ISO New England Overview

Resources Recovery Task Force Meeting

Eric Johnson
Director, External Affairs
ISO NEW ENGLAND OVERVIEW

Eric Johnson, Director, External Affairs
About ISO New England

• **Not-for-profit corporation created in 1997 to oversee New England’s restructured electric power system**
  – Regulated by the Federal Energy Regulatory Commission (FERC)

• **Regional Transmission Organization**
  – Independent of companies doing business in the market
  – No financial interest in companies participating in the market
  – Neutral as to resource fuel type

• **Major Responsibilities**
  – Operating the Regional Power System
  – Administering Wholesale Electricity Markets
  – Regional Power System Planning
New England’s Electric Power Grid at a Glance

- 6.5 million households and businesses; population 14 million
- 350+ generators
- 8,000+ miles of high-voltage transmission lines (115 kV and above)
- 13 interconnections to electricity systems in New York and Canada
- 31,750+ megawatts (MW) of generating capacity and approximately 1,850 MW of demand resources
- 28,130 MW all-time peak demand, set on August 2, 2006
- 500+ buyers and sellers in the region’s wholesale electricity markets
- $5 billion in transmission investment since 2002; approximately $6 billion planned over next 5 years
- $5 billion total energy market value in 2012
Industry Structure in New England

Federal Energy Regulatory Commission

North American Electric Reliability Corporation

Northeast Power Coordinating Council

ISO New England

New England Electricity Market Participants (NEPOOL)

New England States

*NESCOE: New England States Committee on Electricity
*NECPUC: New England Conference of Public Utilities Commissioners

Independent Board of Directors

Operating the Power System

Administering Wholesale Electricity Markets

Power System Planning

Markets, Reliability, and Transmission Committees

Six Sectors: Generators, Transmission Owners, Suppliers, Publicly Owned Entities, End Users, Alternative Resources

New England Electricity Market Participants Committee and Technical Committees

Governors (NESCOE)*

Consumer Advocates, Attorneys General, Consumer Liaison Group

Policymakers

Public Utility Commissions (NECPUC)*

Environmental Regulators

Energy Boards and Commissions

Comprehensive Regional Planning Process through Planning Advisory Committee
We are Part of the Eastern Interconnection
Ties to Neighboring Regions

*New England is not an energy island*

- Transmission system is tied to neighboring power systems in the U.S. and Eastern Canada:
  - New York (9 ties)
  - Hydro Québec (2 ties)
  - New Brunswick (2 ties)
ISO New England’s Responsibilities

Operating the Regional Power System
- Balance electricity supply and demand every minute of the day by centrally dispatching the generation and flow of electricity across the region’s transmission lines.

Administering Wholesale Electricity Markets
- Develop and administer the region’s marketplace through which wholesale electricity is bought and sold.

Regional Power System Planning
- Ensure the development of a reliable and efficient power system to meet current and future electricity needs.
Operate the Regional Power System

- Maintain minute-to-minute reliable operation of region’s power grid
- Perform centralized dispatch of the lowest-priced resources
- Coordinate and schedule maintenance outages
- Coordinate operations with neighboring power systems
Administer Wholesale Electricity Markets

- Energy Market
- Forward Capacity Market (FCM)
- Ancillary Services
New England’s Wholesale Electricity Markets

Wholesale market costs have ranged from approx. $6 B to $14 B over last five years

Major Components

Energy Market
Daily market for wholesale customers to buy and sell electric “energy”

Capacity Market
Three-year forward market that commits “capacity” resources to meet system resource-adequacy needs

Regional Power System Planning

- Administer requests for interconnection of generation, and regional transmission system access
- Conduct transmission system needs assessments
- Plan regional transmission system to provide regional network service
- Develop annual Regional System Plan (RSP)
  - RSP13 looks at system needs 10 years ahead (2013-2022)
Regional *Capacity* Shifts Toward Natural Gas

*Percent of Total System Capacity*

- **2000**
  - Oil: 34%
  - Coal: 12%
  - Natural gas: 18%
  - Nuclear: 18%
  - Hydro and other renewables: 11%
  - Pumped storage: 7%

- **2012**
  - Oil: 22%
  - Coal: 8%
  - Natural gas: 43%
  - Nuclear: 15%
  - Hydro and other renewables: 8%
  - Pumped storage: 5%

*Other renewables* include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and misc. fuels.

