ISO New England Overview and Regional Update

Connecticut General Assembly

Energy & Technology Committee

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About ISO New England

- **Regulated by** the Federal Energy Regulatory Commission (FERC)
- **Reliability coordinator** for New England under the North American Electric Reliability Corporation (NERC)
- Nearly two decades of experience overseeing New England’s restructured electric power system
- **Independent** of companies doing business 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
Federal Entities and an Independent Board Provide Oversight of ISO’s Responsibilities

Robust stakeholder process for states and market participants informs ISO-NE

*NESCOE: New England States Committee on Electricity
*NECPUC: New England Conference of Public Utilities Commissioners
ISO New England is Part of a Larger Electric Power System

- Eastern Interconnection spans from Rocky Mountains to East Coast and Canadian Maritimes
  - Primarily alternating-current (AC) transmission
  - New England linked to rest of Eastern Interconnection via transmission ties to New York and New Brunswick

- Tied to Quebec only through direct-current (DC) transmission

- 2003 Blackout ushered in wide-area monitoring and mandatory reliability standards
New England has Multiple Ties to Neighboring Regions

- Transmission system is tied to neighboring power systems in the U.S. and Eastern Canada:
  - New York (8 AC ties, 1 DC tie)
  - Hydro Québec (2 DC ties)
  - New Brunswick (2 AC ties)

Note: AC stands for Alternating Current and DC stands for Direct Current
New England’s Energy Use at a Glance

- **6.5 million** households and businesses; **14 million** population
- **28,130 MW** all-time summer peak demand set on August 2, 2006
- **22,818 MW** all-time winter peak demand set on January 15, 2004
- Region’s *peak* demand forecasted to grow **1.3%** annually
- Region’s *overall* electricity demand forecasted to grow **1.0%** annually
- Energy efficiency slows growth in peak demand and flattens overall electricity demand
New England’s Transmission Grid at a Glance

- **8,500 miles** of high-voltage transmission lines (115 kV and above)

- **13 transmission interconnections** to power systems in New York and Eastern Canada

- **16%** of region’s energy needs met by imports in 2014

- **$7 billion** invested to strengthen transmission system reliability since 2002; **$4.5 billion** planned

- Developers propose multiple transmission projects to access non-carbon-emitting resources
New England’s Generation and Demand Resources at a Glance

• **350** generators in the region
• **31,000 MW** of generating capacity
• **9,500 MW** of proposed generation
• **3,500 MW** of generation capacity retiring over the next five years
• **700 MW** of active demand response and **1,400 MW** of energy efficiency with capacity supply obligations
New England’s Wholesale Markets at a Glance

• More than 400 buyers and sellers in the markets

• $10.4 billion traded in wholesale electricity markets in 2014
  – $9.1 billion in energy markets
  – $1.3 billion in capacity and ancillary services markets

• Forward and spot markets

• Prices vary by time and location, and by changes in demand and available resources

• Extensive analysis and reporting of market results

Note: 2014 wholesale electricity market data is still preliminary and subject to reconciliation
Major Responsibility: Operations

Oversee the day-to-day operation of New England’s electric power generation and transmission 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
Major Responsibility: Markets

Developing and administering the region’s competitive wholesale electricity markets

New England’s Wholesale Electricity Markets

- **Energy Market**: Daily market for wholesale customers to buy and sell electric “energy”
- **Forward Capacity Market**: Three-year forward market that commits “capacity” resources to meet system resource-adequacy needs
- **Ancillary Markets**: Reserves and regulation provide support for system operations
Major Responsibility: Planning

Managing comprehensive regional power system planning

- Manage regional power system planning in accordance with mandatory reliability standards
- 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) with a ten year planning horizon
ISO New England’s Strategic Planning Initiative
Focused on developing solutions to the region’s top reliability risks

Reliability requires a flexible, high-performance fleet:

- **Natural Gas Dependency**
  - “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
Dramatic Changes in the Energy Mix

The fuels used to produce New England’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.

