Overview of Wind Power

Massachusetts Wind Working Group

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EXTERNAL AFFAIRS
Who is ISO New England, and What is Our Role?

• ISO New England was created to oversee the region’s restructured electric power system
  – Private, not-for-profit corporation
  – Regulated by the Federal Energy Regulatory Commission (FERC)

• ISO-NE is the Regional Transmission Organization
  – Independent of companies doing business in the market
  – No financial interest in companies participating in the market

• Major Responsibilities
  – Reliable operation of the electric grid
  – Administer wholesale electricity markets
  – Plan for future system needs
Wind Overview

• New England has seen significant growth in wind development
  – Mostly on-shore
  – Proposed off-shore

• *New England Wind Integration Study* (NEWIS) concluded that large scale wind integration is possible for the region

• Depending on location, transmission is key factor for future wind development

• ISO process improvements aimed at easing the integration of wind power
“At Risk” Unit Retirements Have Begun

More than 4,000 MW of generation and demand resources plan to retire, including almost 2,700 MW of coal and oil units the ISO identified as “at risk”

Major Retirement Requests:

- **Salem Harbor Station (749 MW)**
  - 4 units (coal & oil)

- **Norwalk Harbor Station (342 MW)**
  - 3 units (oil)

- **Brayton Point Station (1,535 MW)**
  - 4 units (coal & oil)

- **Vermont Yankee Station (604 MW)**
  - 1 unit (nuclear)

<table>
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<tr>
<th>Total MW Retiring in New England*</th>
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<tbody>
<tr>
<td>Connecticut</td>
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<td>Maine</td>
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<td>Massachusetts</td>
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<td>New Hampshire</td>
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<td>Rhode Island</td>
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<td>Vermont</td>
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<td><strong>Total</strong></td>
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*Megawatts based on relevant Forward Capacity Auction (FCA) summer qualified capacity (NOTE: total includes full and partial generator and demand response Non-Price Retirement (NPR) requests for Capacity Commitment Period (CCP) 2013-2014 through CCP 2017-2018)

Source: Status of Non-Price Retirement Requests; December 20, 2013
WIND CAPACITY AND ENERGY PRODUCTION
Current Wind Capacity in New England

As of January 15, 2014

• 710 MW of commercial wind power within the area administered by ISO

• 2,029 MW of wind power in the Interconnection Queue
  • Includes non-FERC-jurisdictional projects requesting interconnection either to the lower voltage distribution system or areas external to ISO’s service territory
Electric Grid is Undergoing Rapid Transformation
Generation shifting from oil, coal and nuclear to natural gas and renewables

* Resources in 2020 assume approx. 5,000 MW of new resources proposed in the ISO Queue as of April 2013 (primarily natural gas and wind); and approx. 3,200 MW of non-price retirement requests for coal, oil and nuclear resources as of October 2013.
Significant Amounts of Wind Proposed

Proposed Generation
Over 2 GW of wind proposed (includes non-FERC jurisdictional), majority of wind development proposals onshore in northern New England and offshore in southern

Wind Proposals

Note: Cumulative numbers for each state may include non-FERC jurisdictional proposals as well both on- and offshore proposals

ISO Generator Interconnection Queue (January 2014)
Annual Electricity Produced by Wind Resources

- In 2013, wind resources generated 1,766 GWh within ISO-NE service territory
- Total New England generation in 2013 was 112,040 GWh
  - Gas: 41,542
  - Nuclear: 37,183
  - All renewables: 8,751
Cumulative Energy by Fuel Type – January 2014

Energy by Fuel - January 2014

- **Nuclear**: 35%
- **NG / LNG**: 26%
- **Coal**: 11%
- **Hydro**: 7%
- **Wind**: 2%
- **Oil**: 13%
- **Other**: 1%
- **Renewable**: 5%
TRANSMISSION
Existing Transmission Infrastructure

- 8,400 miles of high voltage transmission lines
- Wind generators connecting into electrically weak parts of region and Eastern Interconnection
- Heavily built out system in central and southern New England
Some Off-Shore Wind Near Demand and Transmission; On-Shore Wind Remote

- Population and electricity demand concentrated in southern New England
- On-shore wind resources do not overlap with high energy demand areas
- New transmission needed to fully realize on-shore and off-shore wind
Challenges for On-Shore Wind in Northern Areas

- Technology provides limited transmission system support
  - Although technologies are improving, technology does not provide significant system voltage or stability support

- Connecting using minimum interconnection standards to weak parts of the system, often where there are local and regional constraints

- First-in wind generators have exhausted limited existing system margins, resulting in more significant system upgrades for subsequent generators

- Wind interconnecting as an energy resource, competing for transmission use, based on bid price
  - Areas of the system where wind competes with wind and other renewable resources, sometimes with the same owner
Local and Regional Constraints Currently Exist in Northern New England

• **Regional transmission constraints**
  - Broader areas of the system which may constrain concurrent operation of larger groups of generation
  - Transmission planned (Maine Power Reliability Program) not intended for power transfer enhancement, but some help

• **Local transmission constraints**
  - Smaller areas of the system which may constrain concurrent operation of smaller groups of generation
Solutions/Improvements Under Consideration

• Develop a more thorough study regimen that considers a wider range of operating conditions, to address the rapid and unacceptable erosion in system operability

• Identify additional system upgrades for interconnection to minimize wind resource limitations
OPERATIONS
Wind Resources Can Help On Peak Days

Wind has helped region with fuel mix diversity and has provided needed energy on peak demand days

2011 Peak Day
July 22
+26,000 MW demand

2013 Peak Day
July 19
+27,000 MW demand

Source: August 2011 COO Report
Source: August 2013 COO Report
Wind Forecasting Tool

- The ISO developed a forecasting tool to provide both the ISO and the region’s wind resources up-to-date and accurate information about wind and grid conditions
- Operational January 2014
Wind Forecasting Tool Now Used to More Efficiently Commit Resources to Meet Demand

**Use**

- Wind forecasting data is continually being uploaded into ISO processes, scheduling, and dispatch services
- Operator situational awareness displays have been created
- Transmission outage coordination is also taking the new wind forecast into account for scheduling purposes

**Benefits**

- The forecast allows the partial integration of wind into the unit commitment processes
- Reduce the need to issue curtailment orders in certain circumstances
- Wind forecasting will become increasingly important as wind resources grow across the region
Conclusion

• Wind resources growing in New England
  – Both capacity and energy production

• ISO New England continues to work with stakeholders to reliably integrate wind resources
  – Studies indicate region can incorporate more wind resources
  – Transmission may be necessary, especially in constrained areas
  – Wind forecasting tool helps integrate resources into grid operations