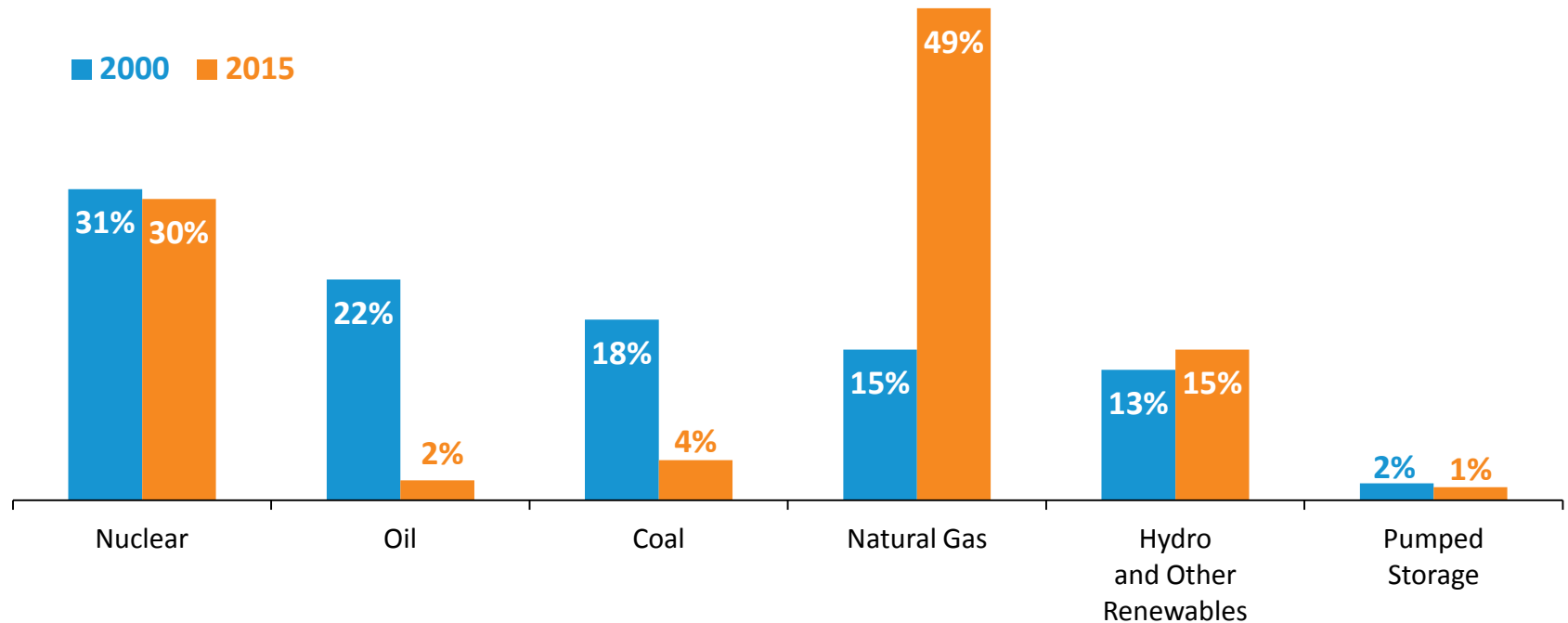


Note: New generating capacity for years 2016 – 2019 includes resources clearing in recent Forward Capacity Auctions.

# New England Has Seen Dramatic Changes in the Energy Mix

*The fuels used to produce the region's electric energy have shifted as a result of economic and environmental factors*

Percent of Total **Electric Energy** Production by Fuel Type  
(2000 vs. 2015)