![Graph showing Monthly Average Natural Gas and Wholesale Electricity Prices in New England.](image)
Total Value of Markets Varies with Fuel Costs

Annual wholesale market costs have ranged from $6 billion to $14 billion

Annual Value of Wholesale Electricity Markets
(in billions)

Source: 2013 Report of the Consumer Liaison Group, Appendix C; 2014 data is still preliminary and subject to reconciliation
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
- Oil
- Biomass
- Fuel Cell
- Hydro
- Solar
- Wind
- Nuclear uprate

Proposed Generation Is Primarily Gas and Wind

All Proposed Generation

Developers propose >5 GW of gas-fired generation and approximately 4 GW wind; wind is mostly onshore in northern New England and offshore in southern New England.

Natural gas 57%
Wind 42%
Other 1%

Wind Proposals

Source: ISO Generator Interconnection Queue (January 2015)
FERC Jurisdictional Proposals Only
Renewable and EE Resources Are Trending Up

**Wind (MW)**
- Existing: 800 MW
- Proposed: 4,000 MW

**Solar (MW)**
- PV thru 2013: 500 MW
- PV in 2023: 1,800 MW

**Energy Efficiency (MW)**
- EE thru 2013: 1,300 MW
- EE in 2023: 3,300 MW

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

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

*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.*
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 3
- Rhode Island 3
- Connecticut 6
- Maine 16
- New Hampshire 22

- Billions spent over the past few years and more on the horizon
  - Approximately $2.3 billion invested from 2009 to 2012
  - ISO estimates $6.3 billion to be invested in EE from 2017 to 2023

Source: American Council for an Energy-Efficient Economy
EE Affects New England’s Electricity Consumption

*Peak demand growth is lower; energy use is flat*

**New England: Summer 90/10 Peak (MW)**

**New England: Annual Energy Use (GWh)**

ISO New England Developed a Distributed Generation Forecast

- The ISO began an initiative in September 2013, working with the states and regional utilities, to forecast long-term incremental DG growth in New England.

- The ISO created a regional Distributed Generation Forecast Working Group (DGFWG) to collect data on DG policies and implementation from the states and regional utilities.

- DGFWG assisted the ISO in developing a forecast methodology.

- DGFWG focused on the following types of DG resources:
  - Under 5 MW
  - Connected to the distribution system
  - Not visible to the ISO directly
  - Focused on solar PV, the largest DG component

- The ISO’s April 2014 interim DG forecast shows steady growth in solar PV through 2023:
  - Interim forecast is based on state policy goals for DG.
ISO’s Interim DG Forecast Shows Growth in Solar PV through 2023

Cumulative Growth in Solar PV through 2023

Source: Final Interim PV Forecast (April 2014); Note: MW values are AC nameplate
Resource Shift Creates Reliability Challenges

• **ISO New England** is increasingly reliant on resources with uncertain performance and availability
  – *Intermittent resource growth* with inherently uncertain output
  – *Natural gas resources* lack fuel storage and rely on “just-in-time” fuel
  – *Coal, oil-steam fleet* is being displaced by more efficient resources

• ISO estimates **up to 8,300 MW of non-gas-fired generation is “at risk” for retirement by 2020** (28 older oil and coal units)
  – If all retire, ISO estimates 6,300 MW of new or repowered capacity will be needed in the region

• More than **3,500 MW of generation are retiring over the next five years**
  – Source: Status of Non-Price Retirement Requests; November 21, 2014
Region Is Losing 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**


• U.S. Department of Energy (DOE) is studying energy infrastructure challenges as part of its Quadrennial Energy Review (QER)

• ISO-NE has worked extensively with DOE throughout 2014 to articulate New England’s challenges
  – ISO-NE has highlighted the region’s increasing reliance on natural gas-fired resources and the need for additional energy infrastructure

• DOE’s initial report is expected in February 2015 (focused on transmission, storage, and distribution of energy)
For More Information...

