ISO on Background—
Strategic Planning Initiative

ISO New England Inc.
October 6, 2011

ISO new england

About ISO New England

- Private, not-for-profit corporation created in 1997 to oversee New England's restructured wholesale electric power system
  - Independent of companies doing business in the market
  - Regulated by the Federal Energy Regulatory Commission (FERC)
- 500 employees headquartered in western Massachusetts

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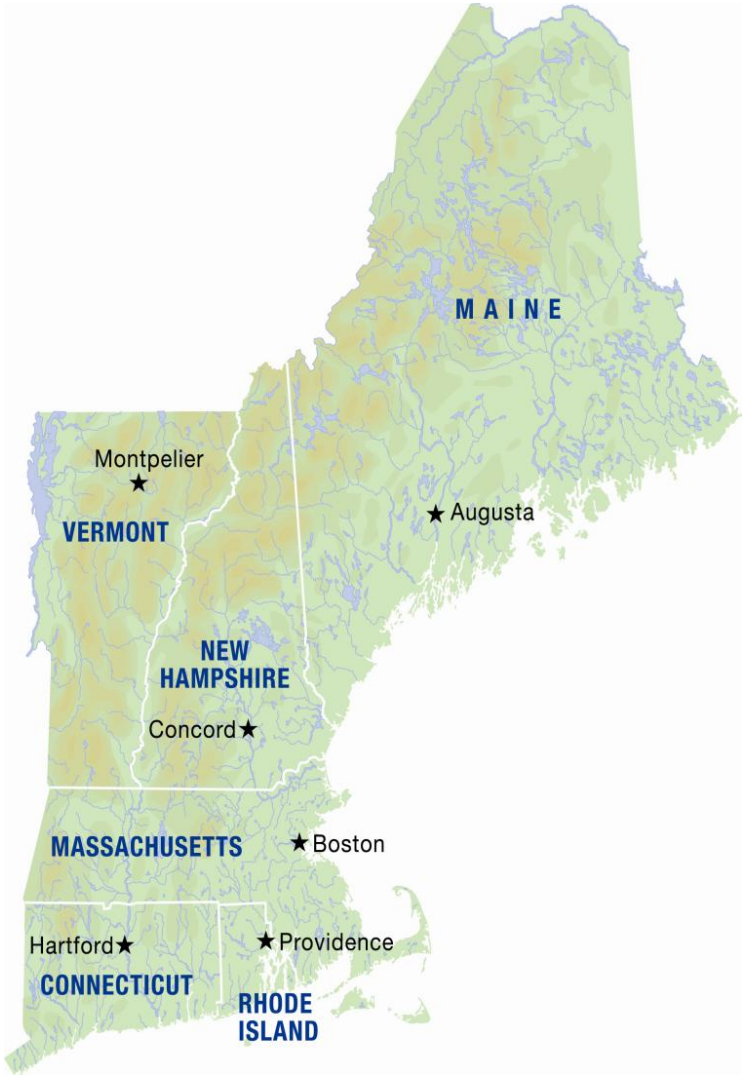
New England's Electric Power Grid at a Glance

- 6.5 million households and businesses; population 14 million
- More than 350 generators
- Over 8,000 miles of high-voltage transmission lines
- 13 interconnections to electricity systems in New York and Canada
- More than 32,000 megawatts (MW) of total supply
  - Includes more than 2,000 megawatts of demand response
- All-time peak demand of 28,130 megawatts, set on August 2, 2006
- Over 400 participants in the market
- $5 - $11 billion energy market value



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ISO New England's Core Responsibilities

Operating the Power System

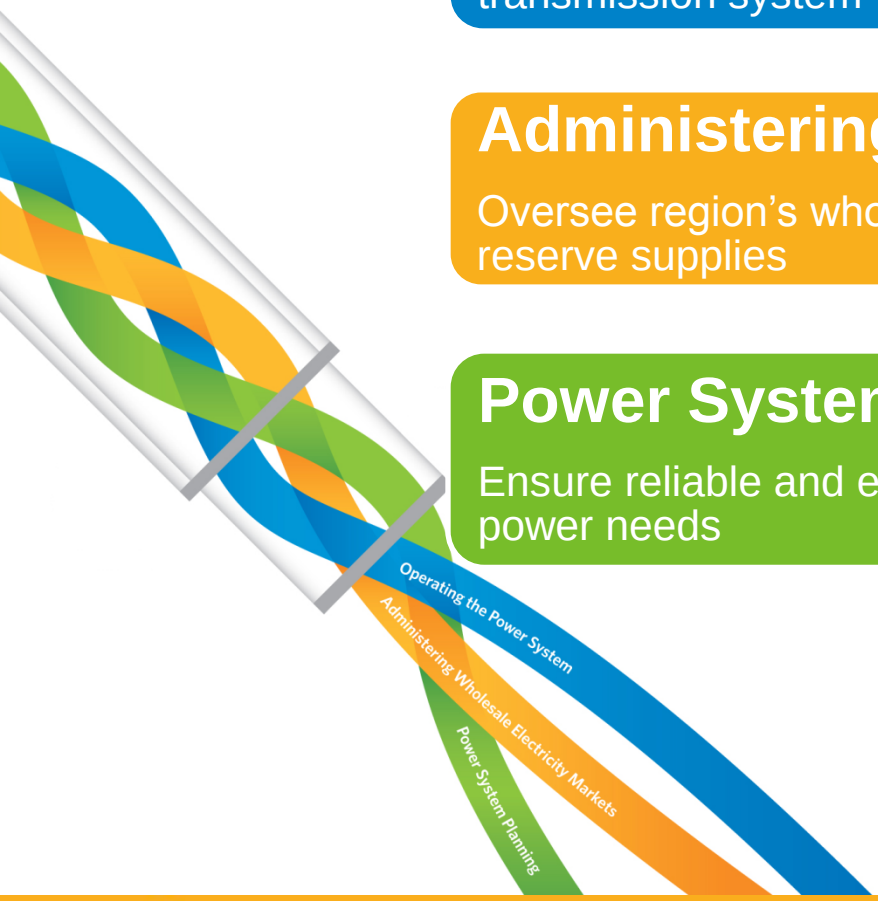
Minute-to-minute reliable operation of region's generation and transmission system