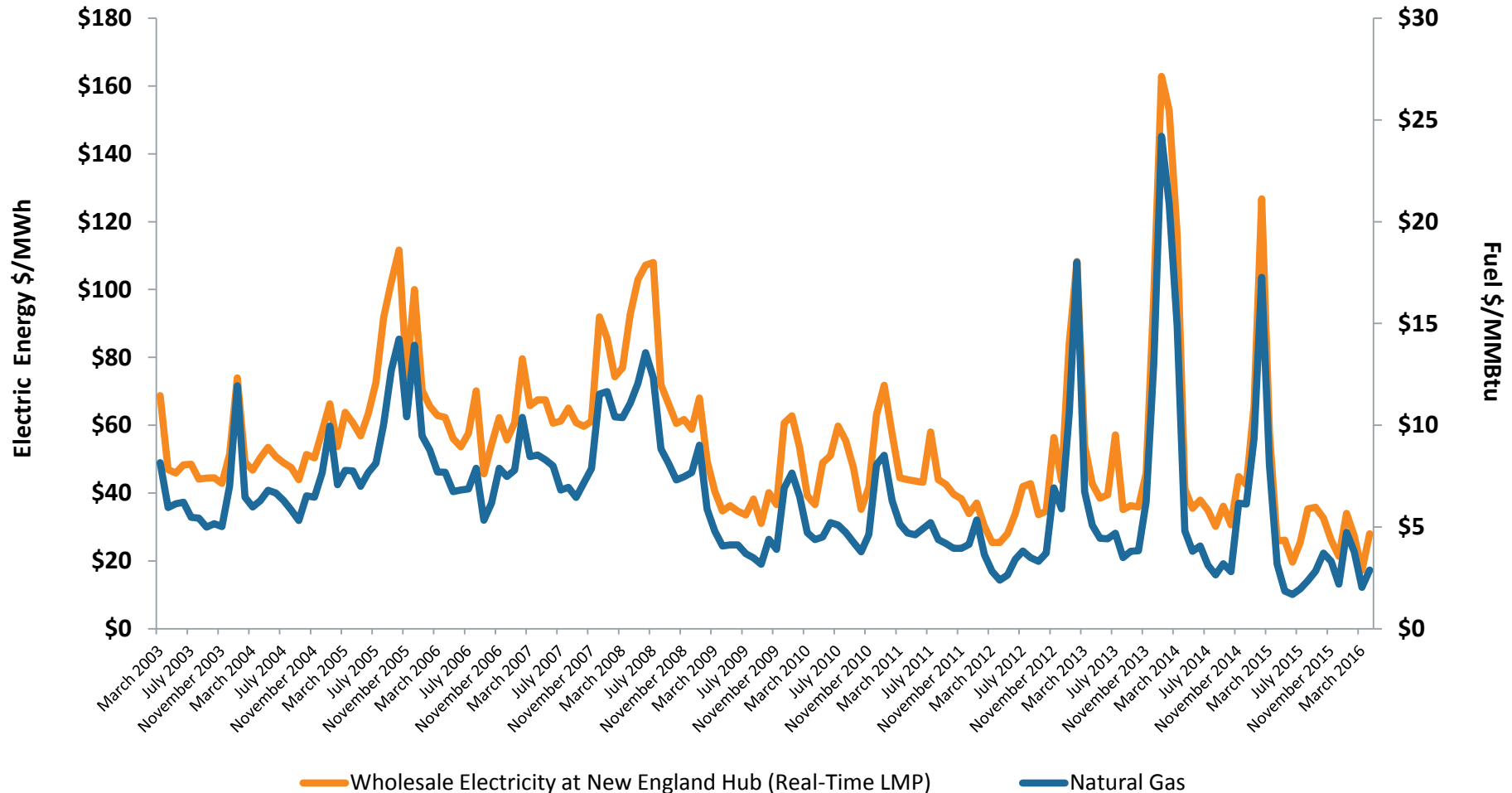
Source: ISO New England [Net Energy and Peak Load by Source](#)

Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels



# Natural Gas and Wholesale Electricity Prices Are Linked

Monthly Average Natural Gas and Wholesale Electricity Prices in New England



— Wholesale Electricity at New England Hub (Real-Time LMP)

— Natural Gas

# Power Plant Emissions Have Declined with Changes in the Fuel Mix



## *Reduction in Aggregate Emissions (ktons/yr)*

| Year                              | NO <sub>x</sub> | SO <sub>2</sub> | CO <sub>2</sub> |
|-----------------------------------|-----------------|-----------------|-----------------|
| 2001                              | 59.73           | 200.01          | 52,991          |
| 2014                              | 20.49           | 11.68           | 39,317          |
| <b>% Reduction,<br/>2001–2014</b> | <b>↓ 66%</b>    | <b>↓ 94%</b>    | <b>↓ 26%</b>    |

## *Reduction in Average Emission Rates (lb/MWh)*

| Year                              | NO <sub>x</sub> | SO <sub>2</sub> | CO <sub>2</sub> |
|-----------------------------------|-----------------|-----------------|-----------------|
| 1999                              | 1.36            | 4.52            | 1,009           |
| 2014                              | 0.38            | 0.22            | 726             |
| <b>% Reduction,<br/>1999–2014</b> | <b>↓ 72%</b>    | <b>↓ 95%</b>    | <b>↓ 28%</b>    |