• Subscribe to the **ISO Newswire**
  – *ISO Newswire* is your source for regular news about ISO New England and the wholesale electricity industry within the six-state region

• Log on to **ISO Express**
  – *ISO Express* provides real-time data on New England’s wholesale electricity markets and power system operations

• Follow the ISO on **Twitter**
  – [@isonewengland](https://twitter.com/isonewengland)

• Download the **ISO to Go App**
  – *ISO to Go* is a free mobile application that puts real-time wholesale electricity pricing and power grid information in the palm of your hand
Questions
APPENDIX: BACKGROUND INFORMATION
ISO New England is part of the ISO/RTO Council.

There are nine ISOs and RTOs in North America:

- California ISO
- Alberta Electric System Operator
- Electricity Reliability Council of Texas (ERCOT)
- Southwest Power Pool
- Midcontinent ISO
- Ontario Independent Electricity System Operator
- PJM Interconnection
- New York ISO
- ISO New England

ISO New England’s Workforce at a Glance

• Key technical roles:
  – Engineers
  – Operators
  – Analysts
  – Economists
  – Forecasters
  – Trainers

Corporate Operations: 17%
Market Operations: 14%
System Operations: 19%
Markets Development: 3%
System Planning: 12%
IT and PMO: 32%
Market Monitoring: 3%

Corporate: Finance, HR, Communications, External Affairs, and Legal; IT and PMO: Information Technology and Program Management Office
ISO New England Follows Best Practices to Address Cybersecurity Risks

• Physical and cyber security are a top priority for the ISO

• The nine Independent System Operators and Regional Transmission Organizations (ISOs/RTOs) in North America are subject to mandatory NERC Critical Infrastructure Protection (CIP) reliability standards that address cybersecurity

• The ISO is actively engaged in NERC grid security exercises that test the readiness of the electricity subsector to respond to physical and cybersecurity threats (e.g., GridEx II)
Capacity Prices Vary with Changes in Supply

Capacity Surplus or Deficit (MW) Against Auction Clearing Prices ($/kWh-month)

- 3,135 MW of capacity submitted
- Non-Price Retirement requests for FCA 8

- Prices cleared at the floor price in the first seven auctions due to excess capacity; therefore, resources were paid a slightly lower prorated price. The clearing price in NEMA/Boston was $14.999/kW-month for FCA 7 (new capacity received $14.999/kW-month and existing capacity received an administrative price of $6.66/kW-month).
- The clearing price in FCA 8 was $15.00/kW-month (new capacity in all zones and existing capacity in NEMA/Boston received $15.00/kW-month and existing capacity in all other zones received an administrative price of $7.025/kW-month).
Dramatic Changes in Power System Resources

The resources making up the region’s installed generating capacity have shifted from nuclear, oil and coal to natural gas.

Percent of Total System **Capacity** by Fuel Type (2000 vs. 2014)

Source: [2014 CELT Report](#), Summer Seasonal Claimed Capability (SCC) Capacity

Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels.
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$_x$</th>
<th>SO$_2$</th>
<th>CO$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>59.73</td>
<td>200.01</td>
<td>52,991</td>
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<tr>
<td>2013</td>
<td>20.32</td>
<td>18.04</td>
<td>40,901</td>
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<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>NO$_x$</th>
<th>SO$_2$</th>
<th>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>
</tr>
</tbody>
</table>

State Requirements Drive Proposals for Renewable Energy

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

- ME: 10%
- NH: 11%
- RI: 12.5%
- MA: 15%
- CT: 20%

* 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 does not have a formal RPS program. It relies on a program known as ‘Sustainably Priced Energy Enterprise Development’ (SPEED) to promote renewable energy development in the state.
Generator Proposals in the ISO Queue

