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# 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)

| Total MW Retiring in New England* | |
|---|---|
| Connecticut | 528 MW |
| Maine | 159 MW |
| Massachusetts | 2,682 MW |
| New Hampshire | 56 MW |
| Rhode Island | 64 MW |
| Vermont | 666 MW |
| **Total** | **4,155 MW** |

*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

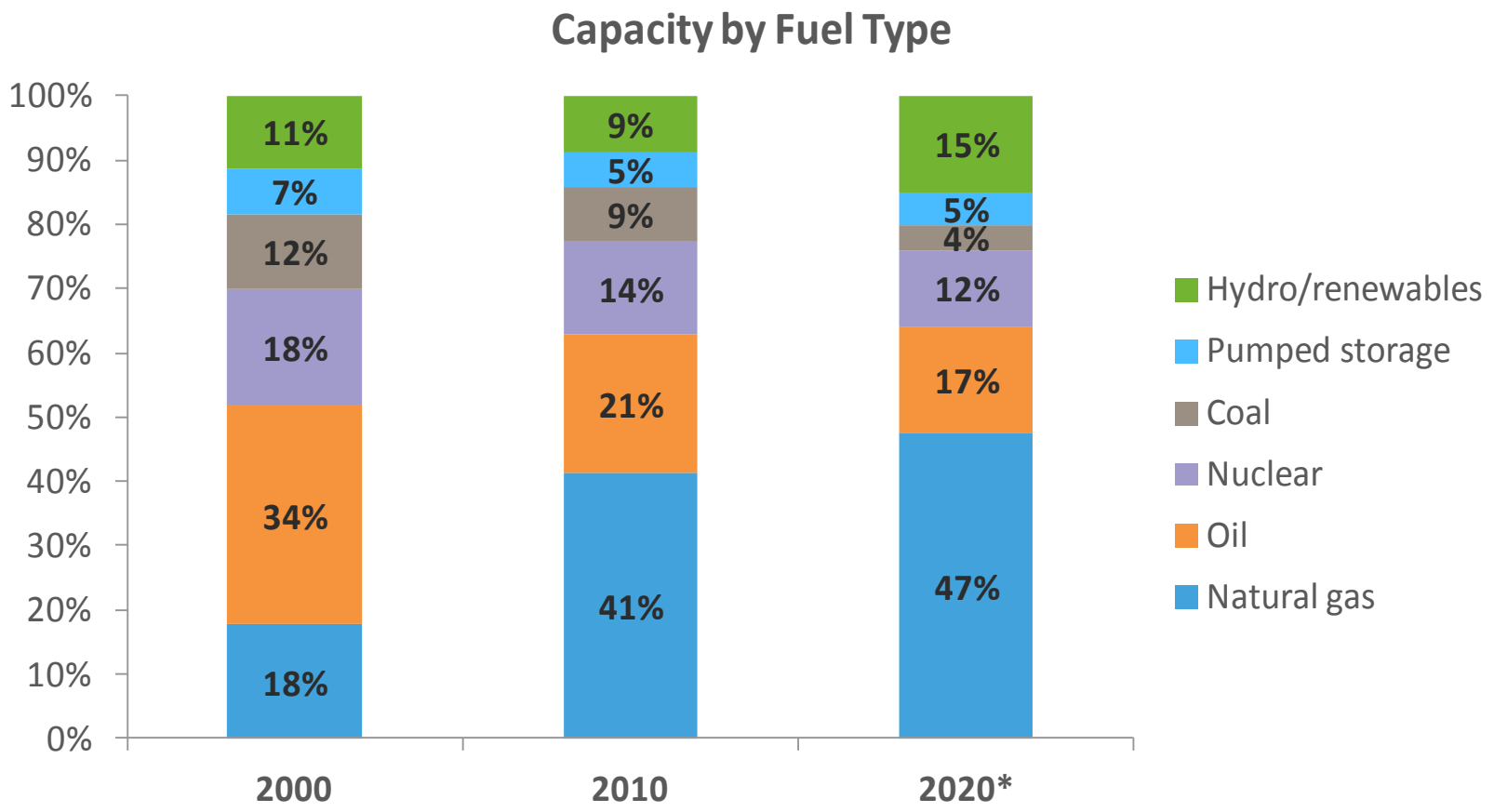
*As of January 15, 2014*

- 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*