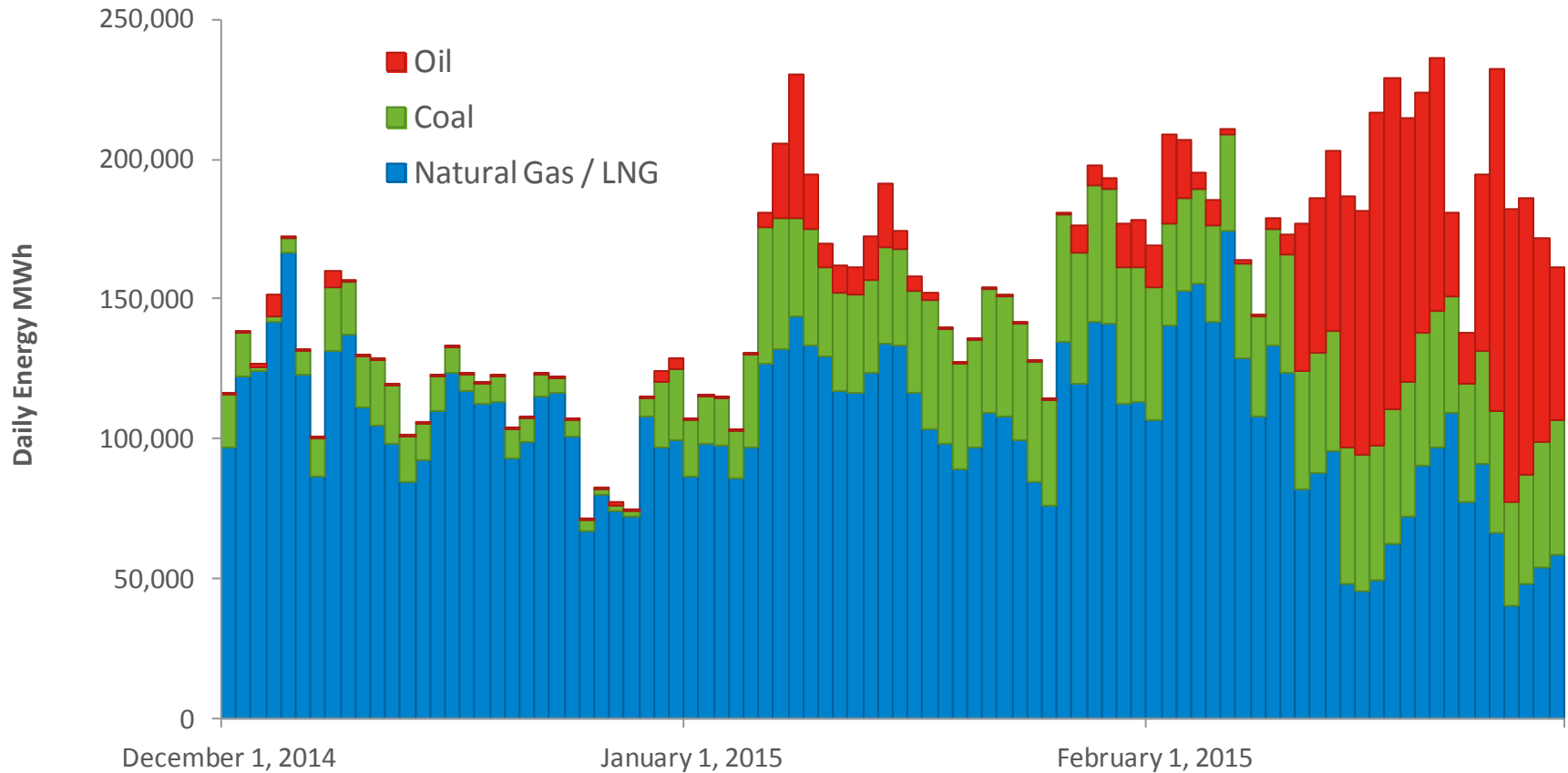
Source: [2014 ISO New England Electric Generator Air Emissions Report](#), January 2016



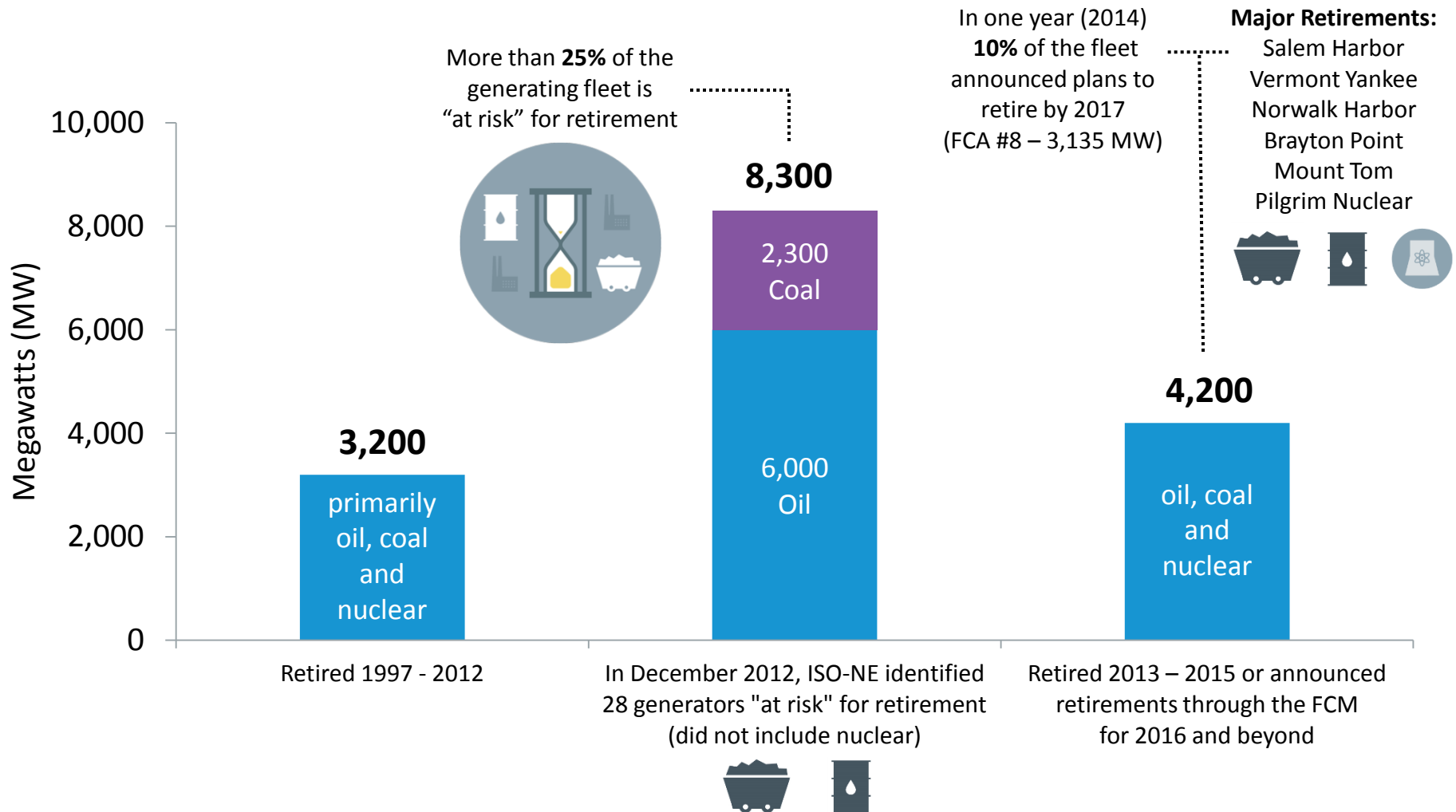


# But, the Region Relies on Coal and Oil in Cold Weather

Daily Energy for December 2014 - February 2015 (MWh)