Administering Wholesale Electric Markets

Oversee region's wholesale marketplace for energy, capacity and reserve supplies

Power System Planning

Ensure reliable and efficient power system to meet current and future power needs



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About the *ISO on Background* Series

- An informal opportunity for media to learn more about the trends affecting New England's electricity industry
- Sessions hosted by ISO New England senior management
- Content is considered on-the-record and attributable to the speaker
- To keep the presentation moving, please hold your questions until the end of the discussion; we will save time for questions and answers

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Overview of Today's Discussion

Topic	Speaker
Strategic Planning Initiative: what it is, why it is important	Gordon van Welie
Strategic Planning Initiative Challenges 1, 2, 3, 4	Vamsi Chadalavada
Strategic Planning Initiative Challenge 5, next steps	Gordon van Welie

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Strategic Planning Initiative

Gordon van Welie
President and Chief Executive Officer

Significant Improvements to New England Power System

Generation

- New generation: 13,177 MW have been added since November 1997
- Cleaner, more efficient power plants and added emission controls have lowered average emission rates between 1999 and 2009
  - Sulfur dioxide (SO_2) down 71%
  - Nitrogen oxide (NO_X) down 66%
  - Carbon dioxide (CO_2) down 18%

Transmission

- 2002 through 2011: 379 projects needed for reliability, totaling $4.6 billion of new infrastructure investment

Demand Resources

- More than 2,000 MW currently part of the regional power system
- 3,600 MW committed for June 1, 2014, through May 31, 2015

Wholesale Markets

- 2010: $9.1 billion in transactions by nearly 500 buyers and sellers
- Number of market participants has increased, creating more wholesale competition

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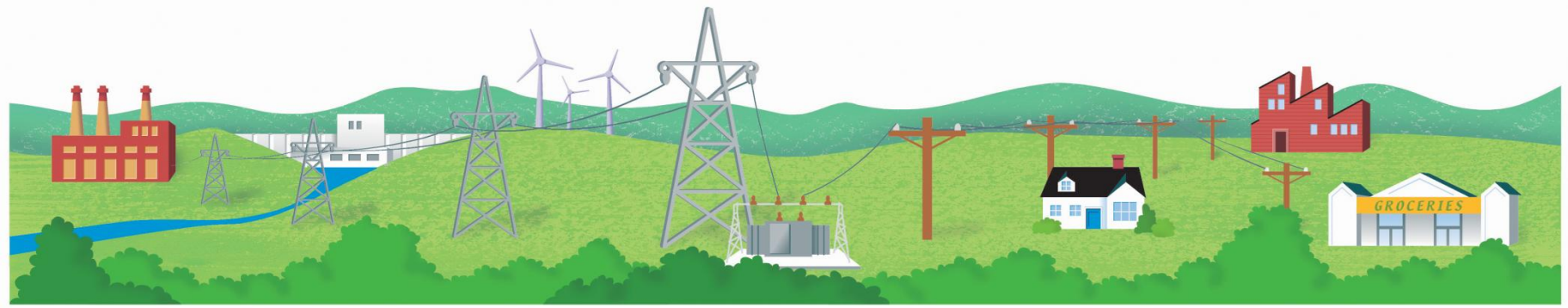
Changing Energy Landscape

Despite advances in transmission, generation, demand resources, and wholesale markets, the energy landscape is rapidly changing:

- Regulatory and policy goals
  - Emissions/environmental
  - Renewables
  - Energy efficiency
- Economic challenges for some older fossil fuel-fired resources
- Advances in technology



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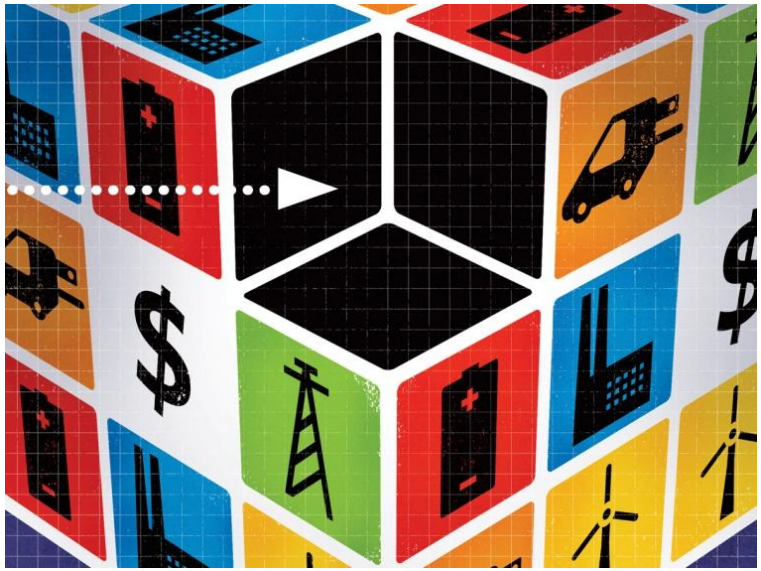
What is the Strategic Planning Initiative?