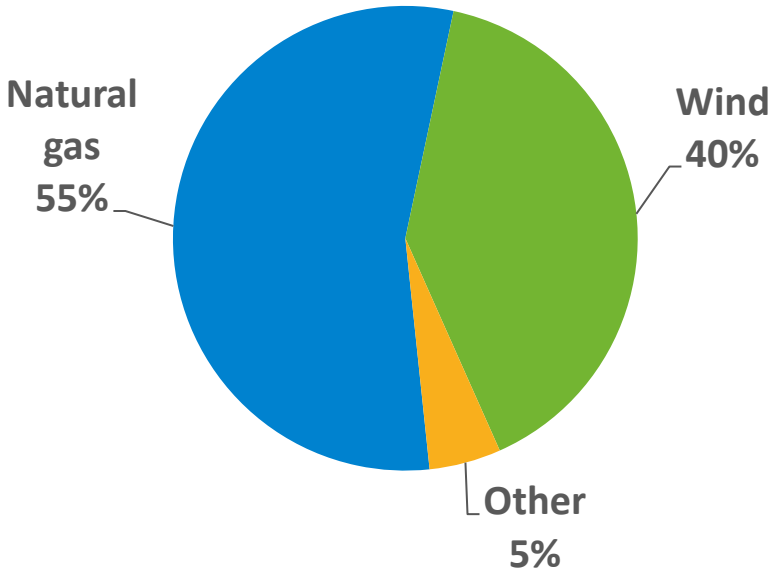



* Resources in 2020 assume approx. 5,000 MW of new resources proposed in the ISO Queue as of April 2013 (primarily natural gas and wind); and approx. 3,200 MW of non-price retirement requests for coal, oil and nuclear resources as of October 2013.

# Significant Amounts of Wind Proposed

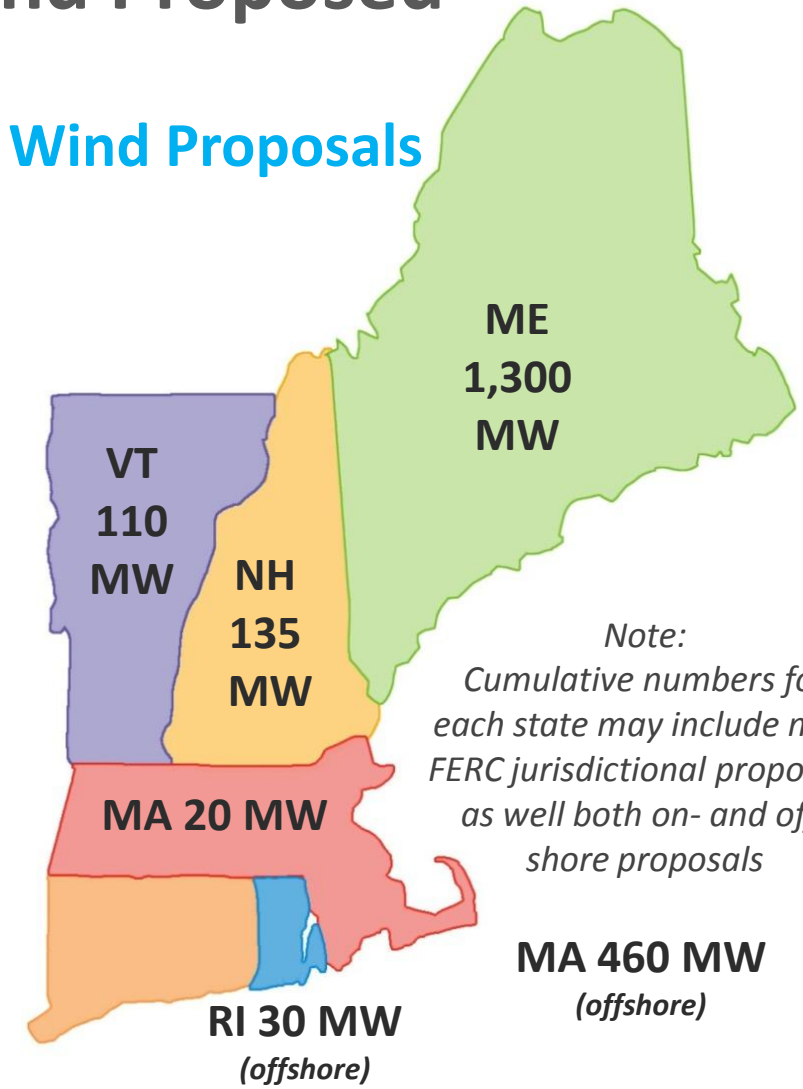
## Proposed Generation

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




ISO Generator Interconnection Queue (January 2014)

