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Coordinating Natural Gas & Electricity in New England: *Who's on First?*

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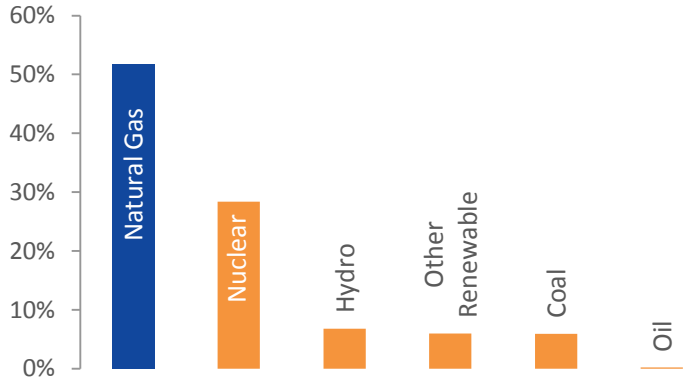
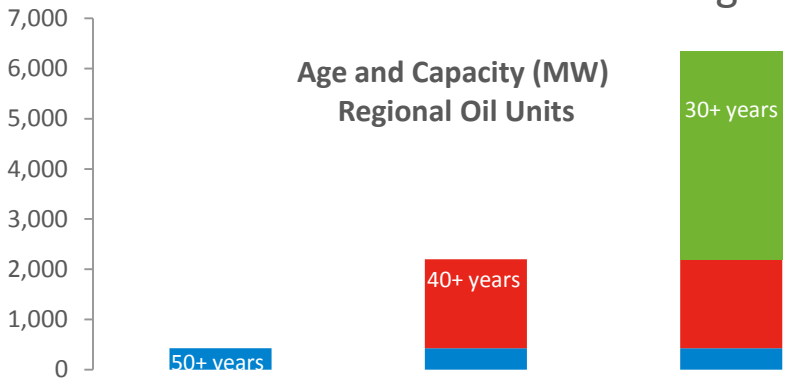
Region Has Significant Reliance on Natural Gas

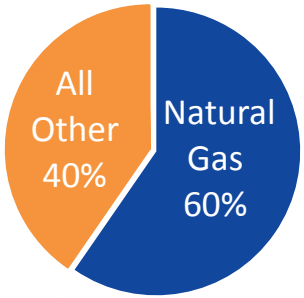
- Energy Production
  - 52% of region's energy derived from natural-gas-fired generators (2011)



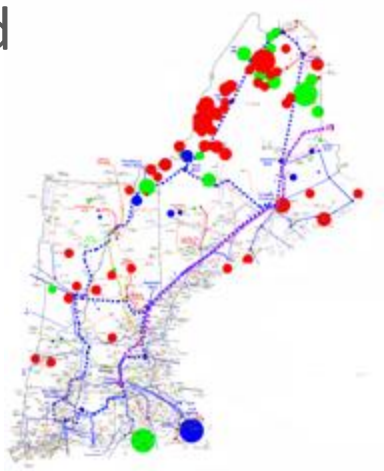
- Potential Oil Retirements
  - Older, less utilized oil units may retire or be retrofitted to use natural gas



- Proposed Development
  - Natural gas predominant fuel proposed for region (April 2012)



- Balance for Wind
  - Large build-out of wind will require balancing for system operation



Examples: Gas-Related Operational Challenges

Date	Scenario	Impact	Challenge Identified
1/14/2004 through 1/16/2004	•Extremely low temperatures •High demand for electricity	•Fuel curtailments at gas plants •Lack of gas transportation for non-firm gas-fired power plants limited unit availability	Vulnerability of system to capacity limitations of regional gas pipeline network
11/30/2007 through 12/5/2007	•Unexpected gas contingency at Sable Island •Diminished natural gas supply injections into Maine	•Gas-fired generation in Maine went offline due to loss of supply •Power Watch for Maine •Power Caution rest of region	Gas supply interruption can impact natural gas generation in region
3/2/2012	•Non-peak winter day •Planned/unplanned transmission outages in Rhode Island and Southeastern Massachusetts	•Critical capacity constraints due to high system demand and pipeline imbalances •Non-gas-fired generation ordered online in RI •Gas-fired generation in RI/SEMA called online •Had local generation not been available high likelihood of load-shedding	Pipeline and transmission service and interruptions can have impacts on reliability

