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New England's Energy Resource Mix is Changing Rapidly

EIA Energy Conference

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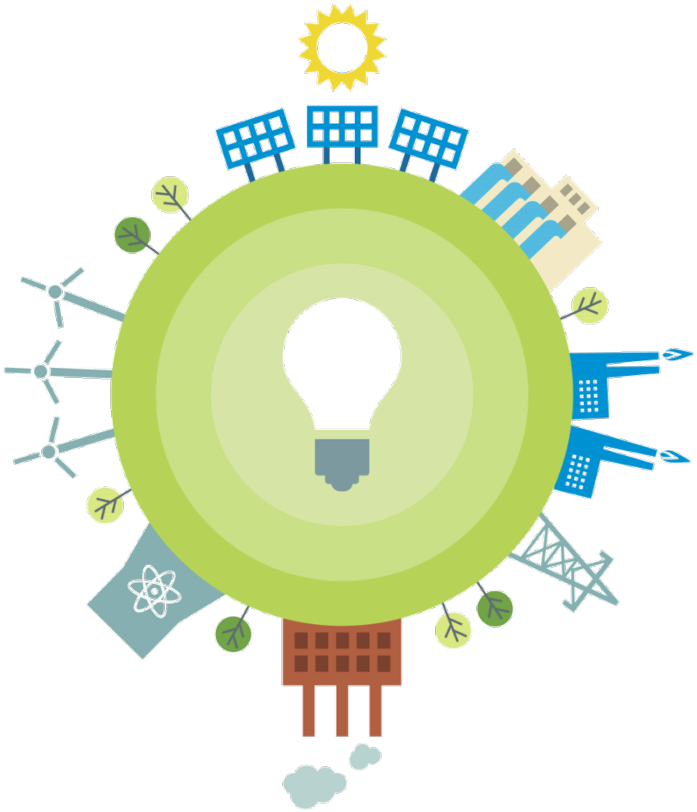
About ISO New England

- **Regulated by** the Federal Energy Regulatory Commission
- **Reliability Coordinator and Planning Coordinator** for New England under the North American Electric Reliability Corporation
- Two decades of experience **overseeing** New England's restructured power system
- **Independent** of companies in the marketplace



Reliability is the Core of ISO New England's Mission

Fulfilled by three interconnected and interdependent responsibilities

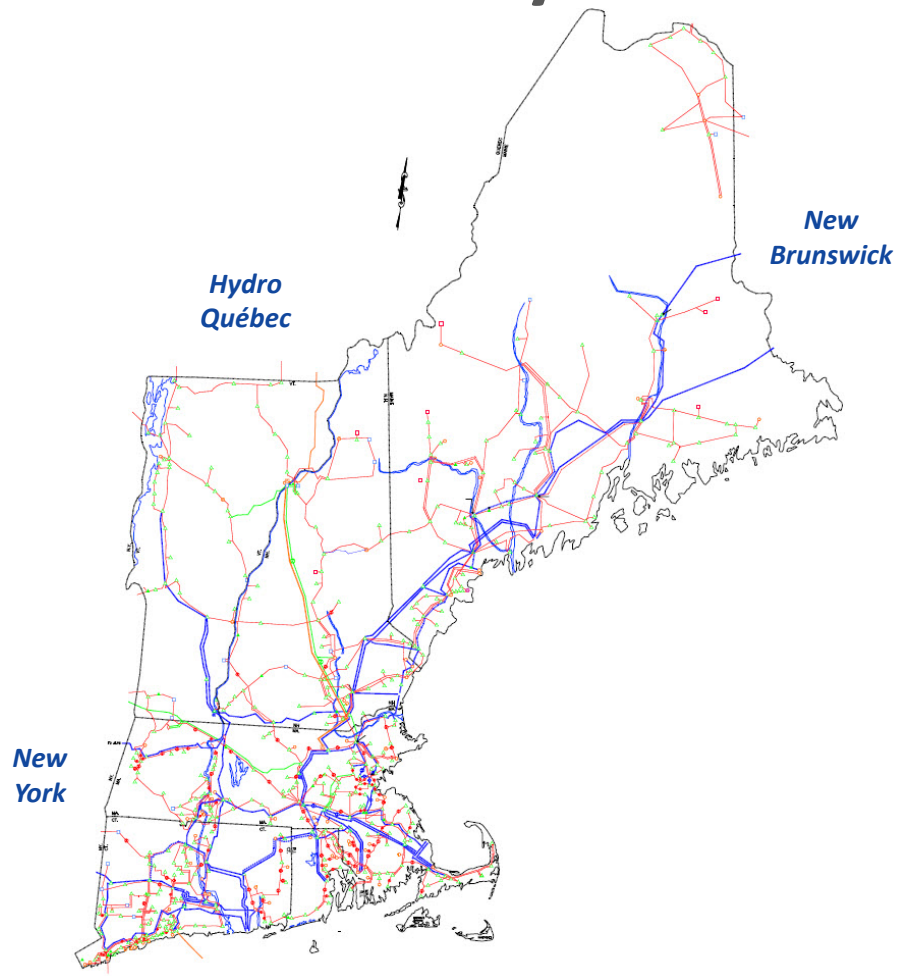
Overseeing the day-to-day operation of New England's electric power generation and transmission system

Managing comprehensive regional power system planning

Developing and administering the region's competitive wholesale electricity markets