## Wind Proposals

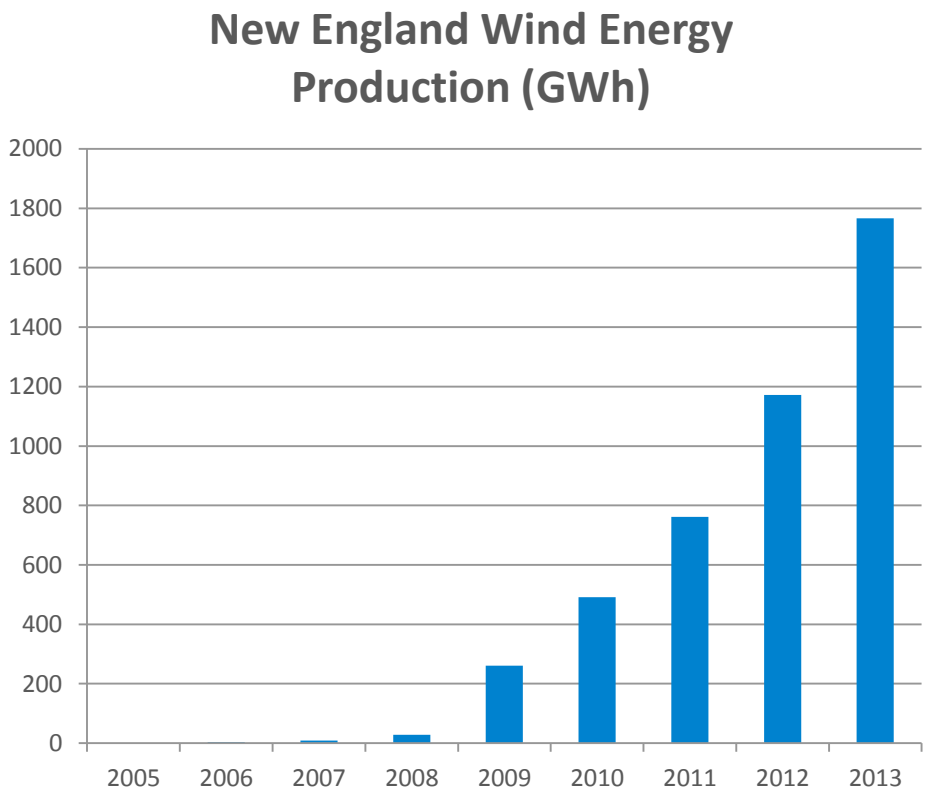



*Note: Cumulative numbers for each state may include non-FERC jurisdictional proposals as well both on- and off-shore proposals*

