

Reliably Integrating & Managing a System with a High Level of Natural Gas & Variable Resources



65th Annual NECPUC Symposium

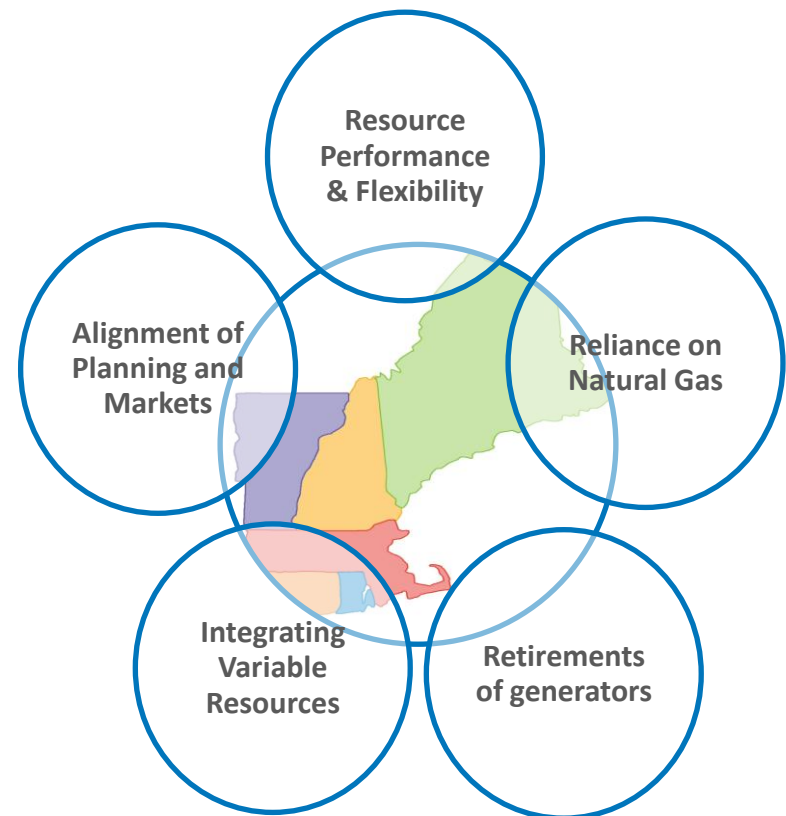
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Strategic Planning Initiative Seeks Solutions to Inter-related Challenges in New England

- How long before aging fossil-fueled generators retire?
- Replacing retired generators with natural-gas resources and renewable-energy resources raises fuel-diversity and system operation concerns
- Region will need a flexible generation fleet to balance variable resources



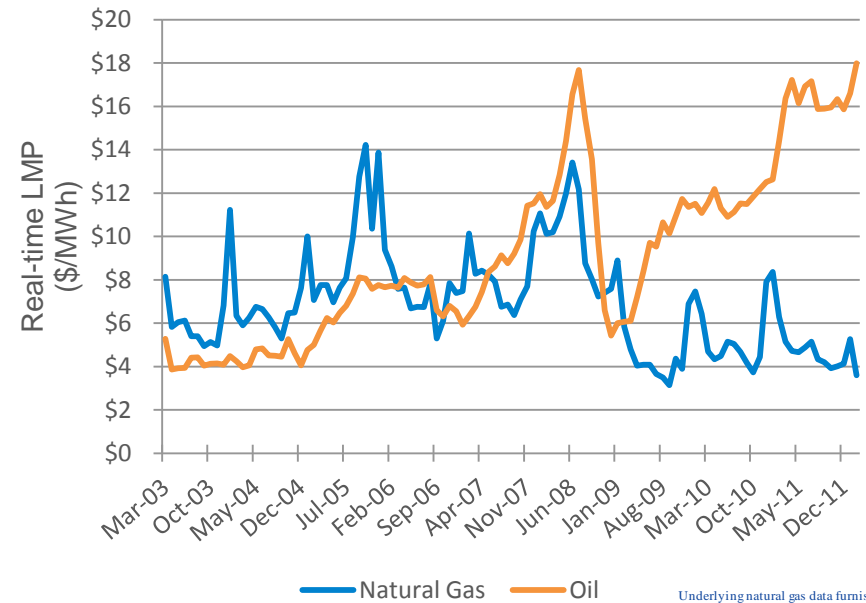
New England has become Increasingly Dependent on Natural Gas for Power Generation

- New England generating fleet has changed over the past two decades
- 1990s: region was largely dependent on oil and nuclear
- Today: Natural gas has grown and continues to be the dominant fuel
- 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