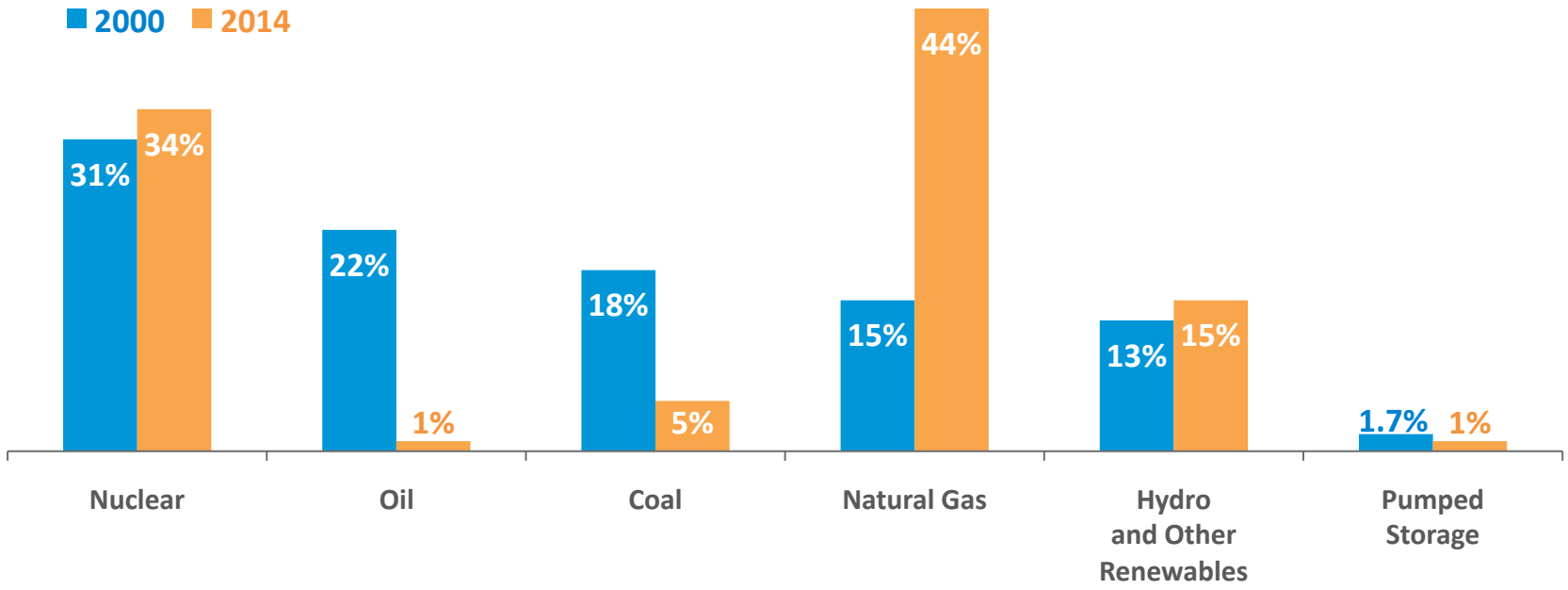
New England's Transmission Grid is the Interstate Highway System for Electricity

- **8,500 miles** of high-voltage transmission lines (115 kV and above)
- **13 transmission interconnections** to power systems in New York and Eastern Canada
- **16%** of region's energy needs met by imports in 2014
- **$7 billion** invested to strengthen transmission system reliability since 2002; **$4.5 billion** planned
- Developers have proposed **multiple** transmission projects to access non-carbon-emitting resources
- Merchant generators own more than **90%** of the region's capacity following industry restructuring



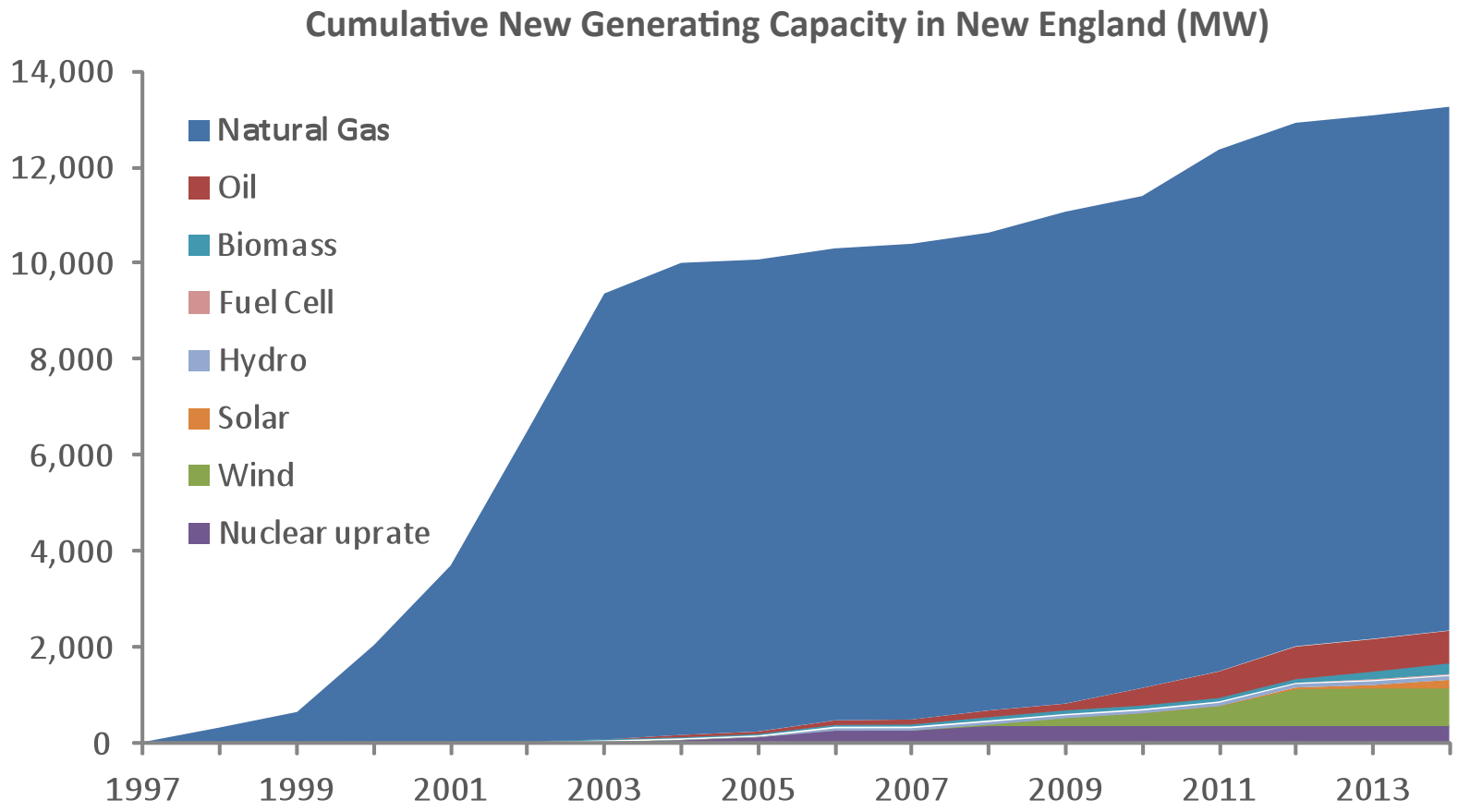
New England has Seen Dramatic Changes in the Energy Mix from Oil and Coal to Natural Gas