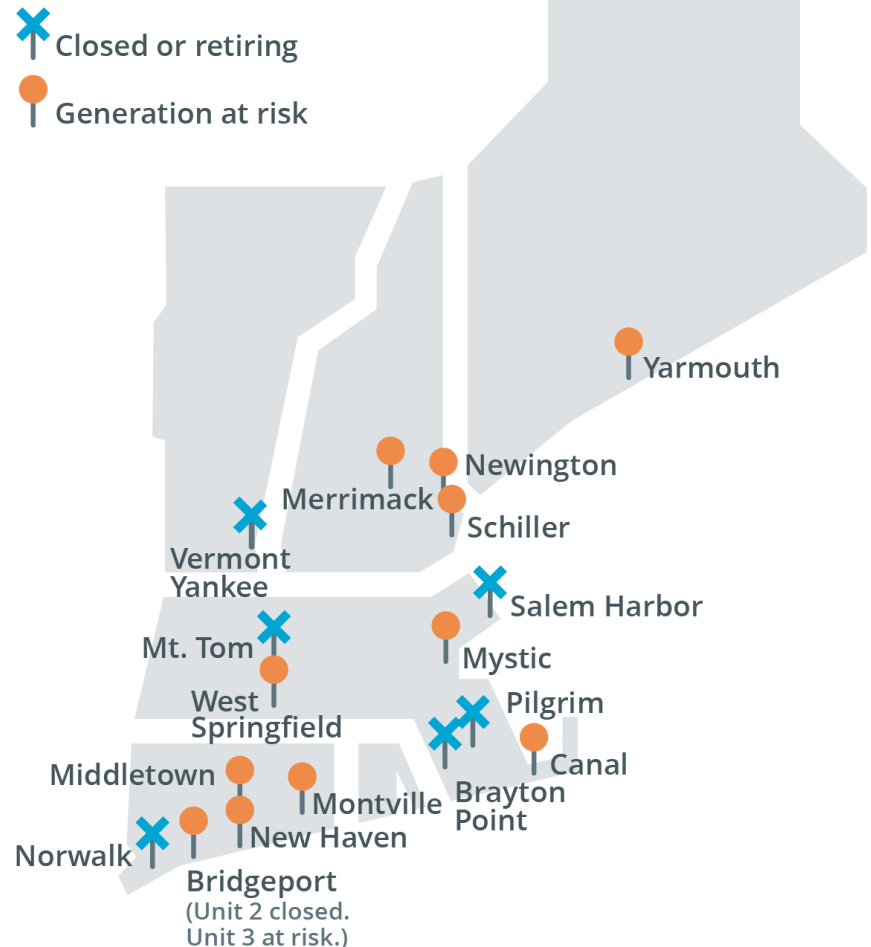
# More Than 4,200 MW of Non-Gas Generation Have Recently Retired or Announced Plans to Retire



# The Region Has Lost—and Is at Risk of Losing—Substantial Non-Gas Resources

## Major Generator Retirements:

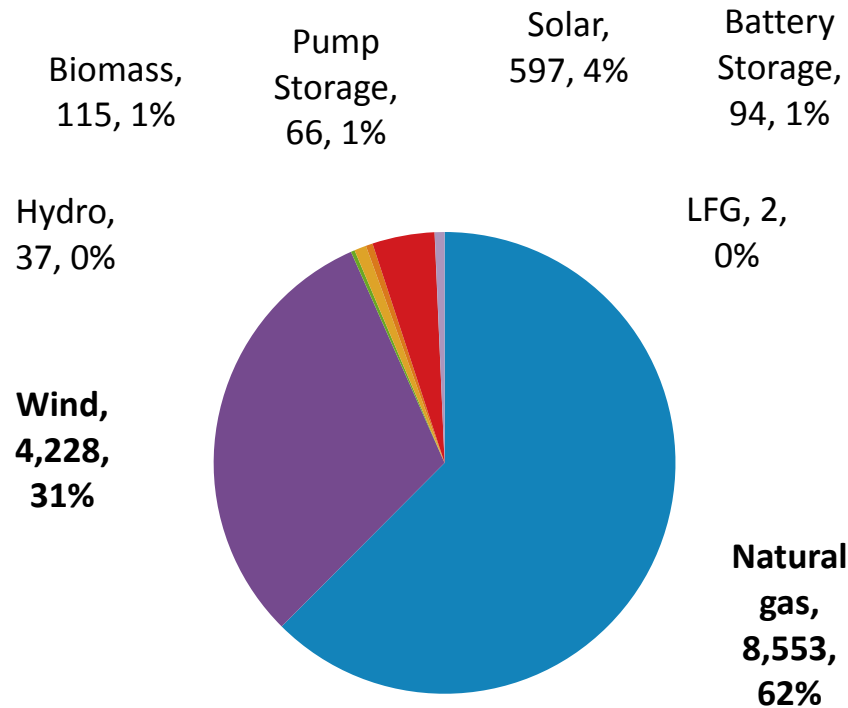
- **Salem Harbor Station (749 MW)**
  - 4 units (coal & oil)
- **Vermont Yankee Station (604 MW)**
  - 1 unit (nuclear)
- **Norwalk Harbor Station (342 MW)**
  - 3 units (oil)
- **Brayton Point Station (1,535 MW)**
  - 4 units (coal & oil)
- **Mount Tom Station (143 MW)**
  - 1 unit (coal)
- **Pilgrim Nuclear Power Station (677 MW)**
  - 1 unit (nuclear)
- *Additional retirements are looming*