For more detailed information on these examples please see slides in appendix

Coordination and Communication Key

Though communications alone will not resolve all reliability issues associated with the region's dependence on natural gas – it helps

- Outages on electric transmission system can impact gas flow and pressure on gas pipelines
- Outages of interstate and intraregional pipelines can cause reliability problems in region
- Coordination and communication between natural gas and electric industry important for reliability

- ISO New England is continually working with the gas industry to better understand and coordinate systems

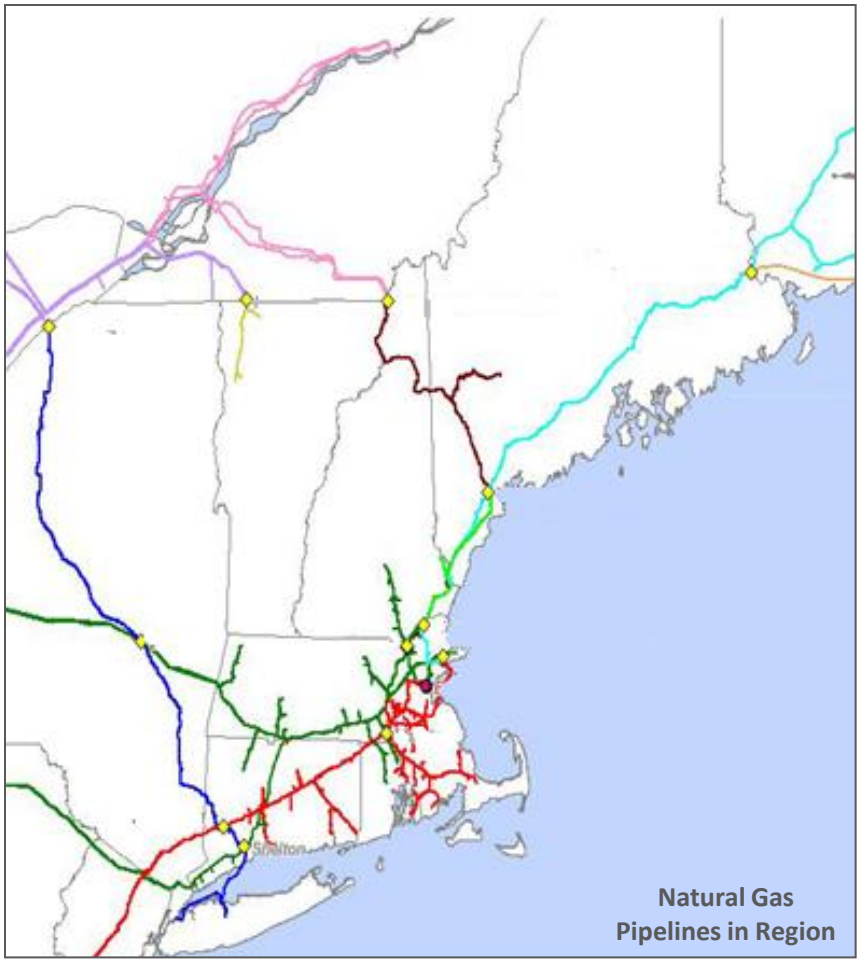
Potential Solutions to Help Operational Challenges

While solutions may be costly, in long-run it will be far more costly to do nothing

- Increased firm pipeline capacity
- Dual-fuel generation
- Local fuel storage to serve peak needs
- Ability to manage electric load
  - Shifting time of day use
  - Dispatching demand resources
  - Energy efficiency
- Market changes to provide better alignment with the gas and electric scheduling cycles

These potential solutions will require investment in infrastructure and some time to implement