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2014)

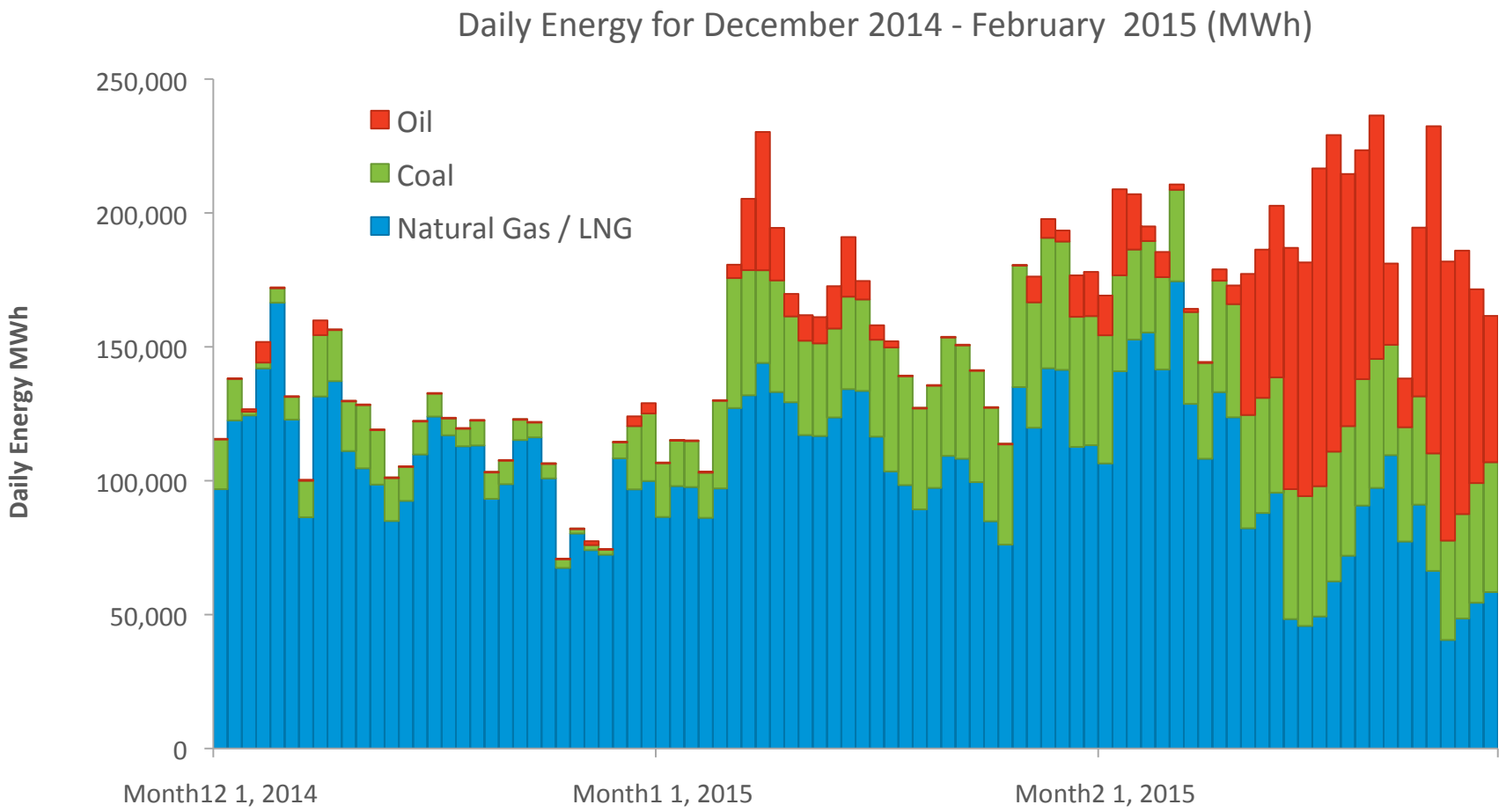


Source: ISO New England Net Energy and Peak Load by Source
Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels

Region has Not Developed Gas Pipeline Infrastructure to Keep Pace with Growth of Gas-fired Generation