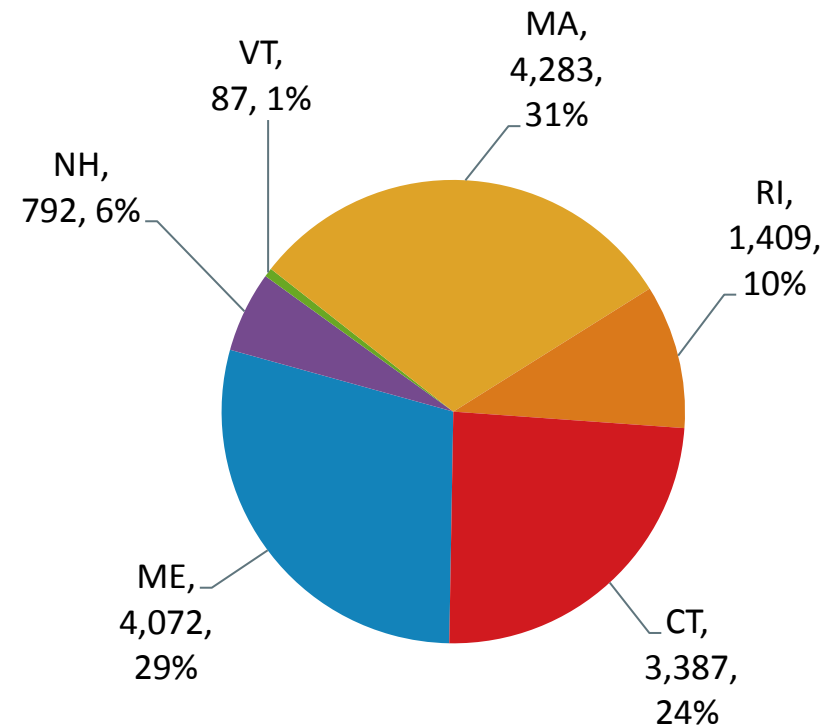
# Natural Gas and Wind Power Dominate New Resource Proposals in the ISO Generator Interconnection Queue

*Approximately 13,700 MW*

## By Type



## By State

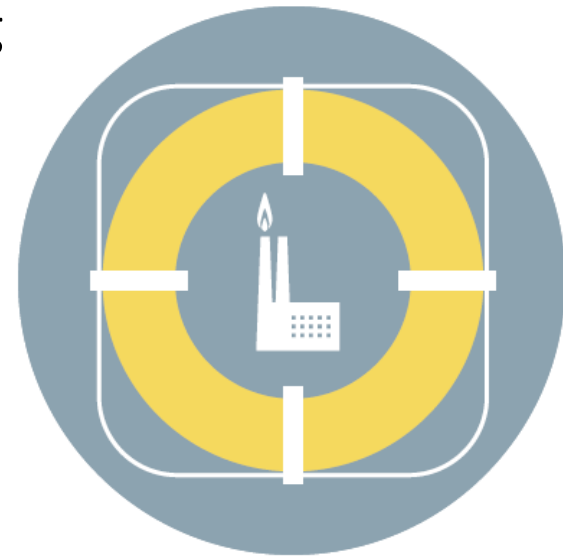


Note: Some natural gas include dual-fuel units (oil)

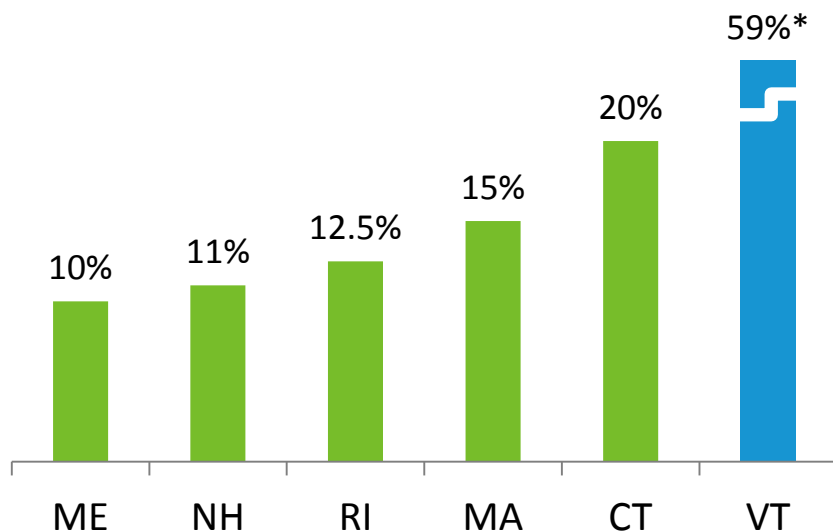
Source: ISO Generator Interconnection Queue (May 2016)  
FERC Jurisdictional Proposals Only