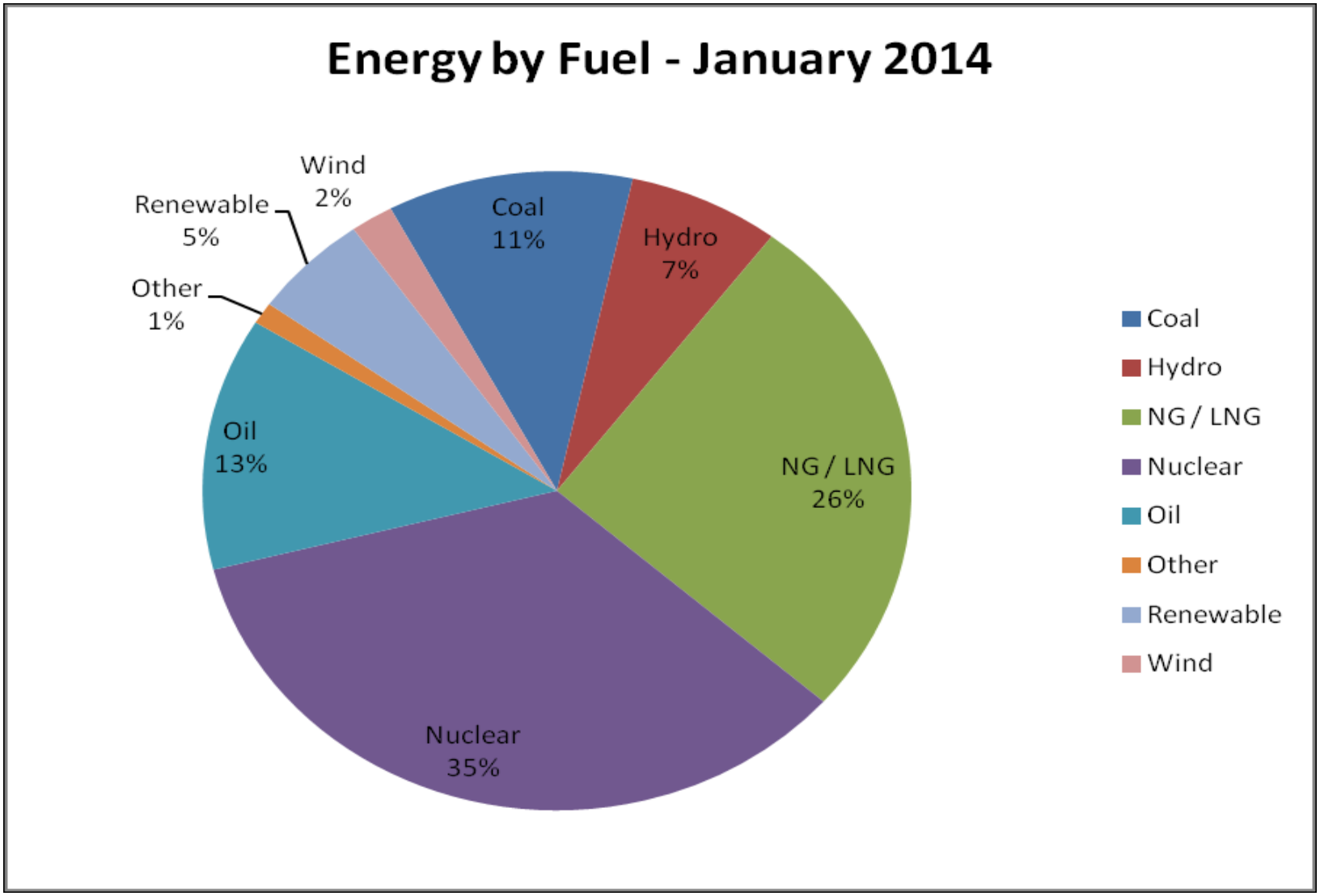
Source: ISO Generator Interconnection Queue (January 2014)