- Proactive effort to prepare for challenges ahead
- ISO-NE and stakeholders have been in discussions about five key challenges that are likely to affect the New England power grid
  - Challenges could affect grid reliability and wholesale market efficiency
- ISO-NE has the tools to maintain reliability
- Enhancements needed to ensure efficient outcomes
- Work has begun to develop short- and long-term solutions



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ISO-NE's Role in Strategic Planning

- ISO-NE is responsible for ensuring reliability – it is embedded in our mission
  - Three overarching responsibilities of mission include system operation, planning, and administration of wholesale markets
- These responsibilities gives us a bird's eye view of emerging issues in the industry
- Independent structure means objective analysis of trends, challenges
- Stakeholder-driven processes facilitate transparency and strong coordination in region

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Strategic Planning Initiative Launched

Five interrelated challenges identified, near- and long-term components

The key challenges to work on are:

1. Resource performance and flexibility
2. Increased reliance on natural gas-fired capacity
3. Retirement of generators
4. Integration of variable resources
5. Alignment of planning and markets

Addressing these challenges will help ensure a reliable system and efficient marketplace in the long-term.

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Impact and Timing of Key Challenges

0-3 Years

1. Resource performance and flexibility
2. Increased reliance on natural-gas-fired capacity

3-6 Years

3. Retirement of generators

6-7 Years

4. Integration of variable resources
5. Alignment of system planning and wholesale electricity markets

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Examples

- July 2011 and September 2010 heat waves
- January 2011 and January 2004 cold weather events
- Salem Harbor announces retirement
- Current wind power on the system vs. what is proposed

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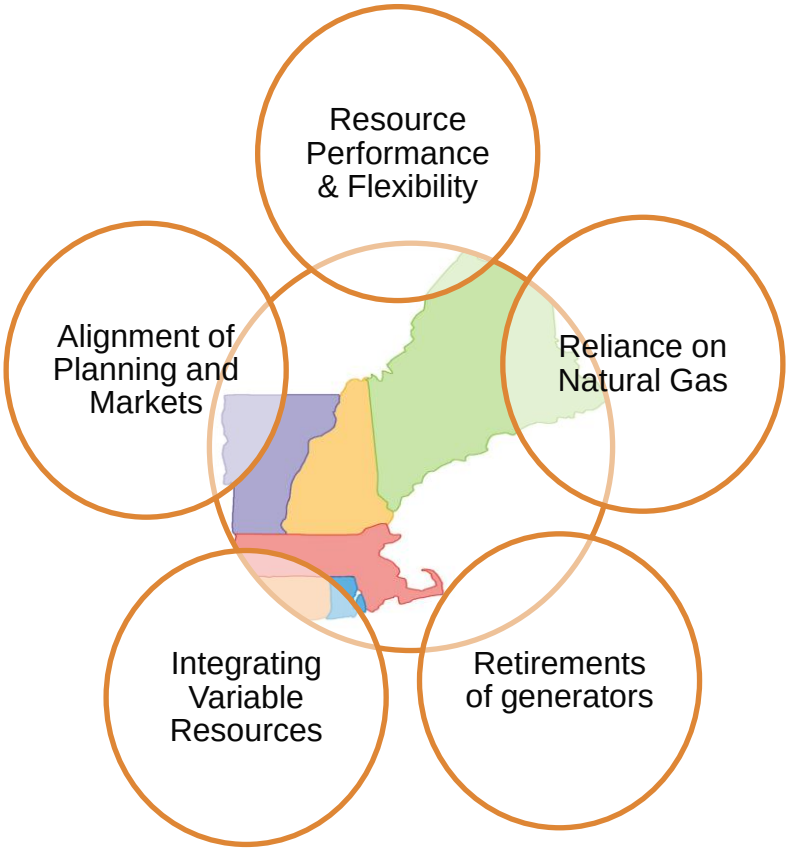
Examination of Challenges

Each challenge is presented in the following way:

- Background
- Real-world example
- Key issues
- Impact
- ISO-NE's actions



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Strategic Planning Initiative Challenge 1: Resource Performance and Flexibility

Vamsi Chadalavada
Executive Vice President and Chief Operating Officer

Resource Performance and Flexibility: Background

- Maintaining a reliable power system means keeping supply and demand in balance at all times
- To ensure reliability through emergencies and tight system conditions, as seen on July 22, 2011, ISO-NE needs a sufficient amount of resources available in reserve every day
- Reserves may be called on if a transmission line or generator trips unexpectedly, or if supplies are running short because demand is peaking

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Resource Performance and Flexibility: Example

July 22, 2011, heat wave

- Set new record for second highest level of peak demand: 27,702 MW
- Four consecutive days of extreme heat
- ISO-NE forced to schedule more expensive, slow-start generators to begin powering up a day (or more) in advance
- Total generation dropped below the level needed to meet demand and reserve requirements, and several actions of operating procedure implemented
- ISO-NE dispatched demand resources to maintain reliability

September 2, 2010, heat wave

- Set all-time peak record for month of September: 26,098 MW
- Similar event
- System conditions exacerbated by limited system flexibility

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Resource Performance and Flexibility: Key Issues

- Differences among resources: availability, output, and how they respond to ISO dispatch instructions
  - Older oil and coal units were not designed to be used as flexible, ramping resources
  - Demand-response resources can only be dispatched in emergency conditions
  - Heavy reliance on a limited set of power plants for quick-start generation

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Resource Performance and Flexibility: Impact

- With few flexible quick-start generators, generators that take 12+ hours to start must be committed in advance to ensure reliability when demand is expected to be high
- Performance uncertain for older units that rarely run
- This can lead to:
  - Inefficient operation of the system
  - An increase in "out-of-market" costs
  - Reliability issues