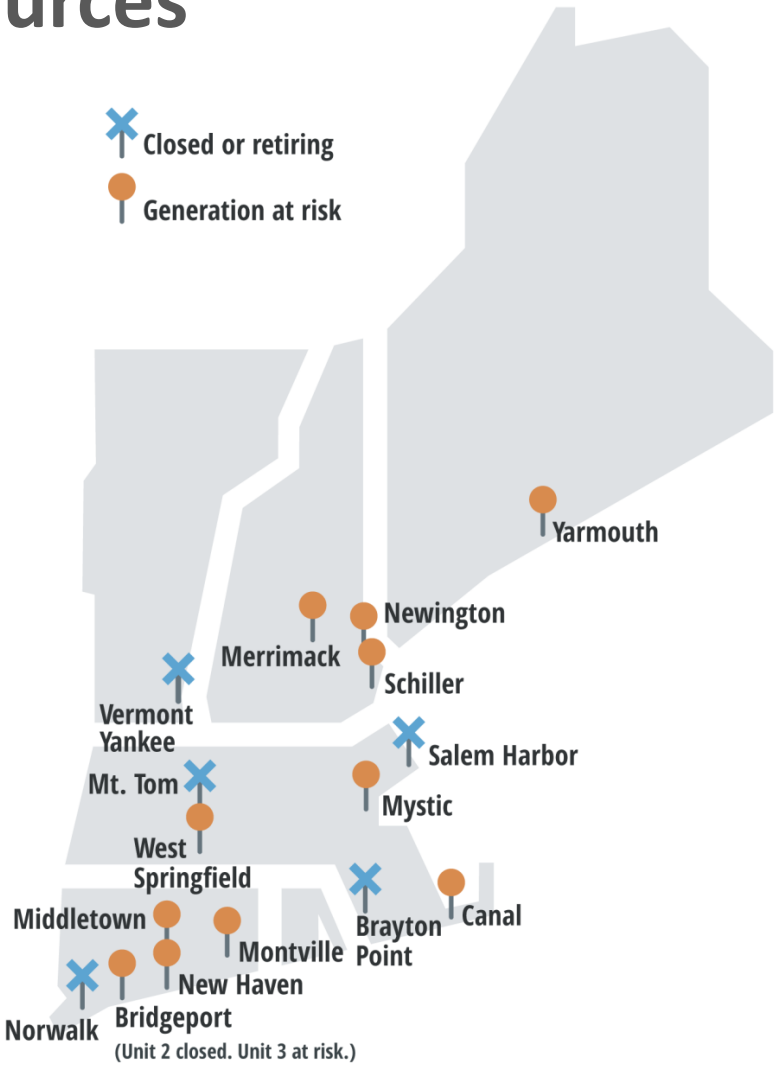
Region has Shifted to Coal and Oil in the Winter



Region has Lost and is at Risk of Losing Substantial Non-Gas Resources

Major Retirements Underway:

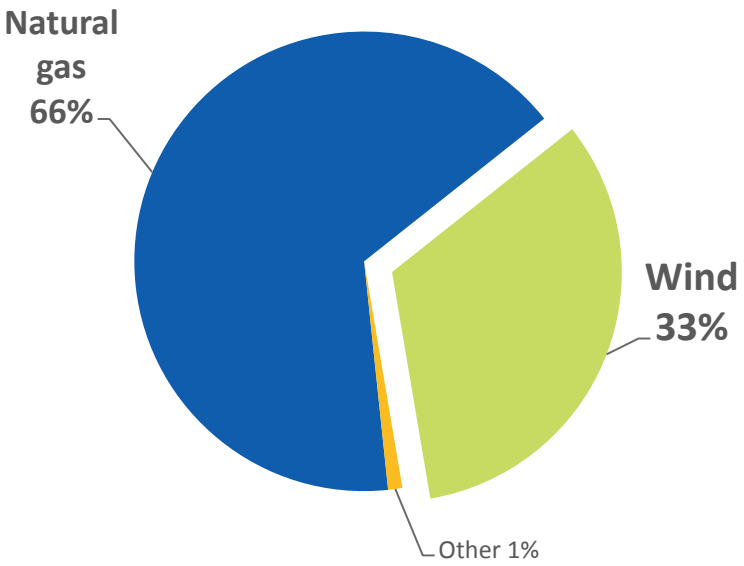
- Salem Harbor Station (749 MW)
  - 4 units (coal & oil)
- Vermont Yankee Station (604 MW)
  - 1 unit (nuclear)
- Norwalk Harbor Station (342 MW)
  - 3 units (oil)
- Brayton Point Station (1,535 MW)
  - 4 units (coal & oil)
- Mount Tom Station (143 MW)
  - 1 unit (coal)
- *Additional retirements are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



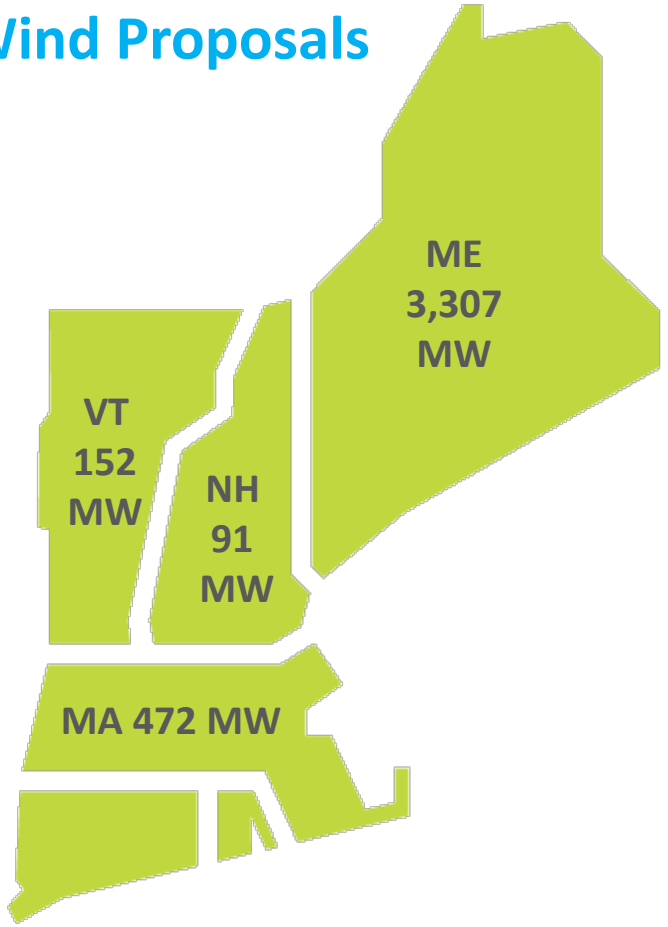
Infrastructure will be Needed to Deliver Energy From Proposed Resources