Approximately 9,500 MW

By Type

- Natural gas, 5,429, 57%
- Wind, 3,987, 42%
- Pumped-storage hydro, 25, 0%
- Hydro, 11, 0%
- Biomass, 70, 1%

By State

- MA, 4,368, 46%
- ME, 3,340, 35%
- CT, 1,447, 15%
- VT, 161, 2%
- NH, 179, 2%

Note: Some natural gas include dual-fuel units (oil)

Source: ISO Generator Interconnection Queue (January 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
On- and Off-shore Wind is Being Proposed

Represents almost half of proposed generation

- Almost 4,000 MW of wind proposed
- Majority of wind development proposals in Maine and northern New England
- Offshore projects proposed in Maine, Massachusetts and Rhode Island

Source: ISO Generator Interconnection Queue (January 2015)
FERC Jurisdictional Proposals Only
FCM Has Attracted Significant Demand Resources

EE is growing, but a lot of “Active” DR has dropped out

Notes: Cleared Active DR represents Real-Time DR and RT Emergency Generation that cleared in the primary auction. Net Active DR represents Active DR remaining at the start of commitment period, net of resources that shed Capacity Supply Obligations after the primary auction.
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>
</tr>
<tr>
<td>BRAYTON POINT 2</td>
<td>Coal</td>
<td>258</td>
<td>01-Jul-64</td>
<td>56</td>
</tr>
<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>
</tr>
<tr>
<td>BRIDGEPORT HBR 3</td>
<td>Coal</td>
<td>401</td>
<td>01-Aug-68</td>
<td>52</td>
</tr>
<tr>
<td>CANAL 1</td>
<td>Oil</td>
<td>597</td>
<td>01-Jul-68</td>
<td>52</td>
</tr>
<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>
<td>60</td>
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<tr>
<td>MERRIMACK 2</td>
<td>Coal</td>
<td>343</td>
<td>30-Apr-68</td>
<td>52</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>
</tr>
<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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<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>Oil</td>
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<td>01-Jun-60</td>
<td>60</td>
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<td>MYSTIC 7 GT</td>
<td>Oil</td>
<td>615</td>
<td>01-Jun-75</td>
<td>45</td>
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<td>NEW HAVEN HBR</td>
<td>Oil</td>
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<td>NEWINGTON 1</td>
<td>Oil</td>
<td>424</td>
<td>01-Jun-74</td>
<td>46</td>
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<tr>
<td>NORWALK HBR 1</td>
<td>Oil</td>
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<td>01-Jan-60</td>
<td>60</td>
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<td>NORWALK HBR 2</td>
<td>Oil</td>
<td>179</td>
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<td>SCHILLER 4</td>
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<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>
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<td>YARMOUTH 2</td>
<td>Oil</td>
<td>56</td>
<td>01-Jan-58</td>
<td>62</td>
</tr>
<tr>
<td>YARMOUTH 3</td>
<td>Oil</td>
<td>122</td>
<td>01-Jul-65</td>
<td>55</td>
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<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**

Source: Strategic Transmission Analysis, Generator Retirements Study, December 2012
Generator Non-Price Retirement Requests

More than 3,500 MW of generation are retiring over the next five years

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**

### Total MW Retiring in New England*

<table>
<thead>
<tr>
<th>State</th>
<th>MW Retiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>354 MW</td>
</tr>
<tr>
<td>Maine</td>
<td>35 MW</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2,502 MW</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>5 MW</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>13 MW</td>
</tr>
<tr>
<td>Vermont</td>
<td>634 MW</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,543 MW</strong></td>
</tr>
</tbody>
</table>

*Megawatts based on relevant Forward Capacity Auction (FCA) summer qualified capacity (NOTE: total includes full and partial generator Non-Price Retirement (NPR) requests for Capacity Commitment Period (CCP) 2014-2015 through CCP 2018-2019; does not include NPRs for demand response (DR) resources)

Source: Status of Non-Price Retirement Requests; November 21, 2014
Transmission Projects to Maintain Reliability Have Progressed in Each State

