Regional Update

Maine Forest Products Council

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Senior External Affairs Representative
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
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
- Developing and administering the region’s competitive wholesale electricity markets
- Managing comprehensive regional power system planning
Ensuring Reliable Power System Operations Is a Major Responsibility

- Maintain minute-to-minute reliable operation of region’s generation and transmission system
- Coordinate and schedule maintenance outages
- Coordinate operations with neighboring power systems
- Perform centralized dispatch of the lowest-priced resources
Uniform Clearing Price Auction

“Bid Stack” allows ISO to compare resource offers and establish a single price for resources dispatched and used to meet demand on the system.

Each resource submits an offer that specifies its incremental cost of producing energy and represents the price at which it is willing to run. These offers are stacked from highest to lowest.

The energy clearing price for the region is set at the point where the offers from supply intersect with the demand levels to serve the next expected megawatt of electricity use.

As Demand Increases the ISO Dispatches More Expensive Resources

- **Baseload**: Dispatch lower cost units
- **Intermediate**: Add more expensive generation as demand grows
- **Peaking**: Dispatch most expensive as needed

As demand increases, the ISO dispatches more expensive resources as needed.
Region Has Not Developed Gas Pipeline Infrastructure to Keep Pace with Growth of Gas-fired Generation

Cumulative New Generating Capacity in New England (MW)
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 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>
<thead>
<tr>
<th>Year</th>
<th>$\text{NO}_x$</th>
<th>$\text{SO}_2$</th>
<th>$\text{CO}_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>59.73</td>
<td>200.01</td>
<td>52,991</td>
</tr>
<tr>
<td>2013</td>
<td>20.32</td>
<td>18.04</td>
<td>40,901</td>
</tr>
<tr>
<td>% Reduction, 2001–2013</td>
<td>↓ 66%</td>
<td>↓ 91%</td>
<td>↓ 23%</td>
</tr>
</tbody>
</table>

Reduction in Average Emission Rates (lb/MWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>$\text{NO}_x$</th>
<th>$\text{SO}_2$</th>
<th>$\text{CO}_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1.36</td>
<td>4.52</td>
<td>1,009</td>
</tr>
<tr>
<td>2013</td>
<td>0.36</td>
<td>0.32</td>
<td>730</td>
</tr>
<tr>
<td>% Reduction, 1999–2013</td>
<td>↓ 74%</td>
<td>↓ 93%</td>
<td>↓ 28%</td>
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</table>

State Policy Requirements Drive Proposals for Renewable Energy

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

* State Renewable Portfolio Standards (RPS) promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Vermont’s new Renewable Energy Standard has a ‘total renewable energy’ requirement (reflected above), which recognizes large-scale hydro and all other classes of renewable energy.
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.

- Natural gas 66%
- Wind 33%
- Other 1%

Wind Propositions

<table>
<thead>
<tr>
<th>State</th>
<th>MW</th>
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</thead>
<tbody>
<tr>
<td>ME</td>
<td>3,307</td>
</tr>
<tr>
<td>VT</td>
<td>152</td>
</tr>
<tr>
<td>NH</td>
<td>91</td>
</tr>
<tr>
<td>MA</td>
<td>472</td>
</tr>
</tbody>
</table>

Source: ISO Generator Interconnection Queue (June 2015)
FERC Jurisdictional Proposals Only
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
Energy Efficiency Is a Priority for State Policymakers

2014 State Energy-Efficiency Scorecard

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

Source: American Council for an Energy-Efficient Economy
Energy Efficiency Is Slowing Peak Demand Growth and Flattening Energy Use

ISO New England Forecasts Strong Growth in Solar PV

Cumulative Growth in Solar PV through 2024 (MW)

Source: Final PV Forecast (April 2015); Note: MW values are AC nameplate
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
Transmission Projects to Maintain Reliability Have Progressed throughout New England

Major 345 kV Projects

- Southwest Connecticut Reliability Project, Phases 1 & 2
- Boston 345 kV Transmission Reliability Project, Phases 1 & 2
- Northwest Vermont Reliability Project, and Vermont Southern Loop Project
- New England East-West Solution
  - Greater Springfield Reliability Project
  - Rhode Island Reliability Project
  - Interstate Reliability Project
- Southeast Massachusetts
  - Short-term Lower SEMA Upgrades
  - Long-term Lower SEMA Project
- Maine Power Reliability Program
- Greater Boston Project

Source: RSP Transmission Project List, June 2015; RSP Transmission Project List also includes 115kV projects
Region Has Made Major Investments in Transmission Infrastructure to Ensure a Reliable Electric Grid

Annual Investment in Transmission to Maintain Reliability
(in billions)

Cumulative Investment through June 2015: $7.2 billion
Estimated Future Investment through 2019: $4.8 billion

Estimated future investment includes projects under construction, planned and proposed
How Are Transmission Costs Allocated?

- The New England electric grid is a tightly interconnected system; each state shares in the benefits of **reliability** upgrades
- The amount of electricity demand in an area determines its share of the cost of new or upgraded transmission facilities needed for reliability

Source: 2014 Network Load by State
Elective Transmission Proposals Are Vying to Move Renewable Energy to New England Load Centers

• As of **June 1, 2015**, ten elective transmission projects had been proposed, representing more than **7,300 MW** of potential imports
  – Primarily large-scale **wind** resources from northern New England and **hydropower** from eastern Canada

• These projects are not needed for reliability, but they must be studied by the ISO to ensure they can interconnect reliably

Source: ISO Interconnection Queue (June 2015)
http://www.iso-ne.com/system-planning/transmission-planning/interconnection-request-queue
Renewable and EE Resources are Trending Up

<table>
<thead>
<tr>
<th>Renewable Resource</th>
<th>Existing</th>
<th>Proposed</th>
<th>PV thru 2013</th>
<th>PV in 2023</th>
<th>EE thru 2013</th>
<th>EE in 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (MW)</td>
<td>800</td>
<td>4,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar (MW)</td>
<td></td>
<td></td>
<td>500</td>
<td>1,800</td>
<td></td>
<td></td>
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<tr>
<td>Energy Efficiency (MW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,300</td>
<td>3,300</td>
</tr>
</tbody>
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**Wind**

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

**Solar**

2014 Final Interim ISO-NE Solar PV Forecast, nameplate capacity, based on state policies.

**Energy Efficiency**

2014 CELT Report, EE through 2013 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2023 includes an ISO-NE forecast of incremental EE beyond the FCM.