The Evolution and Expansion of System Planning

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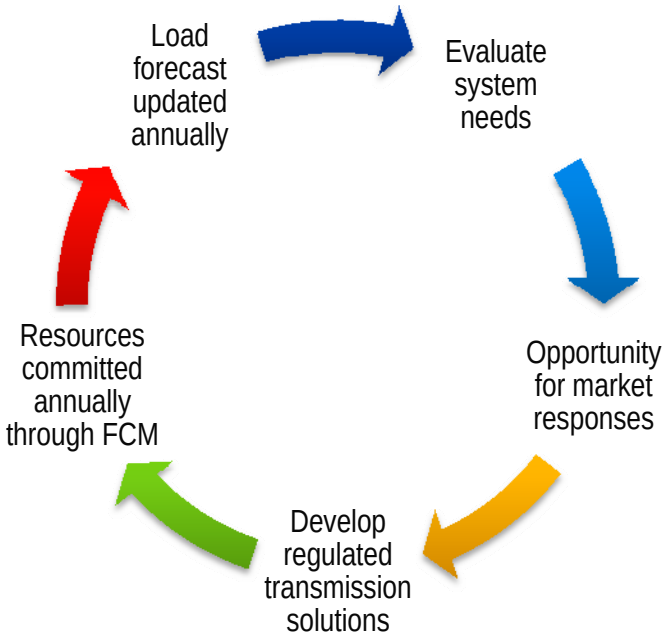
New England Planning Process is Continuous, Adaptive, Successful

- Transparent, 10-year annual needs assessment reflects:
  - Updated load forecasts
  - Market responses
  - Timing of future resource needs
- Preferred transmission solutions
- Results: reliability-based transmission investment across the region