1. Southwest CT Phases I & II
2. Boston 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. Rhode Island Reliability Project
   c. Interstate 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
11. New Hampshire/Vermont Upgrades

Source: RSP Transmission Project Listing, October 2014; (does not include “concept” projects)
ISO Continuously Studies Transmission System Needs to Maintain Reliability

1. Greater Hartford and Central Connecticut
2. Southwest Connecticut
3. Eastern Connecticut
4. Southeast Massachusetts and Rhode Island
5. Greater Boston
6. Pittsfield and Greenfield
7. New Hampshire and Vermont
8. Maine

Source: ISO New England Key Study Areas at http://www.iso-ne.com/system-planning/key-study-areas
New Transmission Investment in New England

Annual Investment in Transmission to Maintain Reliability (in billions)

Cumulative Investment through 2014 | $7.0 billion
--- | ---
Estimated Future Investment through 2018 | $4.5 billion

Source: ISO New England RSP Transmission Project Listing, October 2014
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: 2013 Network Load by State
On- and Off-shore Transmission Proposals are Vying to Move Renewable Energy to New England Load Centers

Note: These projects are NOT reliability projects, but ISO New England’s role is to ensure the reliable interconnection of these types of projects.

A. Northern Pass – Hydro Quebec/Northeast Utilities
B. Northeast Energy Link – Emera Maine/National Grid
C. Green Line – New England ITC
D. Bay State Offshore Wind Transmission System – Anabaric Transmission
E. Northeast Energy Corridor – Maine/New Brunswick/Irving
F. Muskrat Falls/Lower Churchill – Nalcor Energy
G. Maine Yankee–Greater Boston
H. Maine–Greater Boston
I. Northern Maine–New England
J. Plattsburgh, NY–New Haven, VT
K. New England Clean Power Link – TDI New England

November 2013: Publicly available information
New England’s Electricity Use Varies by Season

Air-conditioning and lighting loads drive seasonal peaks

New England Peak-Day Hourly Load

Jan. 15, 2004
Aug. 2, 2006
Peak Demand is Growing

Summer peak demand forecasted to grow 1.3% annually to 2023

Peak Demand: History (2000-2013) and Forecast (2014-2023)*

* NOTE: Forecasted peaks do not include passive demand response.
** Source: ISO-NE Annual Energy & Seasonal Peak Forecast 2014-2023
Wholesale Markets Have Resulted in Efficiency Gains in New England’s Power Generation Fleet

- Markets reveal a resource’s true operating cost
  - Fuel is the primary driver of operating costs
  - The dollar value of New England’s energy markets fell from 2008-2013 as low-cost natural gas displaced older, fossil fuel-fired units

- Gas-fired generators are becoming more efficient
  - Improvements in technology have made newer generators more economic than earlier models

- Region has invested in cleaner technologies ahead of much of the rest of the country and has seen regional air emissions decline significantly over the past decade
Forward Capacity Market: Overview

- Procures capacity to meet New England’s forecasted Installed Capacity Requirement (ICR) three years in the future
- Allows new capacity projects to compete in the market and set the price for capacity in the region
- Selects a portfolio of supply and demand resources through a competitive Forward Capacity Auction (FCA) process
  - Resources must be pre-qualified to participate in the auction
  - Resources must participate and clear in the auction to be paid for capacity
- Provides a long-term (up to 7-year) commitment to new supply and demand resources to encourage investment
FCM Objectives and Results

• New England’s capacity market has two main objectives:
  – Ensure sufficient resources to meet New England’s electricity demand and reliability standards, and
  – Ensure that sufficient resources are procured in a cost-effective manner
    • FCM aims to foster competition by creating a level playing field with respect to technology, investors, and existing versus new entrants

