From Restructuring to Decarbonization: Operational and Market-Design Challenges in New England

USAAE/IAEE North American Conference
“Evolving Energy Realities”

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**New England Has Embarked on a Journey**

*From restructuring the wholesale power industry to decarbonizing the economy*

- In the late 1990s, New England restructured its wholesale power industry with three key principles in mind
  - **Competition** between buyers and sellers yields prices that reflect a resource’s true operating costs
  - **Efficiency and transparency** spur innovation and investment in new technologies
  - **Investment risk** shifts from consumers to private investors

- Today, and for decades to come, New England will be focused on decarbonizing the economy
  - **Reducing carbon emissions** from the electricity sector and, in time, the transportation and buildings sectors
  - **Greening the grid** with more renewable energy sources to meet decarbonization goals
Competition Fosters Lower Market Prices Over Time

*New England’s total wholesale electricity market price has declined over the past decade, but faces continued volatility due to natural gas price spikes in winter*

Notes: Total wholesale market price includes all capacity, energy, and ancillary service market charges in the ISO-administered markets, including RTO costs, expressed per kilowatt-hour (kWh) of real-time load. Sources: U.S. Bureau of Labor Statistics (inflation data) and ISO-NE (market data).
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. 2017)


Renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels.

This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.
Frigid Cold Drove Up Regional Demand for Natural Gas

This led to spikes in natural gas prices, which then led to spikes in wholesale electricity prices; with natural gas at a premium, oil generation became economic.

Cold Weather Period Prices for Natural Gas and Wholesale Electricity

- Marcellus Shale Gas at Source
- Massachusetts Natural Gas Index
- Real-Time Wholesale Electricity

Underlying natural gas data furnished by: ICE Global markets in clear view
Since 2013, More Than 4,600 MW of Generation Have Retired or Announced Plans for Retirement in the Coming Years

- More than 5,000 MW of remaining coal and oil are at risk of retirement
- These resources have played an important role in recent winters when natural gas supply is constrained in New England
Winter Fuel-Security Observations

- New England is trending toward a **riskier fuel-security profile**
- The **operational risk** manifests itself as a **lack of firm energy** during cold weather
- The region is likely to remain exposed to winter energy constraints for the foreseeable future – and the region will become more dependent on large volumes of LNG
- Coordinating the timing of exit and entry of resources will be very challenging – state-sponsored renewable resources will reduce energy market revenues over time, causing increases in capacity market revenues and gradual retirement of existing resources
- Premature loss of existing non-pipeline-gas units will greatly exacerbate operational risks – Exelon’s plans to retire Mystic units in 2022 accelerates discussions on fuel security
A Hybrid Grid Is Emerging in New England

There are two dimensions to this transition, happening simultaneously

1. A shift from conventional generation to renewable energy

2. A shift from centrally dispatched generation to distributed energy resources
The Road to Decarbonization Presents Operational and Market-Design Challenges

• Maintaining reliable power system operations becomes more complex with the shift to greater intermittent and distributed energy resources

• The decarbonization agenda, market economics, and structural gap between the business model for wholesale generators and the investment model for regional fuel infrastructure has led to concerns about energy shortfalls during cold weather periods that add an additional layer of complexity
The Road to Decarbonization Presents Operational and Market-Design Challenges, continued

- These forces are imposing significant stress on the **wholesale market construct**, in particular, the Forward Capacity Market, which is a vital revenue stream for resources.

- Capacity market revenues **complement** energy market revenues, which face significant future reductions with increasing penetrations of renewable resources capable of producing zero (or even negative) marginal cost energy.

- Improvements to the energy, capacity, and ancillary services markets will be required in the next several years to ensure that necessary **reliability services** are appropriately compensated.
As the Generation Fleet Turns Over, the New England States Seek to Influence the Future Resource Mix

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

- **VT**: 2018 – 55%
  2020 – 59%
  2025 – 63%
  2030 – 71%
  2035 – 75%
  2040 – 75%

- **RI**:
- **MA**:
- **CT**:
- **NH**: percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006).
- **RI**: requirement for ‘new’ renewable energy plateaus at 36.5% in 2035. Vermont’s ‘total renewable energy’ requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.

Notes: State RPS requirements 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. Connecticut’s Class I RPS requirement plateaus at 40% in 2030. Maine’s Class I RPS requirement plateaus at 10% in 2017 and expires in 2022 (but has been held constant in this chart for illustrative purposes). Massachusetts’ Class I RPS requirement increases by 2% each year between 2020 and 2030, reverting back to 1% each year thereafter, with no stated expiration date. New Hampshire’s percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006). New Hampshire’s Class I and Class II RPS requirements plateau at 15.7% in 2025. Rhode Island’s requirement for ‘new’ renewable energy plateaus at 36.5% in 2035. Vermont’s ‘total renewable energy’ requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.
The New England states are promoting GHG reductions on a state-by-state basis, and at the regional level, through a combination of legislative mandates (e.g., CT, MA, RI) and aspirational, non-binding goals (e.g., ME, NH, VT and the New England Governors and Eastern Canadian Premiers).