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Resource Performance and Flexibility: ISO-NE Actions

- ISO-NE periodically meets with plant managers and operators, transmission owners, and demand response aggregators to review procedures
- Looking at how we operate the grid and the structure of markets
  - Contingency tools (measures ISO-NE control room can take to manage through operational issues)
  - Better-defined system operating needs and incentives for resource performance
  - Operating procedures should be refined to reflect resource performance characteristics

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Strategic Planning Initiative Challenge 2: Increased Reliance on Natural Gas

Increased Reliance on Natural Gas: Background

- New England generating fleet has changed over the past two decades
- 1990s: region largely dependent on oil and nuclear
- By 2010: Natural gas has grown and continues to be dominant fuel
  - Natural gas-fired generation produced 46% of electricity; nuclear produced 30%; coal produced 11%; oil produced just 0.4%
- Reasons for shift:
  - Economics: lower price of natural gas (impacted by discovery of shale deposits)
  - Emissions profile: natural gas typically has a lower emissions profile than oil- or coal-fired plants; easier to comply with New England environmental regulations
  - Transmission: upgrades ease the flow of power, reduce reliance on older units to ensure reliability

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Increased Reliance on Natural Gas: Example

January 2011 cold weather event

- Extremely cold temperatures
- Weather-related equipment issues at natural gas-fired generators caused outages at several plants
- Nearly 2,000 MW of generation was unavailable during the operating day
- Oil and coal units not able to quickly replace loss of generation, due to lengthy start-up times
- Showcased the interdependency of natural gas and electric system operations
- Low wind speed

January 2004 cold weather event

- Similar, but more severe event than January 2011

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Increased Reliance on Natural Gas: Key Issues

- Gas-fired generators generally do not have firm fuel contracts for delivery of natural gas
  - Can result in potential delivery restrictions to power plants when pipeline is loaded
- The consequence is that the natural gas heating market (firm fuel contracts) takes priority over electricity generation when demand for natural gas is high
- Current rules and procedures don't incorporate pipeline contingencies in long-term system planning
- Pipeline capacity limitations in light of new gas-fired generation additions

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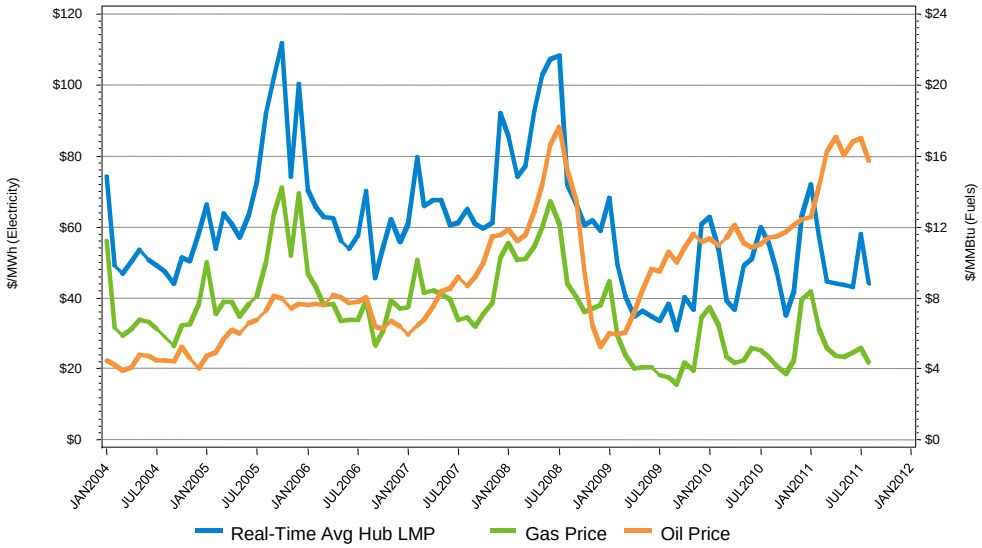
Increased Reliance on Natural Gas: Impact

- Heavy reliance on natural gas heightens vulnerability to natural gas infrastructure problems
  - If outages on the gas infrastructure prevent gas-fired generators from operating, oil-fired units are unable to replace that loss quickly because of long start times
- Natural gas often sets wholesale energy prices, which could subject region to price fluctuations
- Dual-fuel capability is important for flexibility, but not required in the region



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Increased Reliance on Natural Gas: ISO-NE Actions

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- Currently studying the region's natural gas system to:
  - Analyze the effects of potential generator retirements (Challenge 3) on fuel diversity
  - Determine how much gas is available for electricity production after all priority heating gas deliveries are accounted for
  - Identify the impact of natural gas infrastructure limitations on the availability of natural gas for electricity production
- Electric/Gas Operations Committee created in 2004
  - Facilitates communication and coordination among electric and natural gas industries and ISO-NE control room
  - Established pipeline protocols and cold weather emergency procedures