Source: Regional Profile (2012/13)
Regional Energy Shifts Toward Natural Gas

Percent of Total Electric Energy Production

### 2000

- **Oil**: 22%
- **Coal**: 18%
- **Natural gas**: 15%
- **Nuclear**: 31%
- **Hydro and other renewables**: 13%
- **Pumped storage**: 2%

### 2012

- **Oil**: <1%
- **Coal**: 3%
- **Natural gas**: 52%
- **Nuclear**: 31%
- **Hydro and other renewables**: 13%
- **Pumped storage**: 1%

*Other renewables* include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and misc. fuels.

Source: Regional Profile (2012/13)
Wholesale Markets Select Lowest-Priced Resource

Natural gas-fired power plants are 50% of the supply mix in New England, often set the price in the wholesale electricity market, and displace more expensive resources (such as oil).
Power Plant Emissions have Declined with Changes in the Fuel Mix

Reduction in Aggregate Emissions (ktons/yr)

<table>
<thead>
<tr>
<th>Year</th>
<th>NO\textsubscript{x}</th>
<th>SO\textsubscript{2}</th>
<th>CO\textsubscript{2}</th>
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<td>59.73</td>
<td>200.01</td>
<td>52,991</td>
</tr>
<tr>
<td>2011</td>
<td>25.30</td>
<td>57.01</td>
<td>46,959</td>
</tr>
<tr>
<td>% Reduction, 2001–2011</td>
<td>↓ 58%</td>
<td>↓ 71%</td>
<td>↓ 11%</td>
</tr>
</tbody>
</table>

Reduction in Average Emission Rates (lb/MWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>NO\textsubscript{x}</th>
<th>SO\textsubscript{2}</th>
<th>CO\textsubscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>1.05</td>
<td>3.51</td>
<td>930</td>
</tr>
<tr>
<td>2011</td>
<td>0.42</td>
<td>0.95</td>
<td>780</td>
</tr>
<tr>
<td>% Reduction, 2001–2011</td>
<td>↓60%</td>
<td>↓73%</td>
<td>↓16%</td>
</tr>
</tbody>
</table>

Natural Gas has Become the Dominant Fuel for Power Generation in New England

**Existing Generation**

*Natural gas has largely displaced oil- and coal-fired generation*

- **Natural gas**: 52%
- **Nuclear**: 31%
- **Renewable Energy**: 13%
- **Pumped storage**: 1%
- **Coal**: 3%
- **Oil**: <1%
- **Coal**: 3%
- **Oil**: <1%
- **Nuclear**: 31%
- **Renewable Energy**: 13%

**Proposed Capacity**

*Natural gas is the fuel of choice for new capacity and gas-fired generators will be needed to balance variable energy resources*

- **Natural gas**: 56%
- **Wind**: 38%
- **Other**: 6%
- **Natural gas**: 56%
- **Wind**: 38%
- **Other**: 6%

Energy by Fuel Type, 2012

ISO Generator Interconnection Queue (April 2013)
Generator Proposals in the ISO Queue

Approximately 5,000 MW

By Type

- Natural gas: 56%
- Wind: 38%
- Hydro: 0%
- Biomass: 4%
- Oil: 0%
- Landfill gas: 1%
- Pumped-storage hydro: 1%
- Solar: 0%

By State

- MA, 2,083, 40%
- CT, 1,445, 28%
- ME, 1,171, 23%
- NH, 275, 5%
- VT, 173, 3%
- RI, 28, 1%

Source: ISO Generator Interconnection Queue (April 2013)
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
Wind Proposed for the Region

- About 2,400 MW proposed (includes non-FERC jurisdictional)
- Majority of wind development proposals in Maine and northern New England
- Large-scale offshore project proposed in Massachusetts