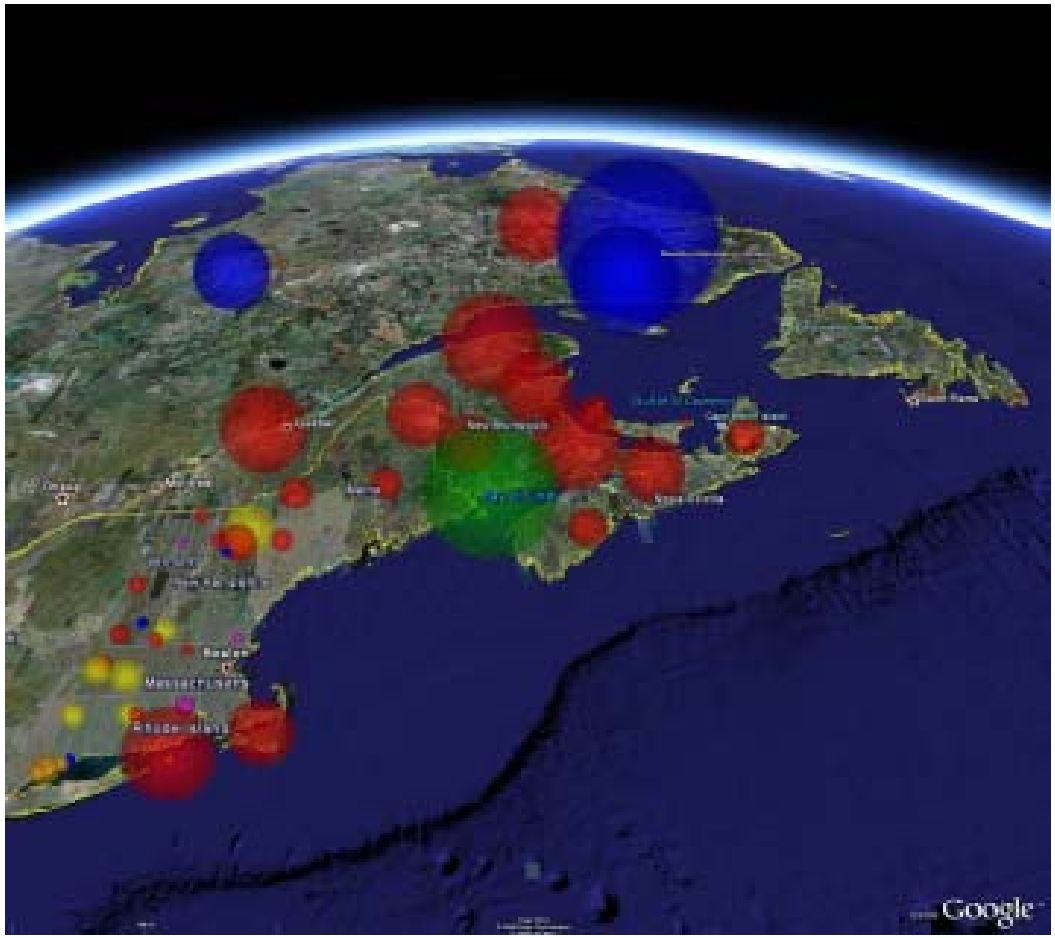


Planning Evolving Beyond Reliability Needs

Policymakers seek environmental, economic solutions

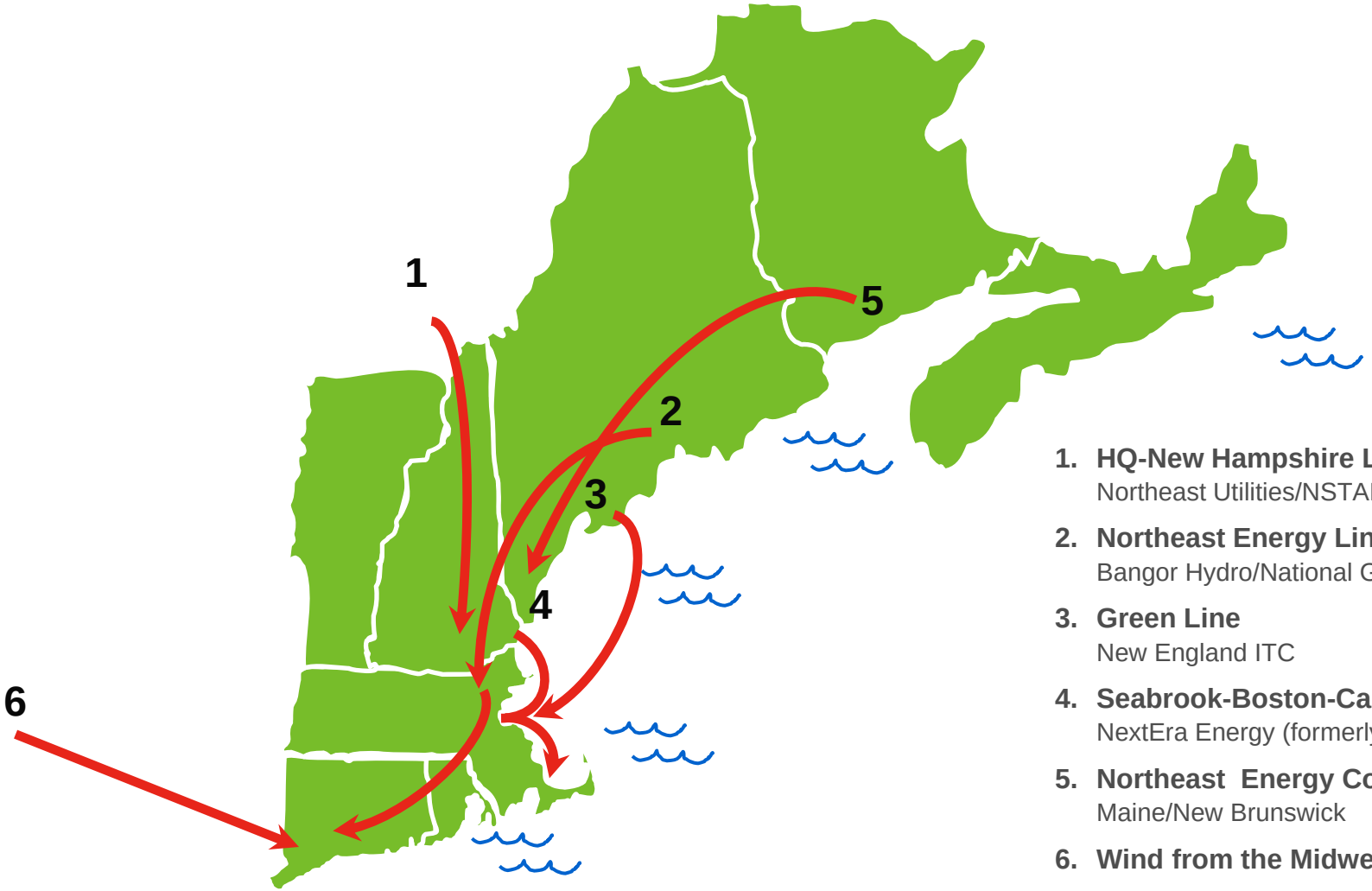
- **FERC** requires economic studies in 2008
  - Studies evaluating multiple long-range resource and transmission scenarios have been performed but cost allocation is undecided
- **Governors** pursue long-term vision for renewable integration
- **Congress** seeking legislation for:
  - Aggressive transmission development, broader planning, a smarter grid, national carbon cap and trade, national RPS

Developers Proposing Renewable, Low- and Non-Emitting Resources in New England, Eastern Canada



- Hydro
- Wind
- Biomass
- Landfill gas
- Fuel cell
- Nuclear

On- and Off-shore HVDC Projects Vying to Move Renewable Energy to New England Load Centers



1. **HQ-New Hampshire Line**
   Northeast Utilities/NSTAR
2. **Northeast Energy Link**
   Bangor Hydro/National Grid
3. **Green Line**
   New England ITC
4. **Seabrook-Boston-Cape Cable**
   NextEra Energy (formerly FPL)
5. **Northeast Energy Corridor**
   Maine/New Brunswick
6. **Wind from the Midwest**

Governors' Request ISO Technical Support for Regional "Blueprint"

- States seek to identify:"***significant sources of renewable energy available to New England, the most effective means to integrate them into our power grid, and the estimated costs***."
  - New England States Committee on Electricity (NESCOE), March 2009
- Request economic study for 2009
- Transmission funding methodology uncertain

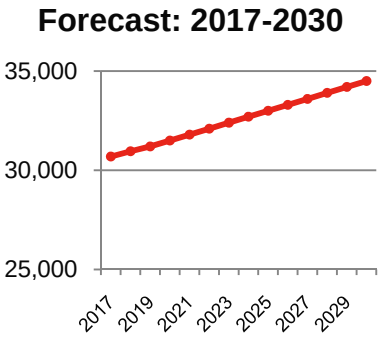
Blueprint: Approach

- Study is based on renewable resource scenarios
  - Combination of wind, demand resources, PHEV, energy storage and expanded imports
  - Range of resource penetrations (low / medium / high)
  - Long-term horizon: approximately 20 years into the future (around 2030)
- Evaluates generation retirement scenarios
  - Gas units added if needed to meet Installed Capacity Requirement
- States are developing study assumptions