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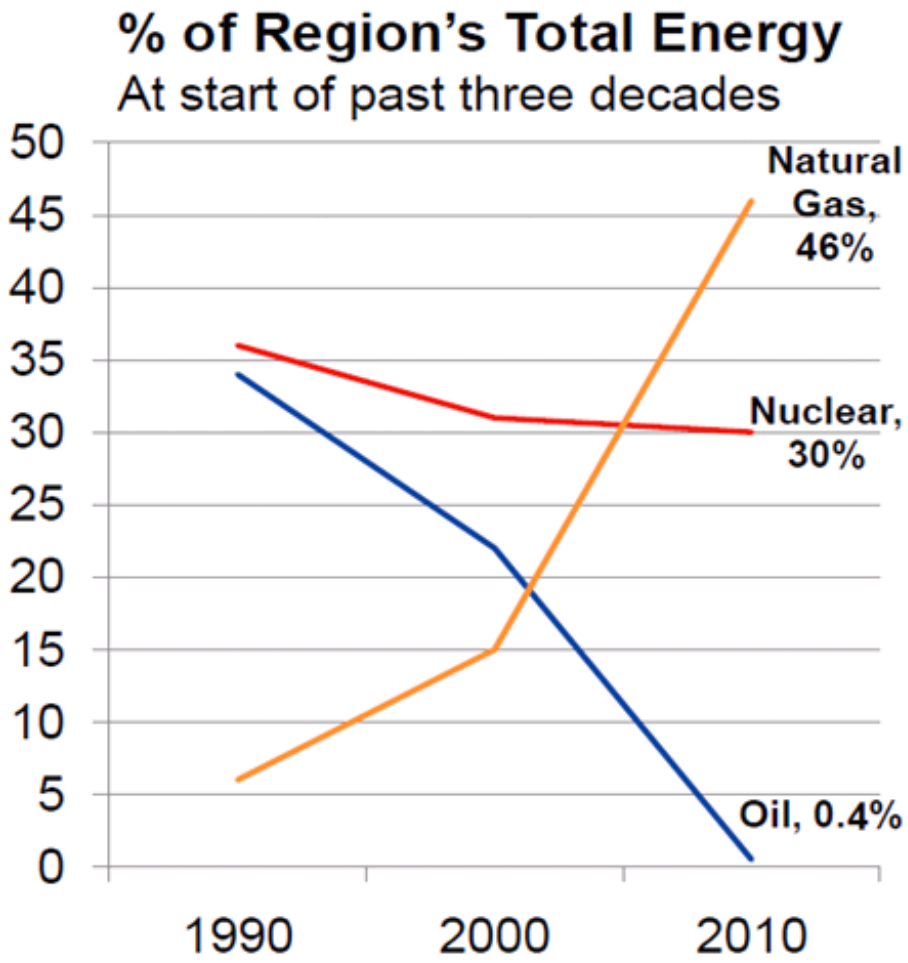
Strategic Planning Initiative Challenge 3: Potential Retirement of Generators

Potential Retirement of Generators: Background

- Potential retirement of generators is closely tied with Challenge 2, dependence on natural gas
- Price of oil compared to other fossil fuels has climbed steeply
- While 21% of the region's generating capacity is oil-fired, only 0.4% of electricity consumed in 2010 was produced by oil-fired power plants



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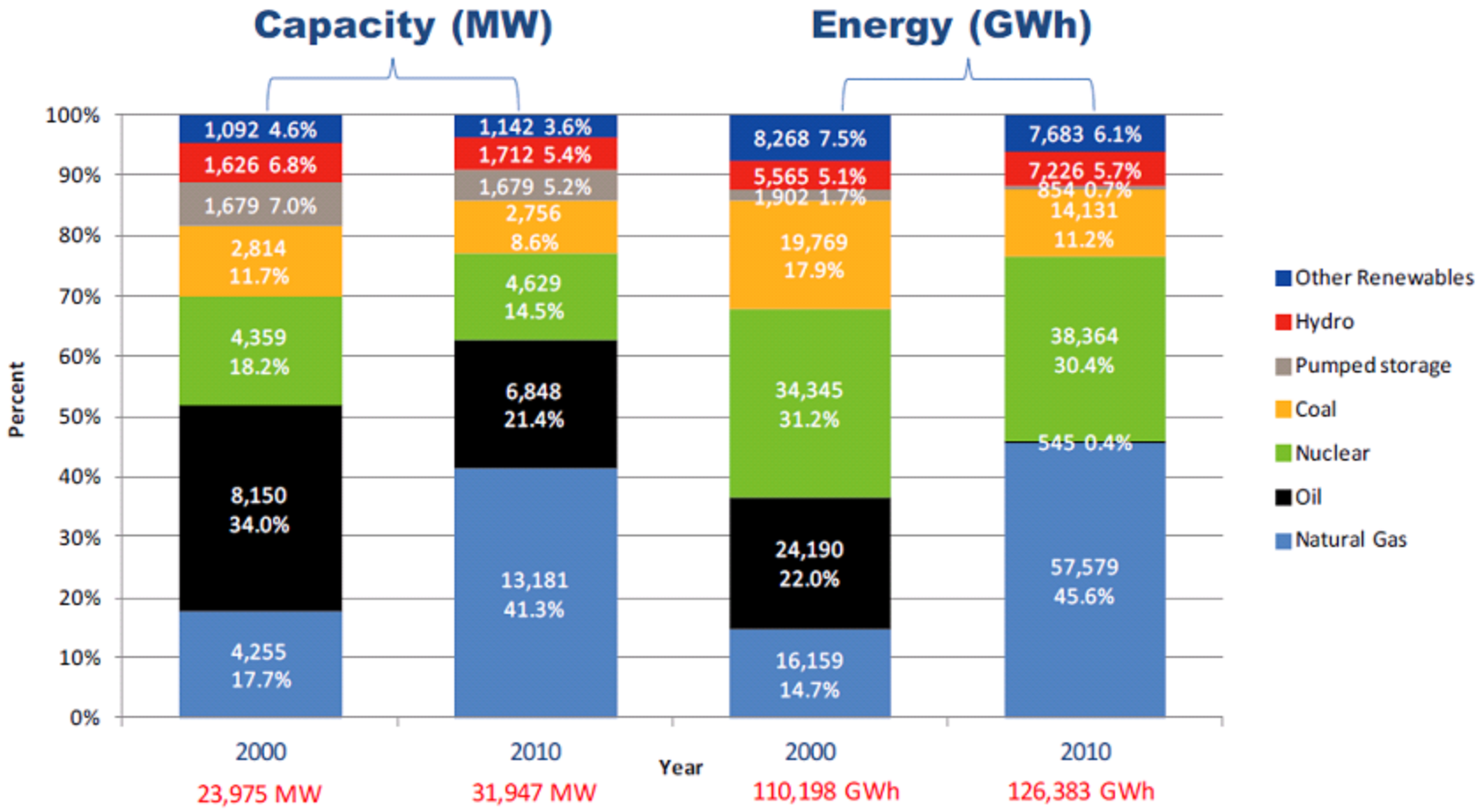
Potential Retirement of Generators: Background