Investments in Infrastructure Needed



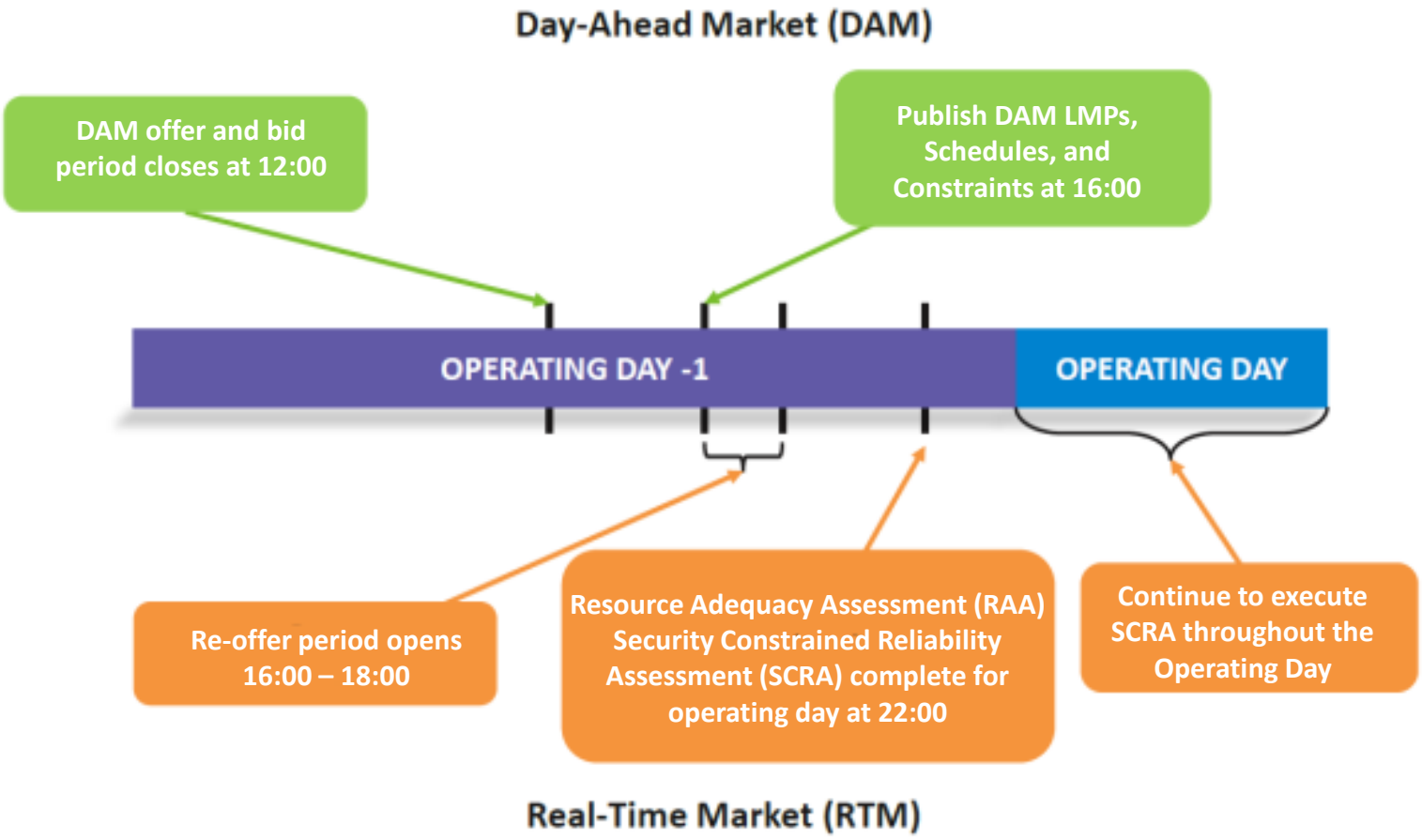
- Infrastructure investment needed to address reliability
- ISO actively working on determining how to have proper market mechanisms in place to allow resources to make investments
  - Dual-fuel capability
  - Firm gas supply
  - Transportation

New England Day-Ahead and Real-Time Markets

- **Day-Ahead Electricity Market**
  - Provides consumers and generators a hedge against real-time prices
  - Uses least cost security constrained economic dispatch
    - Meet demand with lowest production costs while ensuring reliability
  - Initial starting point for real-time commitment
  - Provides operators with look-ahead so they can plan for next operating day

- **Real-Time Electricity Market**
  - Deviations in real-time from expectations set day-ahead and during resource adequacy assessment
    - Load forecast error
    - Scheduling deviation
    - Unplanned outage
    - Contingency response
  - Gives operators ability to meet minute-to-minute demand
  - Requires flexibility in generation fleet to respond to real-time demand