All Proposed Generation

Developers are proposing to build more than 12,000 MW of generation, including 8 GW of gas-fired generation and 4 GW of wind

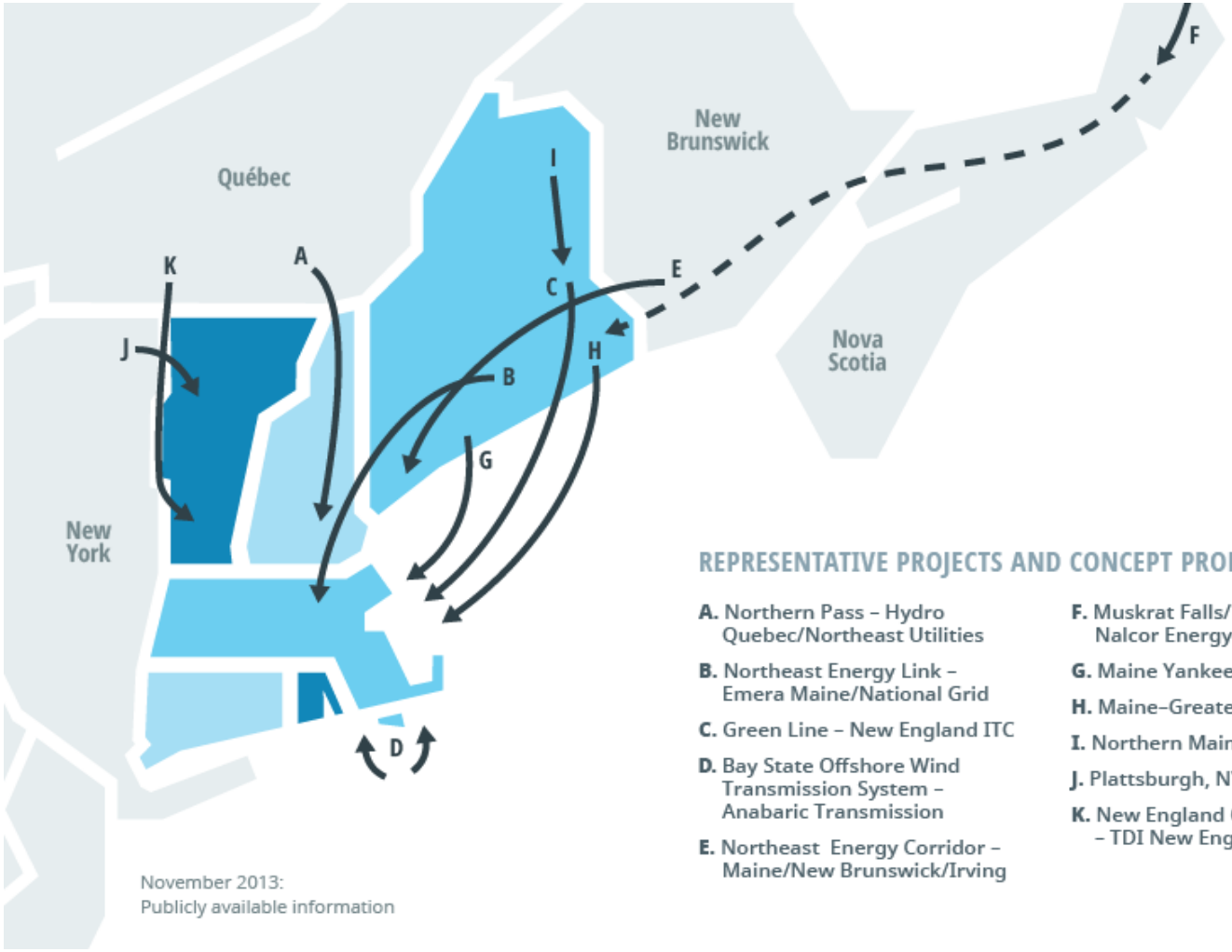


Wind Proposals



Source: ISO Generator Interconnection Queue (June 2015)
FERC Jurisdictional Proposals Only

On- and Off-shore Transmission Proposals are Vying to Move Renewable Energy to New England Load Centers