Fuel Prices affect Generator Dispatch

- Price of oil compared to other fossil fuels has climbed steeply over the past few years
- While 22% of the region's generating capacity is oil-fired, less than 1% of electricity consumed in 2011 was produced by oil-fired power plants

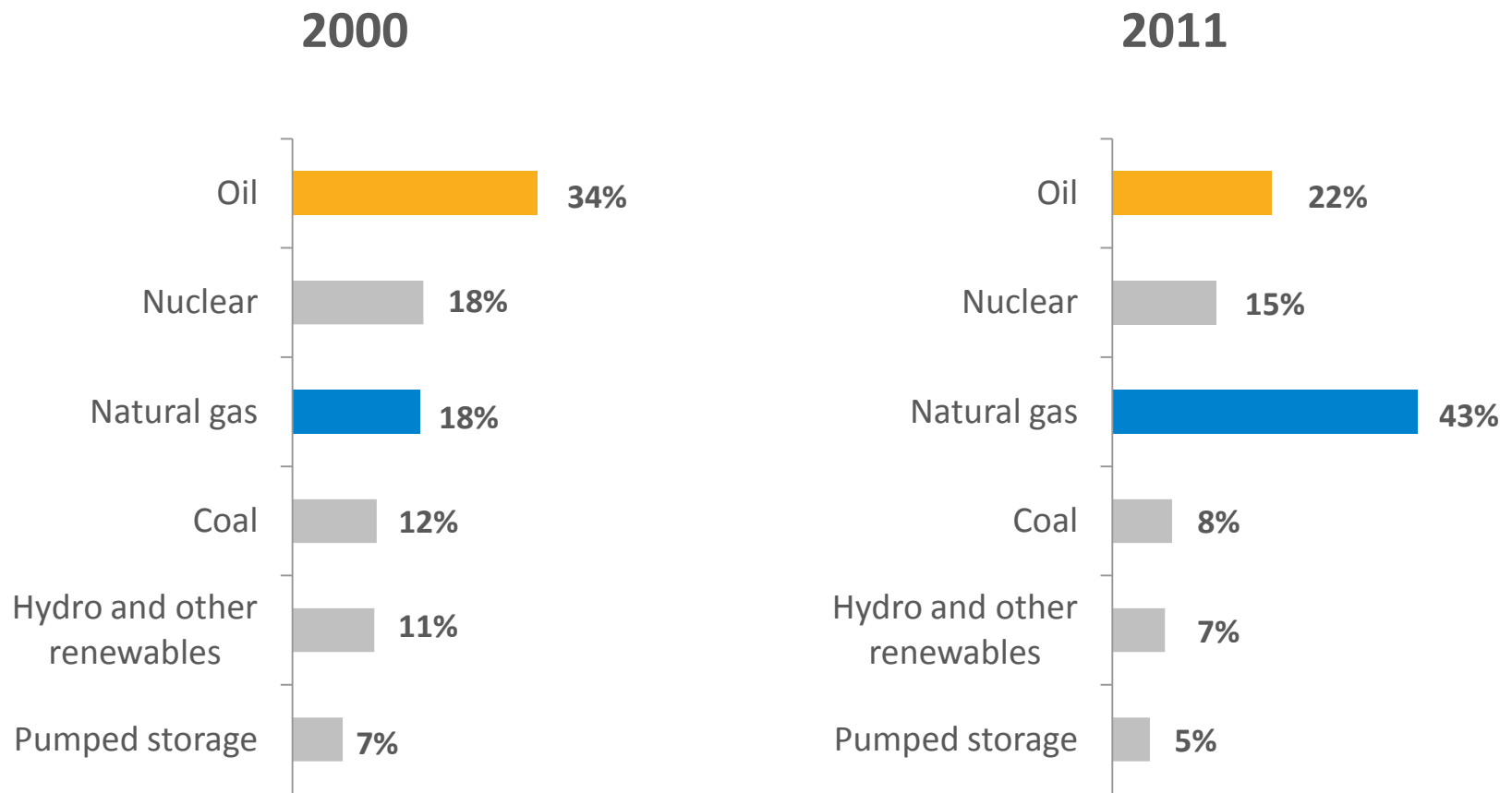


Underlying natural gas data furnished by:



Region's Generating Capacity has Shifted to Natural Gas

Percent of Total System Capacity



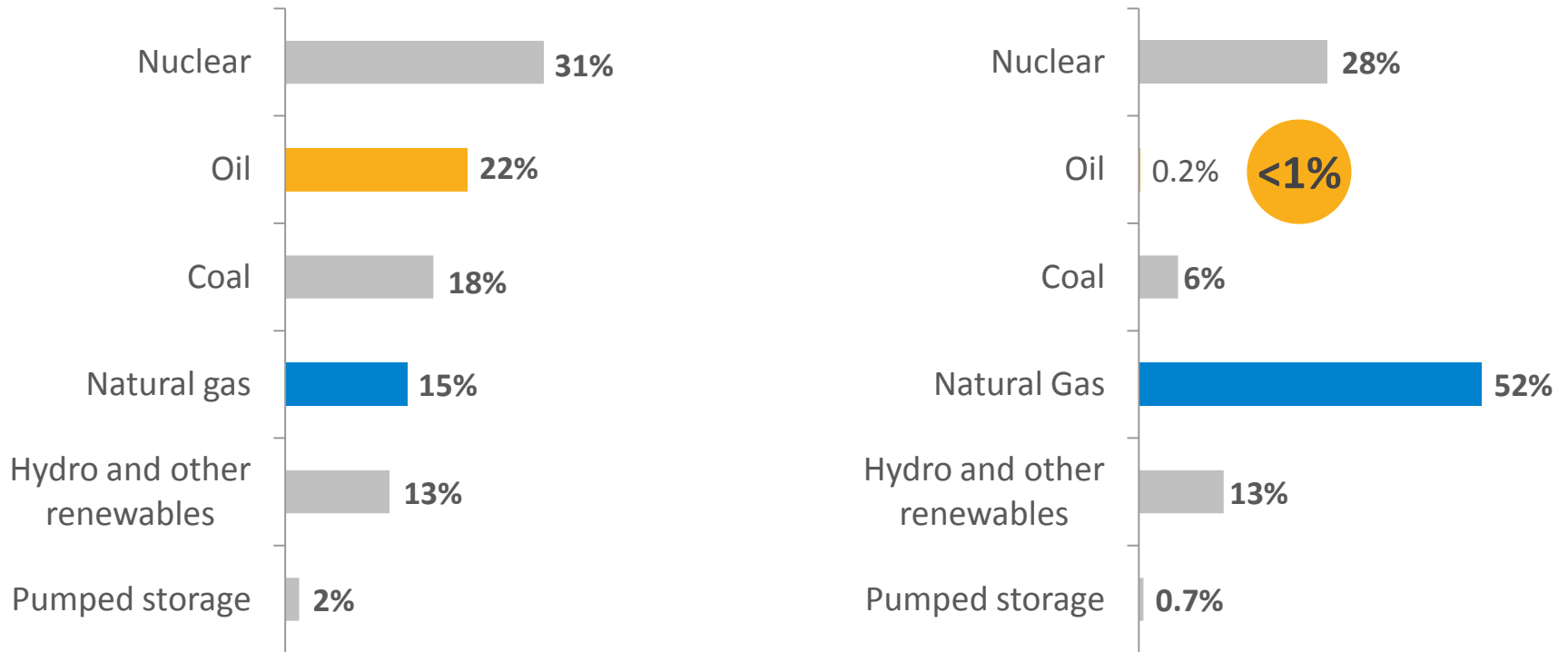
Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and misc. fuels.

Electric Energy Production also has Shifted to Natural Gas

Percent of Total Electric Energy Production

2000

2011



Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and misc. fuels.