Source: ISO Generator Interconnection Queue (April 2013)
Energy-Efficiency is a Priority for New England

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

- Massachusetts 1
- Vermont 5
- Connecticut 6
- Rhode Island 7
- New Hampshire 18
- Maine 25

- Billions spent over the past few years; more on the horizon
  - Approximately $1 billion invested from 2008 to 2010
  - ISO estimates $5.7 billion to be invested in EE from 2015 to 2021

Source: American Council for an Energy-Efficient Economy
Energy-Efficiency Forecast

New England: Summer 90/10 Peak (MW)

- 1.4% growth rate
- 0.9% growth rate

Source: ISO-NE EE Forecast for 2016-2022, February 2013
Demand Resources Growing in New England

Enrollment in ISO programs prior to start of FCM

FCM* ➔

*2010/11–2016/17: Total DR cleared in FCAs 1–7 (New and Existing); Real-Time Emergency Generation capped at 600 MW.
GENERATOR RETIREMENT
Generator Retirement Study

• Objective
  – Evaluate reliability impact associated with the assumed retirement of 28 coal- and oil-fired resources with 8,300 MW of capacity by 2020

• Primary Concerns
  – Resource Adequacy
  – Load-Resource Energy Balance
  – Area Transmission Security

• Another Issue
  – Consequence of constraints impacting deliverability of existing capacity resources to load
Generator Non-Price Retirement Requests

More than 3,300 MW of generation plan to retire within the next five years

Major Generator Retirement Requests

- **Salem Harbor Station (749 MW)**
  - Unit 1: 82 MW (coal)
  - Unit 2: 80 MW (coal)
  - Unit 3: 150 MW (coal)
  - Unit 4: 437 MW (oil)

- **Vermont Yankee Nuclear Station (604 MW)**
  - Unit 1: 604 MW (nuclear)

- **Norwalk Harbor Station (342 MW)**
  - Unit 1: 162 MW (oil)
  - Unit 2: 168 MW (oil)
  - Unit 10: 12 MW (oil)

- **Brayton Point Station (1,535 MW)**
  - Unit 1: 239 MW (coal)
  - Unit 2: 239 MW (coal)
  - Unit 3: 612 MW (coal)
  - Unit 4: 435 MW (oil)
  - Brayton Diesels 1-4: 10 MW

**Total MW Retiring in New England***

<table>
<thead>
<tr>
<th>State</th>
<th>MW</th>
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</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>348 MW</td>
</tr>
<tr>
<td>Maine</td>
<td>37 MW</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2,334 MW</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>1 MW</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>13 MW</td>
</tr>
<tr>
<td>Vermont</td>
<td>604 MW</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,337 MW</strong></td>
</tr>
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</table>

*Megawatts based on relevant FCA summer qualified capacity

Account for 97% of total MW retiring in New England

Source: Status of Non-Price Retirement Requests; October 7, 2013
Major Non-Gas-Fired Generators Retiring

Account for 97% of total MW retiring within the next five years

Vermont Yankee Nuclear Station
Unit 1: 604 MW
Total: 604 MW

Norwalk Harbor Station
Unit 1: 162 MW (oil)
Unit 2: 168 MW (oil)
Unit 10: 12 MW (oil)
Total: 342 MW

Brayton Point Station
Unit 1: 239 MW (coal)
Unit 2: 239 MW (coal)
Unit 3: 612 MW (coal)
Unit 4: 435 MW (oil)
Brayton Diesels 1-4: 10 MW
Total: 1,535 MW

Salem Harbor Station
Unit 1: 82 MW (coal)
Unit 2: 80 MW (coal)
Unit 3: 150 MW (coal)
Unit 4: 437 MW (oil)
Total: 749 MW

*Megawatts based on relevant FCA summer qualified capacity

Source: Status of Non-Price Retirement Requests; October 7, 2013
## Resources Assumed to be “At Risk” of Retirement

