Regional Energy Overview and What’s Trending

Massachusetts Municipal Association’s Annual Meeting and Trade Show

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

Reliability requires a flexible, high-performance fleet:

• Reliance on Natural Gas
  – “Just-in-time” fuel delivery presents an immediate risk to reliability

• Power Plant Retirements
  – New England will need new ways to meet peak demand as aging plants close

• Renewable Resource Integration
  – Balancing variable generation with reliability will require changes in system operations
Region Has Not Developed Gas Pipeline Infrastructure to Keep Pace with Growth of Gas-fired Generation

Cumulative New Generating Capacity in New England (MW)

- Natural Gas
- Fuel Cell
- Hydro
- Solar
- Biomass
- Nuclear
- Wind
- Oil

Note: New generating capacity for years 2016 – 2018 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. 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.
Natural Gas and Nuclear Resources Represented Vast Majority of 2014 Generation

![Generation Graph]

- Natural Gas
- Nuclear
- Other Renewables
- Wind
- Solar
- Hydro
- Coal
- Oil/Gas
- Oil

Month:
- JAN
- FEB
- MAR
- APR
- MAY
- JUN
- JUL
- AUG
- SEP
- OCT
- NOV
- DEC

Generation (MWh)
New England Shifted to Coal and Oil Last Winter

Daily Energy for December 2014 - February 2015 (MWh)

Oil
Coal
Natural Gas / LNG

Daily Energy MWh

December 2014
January 2015
February 2015

0
50,000
100,000
150,000
200,000
250,000

0
50,000
100,000
150,000
200,000
250,000
300,000
300,000

New England Shifted to Coal and Oil Last Winter
Natural Gas and Wholesale Electricity Prices Are Linked

Because of New England’s heavy reliance on natural gas as a fuel source, natural gas typically sets the price for wholesale electricity.
Power Plant Emissions Have Declined with Changes in the Fuel Mix

Reduction in Aggregate Emissions (ktons/yr)

<table>
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<th>Year</th>
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<th>SO\textsubscript{2}</th>
<th>CO\textsubscript{2}</th>
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<td>59.73</td>
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<td>2014</td>
<td>20.49</td>
<td>11.68</td>
<td>39,317</td>
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<tr>
<td>% Reduction, 2001–2014</td>
<td>↓ 66%</td>
<td>↓ 94%</td>
<td>↓ 26%</td>
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Reduction in Average Emission Rates (lb/MWh)

<table>
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<tr>
<th>Year</th>
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<th>SO\textsubscript{2}</th>
<th>CO\textsubscript{2}</th>
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<tr>
<td>1999</td>
<td>1.36</td>
<td>4.52</td>
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<td>2014</td>
<td>0.38</td>
<td>0.22</td>
<td>726</td>
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<tr>
<td>% Reduction, 1999–2014</td>
<td>↓ 72%</td>
<td>↓ 95%</td>
<td>↓ 28%</td>
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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
Infrastructure Will Be Needed to Deliver Energy from Proposed Resources

All Proposed Generation

Developers are proposing to build 13,000 MW of generation, including nearly 8,200 MW of gas-fired generation and more than 4,200 MW of wind.

- Natural gas: 63%
- Wind: 33%
- Other: 4%

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

Wind Proposals

- ME: 3,641 MW
- VT: 47 MW
- NH: 91 MW
- MA: 464 MW

Wind proposals will require infrastructure to deliver energy from proposed resources.
New England Has Significant Wind Potential

• Population and electric demand are concentrated along the coast in central and southern New England

• 12,000 MW of onshore and offshore wind potential
  – Preliminary screening eliminated wind sites near urban areas and sensitive geographic locations (e.g., Appalachian Trail)

• Transmission will be required to connect potential wind resources to load centers in New England
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
• 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
Energy Efficiency Is a Priority for State Policymakers

2015 State Energy-Efficiency Scorecard

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

- Massachusetts 1
- Vermont 3
- Rhode Island 4
- Connecticut 6
- Maine 14
- New Hampshire 20

- 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
Energy Efficiency Is Slowing Peak Demand Growth and Flattening Energy Use

The gross forecast of peak demand and energy use

The forecast minus the impact of EE participating in the Forward Capacity Market to date

The forecast minus anticipated EE growth

Renewable and EE Resources Are Trending Up

### Wind (MW)
- Existing: 800
- Proposed: 4,200

### Solar (MW)
- PV thru 2014: 900
- PV in 2024: 2,400

### Energy Efficiency (MW)
- EE thru 2014: 1,500
- EE in 2024: 3,600

**Notes:**
- Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW).
- 2015 ISO-NE Solar PV Forecast, nameplate capacity, based on state policies.
- 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.