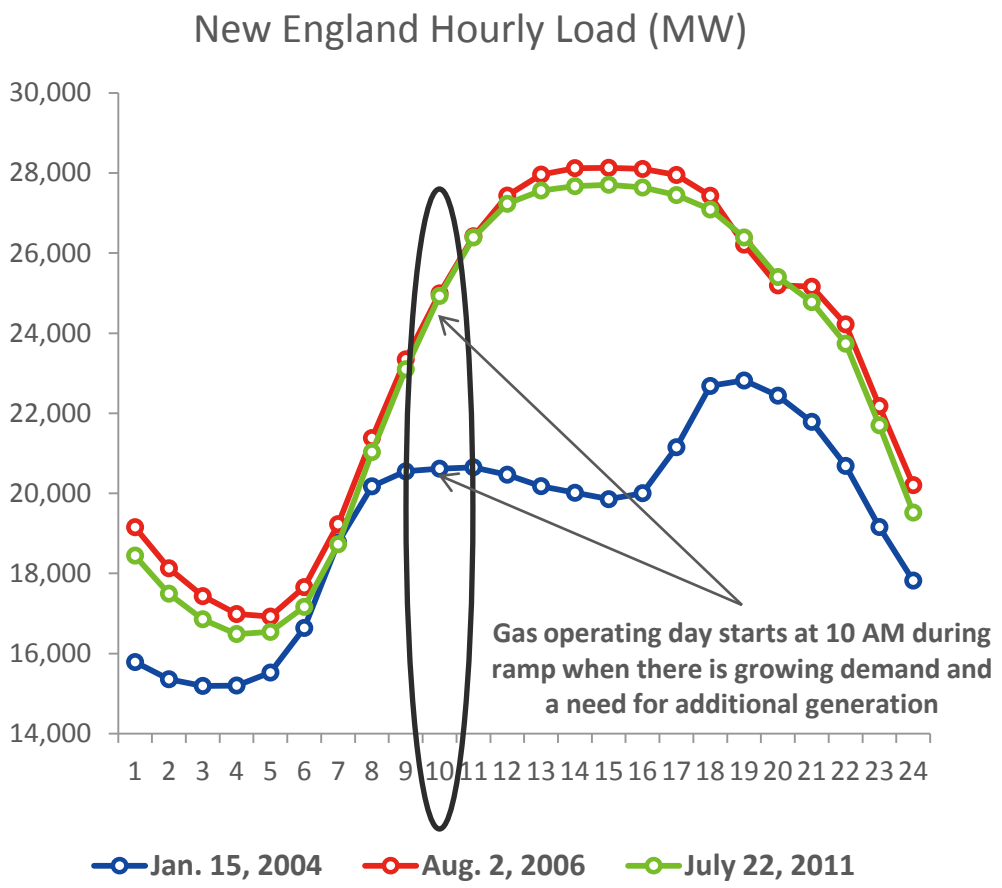
Day-Ahead and Real-Time Electricity Market Process



Gas and Electricity Markets Not Aligned

Gas operating day starts during morning-ramp; ISO has seen gas units curtailed during morning ramp until start of new gas day

- Market alignment issues can have significant impact on energy industry
  - Operators
    - Need to provide reliability during various contingencies
    - Need to know what units are really available intraday
  - Natural gas-fired generation
    - Differences in natural gas and electric operating days makes it difficult for gas-fired generators to satisfy scheduling requirements in electric and gas markets



Hourly Day-Ahead and Intraday Reoffers

- ISO is evaluating energy market design changes
  - Allow dispatchable resources to submit hourly energy offers into DAM and to modify the commitment cost components (i.e. start up and no-load costs) and the incremental energy offer components of supply offers during the operating day
  - Anticipated timeline (estimate):

Timing	Description
April 2012 – December 2012	Assessment
January 2013 – March 2012	Start of stakeholder process
April 2013 – December 2014	Stakeholder process, market rule and tariff changes
January 2015	Earliest effective date

APPENDIX: BACKGROUND INFORMATION

Examples of operational challenges and disconnection in timing between markets

Examples: Cold Snap

- January 14–16, 2004 (aka “Cold Snap”)
  - Extremely low temperatures
  - High demand for electricity
  - Tight conditions in gas market
    - High and volatile gas prices
    - Fuel curtailments at some gas plants
    - Lack of gas transportation for non-firm gas-fired power plants limited unit availability
  - Operational problems reported for all types of units due to weather
  - Resulted in development of *Appendix H – Operations During Cold Weather Conditions*
    - Improved communication with pipelines and generators during cold weather events
- January 19 – 23, 2011
  - Similar cold weather-related issues