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Potential Retirement of Generators: Examples

- In the past five years, more than 730 MW have retired
- Currently:
  - Salem Harbor
    - ~745 MW total capacity, retiring June 1, 2014
    - ISO-NE working with regional transmission owners to develop long- and short-term solutions to the retirement of all four units
  - Vermont Yankee
    - ~600 MW total capacity
    - Continued operation after March 1, 2012 uncertain

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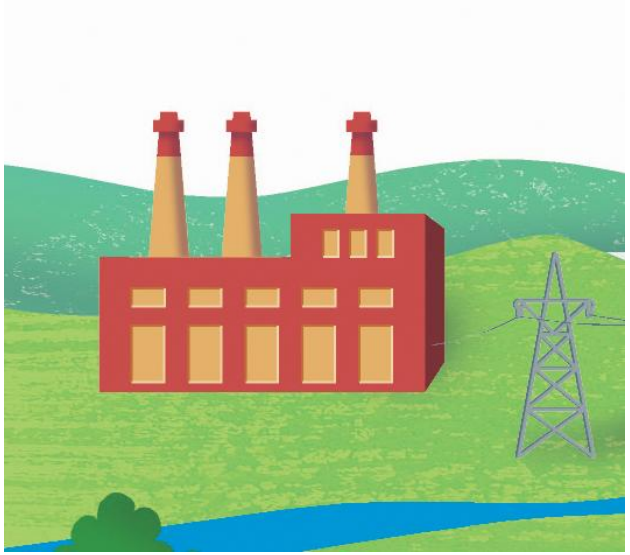
Potential Retirement of Generators: Key Issues

- Lower natural gas prices usually set the wholesale clearing price in the day-ahead market
- Units fueled by higher-priced oil and coal find it hard to compete
  - Unless needed for reliability, a resource that doesn't clear is not called to run and does not get paid
- Proposed environmental rules may accelerate retirements of oil- and coal-fired power plants



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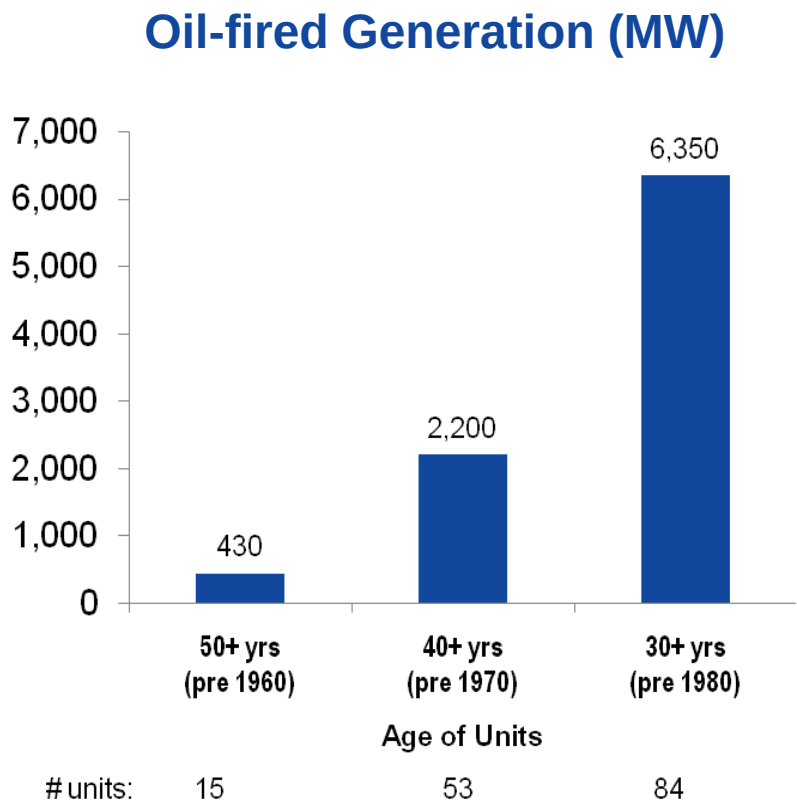
Potential Retirement of Generators: Key Issues (cont.)