Blueprint: Preliminary Assumptions

Existing Resources

- Existing capacity plus resources selected in Forward Capacity Market



Demand Forecast

- Extrapolate *2009 Regional System Plan* forecast to 2030 (Approx. 34,500 MW peak demand)

Blueprint: Preliminary Assumptions

Wind

- Add up to 12,000 MW of on- and off-shore wind in New England
  - Off-shore wind distributed evenly between Maine, Massachusetts, and Rhode Island

New Demand Resources

- On-peak and seasonal peak energy efficiency (Passive)
- Real-time Demand Response (Active)
- Emergency Generation

Blueprint: Preliminary Assumptions

Energy Storage

- Add generic energy storage scenario as a proxy for new pumped storage hydro, batteries, compressed air, or other technologies

Plug-in Electric Vehicles

- Up to 2.5 million PHEVs in New England by 2030

Blueprint: Preliminary Assumptions

Repowering:

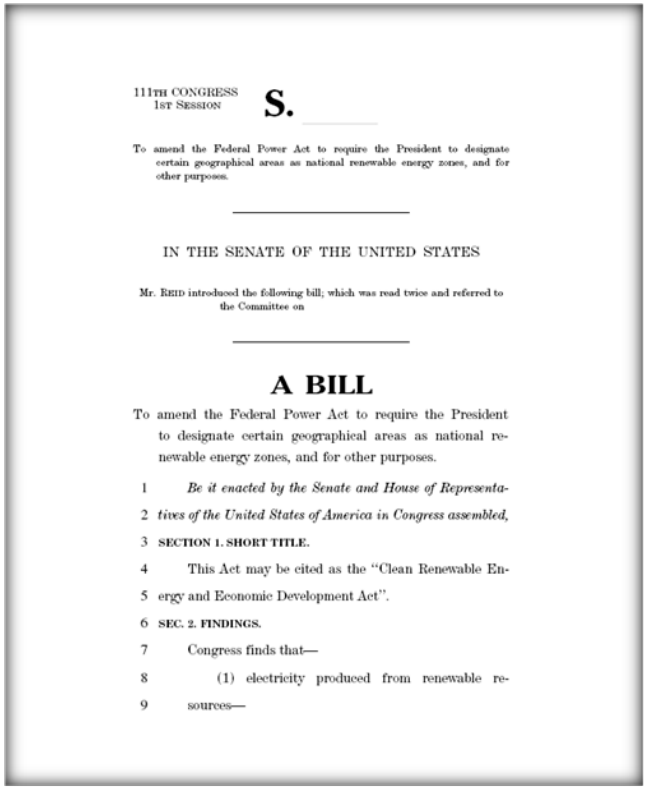
- Repower older fossil generators (oil and coal) with new state-of-the-art natural gas generators

Imports:

- Expand interconnections with neighboring systems to increase imports of clean energy supplies

Congress to Require Broad-based Planning

- Stimulus calls for interconnection-wide planning, study of renewable integration
- Discussion of new planning entity to develop transmission for Eastern Interconnection
- National debate ongoing:
  - Should planning be top-down or bottom-up?
  - Scenarios or plans or combinations?
  - Appropriate role of ISOs/RTOs and states?



111TH CONGRESS
1ST SESSION

S. _____

To amend the Federal Power Act to require the President to designate certain geographical areas as national renewable energy zones, and for other purposes.

IN THE SENATE OF THE UNITED STATES

Mr. REID introduced the following bill; which was read twice and referred to the Committee on

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A BILL

To amend the Federal Power Act to require the President to designate certain geographical areas as national renewable energy zones, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Clean Renewable Energy and Economic Development Act".

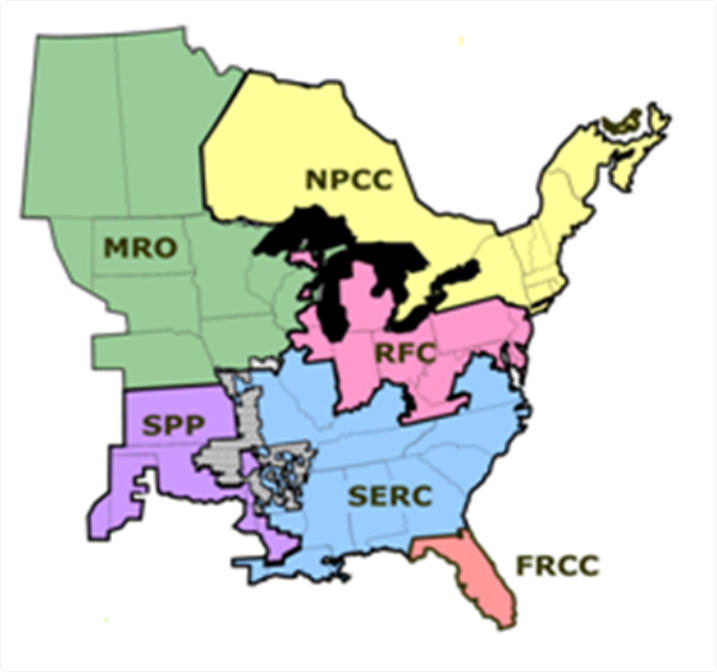
SEC. 2. FINDINGS.