<table>
<thead>
<tr>
<th>Unit</th>
<th>Unit Type</th>
<th>MW Maximum Assumed</th>
<th>In-service Date</th>
<th>Age in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAYTON POINT 1</td>
<td>Coal</td>
<td>261</td>
<td>01-Aug-63</td>
<td>57</td>
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<tr>
<td>BRAYTON POINT 2</td>
<td>Coal</td>
<td>258</td>
<td>01-Jul-64</td>
<td>56</td>
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<tr>
<td>BRAYTON POINT 3</td>
<td>Coal</td>
<td>643</td>
<td>01-Jul-69</td>
<td>51</td>
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<tr>
<td>BRAYTON POINT 4</td>
<td>Oil</td>
<td>458</td>
<td>01-Dec-74</td>
<td>46</td>
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<tr>
<td>BRIDGEPORT HBR 2</td>
<td>Oil</td>
<td>190</td>
<td>01-Aug-61</td>
<td>59</td>
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<tr>
<td>BRIDGEPORT HBR 3</td>
<td>Coal</td>
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<td>52</td>
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<tr>
<td>CANAL 1</td>
<td>Oil</td>
<td>597</td>
<td>01-Jul-68</td>
<td>52</td>
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<tr>
<td>CANAL 2</td>
<td>Oil</td>
<td>599</td>
<td>01-Feb-76</td>
<td>44</td>
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<tr>
<td>MERRIMACK 1</td>
<td>Coal</td>
<td>121</td>
<td>01-Dec-60</td>
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<tr>
<td>MERRIMACK 2</td>
<td>Coal</td>
<td>343</td>
<td>30-Apr-68</td>
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<tr>
<td>MIDDLETOWN 2</td>
<td>Oil</td>
<td>123</td>
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<td>62</td>
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<tr>
<td>MIDDLETOWN 3</td>
<td>Oil</td>
<td>248</td>
<td>01-Jan-64</td>
<td>56</td>
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<tr>
<td>MIDDLETOWN 4</td>
<td>Oil</td>
<td>415</td>
<td>01-Jun-73</td>
<td>47</td>
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<tr>
<td>MONTVILLE 5</td>
<td>Oil</td>
<td>85</td>
<td>01-Jan-54</td>
<td>66</td>
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</table>

<table>
<thead>
<tr>
<th>Unit</th>
<th>Unit Type</th>
<th>MW Maximum Assumed</th>
<th>In-service Date</th>
<th>Age in 2020</th>
</tr>
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<tbody>
<tr>
<td>MONTVILLE 6</td>
<td>Oil</td>
<td>418</td>
<td>01-Jul-71</td>
<td>49</td>
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<tr>
<td>MOUNT TOM 1</td>
<td>Coal</td>
<td>159</td>
<td>01-Jun-60</td>
<td>60</td>
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<tr>
<td>MYSTIC 7 GT</td>
<td>Oil</td>
<td>615</td>
<td>01-Jun-75</td>
<td>45</td>
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<tr>
<td>NEW HAVEN HBR</td>
<td>Oil</td>
<td>483</td>
<td>01-Aug-75</td>
<td>45</td>
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<tr>
<td>NEWINGTON 1</td>
<td>Oil</td>
<td>424</td>
<td>01-Jun-74</td>
<td>46</td>
</tr>
<tr>
<td>NORWALK HBR 1</td>
<td>Oil</td>
<td>173</td>
<td>01-Jan-60</td>
<td>60</td>
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<tr>
<td>NORWALK HBR 2</td>
<td>Oil</td>
<td>179</td>
<td>01-Jan-63</td>
<td>57</td>
</tr>
<tr>
<td>SCHILLER 4</td>
<td>Coal</td>
<td>51</td>
<td>01-Apr-52</td>
<td>68</td>
</tr>
<tr>
<td>SCHILLER 6</td>
<td>Coal</td>
<td>51</td>
<td>01-Jul-57</td>
<td>63</td>
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<tr>
<td>W. SPRINGFIELD 3</td>
<td>Oil</td>
<td>111</td>
<td>01-Jan-57</td>
<td>63</td>
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<tr>
<td>YARMOUTH 1</td>
<td>Oil</td>
<td>56</td>
<td>01-Jan-57</td>
<td>63</td>
</tr>
<tr>
<td>YARMOUTH 2</td>
<td>Oil</td>
<td>56</td>
<td>01-Jan-58</td>
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<td>YARMOUTH 3</td>
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<td>122</td>
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<td>55</td>
</tr>
<tr>
<td>YARMOUTH 4</td>
<td>Oil</td>
<td>632</td>
<td>01-Dec-78</td>
<td>42</td>
</tr>
</tbody>
</table>