- Plants are aging; currently, more than 8,600 MW of New England generation is 30+ years old
  - 6,350 MW are produced by oil-fired generation
  - By 2020, these units will range in age from 40 to 70 years old
- Approximately 90% of the 7,000 MW of total oil-fired generation was originally built as baseload plants (intended to run daily)
  - Many have long start-up times



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Potential Retirement of Generators: Impact

- Impending retirements may mean large loss of capacity that is needed when demand is peaking
- Significant retirements of coal, oil and nuclear capacity would increase the region's dependence on natural gas-fired power plants
- ISO-NE estimates that 3,300 – 5,300 megawatts of oil- and coal-fired generation could be affected by pending environmental regulations
- Affected generators could:
  - Invest in technology to comply with new laws
  - Ask to delist from capacity market on a temporary basis
  - Ask to retire (if needed for reliability, they have the option of remaining operational and receiving higher compensation, if approved by FERC)

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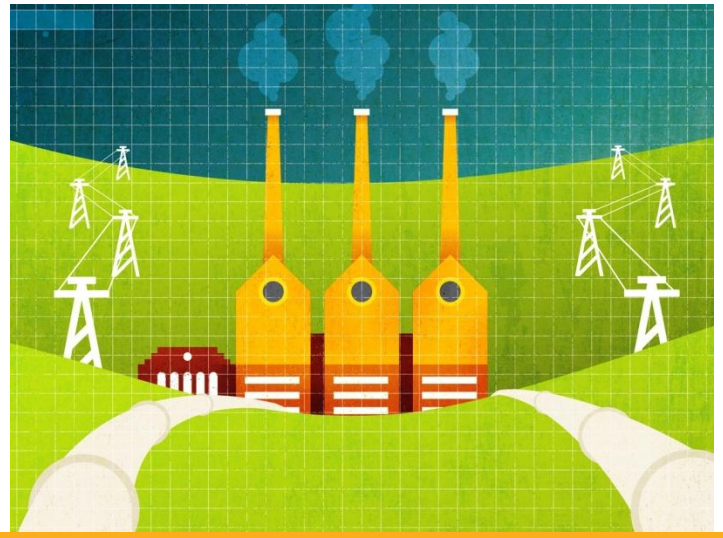
Potential Retirement of Generators: ISO-NE Actions

- ISO-NE is currently conducting a study to identify impact of resource retirements on reliability and transmission system operations
- Examining changes to market rules, operating procedures, and planning processes



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Strategic Planning Initiative Challenge 4: Integration of a Greater Level of Variable Resources

Integration of a Greater Level of Variable Resources: Background

4

- New England states have ambitious goals for increasing renewable energy resources
  - Five of the six New England states have Renewable Portfolio Standards (RPS) mandating that varying levels of electricity come from renewable sources (Vermont does not have a traditional RPS, but a program structured to achieve similar outcomes)
  - States' collective goal calls for 30% of New England's total electric energy demand to be met by renewables and energy efficiency in 2020
  - The Regional Greenhouse Gas Initiative (RGGI) is an effort supported in New England to reduce carbon emissions from power plants
- New England Wind Integration Study (NEWIS) completed
  - Large-scale wind integration in New England—as much as 24%—is achievable, but many conditions must be met

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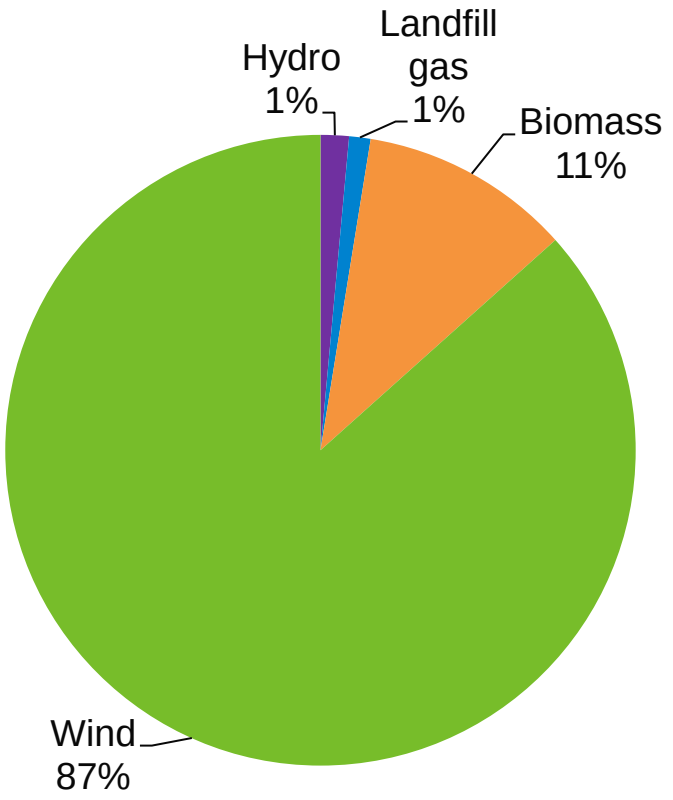
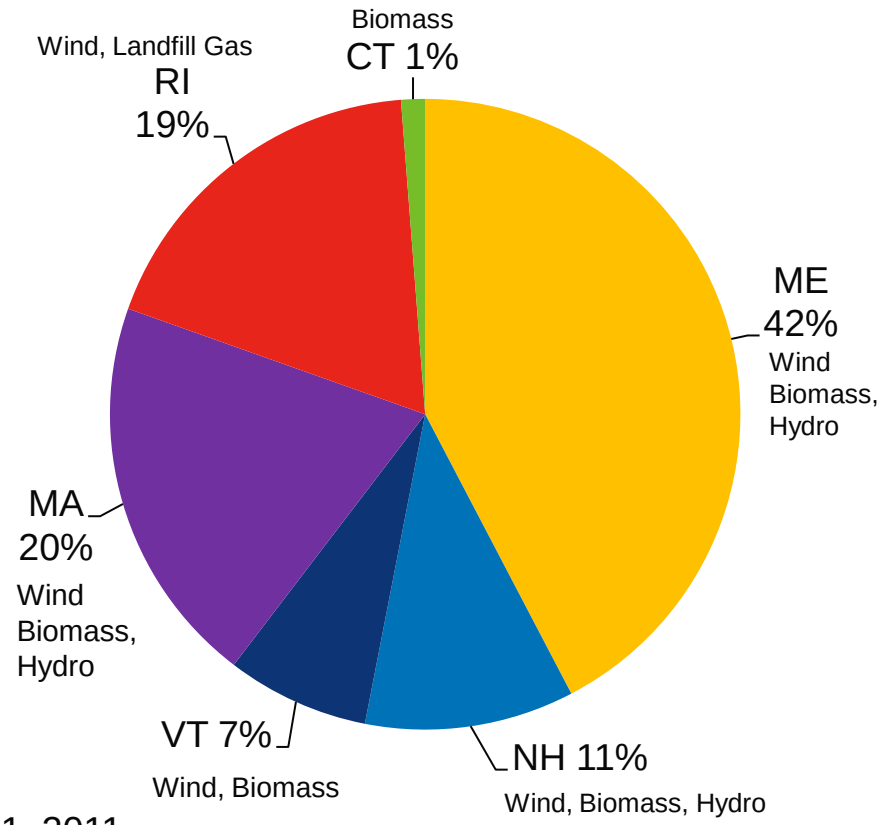
Integration of a Greater Level of Variable Resources: Background