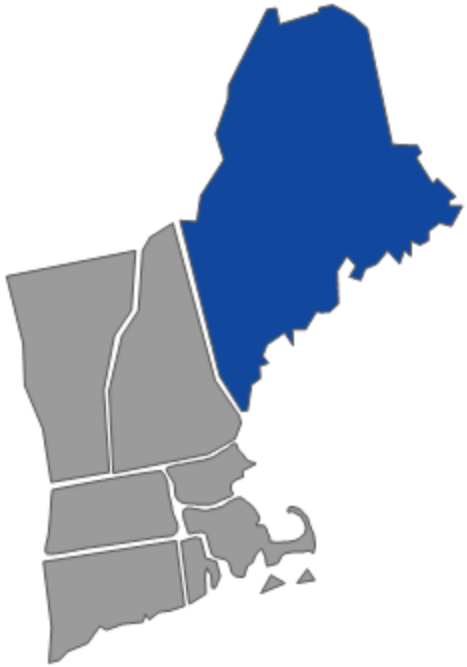
The Cold Snap highlights vulnerability of system due to capacity limitations of regional gas pipeline network

Cold Snap has regionwide implications

Examples: Sable Island

- November 30, 2007 – December 5, 2007
  - Unexpected gas contingency at Sable Island
  - Significantly diminished natural gas supply injections into Maine
  - Gas-fired generation in Maine went offline due to loss of supply
  - Capacity deficiency in Maine
  - *Operating Procedure No. 4* implemented for all of region; Power Watch implemented for Maine to ensure electric system reliability
  - Resulted in reexamination of operating procedures (No. 8 and No. 21) to proactively address future supply issues
    - Event resulted in improved communications with gas industry

Sable Island gas disruption highlights how a gas supply interruption can impact natural gas generation in region

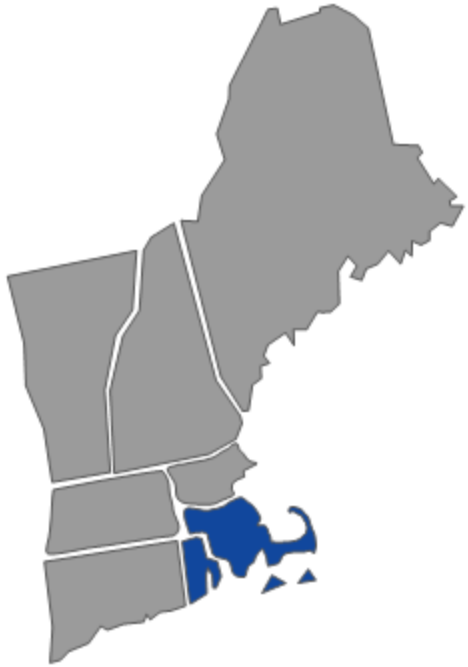


Power Warning declared for Maine – request for conservation

Examples: Rhode Island/Southeast Massachusetts

- March 2, 2012
  - Non-peak winter day
  - Planned and unplanned transmission outages in Rhode Island (RI) and Southeast Massachusetts (SEMA)
  - Gas pipeline issues
    - Critical capacity constraints due to high system demand and pipeline imbalances
    - Operating flow balancing alert for region
  - Non-gas-fired generation ordered online in RI
  - Gas-fired generation in RI and SEMA called online
    - Had this generation not been available high likelihood of load-shedding
- December 10, 2010 and June 6, 2011
  - Similar to March 2, 2012, pipeline maintenance outages and gas restrictions occurred

Events in RI/SEMA highlight how pipeline and transmission service and interruptions can have local impacts



RI/SEMA impacted

Examples: 2011 Heat Wave

- July 22, 2011
  - Historic temperatures
  - Second-highest demand – 27,702 MW
  - Demand response was strong
  - About 3,400 MW of forced outages and reductions
  - Continued communications between ISO, gas industry, and generation

July 22 MW Generation Peak Hour			
Gas	12,577	Hydro Pump Storage	1,148
Nuclear	4,608	Other Hydro	847
Oil	3,611	Wind	162
Coal	2,383	Other Renewable	830

Large amount of gas on system at time of annual system peak underscores importance and magnitude of natural gas in region

Peak use had regionwide implications

Disconnect between Gas and Electric Days