Congress finds that—

(1) electricity produced from renewable resources—

Making Broad Interconnection Planning Work for New England

- Planning authorities establishing collaborative for coordinated planning
- Create analysis of Eastern Interconnection using regional plans as foundation
- “Bottom-up” approach ensures New England characteristics, including Governors’ Blueprint, are considered
- FERC authority to modify regional plans



Moving New England Toward Smart Grid

- Drivers:
  - Improve capacity utilization, reduce consumer costs, promote integration of DR, renewables, energy storage technology
- Requirements:
  - Clear objectives from federal and state policy makers
  - National standards; communications, interoperability, cybersecurity
- Progress:
  - Multiple ISO initiatives to enhance communications, visibility of smart grid devices, and testing of new technologies

Challenges for ISO New England

- **Growing requirements in a period of significant cost control**
  - Existing initiatives stretching current resources
  - Accelerating state, regional and national regulatory requirements to integrate renewable resources and implement smart grid initiatives
  - Increasing stakeholder demand for complex and resource-intensive market improvements and planning services
- **Dilemma: Deciding priorities in a budget-constrained environment**

Conclusion

- Regional planning and cooperation is a solid foundation to meet new planning requirements
- New England to contribute to national energy goals
- ISO New England:
  - To support New England states in developing a regional blueprint for the future
  - Seeks input on five-year business plan and priorities

Natural Gas Use in New England's Power Sector

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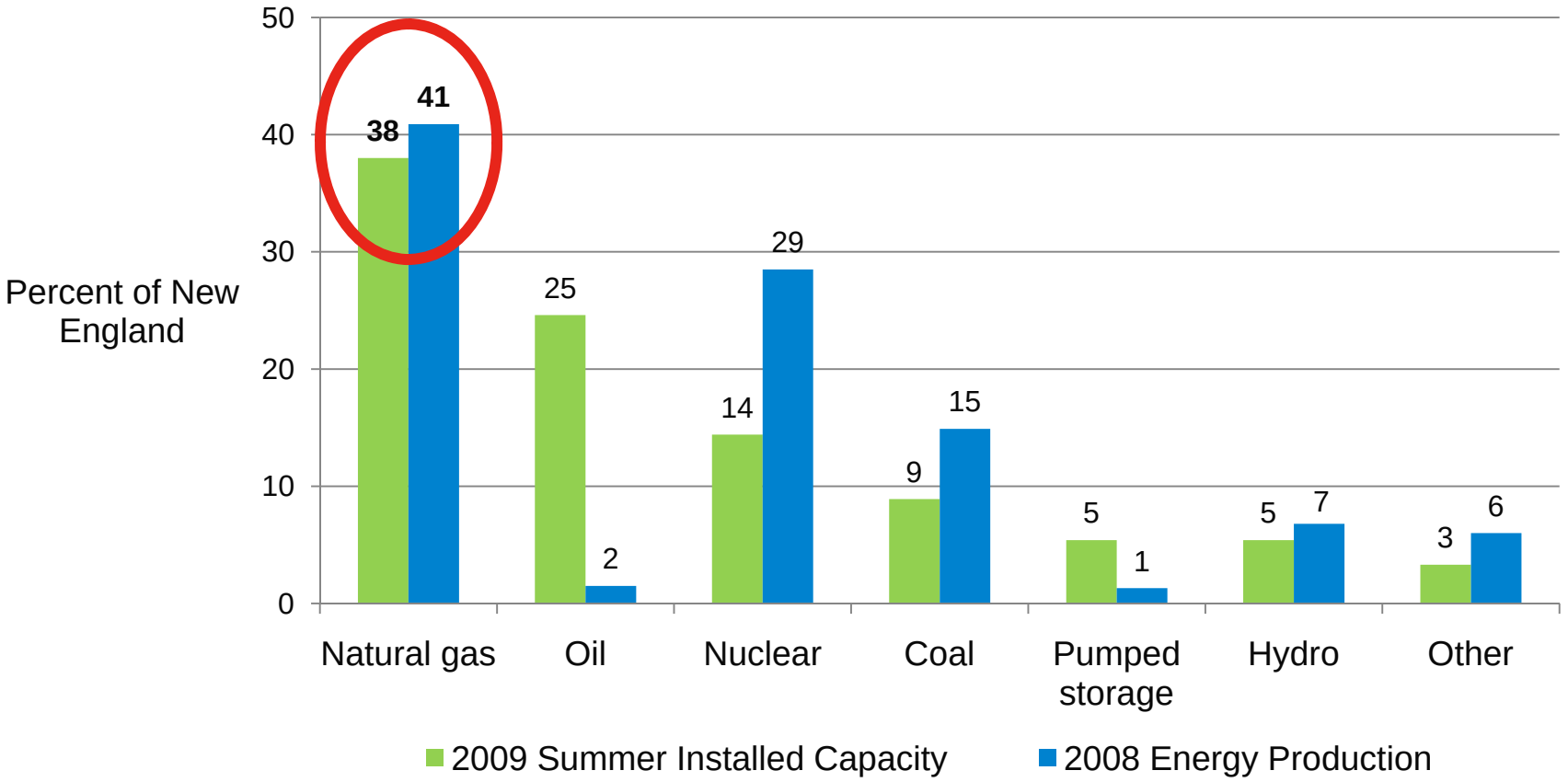
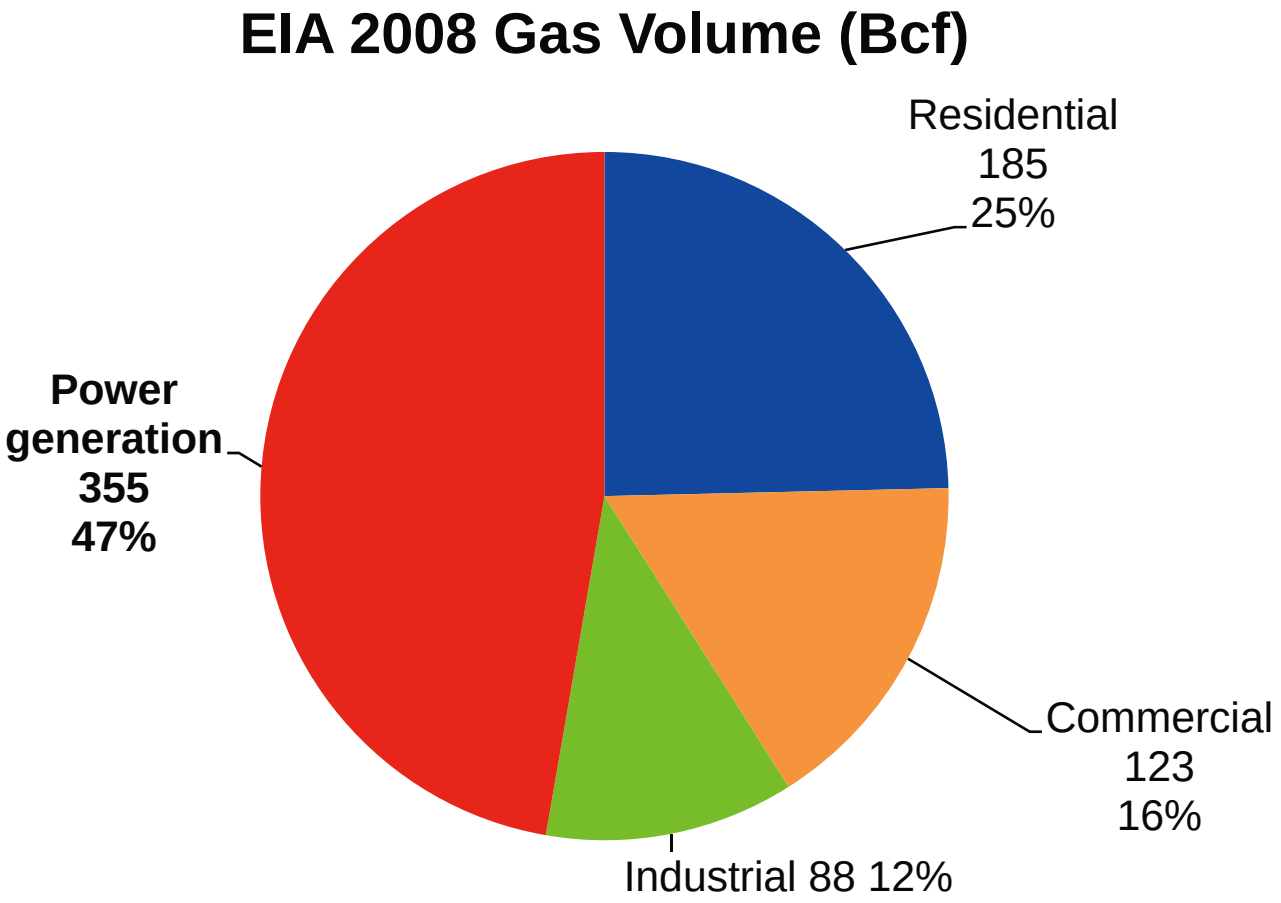
New England is Heavily Reliant on Natural Gas for Capacity and Energy