• Eight Forward Capacity Auctions have been conducted and four commitment periods completed
  – FCM has obtained sufficient resources in each auction to meet capacity requirements, except for FCA #8, which concluded in a slight shortfall
    • New England has not experienced outages due to lack of resources
  – Market has generated participation from diverse types of resources
    • This includes demand-response and energy-efficiency resources
  – Lowest-cost resources have been developed and brought to market
    • FCM has eliminated reliance on reliability arrangements with generators
## Results of Forward Capacity Auctions

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<tbody>
<tr>
<td>FCA 1 2010/2011</td>
<td>34,077</td>
<td>32,305</td>
<td>1,772</td>
<td>1,188</td>
<td>626</td>
<td>$4.50 Floor price</td>
<td>$4.25</td>
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<tr>
<td>FCA 2 2011/2012</td>
<td>37,283</td>
<td>32,528</td>
<td>4,755</td>
<td>448</td>
<td>1,157</td>
<td>$3.60 Floor price</td>
<td>$3.12</td>
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<tr>
<td>FCA 3 2012/2013</td>
<td>36,996</td>
<td>31,965</td>
<td>5,031</td>
<td>309</td>
<td>1,670</td>
<td>$2.95 Floor price</td>
<td>ROP: $2.54 Maine: $2.47</td>
</tr>
<tr>
<td>FCA 4 2013/2014</td>
<td>37,501</td>
<td>32,127</td>
<td>5,374</td>
<td>515</td>
<td>144</td>
<td>$2.95 Floor price</td>
<td>ROP: $2.52 Maine: $2.34</td>
</tr>
<tr>
<td>FCA 5 2014/2015</td>
<td>36,918</td>
<td>33,200</td>
<td>3,718</td>
<td>263</td>
<td>42</td>
<td>$3.21 Floor price</td>
<td>$2.86</td>
</tr>
<tr>
<td>FCA 6 2015/2016</td>
<td>36,309</td>
<td>33,456</td>
<td>2,853</td>
<td>313</td>
<td>79</td>
<td>$3.43 Floor price</td>
<td>$3.13</td>
</tr>
<tr>
<td>FCA 7 2016/2017</td>
<td>36,220</td>
<td>32,968</td>
<td>3,252</td>
<td>245</td>
<td>800</td>
<td>$3.15 Floor price $14.999* NEMA/Boston</td>
<td>ROP: $2.74 Maine: $2.74 CT: $2.88</td>
</tr>
<tr>
<td>FCA 8 2017/2018</td>
<td>33,712</td>
<td>33,855</td>
<td>-143</td>
<td>394</td>
<td>30</td>
<td>$15.00*</td>
<td>n/a</td>
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* In FCA 7, the NEMA/Boston zone cleared at $14.999/kW-month. New capacity will receive $14.999/kW-month and existing capacity will receive an administrative price of $6.66/kW-month. In FCA 8, the auction cleared at $15.00/kW-month. New capacity in all zones and existing capacity in NEMA/Boston will receive $15.00/kW-month and existing capacity in all other zones will receive an administrative price of $7.025/kW-month.
Resource Performance Issues Drove ISO to Propose Changes to the Capacity Market Design

• Capacity payments are poorly linked to resource performance
• Consequences for non-performance are negligible
• We see pervasive and worsening performance problems with existing generators
• Resource owners lack incentive to make investments to ensure they can provide energy and reserves when needed
• Current design delays exit of poor performers from the market; creates a bias in the FCM to clear less-reliable resources
• Lack of investment poses serious threats to system reliability
Pay-for-Performance (PFP) Effective for FCA #9

• FERC issued an order on May 30, 2014 that accepted, in large part, the ISO’s proposal to tie capacity payments to resources’ performance during stressed system conditions

• FERC accepted NEPOOL’s proposal to increase the Reserve Constraint Penalty Factors (RCPFs)

• PFP will be implemented for the next capacity auction in February 2015 (FCA #9), and will be effective for the 2018-2019 commitment period
Sloped Demand Curve Effective for FCA #9