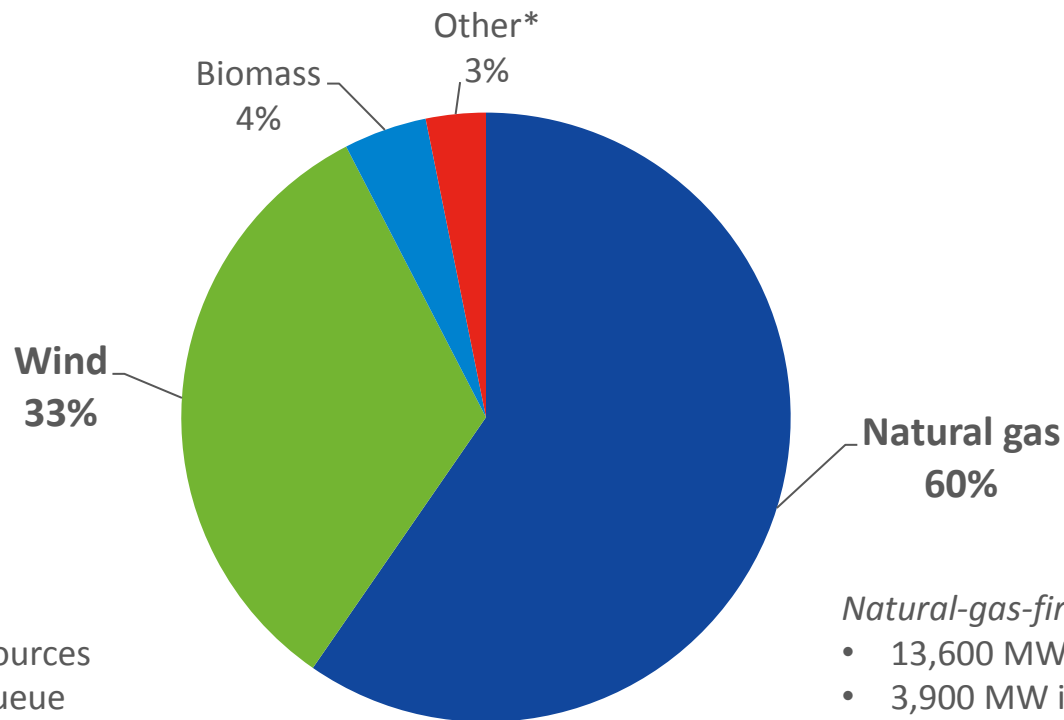
Potential Retirement of Generators

- 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 total oil-fired generation was originally built as base load or intermediate plants (intended to run daily)
 - Many have long start-up times



Natural Gas and Wind are the Main Proposals in the ISO Generator Interconnection Queue

Total: 6,500 MW



Wind generators:

- 500 MW of existing resources
- 2,100 MW in the ISO Queue

Natural-gas-fired generators:

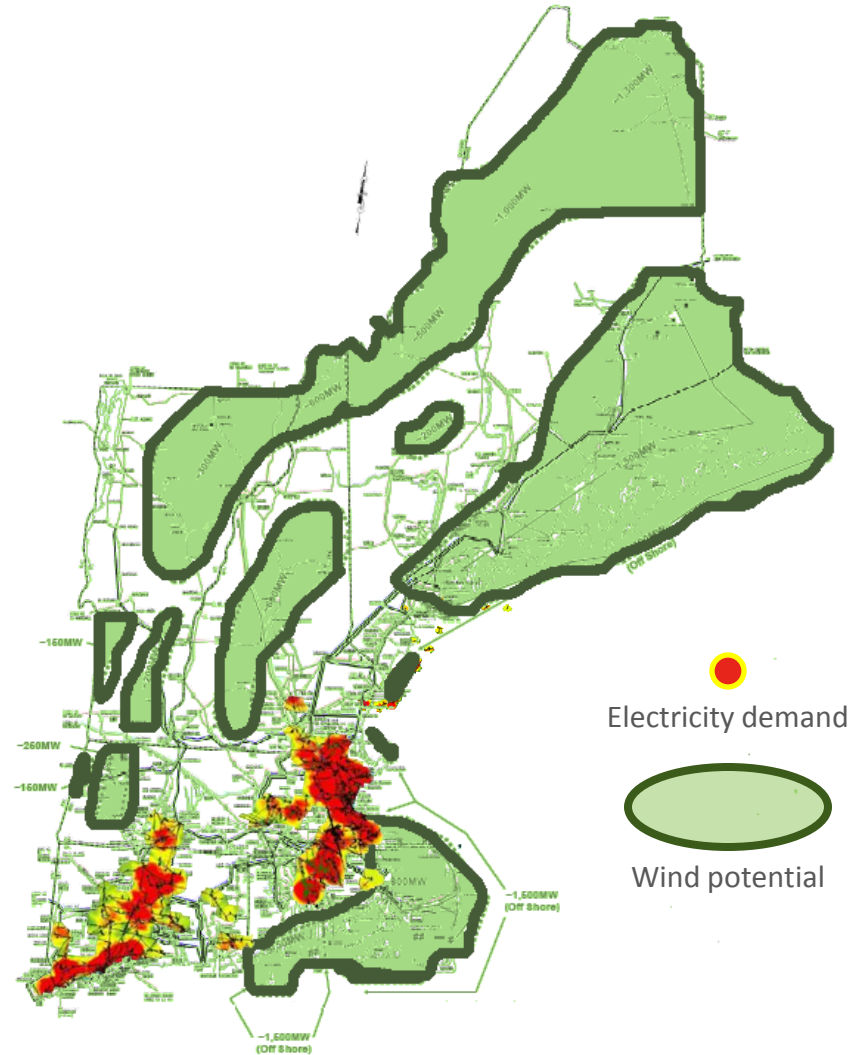
- 13,600 MW of existing resources
- 3,900 MW in the ISO Queue

As of April 2012

*Other includes oil, landfill gas, solar, and nuclear uprates.