Nearly Half of Natural Gas Consumed in New England is for Power Generation



Power Supply and Gas Supply Diversity in New England

- State *Renewable Portfolio Standards* (RPS) promote diversity of generation
- Diversification of the regional natural gas supply and delivery system is in progress
  - New natural gas delivery infrastructure
    - Northeast Gateway & Neptune Deepwater Ports
    - Canaport LNG
    - Rockies Express
    - Enhanced storage capability and ability to flow gas bi-directionally
  - New natural gas supply sources
    - Global LNG
    - Rocky Mountain gas
    - Shale gas (Marcellus & others)

New and Improved Tools to Improve Electric System Operators' Visibility of Gas System

- Electric/Gas Operations Committee (EGOC) facilitates education, understanding, communications and coordination
- Access to all regional pipeline Electronic Bulletin Boards (EBBs)
- Software tool that compiles information from EBBs: maps, gas flows, notices, etc. (Bentek Energy)
- FERC Order No. 698 provides ISO with authority to obtain fuel supply information from individual gas-fired generators

Communications is Key

- Electric system operators need advance notice of events on the gas system that may impact fuel deliveries to gas-fired generators
  - *Electric/Gas Operations Communications Protocol* provides real-time gas system information to ISO control room
  - Northeast Gas Association (NGA) supports ISO-NE, NYISO & PJM
    - Winter Gas Supply Manual
    - Gas Supply Task Force (GSTF) debriefing notes
    - Any other pertinent gas sector information
- ISO-NE and regional pipelines are now coordinating maintenance outages to ensure both electric & gas system reliability

Mitigating Reliability Issues

- **Completed actions**:
  - Improvements to market rules and procedures
  - New inter-industry coordination and communications protocols
  - Prominent infrastructure additions within both sectors
- **Continued challenges**:
  - Mismatch between the wholesale natural gas and electric markets
  - Resource commitment uncertainties
  - Unforeseen events in real-time operations
  - LNG supply risks
  - Natural gas quality/interchangeability
  - Price exposure
  - Others

What's Next on the Horizon?