FERC approved ISO proposal in May for effect in February 2015 auction

- Proposal received strong support from NEPOOL and the New England States
- Parties did not agree on all elements, but supported the overall package
- Proposal struck a balance between limiting exposure to high prices when the market is not competitive and ensuring prices induce new entry into the market

Demand curve proposed by ISO New England and NEPOOL, and filed with FERC on April 1, 2014.
Demand Curve Changes: Key Features

- Replace the vertical demand curve used in the first eight auctions with a system-wide sloped demand curve for the next auction (zonal curves to follow one year later)
- Reduce price volatility that occurs if the region is just short or long on capacity (this volatility is a symptom of a vertical demand curve)
- Achieve resource adequacy over the long term, although the market might clear more or less than the Installed Capacity Requirement (ICR) in a given auction
- Extend the period that new resources can “lock-in” the capacity price, from five years to seven years
- Exempt up to 200 MW of Renewable Technology Resources from buyer-side mitigation rules (minimum offer price rule)
- Eliminate the need for administrative pricing rules
Region is Taking Action to Improve Electric Market Efficiency and Enhance Gas-Electric Coordination

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<tr>
<td>• Ongoing improvements to information sharing with natural gas pipeline companies</td>
<td>• Strengthen Forward Capacity Market Performance Incentives “Pay-for-Performance” (will apply to 2018-19 capacity commitment period)</td>
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<tr>
<td>• Moved Day-Ahead Energy Market timeline in 2013 to better align electricity and natural gas markets</td>
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<tr>
<td>• Increased forward reserve requirements in 2013</td>
<td>• Implement Demand Curve and improve zonal modeling in capacity market</td>
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<td>• FERC clarification of generator obligations (must purchase fuel unless physically unavailable – economics is not an excuse)</td>
<td>• Further improvements to energy market pricing</td>
</tr>
<tr>
<td>• Tightened FCM Shortage Event trigger (effective November 2013)</td>
<td>• New England States are driving investments in additional natural gas pipelines, and transmission to enable additional renewable energy</td>
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<tr>
<td>• Developed energy market offer-flexibility enhancements (effective December 2014)</td>
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<tr>
<td>• Changed NCPC cost allocation to drive more load to Day-Ahead Energy Market (effective December 2014)</td>
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States Pursue Long-Term Contracts to Achieve Renewable Energy Goals

Examples of agreements with utilities

- **Burgess BioPower**
  - 75 MW
  - (PPA with PSNH)

- **Groton Wind**
  - 48 MW
  - (PPA with NSTAR)

- **Hoosac Wind**
  - 28 MW
  - (PPA with NSTAR)

- **Lempster Wind**
  - 24 MW
  - (PPA with PSNH)

- **Fusion Solar Center**
  - 20 MW
  - (PPA with CLP & UI)

- **Sheffield Wind**
  - 40 MW
  - (PPA with Vermont Utilities)

- **Granite Reliable Wind**
  - 99 MW
  - (PPA with Vermont Utilities)

- **Bowers Wind**
  - 48 MW
  - (PPA with National Grid)

- **Rollins Hill Wind**
  - 60 MW
  - (PPA with CMP & BHE)

- **Verso Paper Bucksport Biomass**
  - 35 MW
  - (PPA with CMP)

- **Oakfield Wind**
  - 147 MW
  - (PPA with Mass Utilities)

- **Bingham Wind**
  - 186 MW
  - (PPA with Mass Utilities)

- **Mars Hill Wind**
  - 42 MW
  - (PPA with New Brunswick Power)

- **Cape Wind**
  - 129 MW
  - (PPA with NU/NSTAR)

- **Number 9 Wind**
  - 250 MW
  - (PPA with CLP & UI)

- **Block Island Wind**
  - 30 MW
  - (PPA with National Grid)

- **Bingham Wind**
  - 186 MW
  - (PPA with Mass Utilities)

As of January 2015; Source: publicly available information (total: > 1,300 MW)