* MA, RI, NH, and VT use a 1990 baseline year for emissions reductions. CT and the NEG-ECP use a 2001 baseline. ME specifies reductions below 2003 levels that may be required “in the long term.” For more information, see the following ISO Newswire article: [http://isonewswire.com/updates/2017/3/1/the-new-england-states-have-an-ongoing-framework-for-reducin.html](http://isonewswire.com/updates/2017/3/1/the-new-england-states-have-an-ongoing-framework-for-reducin.html).

December 2017 Solar PV Installed Capacity (MW\textsubscript{ac})

<table>
<thead>
<tr>
<th>State</th>
<th>Installed Capacity (MW\textsubscript{ac})</th>
<th>No. of Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>365.6</td>
<td>29,512</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1,602.3</td>
<td>78,047</td>
</tr>
<tr>
<td>Maine</td>
<td>33.5</td>
<td>3,598</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>69.7</td>
<td>7,330</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>62.2</td>
<td>4,148</td>
</tr>
<tr>
<td>Vermont</td>
<td>257.2</td>
<td>9,773</td>
</tr>
<tr>
<td>New England</td>
<td>2,390.5</td>
<td>132,408</td>
</tr>
</tbody>
</table>

Cumulative Growth in Solar PV through 2027 (MW\textsubscript{ac})

- Jan. 2010: 40 MW
- Thru 2017: 2,391 MW
- 2027: 5,833 MW

Note: The bar chart reflects the ISO’s projections for nameplate capacity from PV resources participating in the region’s wholesale electricity markets, as well as those connected “behind the meter.” Source: Final 2018 PV Forecast (March 2018); MW values are AC nameplate.
Behind-the-Meter (BTM) Solar Is Having a Significant Impact on Electricity Demand in New England

At 1:30 p.m. on April 21, 2018, BTM solar reduced grid demand by more than 2,300 MW
Growing Provision of Long-Term, Above-Market Contracts to Clean Energy Resources

- The states are seeking to develop (or retain) more than 5,000 MW of clean energy resources through large-scale procurement efforts to meet public policy goals.

<table>
<thead>
<tr>
<th>State(s)</th>
<th>State Procurement Initiatives for Large-Scale Clean Energy Resources</th>
<th>Resources Eligible/Procured</th>
<th>Target MW (nameplate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA, CT, RI</td>
<td>2015 Multi-State Clean Energy RFP</td>
<td>Solar, Wind</td>
<td>390 MW</td>
</tr>
<tr>
<td>MA</td>
<td>2017 Section 83D Clean Energy RFP</td>
<td>Hydro Import</td>
<td>Approx. 1,200 MW (9,554,000 MWh)</td>
</tr>
<tr>
<td>MA, RI</td>
<td>2017 Section 83C Offshore Wind RFP</td>
<td>Offshore Wind</td>
<td>1,600 MW (MA) 400 MW (RI)</td>
</tr>
<tr>
<td>CT</td>
<td>2018 Renewable Energy RFP</td>
<td>Offshore Wind, Fuel Cells, Anaerobic Digestion</td>
<td>254 MW</td>
</tr>
<tr>
<td>CT</td>
<td>2018 Zero-Carbon Resources RFP</td>
<td>Nuclear, Hydro, Class I Renewables, Energy Storage</td>
<td>Approx. 1,400 MW (12,000,000 MWh)</td>
</tr>
<tr>
<td>RI</td>
<td>2018 Renewable Energy RFP</td>
<td>Solar, Wind, Biomass, Small Hydro, Fuel Cells and Other Eligible Resources</td>
<td>400 MW</td>
</tr>
</tbody>
</table>

Note: Nameplate megawatts (MW) may be higher than qualified Forward Capacity Market (FCM) capacity MW.
Wind Power and Other Forms of Clean Energy Dominate New Resource Proposals in the Queue

Proposals by Type

- **Battery Storage**: 845 MW, 6%
- **Hydro**: 74 MW, 1%
- **Biomass**: 37 MW, <1%
- **Fuel Cell**: 15 MW, <1%
- **Solar**: 1,533 MW, 11%
- **Natural Gas**: 3,092 MW, 23%
- **TOTAL**: 13,544 MW

Wind Proposals

- **ME**: 3,789 MW
- **VT**: 30 MW
- **NH**: 28 MW
- **MA**: 17 MW
- **RI**: 21 MW
- **Offshore Wind MA**: 4,063 MW

Note: Some natural gas proposals include dual-fuel units (oil); some wind and solar proposals include battery storage; megawatts represent nameplate capacity ratings.

Source: ISO Generator Interconnection Queue (August 2018)
State Support for Clean Energy Resources Is Raising Long-Term Questions About Capacity Markets

• Given the current realities (and future trajectory), are we eventually forced to address the **structural asymmetry** in marketplace mechanisms and commitments?
  – Competitive load-serving entities typically buy power only one-to-two years in advance
  – ISO New England’s capacity market offers three-year forward commitments to resources on a year-to-year basis
  – The states are utilizing RFPs to contract for much longer periods of time (e.g., 20-year contracts)

• What are the market implications when a large percentage of resources are locked into long-term contracts?
  – How do we **adapt** the market design to these new realities?
  – Will it be possible to appropriately **price** carbon (e.g., New York)?
  – What is the likelihood that state policymakers focus on decarbonization but allow the **market** to dictate where investments occur?
Questions