**TOTAL 8,281 MW**
Transmission Projects to Maintain Reliability are Progressing Regionwide

$5.5\ billion\ invested\ since\ 2002,\ $5.7\ billion\ on\ the\ horizon

1. Southwest CT Phases I & II
2. NSTAR 345 kV Project, Phases I & II
3. Northwest Vermont
4. Northeast Reliability Interconnect
5. Monadnock Area
6. New England East-West Solution
   a. Greater Springfield Reliability Project
   b. Greater Rhode Island Reliability Project
   c. Interstate Reliability Project
   d. Central Connecticut Reliability Project
7. Southeast Massachusetts
   a. Short-term upgrades
   b. Long-term Lower SEMA Project
8. Maine Power Reliability Program
9. Vermont Southern Loop
10. Merrimack Valley/North Shore Reliability

Source: RSP Transmission Project Listing, June 2013; (does not include “concept” projects)

Representative Projects and Concept Proposals

- **a. Northern Pass**
  Hydro Quebec/Northeast Utilities

- **b. Northeast Energy Link**
  Bangor Hydro/National Grid

- **c. Green Line**
  New England ITC

- **d. Bay State Offshore Wind Transmission System**
  Anbaric Transmission

- **e. Northeast Energy Corridor**
  Maine/New Brunswick

- **f. Muskrat Falls/Lower Churchill**
  Newfoundland and Labrador (Nalcor) and Nova Scotia (Emera)

- **g. Maine Yankee—Greater Boston**
- **h. Maine—Greater Boston**
- **i. Northern Maine—New England**
- **j. Plattsburgh, NY—New Haven, VT**

Note: These projects are NOT reliability projects, but ISO New England’s role is to ensure the reliable interconnection of these types of projects.
STRATEGIC PLANNING INITIATIVE
ISO New England’s Strategic Planning Initiative
Focused on developing solutions to the top five challenges facing the region

1. Resource Performance and Flexibility
2. Increased Reliance on Natural Gas-Fired Capacity
3. Retirement of Generators
4. Integration of a Greater Level of Variable Resources
5. Alignment of Markets with Planning
Why the ISO and Stakeholders are Taking Action

• Operational and market improvements are needed to address emerging concerns for New England’s increasing reliance on natural gas for power generation and resource performance issues in the region.
Summary: Recent and Coming Improvements

Working with stakeholders to improve electric market efficiency and enhance coordination with the natural gas market

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>• Ongoing improvements to information sharing with natural gas pipelines</td>
<td>• 2013-2014 Winter Reliability Program (approved by FERC)</td>
<td>• Strengthen Forward Capacity Market Performance Incentives “Pay-for-Performance”</td>
</tr>
<tr>
<td>• Moved Day-Ahead Market timeline in 2013</td>
<td>• Proposed to tighten FCM Shortage Event trigger (pending at FERC)</td>
<td></td>
</tr>
<tr>
<td>• Increased forward reserve requirements (2013)</td>
<td>• Developed energy market offer-flexibility enhancements (take effect in Dec. 2014)</td>
<td></td>
</tr>
</tbody>
</table>
For More Information

• ISO Training
  http://www.iso-ne.com/support/training/index.html

• ISO Express data portal
  http://isoexpress.iso-ne.com/guest-hub

• ISO to Go mobile app
  – For iPhone and Android
    http://www.iso-ne.com/support/isotogo/
Questions