# 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

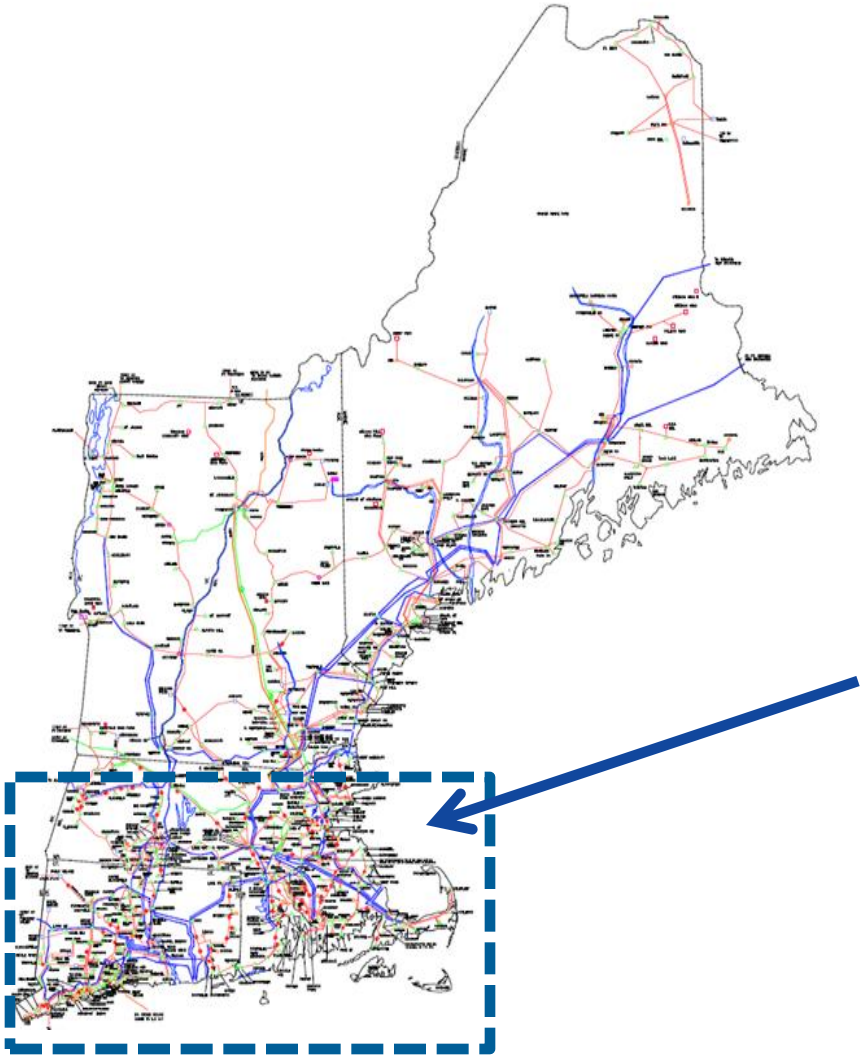


# Cumulative Energy by Fuel Type – January 2014



# TRANSMISSION

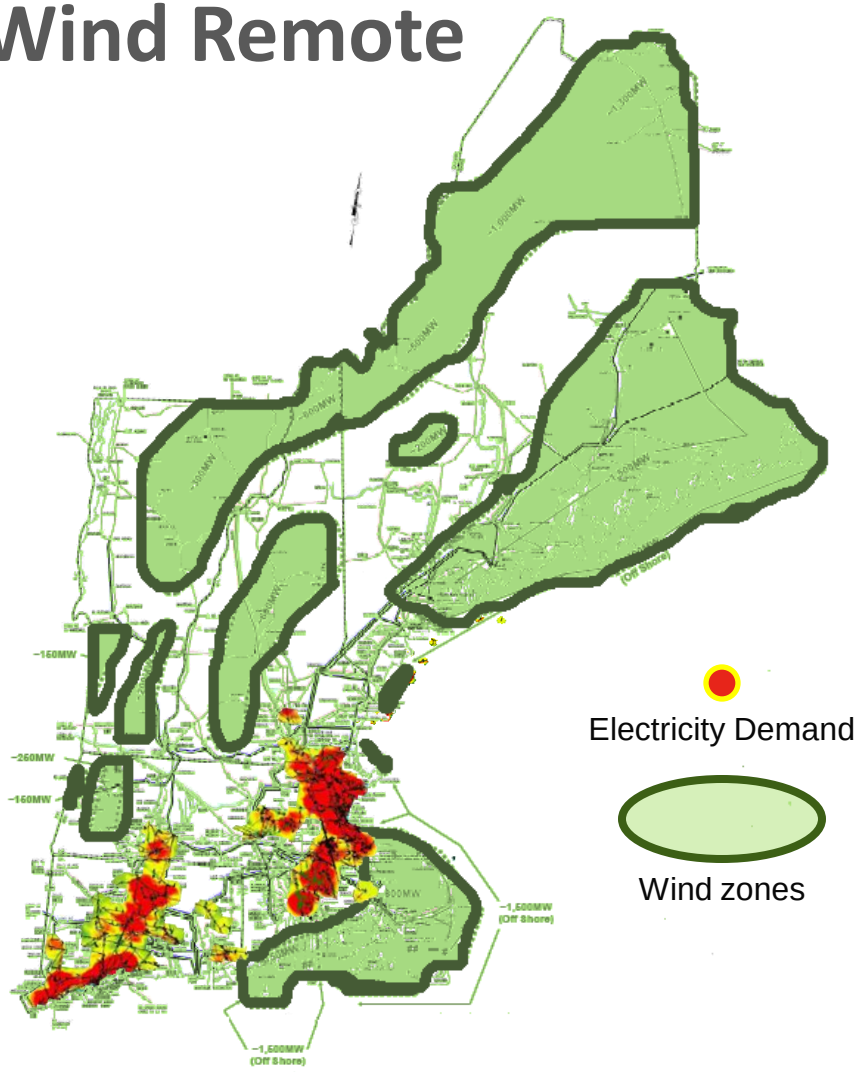
# Existing Transmission Infrastructure



- 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

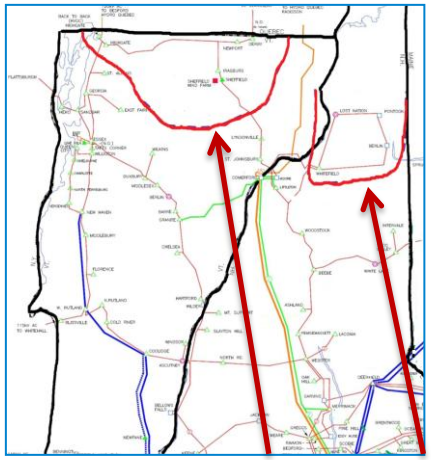


# Challenges for On-Shore Wind in Northern Areas

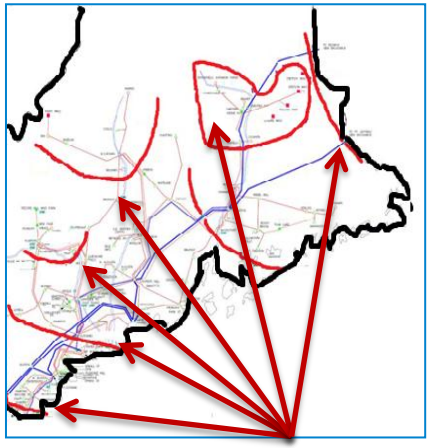
- Technology provides limited transmission system support
  - Although technologies are improving, technology does not provide significant system voltage or stability support
- Connecting using minimum interconnection standards to weak parts of the system, often where there are local and regional constraints
- 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