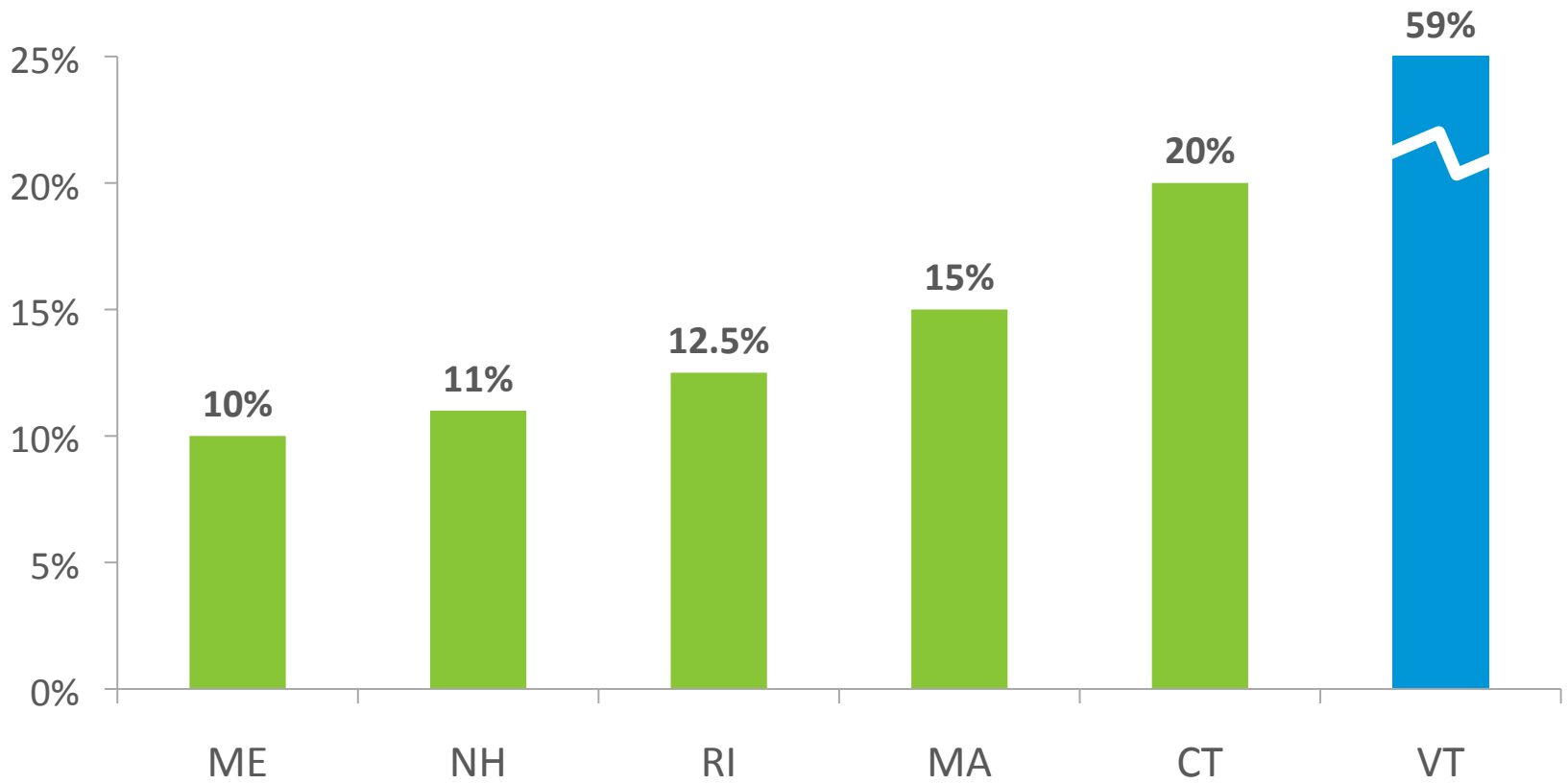
REPRESENTATIVE PROJECTS AND CONCEPT PROPOSALS

- **A.** Northern Pass – Hydro Quebec/Northeast Utilities
- **B.** Northeast Energy Link – Emera Maine/National Grid
- **C.** Green Line – New England ITC
- **D.** Bay State Offshore Wind Transmission System – Anabaric Transmission
- **E.** Northeast Energy Corridor – Maine/New Brunswick/Irving
- **F.** Muskrat Falls/Lower Churchill – Nalcor Energy
- **G.** Maine Yankee–Greater Boston
- **H.** Maine–Greater Boston
- **I.** Northern Maine–New England
- **J.** Plattsburgh, NY–New Haven, VT
- **K.** New England Clean Power Link – TDI New England

Note: These projects are NOT reliability projects, but ISO New England' s role is to ensure the reliable interconnection of these types of projects.

State Requirements Drive Development of Renewable Energy

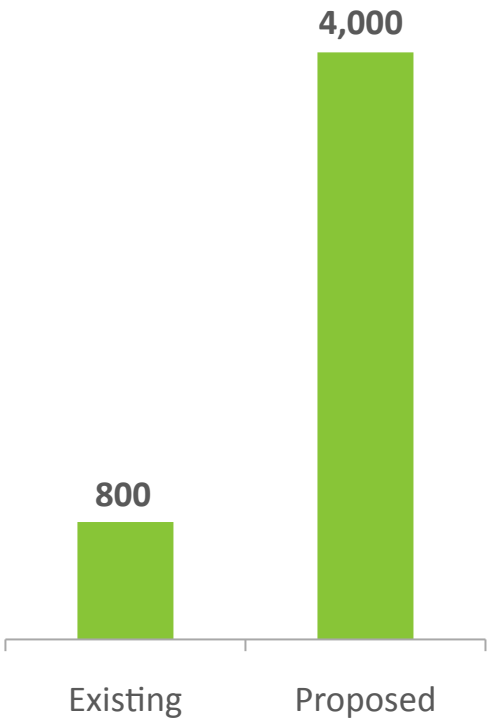
State Renewable Energy Requirements by 2020*



* State Renewable Portfolio Standards (CT, MA, ME, NH) and Renewable Energy Standards (RI, VT) require electricity providers to serve a minimum percentage of their retail load using renewable energy from defined technologies. Vermont's program has a high renewable requirement, but unlike other states, defines renewable energy to include large-scale hydro.

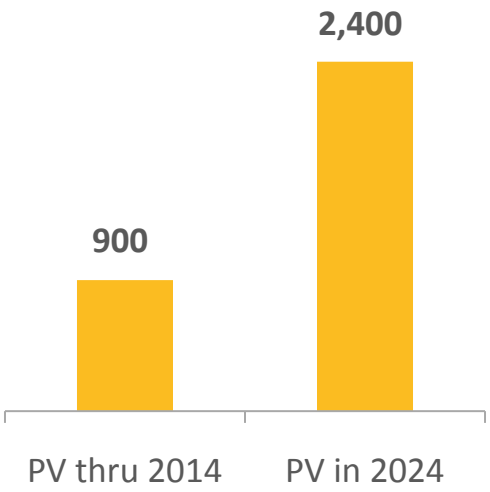
Renewable and EE Resources are Trending Up

Wind
(MW)



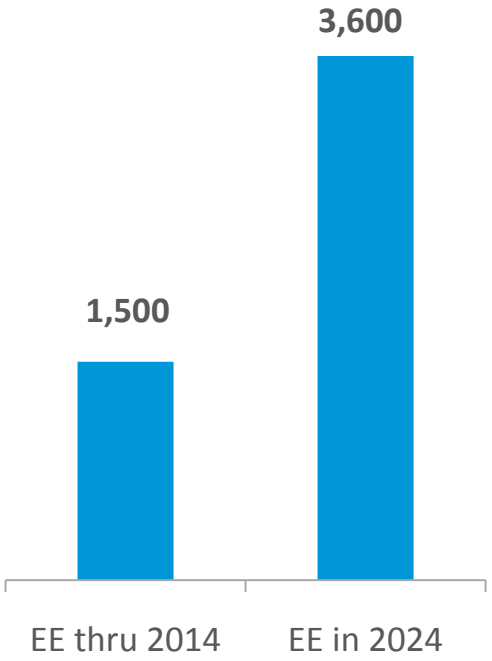
Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW).