Connecting Wind Energy to Load Centers

- New England's population and electric demand are concentrated along the coast in central and southern New England
- Region has 12,000 MW of onshore and offshore wind potential
- Transmission will be required to connect potential wind resources to load centers in New England



New England Wind Integration Study (NEWIS)

A New England-focused wind integration analysis

- Under certain conditions, large-scale wind integration in New England is achievable
- When available to provide energy, wind resources could reduce fossil-fueled generation as an energy resource
- Large-scale wind integration in the region would require:
 - Significant transmission upgrades
 - Increases in regulation service and operating reserves
 - Wind-power forecasting

Final Report:
New England Wind Integration Study

Prepared for:
ISO New England

Prepared by:
GE Energy Applications and Systems Engineering
EnerNex Corporation
AWS Truepower




Project Leaders:

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Principal Contributors

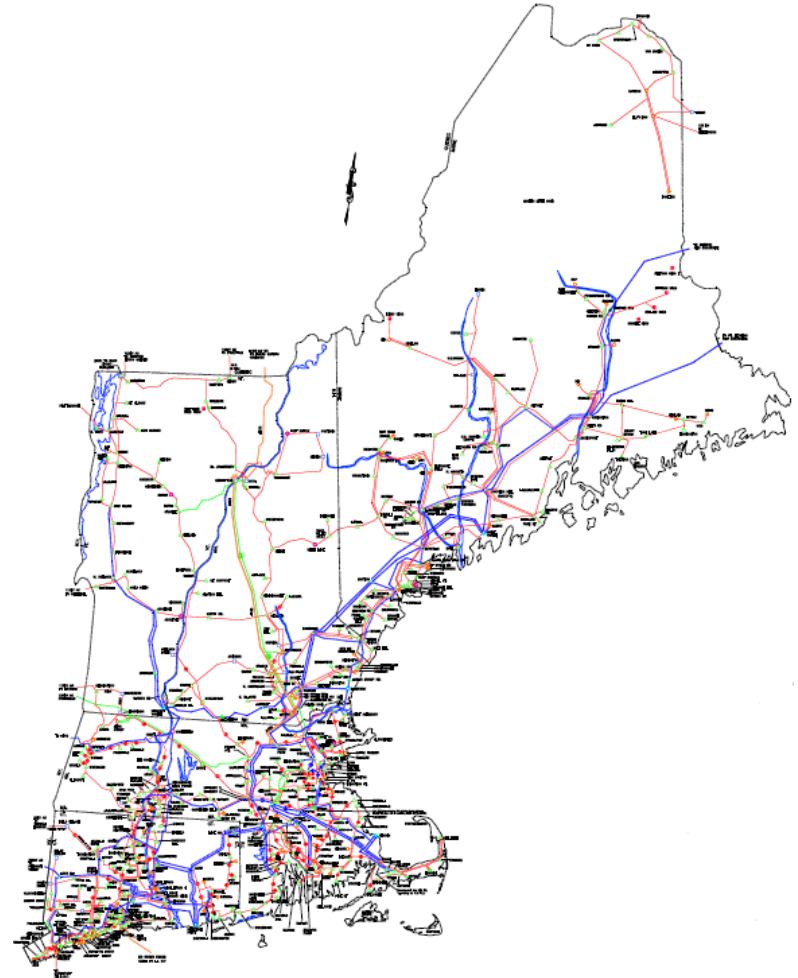
GE Energy Gene Hinkle Richard Piwko Gary Jordan Amanvir Chahal Nick Miller Shakeer Meeran	EnerNex Robert Zavadil Jack King Tom Mousseau	AWS Truepower John Manobianco
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December 5, 2010

Planning for the Future

- How will the transmission system evolve?
 - Older fossil-fueled generators run infrequently, but are dispatchable and located near the load and the transmission system
 - In comparison, wind is a variable energy resource that is distant from the load and from the transmission system
- ISO's Strategic Transmission Analysis is refining transmission needs identified for New England Governors' 2009 Renewable Energy Blueprint



Planning for the Future, *cont.*

- Will the region have adequate pipeline capacity and LNG resources to serve growing demand from gas-fired generation?
- Will the natural gas system have the flexibility to meet additional ramping requirements of gas-fired generators?



Source: Northeast Region Natural Gas Pipeline Network
U.S. Energy Information Administration; www.energy.gov.

Questions