**Constraints in VT & NH**



**Constraints in Maine**

# 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

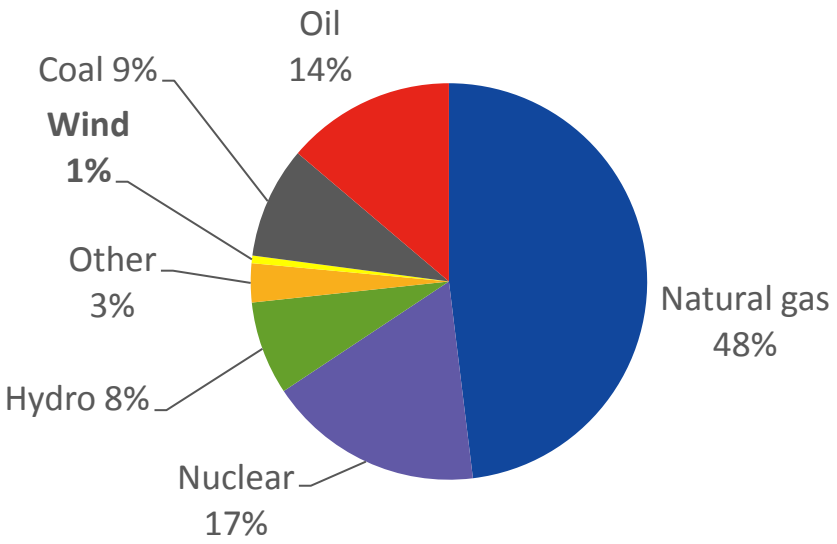
# OPERATIONS

# 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

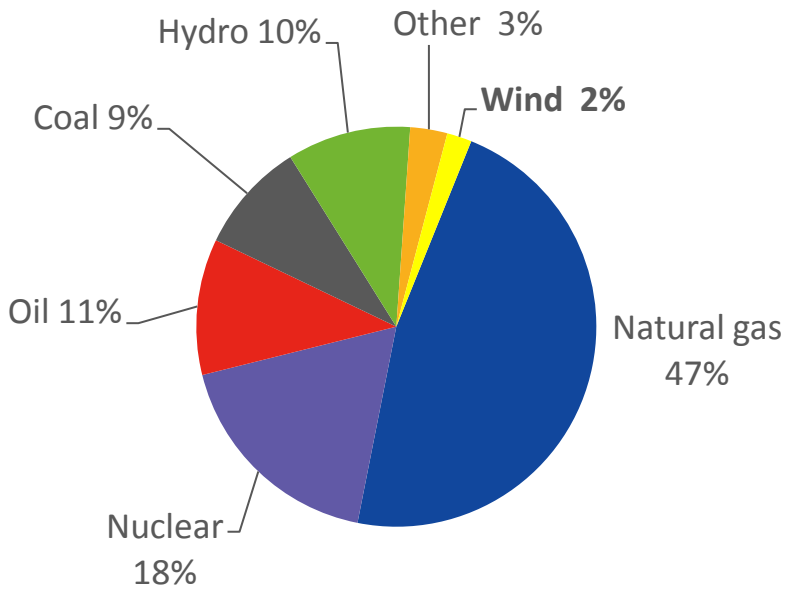
*+26,000 MW demand*




Source: August 2011 COO Report

## 2013 Peak Day
## July 19

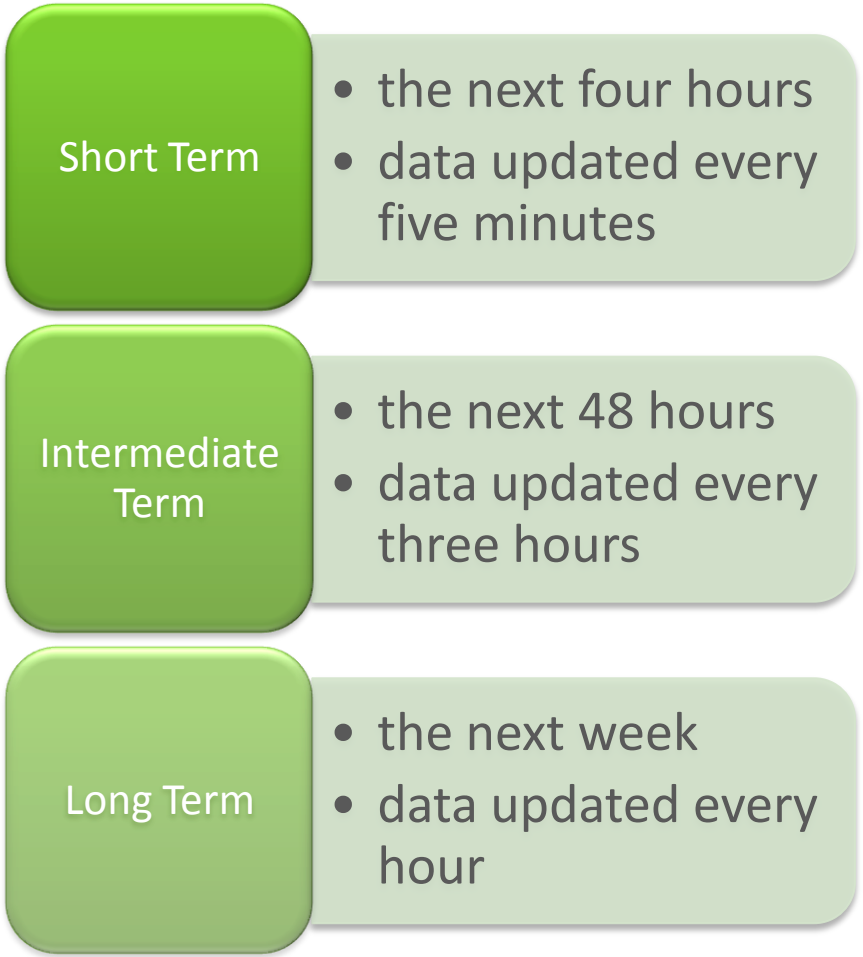
*+27,000 MW demand*




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