Solar
(MW)



2015 ISO-NE Solar PV Forecast, AC nameplate capacity, based on state policies.

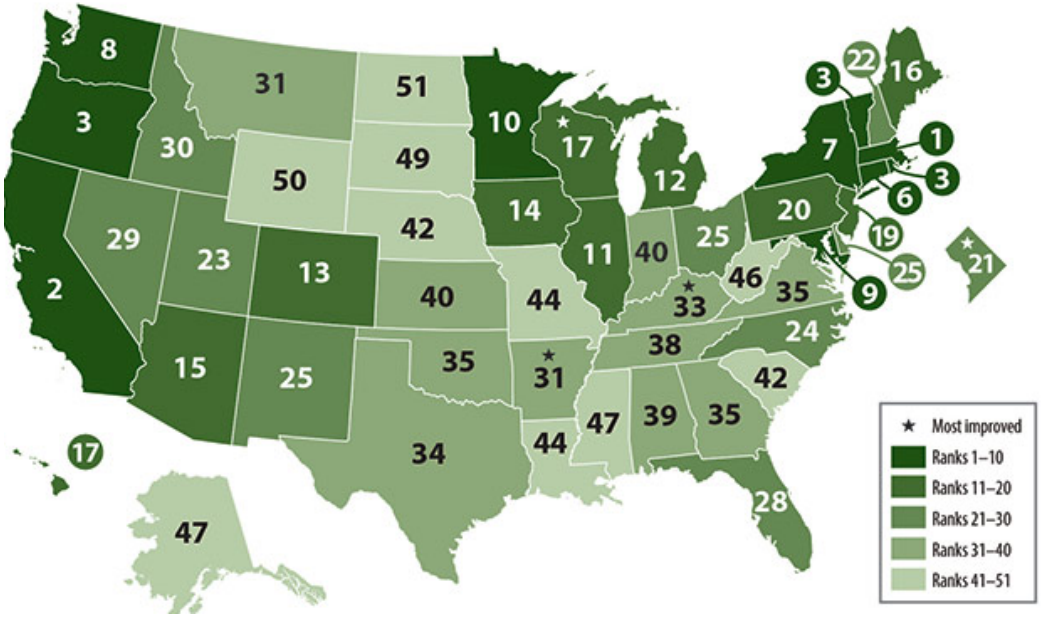
Energy Efficiency
(MW)



2015 CELT Report, EE through 2014 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2024 includes an ISO-NE forecast of incremental EE beyond the FCM.

Energy Efficiency is a Priority for New England

2014 State Energy-Efficiency Scorecard



Source: American Council for an Energy-Efficient Economy

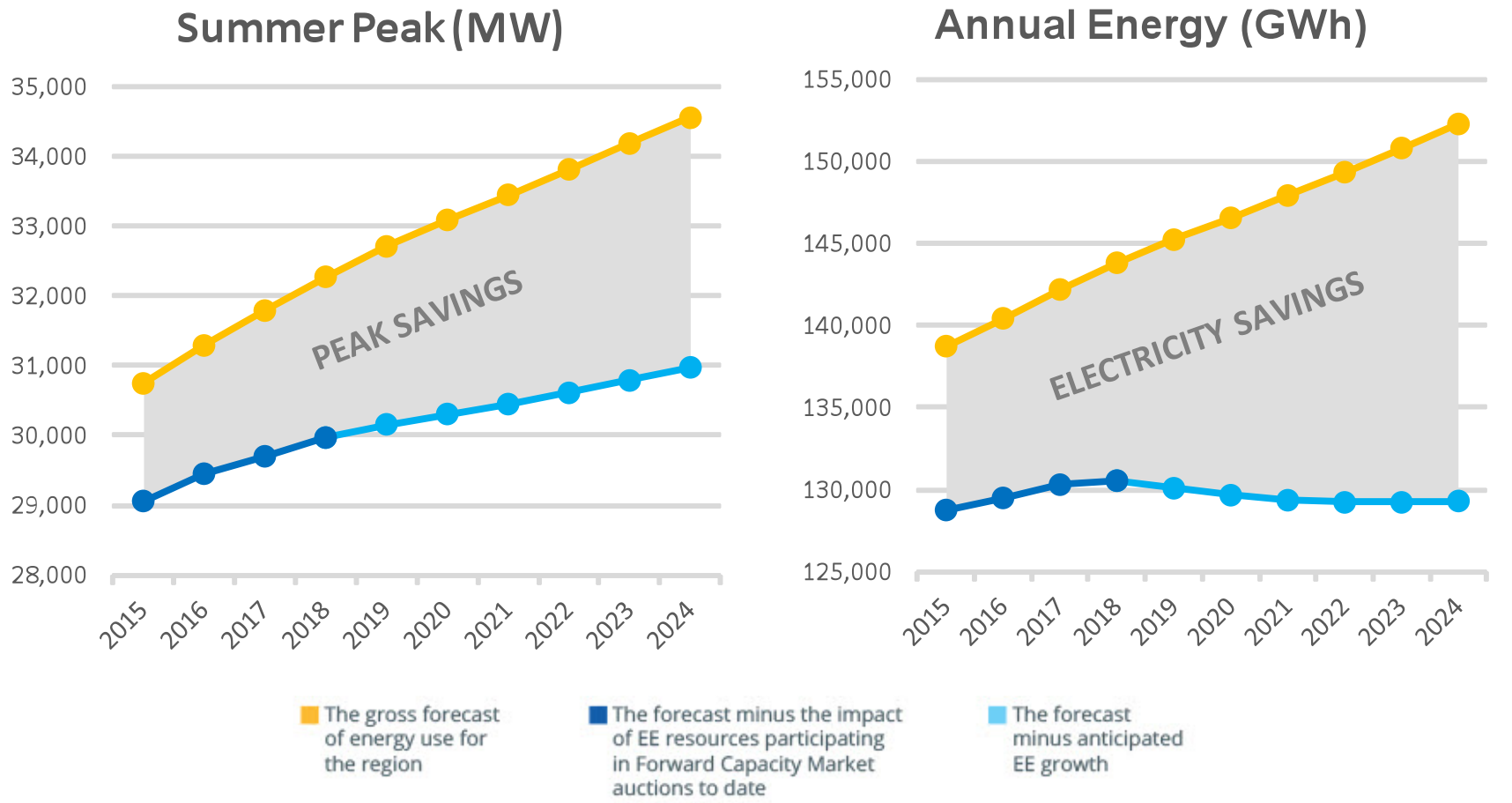
Ranking of state EE efforts by the *American Council for an Energy-Efficient Economy*:

- Massachusetts 1
- Vermont 3
- Rhode Island 3
- Connecticut 6
- Maine 16
- New Hampshire 22

- Billions spent over the past few years and more on the horizon
  - Approximately $3 billion invested from 2009 to 2013
  - ISO estimates $6.2 billion to be invested in EE from 2019 to 2024

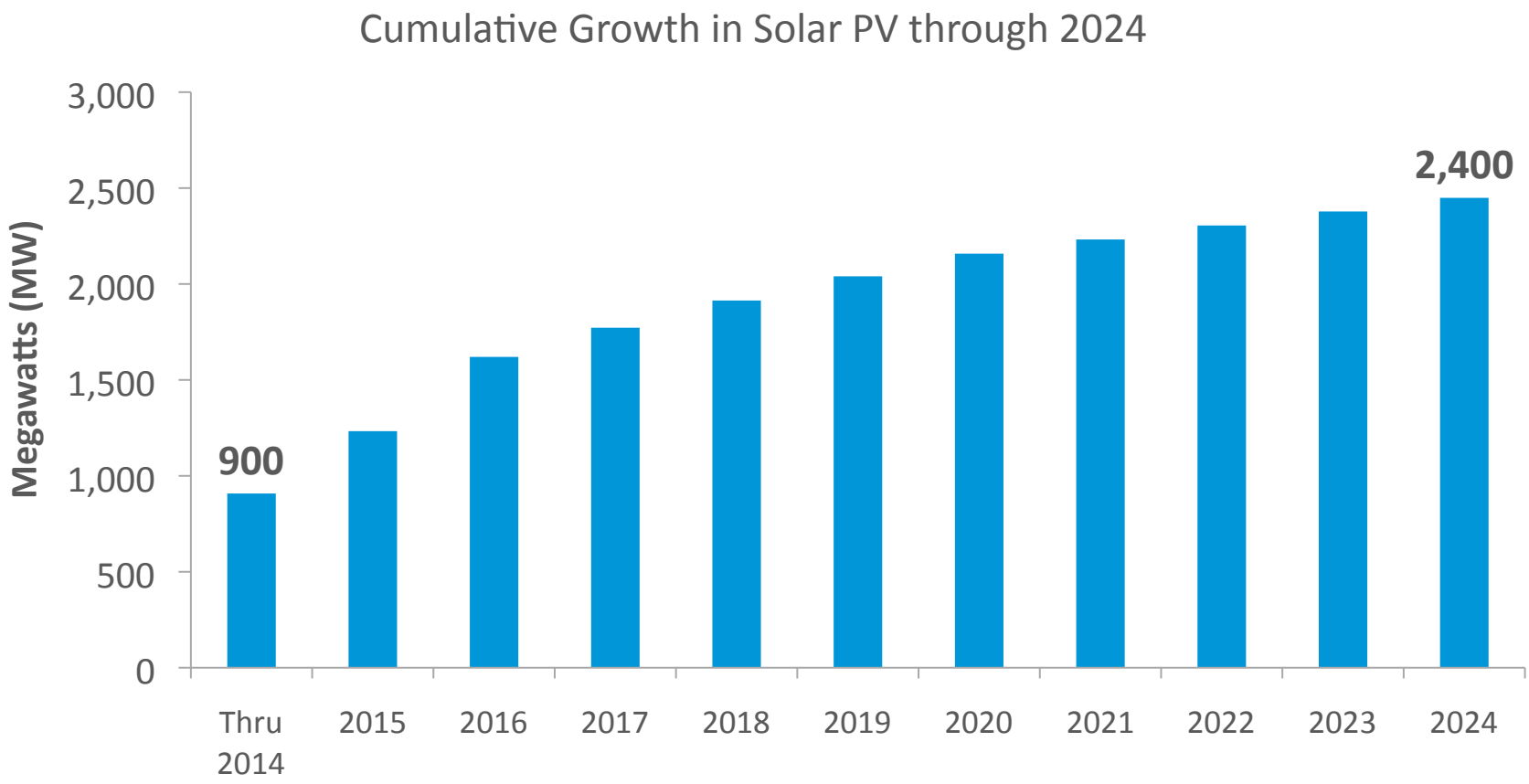
EE Affects New England's Electricity Consumption

Peak demand growth is lower; energy use is flat



Source: Final ISO New England EE Forecast for 2018-2023 (April 2015)

States are Driving Strong Growth in Solar PV



Source: Final PV Forecast (April 2015); Note: MW values are AC nameplate

Summary

- New England is seeing a tremendous change in the energy and capacity mix to serve the region's power supply needs
  - This change is driven largely by market forces and state policies
  - Energy efficiency and solar resources are having a profound change on overall system demand
- Natural gas and electric transmission infrastructure upgrades will be required to support reliable operation of the power system
- The ISO will develop any necessary operational strategies to maintain reliability based on the timing of infrastructure improvements and unit retirements

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