- Significant interest in renewable projects
  - Wind, biomass, small hydro, fuel cells, other projects
  - Imports from Eastern Canada
- System will need resources with quick-start, fast-ramping characteristics
  - Newer gas-fired generators can balance output from intermittent resources
- *New England's power sector will continue to rely on natural gas for many years to come*

Roadmap to Renewable and Demand Resource Integration in New England

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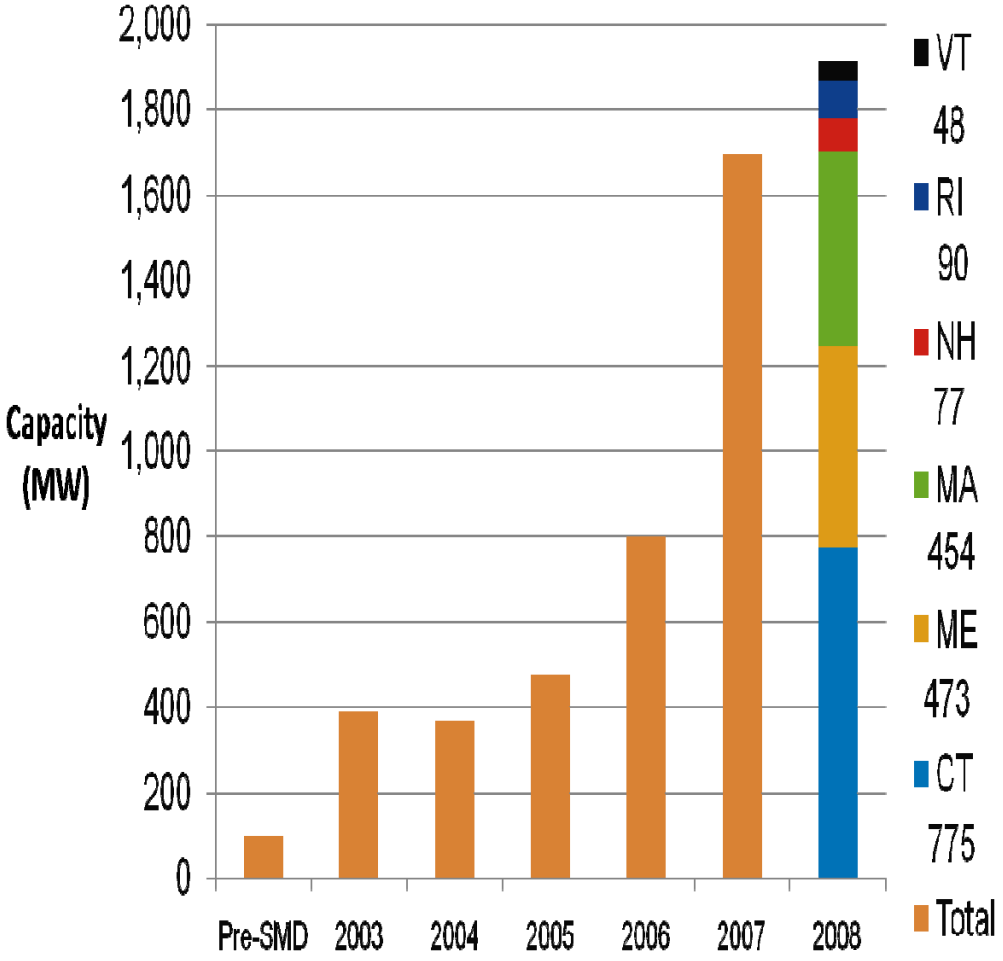
New England's Future Grid

- Distributed and renewable resources are starting to become main-stream
- The power system grid is evolving from a traditional generation base to various different kinds of resources:
  - Demand Resources
  - Wind and other intermittent renewable resources
  - Storage devices such as flywheels, batteries and plug-in hybrids
- Wind resources present the largest opportunity for growth in renewable integration

Operational Challenge

- Integration of demand and renewable resources effectively into real-time operations is critical to maintain reliability
  - Today, the ISO is focused on the integration of Demand Resources
  - Next, the ISO will be focused on the integration of wind and “smart grid” resources

