Resource Developments and Transformation of the New England Electric Grid

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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 Has Seen Dramatic Changes in the Energy Mix: *From Coal and Oil to Natural Gas*

Percent of Total **Electric Energy** Production by Fuel Type (2000 vs. 2016)

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

Renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels.
Investment in Gas-Fired Capacity Has Outpaced All Other Fuels—and More Is on the Way

- Primary fuel for 44% of installed capacity
- 49% of 2016 fuel mix
- Sets the real-time price of electricity 75% of the time
- Accounts for nearly 35% of proposed new generating capacity

Note: New generating capacity for years 2017–2019 includes resources clearing in recent Forward Capacity Auctions.
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)

- **Norwalk Harbor Station (342 MW)**
  - 3 units (oil)

- **Mount Tom Station (143 MW)**
  - 1 unit (coal)

- **Vermont Yankee Station (604 MW)**
  - 1 unit (nuclear)

- **Brayton Point Station (1,535 MW)**
  - 4 units (coal & oil)

- **Pilgrim Nuclear Power Station (677 MW)**
  - 1 unit (nuclear)

- **Bridgeport Harbor Station (564 MW)**
  - 2 units (coal & oil)

- *Additional retirements are looming*
The Forward Capacity Market Is Attracting New Resources Amid Retirements

**Demand Resources**
energy-efficiency and active demand response resources

**Natural Gas Resources**
efficient and fast-starting gas resources, many with dual-fuel capability

**Renewable Resources**
onshore and offshore wind, solar photovoltaics, and fuel cells
Energy-Efficiency and Renewable Resources Are Trending Up in New England

<table>
<thead>
<tr>
<th>Energy Efficiency (MW)</th>
<th>Solar (MW)</th>
<th>Wind (MW)</th>
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</thead>
<tbody>
<tr>
<td>EE thru 2016: 2,100</td>
<td>PV thru 2016: 1,900</td>
<td>Existing: 1,100</td>
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<tr>
<td>EE in 2026: 4,500</td>
<td>PV in 2026: 4,700</td>
<td>Proposed: 7,300</td>
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*Final 2017 CELT Report,* EE through 2016 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2026 includes an ISO-NE forecast of incremental EE beyond the FCM.

*Final 2017 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.”

Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; some wind proposals include battery storage.
Energy Efficiency Is a Priority for State Policymakers

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

- Massachusetts 1
- Rhode Island 3
- Vermont 4
- Connecticut 6
- Maine 13
- New Hampshire 21

- Billions spent over the past few years and more on the horizon
  - Nearly $4.5 billion invested from 2010 to 2015
  - ISO estimates $7.2 billion to be invested in EE from 2021 to 2026
Energy Efficiency and Behind-the-Meter Solar Impact
Peak Demand and Annual Energy Use

The gross peak and load forecast
minus forecasted “behind-the-meter” (BTM) solar PV resources

The gross peak and load forecast
minus forecasted BTM solar PV, minus energy-efficiency (EE) resources in the Forward Capacity Market 2017-2020 and forecasted EE 2021-2026

Note: Summer peak demand is based on the “90/10” forecast, which accounts for the possibility of extreme summer weather (temperatures of about 94°F).
Deep Load Reductions During Winter Daylight Hours Result in Steep Ramp Into the Evening Peak

Tuesday, January 7, 2014

PV does not reduce winter peak

High PV penetrations will increase the need for ramping capability throughout sunlight hours.
Solar PV Penetration Shifts Timing of Hourly Peaks Later in the Day During Summer

*PV contributes less to summer peak as larger penetrations shift the peak later in the day when daylight fades*
Solar in Spring/Fall Displaces Generation and Increases Need to Back Down Generation in Low-Load Hours

Potential minimum generation emergency events during midday hours (minimum load hours are shown in green)
New Energy Storage Is Emerging in the ISO Generator Interconnection Study Queue

- As of December 1, 2017, battery storage projects totaling more than 400 MW of capacity have requested interconnection to the regional power system.

- New England has benefited from grid-scale electrical energy storage capabilities for more than 40 years in the form of pumped storage.

Source: ISO Interconnection Queue (as of December 1, 2017)
Wind Power and Natural Gas Dominate New Resource Proposals in the ISO Queue

All Proposed Generation
Developers are proposing to build roughly 13,500 MW of generation, including nearly 4,600 MW of gas-fired generation and more than 7,300 MW of wind.

Wind Proposals
- ME 4,533 MW
- VT 30 MW
- NH 28 MW
- MA 10 MW
- Offshore wind MA 2,768 MW

Source: ISO Generator Interconnection Queue (December 1, 2017)
FERC Jurisdictional Proposals Only; Nameplate Capacity Ratings

Note: Some wind proposals include battery storage.
Developers Are Proposing Large-Scale Transmission Projects to Help Deliver Clean Energy to Load Centers

- Developers are proposing 23 elective transmission upgrades (ETUs) to help deliver 16,000+ MW of clean energy
  - Mostly Canadian hydro and onshore wind from northern New England
- Wind projects make up 55% of proposed new power resources, but most are remote
- Massachusetts has plans to contract for 1,600 MW of offshore wind

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

Source: [ISO Interconnection Queue](https://www.iso-ne.com) (as of December 1, 2017)
A “Hybrid Grid” Is Emerging

The region is changing how it generates, delivers, and uses electricity

- Large grid-connected power resources + thousands of small “behind-the-meter” resources
- Changes in how much grid energy people use and when they use it
- Significant amounts of variable generation and some battery storage
- Two-way grid communications
Making Every Season Bright

Happy Holidays from ISO new england
Questions