# Resource Shift Creates Reliability Challenges

- New England's generation fleet is changing rapidly – older, fossil fuel-fired units are retiring and reliance on natural gas for power generation is increasing
- The ISO must rely increasingly on resources with uncertain performance and availability
  - Intermittent resources (wind, solar) may not produce power at the times it is needed most
  - Natural gas resources lack fuel storage and rely on “just-in-time” fuel
  - Coal, oil-steam fleet is aging, prone to mechanical problems, subject to increasingly stringent environmental regulations
- Reliable operation of the New England power system is challenged by these developments, particularly during the winter

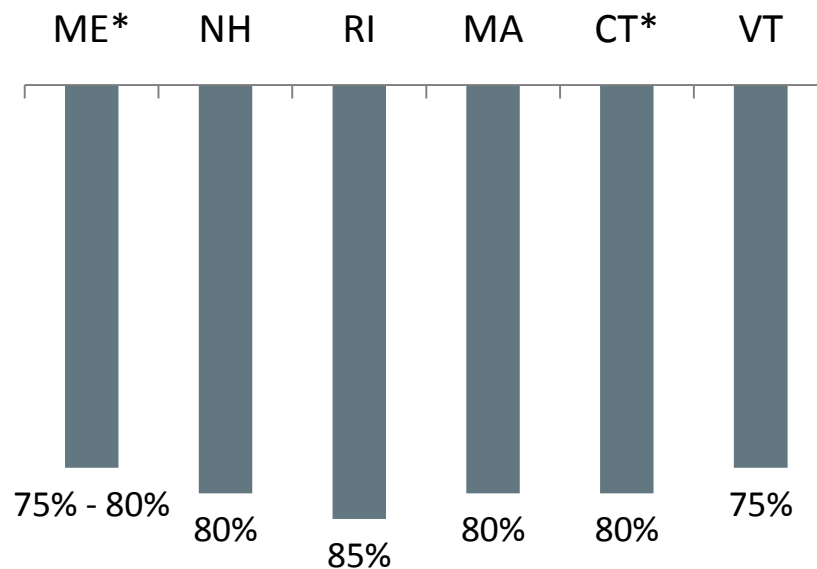


# States Have Set Goals to *Increase* Renewable Energy and *Reduce* Greenhouse Gas Emissions



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

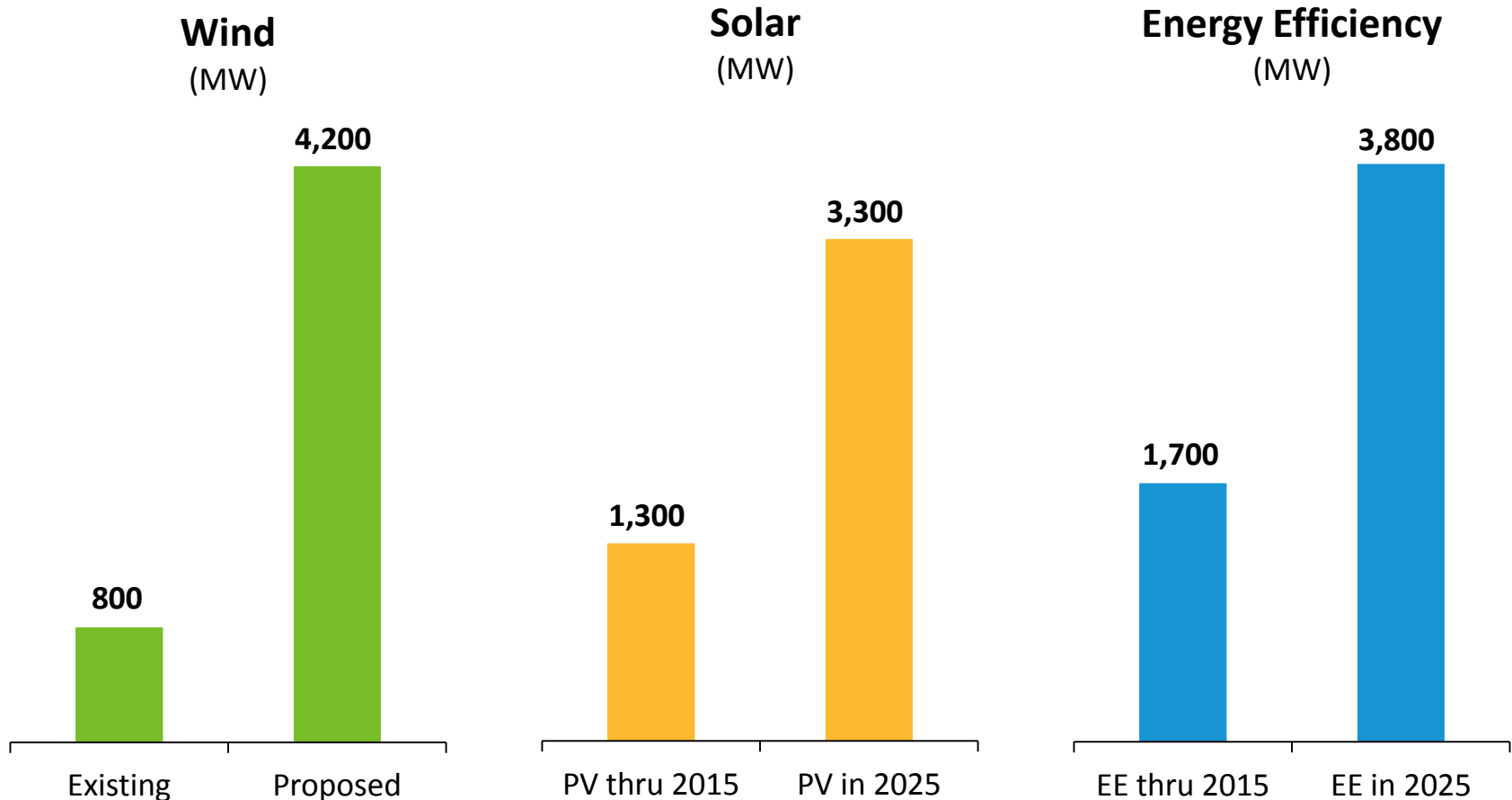
Percent Reduction of Greenhouse Gas (GHG) Emissions Below 1990 Levels\* by 2050 (economy wide)