Renewable Resources in ISO-NE Queue; approximately 3,100 MW

Type



State



Note: Pumped storage is not included in total for hydro.

As of Sept, 1, 2011

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Integration of a Greater Level of Variable Resources: Example

4

Amount of interconnected wind vs. amount in queue

- Currently, there are approximately 300 MW of wind on the system
- Nearly 10 times that are in the interconnection queue*
- Despite the long list, the current pace of development is relatively modest – for the time being
- Pace will likely be affected by:
  - The region's willingness to fund transmission projects
  - Litigation and siting that could delay project construction
  - Lower natural gas prices
  - Public policy goals

*The interconnection queue lists the requests submitted by generators to interconnect to the high voltage New England power system.

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Integration of a Greater Level of Variable Resources: Key Issues

- Variability of wind – large swings in electricity output can happen quickly
- Best potential for wind in New England is offshore and in remote locations (far away from demand centers)
- Hard to predict and forecast
- Power system operations must account for variability

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Integration of a Greater Level of Variable Resources: Impact

4

- Billions of dollars in transmission investment needed to transport wind-generated electricity to demand centers
  - Ongoing debate about who pays for transmission upgrades to meet public policy goals
- Large swings in electricity production could result in an unbalanced grid
  - Need to develop accurate wind forecasting system
  - Need more quick-ramping, flexible resources on the system to balance wind's variability (most likely will come from natural gas-fired generation)
  - May require market rule changes to increase amount of reserves, regulation

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Integration of a Greater Level of Variable Resources: ISO-NE Actions

4

- Two-year study to determine what would be needed to integrate large amounts of wind energy (NEWIS)
- Developing wind-forecasting technology
- Considering market changes to better meet operational needs
- Participating in national discussions/forums

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Strategic Planning Initiative Challenge 5: Alignment of Planning with Markets

Gordon van Welie
President and Chief Executive Officer

Alignment of Planning with Markets: Background

- ISO-NE works with stakeholders on an annual basis to develop Regional System Plans that look out 10 years
- Plan identifies system shortcomings and measures that could address reliability needs
  - New England relies first on projects proposed from the market to solve power system needs
  - If market-side investments, such as generation or demand resources, are not proposed, ISO-NE identifies a transmission solution
- As a Regional Transmission Organization, ISO-NE has “backstop authority” to require transmission to be built
  - This has not been needed in New England to date

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Alignment of Planning with Markets: Key Issues

- Regional stakeholders concerned that current market and planning designs may not provide sufficient incentives for market resources to respond to reliability needs, such as generator retirements
- Need to better align wholesale markets with transmission planning process
- ISO-NE's authority is confined to the identification and development of transmission solutions
  - ISO-NE is not in a position to promote one resource over another
- Much discussion about alternatives to building transmission

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Alignment of Planning with Markets: Impact

- Currently, if market-side resources aren't brought forward, region will develop transmission solutions to solve reliability issues
  - Depending on the location, cost, and other factors, a market resource (e.g. power plant, demand resources) may be the more efficient and/or cost-effective choice
- The region is facing a significant transition
  - Enhancements to market design and planning processes will help the region manage through that transition in the most cost-effective way

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Alignment of Planning with Markets: ISO-NE Actions

- ISO-NE recently completed a pilot study analyzing the potential for market resources to solve reliability needs in Vermont and New Hampshire
  - Assessed how many MWs of generation and demand resources would be required to address the reliability need in place of transmission upgrades
- ISO-NE intends to conduct more such analyses showing how market resources can meet reliability needs

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Strategic Planning Initiative – Next Steps

Defining Solutions

- ISO-NE's long-term vision is to address these strategic challenges through wholesale markets
  - Will likely require enhancements to existing markets
  - May include the development of new services or markets
  - Key goal is to provide incentives for resources that fulfill locational needs and desired performance characteristics that can address each of the five challenges
- In the near term, we have identified the following actions:
  - Update existing requirements of the Forward Reserve Market
  - Improve dispatch of demand resources; integrate demand response into the energy market
  - Increase market incentive/penalty structures for resource availability and performance
  - Require more detailed information from resources about their performance characteristics and fuel capability
  - Incorporate natural gas system emergencies in planning analysis

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Ongoing Collaboration and Effort

- Goal is to get ahead of the curve
- Market design and power system infrastructure take time to develop
- Going forward, will build on collaborative process
  - Dozens of meetings with stakeholders, including state government officials, market participants, consumer advocates, and end users
  - Will continue to seek feedback and hold open discussions about challenges and proposed solutions from stakeholders
- Finalize ongoing studies and analyses
- Begin implementing short-term solutions and identifying possible long-term solutions

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