Demand Resources Integration

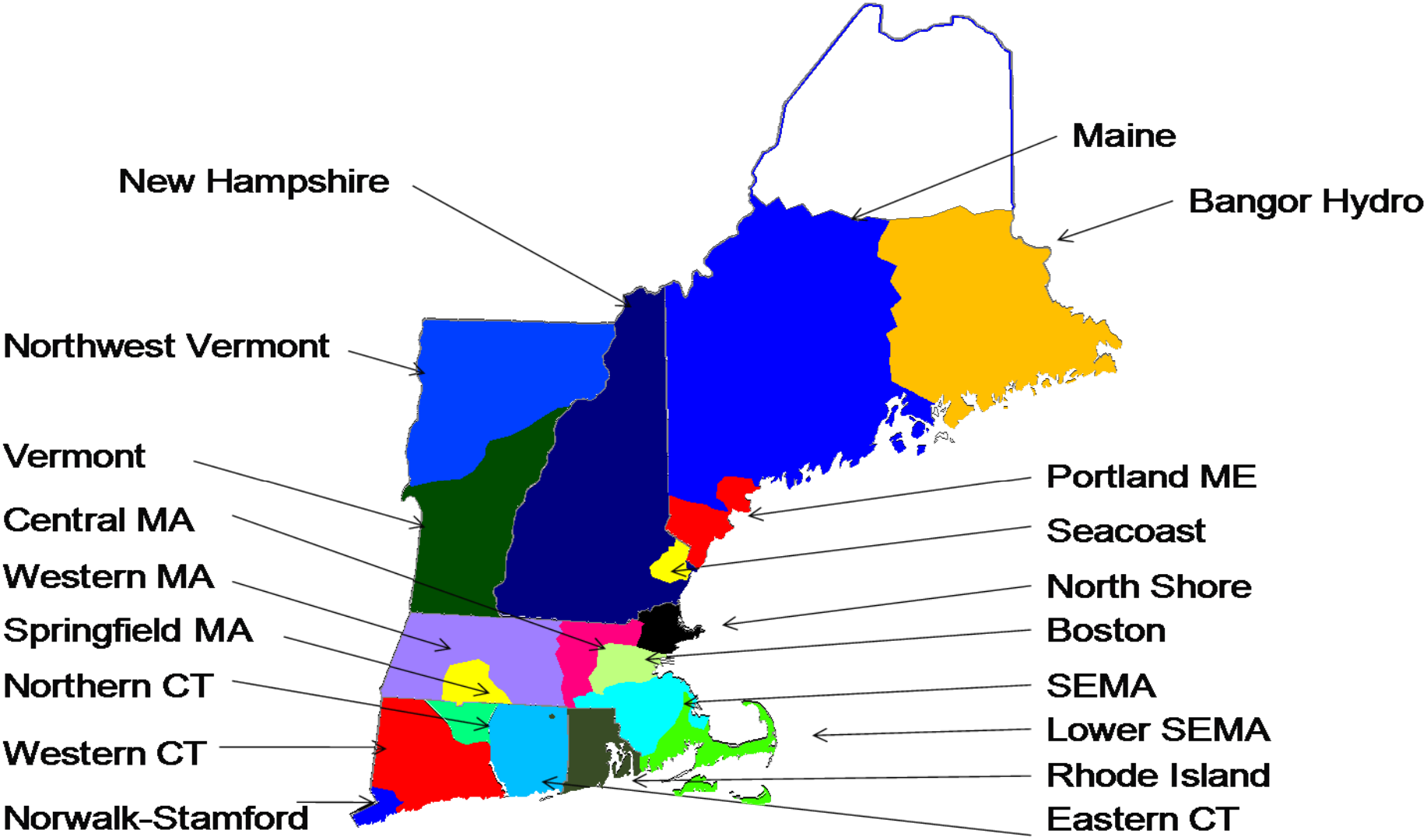


- Growth of Demand Resources (DR) continues under FCM
- DR Clearing in Forward Capacity Auctions:
  - FCA #1: over 2500 MW
  - FCA #2: over 2900 MW

New Dispatch Rules Improve DR Performance

- DR to be dispatched in “Dispatch Zones”
  - Allows dispatch of resources only when, where and in amounts needed
  - Dispatch in 19 targeted areas:
    - Prevents unnecessary activation of DR
    - Limits customer fatigue
  - Flexibility allowed for providers to use a portfolio of assets to respond within a zone

Dispatch Zones Under FCM



Improved DR Software & Communications Infrastructure

- Developing enhanced and secure communication with DR
- Improving forecasting of DR availability and projected use
- Implementing new software that will fully integrate the DR solution into the Energy Management System

Integrating Wind Resources

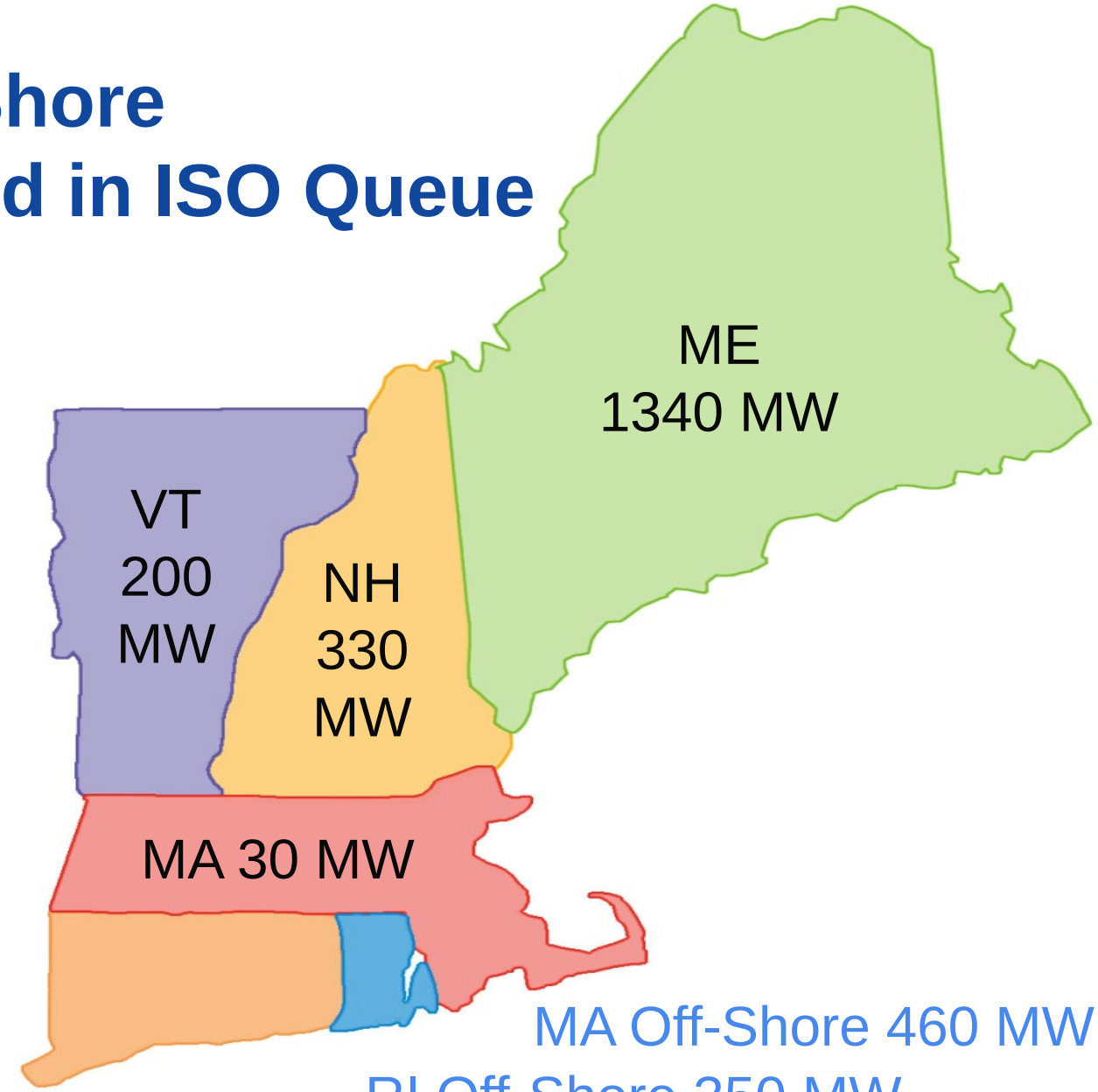
- Transmission infrastructure to deliver large-scale wind from remote areas to load centers
- Transmission funding mechanisms
  - i.e., participant funding, cost sharing agreements, federal incentives
- Favorable investment and regulatory environment
- Identification and resolution of operational challenges