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

\* 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).

*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.

# Energy Use Is Growing, But Energy Efficiency and Behind-the-Meter Solar Are Slowing the Growth Rate

- **7.1 million** retail electricity customers drive the demand for electricity (14.1 million population)
- Region's all-time summer peak demand set on August 2, 2006 at **28,130 MW**
- Region's all-time winter peak demand set on January 15, 2004 at **22,818 MW**
- Energy efficiency and behind-the-meter solar slow the growth in summer *peak* demand to **0.3%** annually and reverse the growth in *overall* electricity demand to **-0.2%** annually
  - Without energy efficiency and solar, the region's *peak* demand is forecasted to grow **1.1%** annually and the region's *overall* electricity demand is forecasted to grow **1.0%** annually

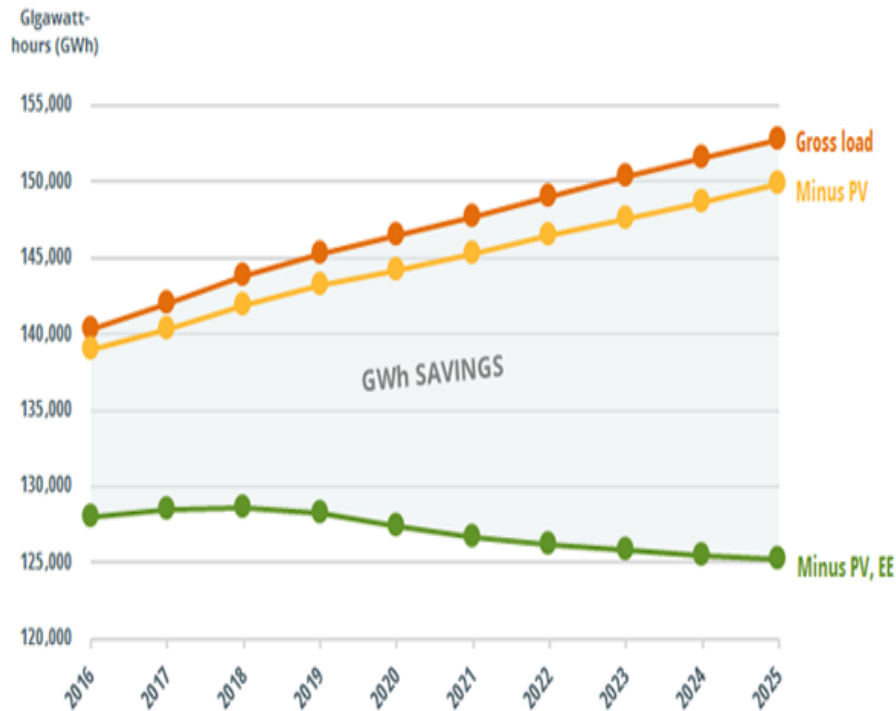


**Note:** Summer peak demand is based on the “90/10” forecast for extreme summer weather.

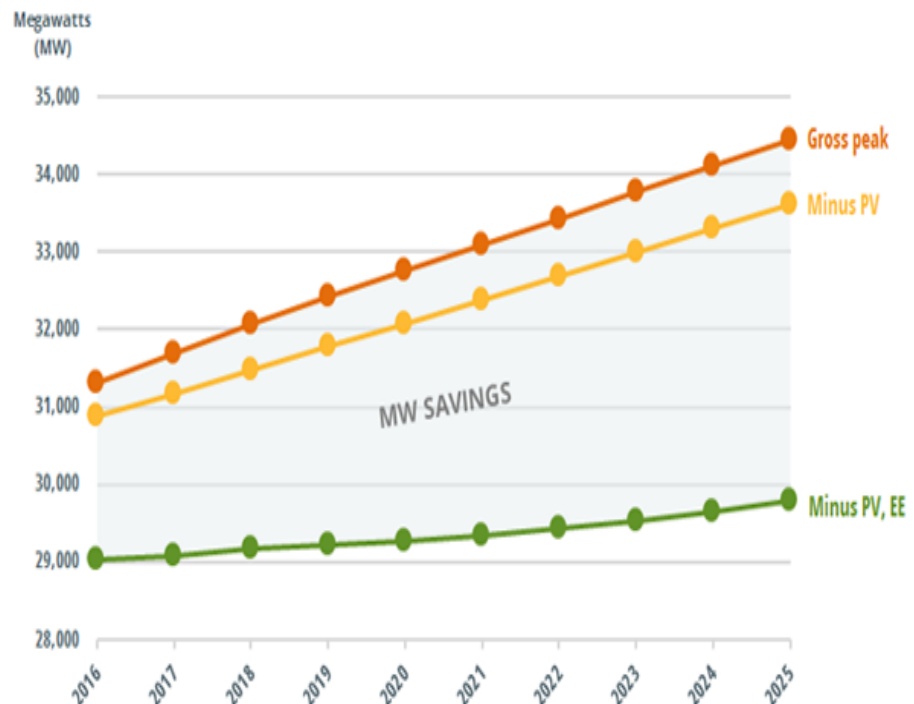


# Solar and Energy Efficiency Investments Are Influencing Load Forecasts

Annual Energy Use With and Without EE and PV Savings



Summer Peak Demand With and Without EE and PV Savings



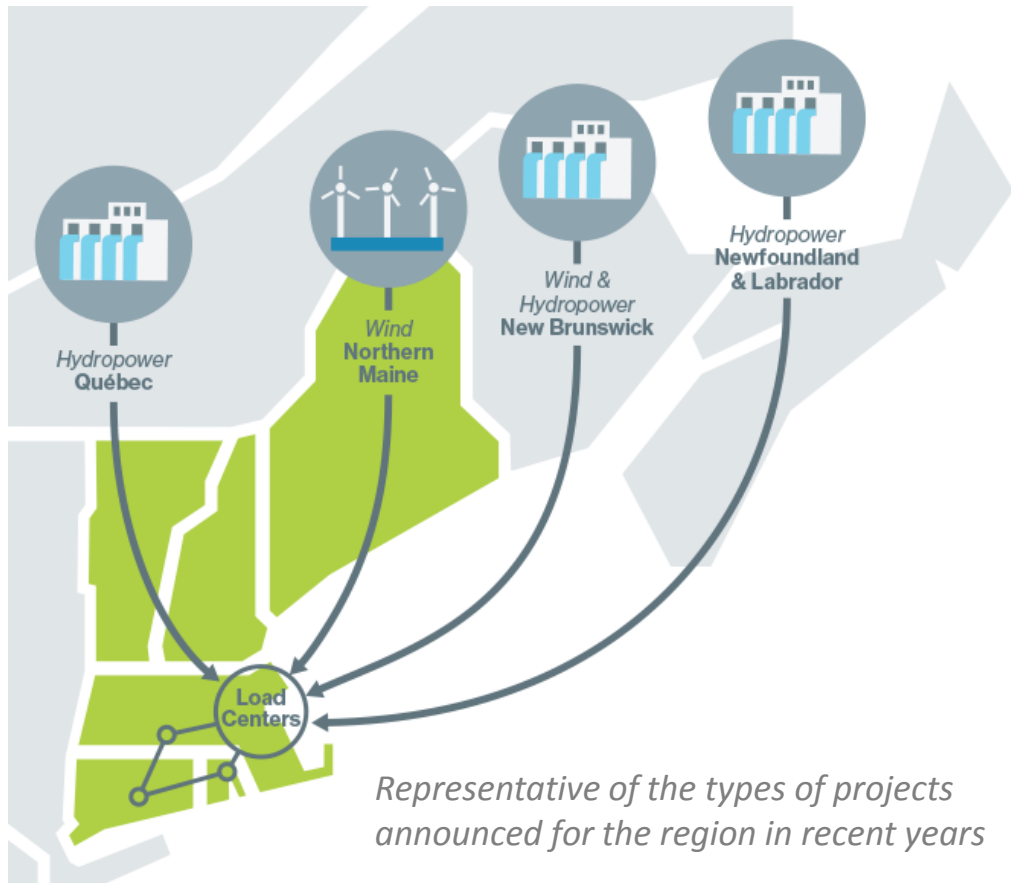
● The gross load forecast (projected regional energy use)

● The gross load forecast minus forecasted "behind the meter" (BTM) solar photovoltaic (PV) resources

● The gross load forecast minus forecasted BTM PV, minus energy-efficiency (EE) resources in the Forward Capacity Market (FCM) 2016-2019 and forecasted EE 2020-2025

Note: Summer peak demand is based on the "90/10" forecast, which accounts for the possibility of extreme summer weather, such as an extended heat wave of about 94°F.

# Transmission Developers Are Proposing to Move Renewable Energy to New England Load Centers



- As of **January 1, 2016**, eleven elective transmission projects had been proposed in the ISO Interconnection Queue, totaling more than **7,000 MW** of potential transfer capability
  - Primarily large-scale **hydro** resources from eastern Canada and **wind** resources from northern New England and northern New York
- These projects seek to address public policy goals, not reliability needs

Source: ISO Interconnection Queue (January 2016)

<http://www.iso-ne.com/system-planning/transmission-planning/interconnection-request-queue>

# Conclusions

- New England's generating resources are rapidly transitioning away from oil, coal and nuclear power toward natural gas and renewable energy
- Relatively low natural gas prices and state policies are driving the transition
- Wholesale prices and emissions spike in the winter when the region's fuel delivery infrastructure is constrained
- New England states are evaluating opportunities to access additional energy resources from neighboring regions



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