On- and Off- Shore Wind Proposed in ISO Queue

On-Shore = 1900 MW

Off-Shore = 810 MW

Total = 2710 MW



Roadmap to Wind Integration

ISO's objectives:

- Understand New England-specific characteristics
  - How wind, load, generation and transmission interact
- Determine forecasting needs and techniques
- Develop operating requirements and solutions

Regional Wind Patterns and System Characteristics

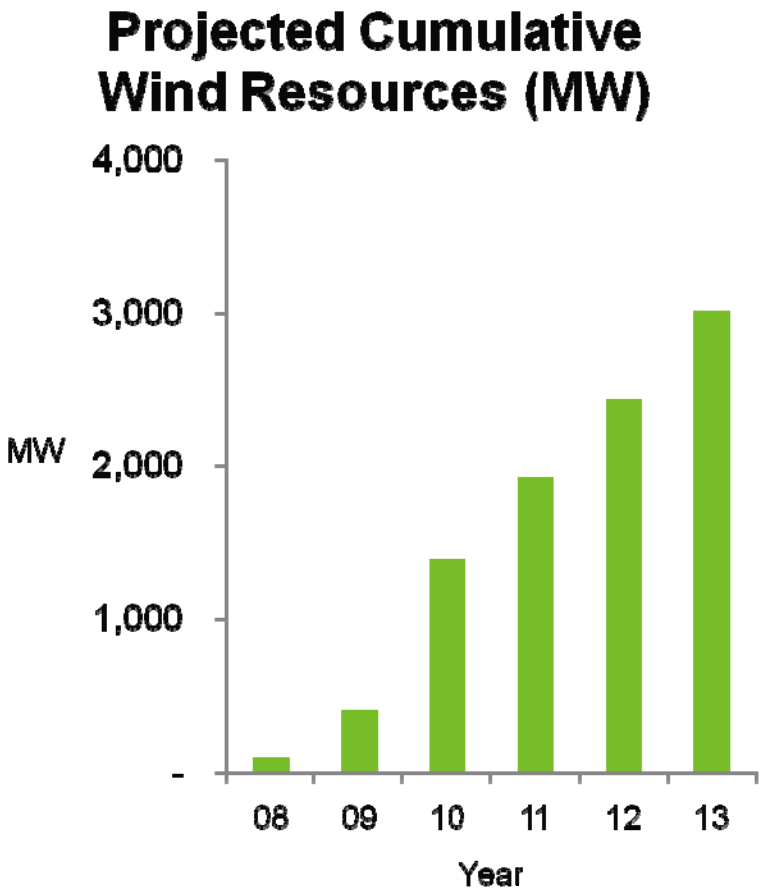
- Wind diversity and interactions
  - Wind and load patterns
  - Installed generation
- Impact of region-specific characteristics
  - Off-shore
  - Neighboring control areas with strong wind resources
  - Located near the end of the Eastern Interconnection
  - Market systems

Operational Issues

- Over/under commitment caused by forecast uncertainty
- Wind curtailments due to lack of transmission
  - Minimum generation and congestion management issues
- Variability may require additional resources including regulation, load following, and reserves
- Coordination of variability with neighbors

New England Wind Integration Study

- Determine technical requirements
- Create wind model including on-shore and off-shore capability
- Assess impact of wind development scenarios on system operations
- Identify best practices to forecast wind
- Determine contribution of wind to system adequacy



Wind Integration Study (cont.)

- Through RFP, ISO has selected industry leaders to complete the study:
  - General Electric (Project Leader)
  - Enernex
  - AWS Truewind
- Study Completion in Summer 2010
  - Technical Review Committee established
  - Scenario assumptions to be reviewed with the Planning Advisory Committee

Integration of DR and Renewables

Sets the stage for the development of the Smart Grid

- Greater reliance on demand and renewable resources will increase complexity of bulk power system management
- From a grid operator perspective, balancing a diverse set of technologies and resources requires controllability and visibility
- Smart Grid technologies and applications will increase the efficiency of the grid
  - Advanced Metering
  - Storage technologies
  - Advanced Grid Simulator
  - Various other technologies and software applications