

Gas Fired Generation of Electricity

Maine Natural Gas: Energy for Maine's Future?!

October 8, 2015

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Heidi Leslie, Emera Energy

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Sarah Tracy, Pierce Atwood LLP

Gas Generator's Market View

John Flumerfelt

Director, Government and Regulatory Affairs

Calpine Corporation

About Calpine:

- Largest gas-fired power producer in U.S.
- Annual gas use approx. 0.8 TCF/\$2.5 Billion
- 87 plants operating or under construction in 18 states and Canada with nearly 27,000 megawatts of generating capacity
- Nation's largest fleet of combined-cycle and combined heat and power (cogeneration) electric generating facilities
- Manages commodity and transportation arrangements from Houston-based trading desk
- Utilizes wide variety of commercial products and structures to fuel fleet:
 - Firm and interruptible transportation
 - Term, day-ahead and intraday commodity purchases
 - Firm delivered products



Westbrook Energy Center – Westbrook Maine



Fore River Energy Center – Weymouth Massachusetts

Horizontal Directional Drilling – Falmouth, Maine – August 2015

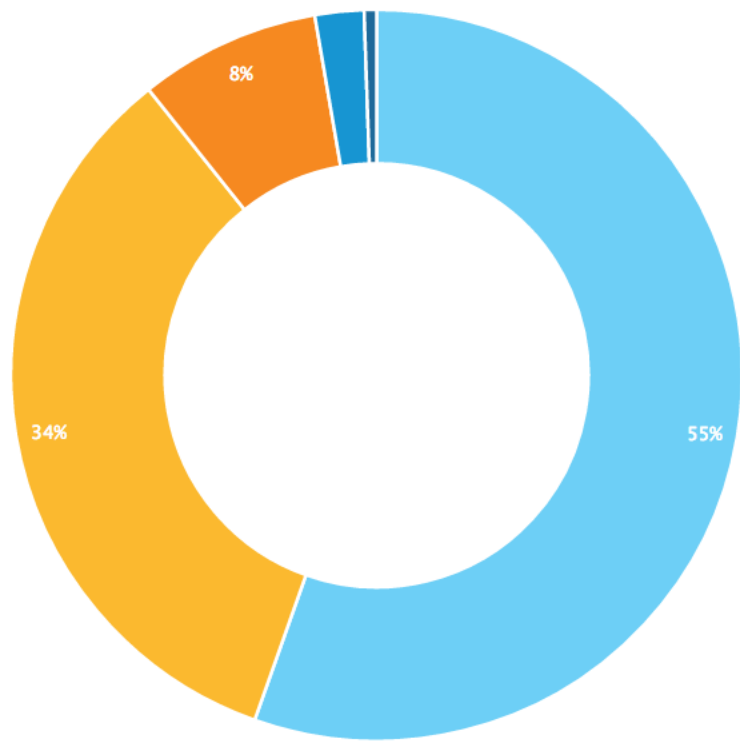


Real-Time Maps and Charts

FUEL MIX CHART

[BACK TO REAL-TIME MAPS AND CHARTS](#)

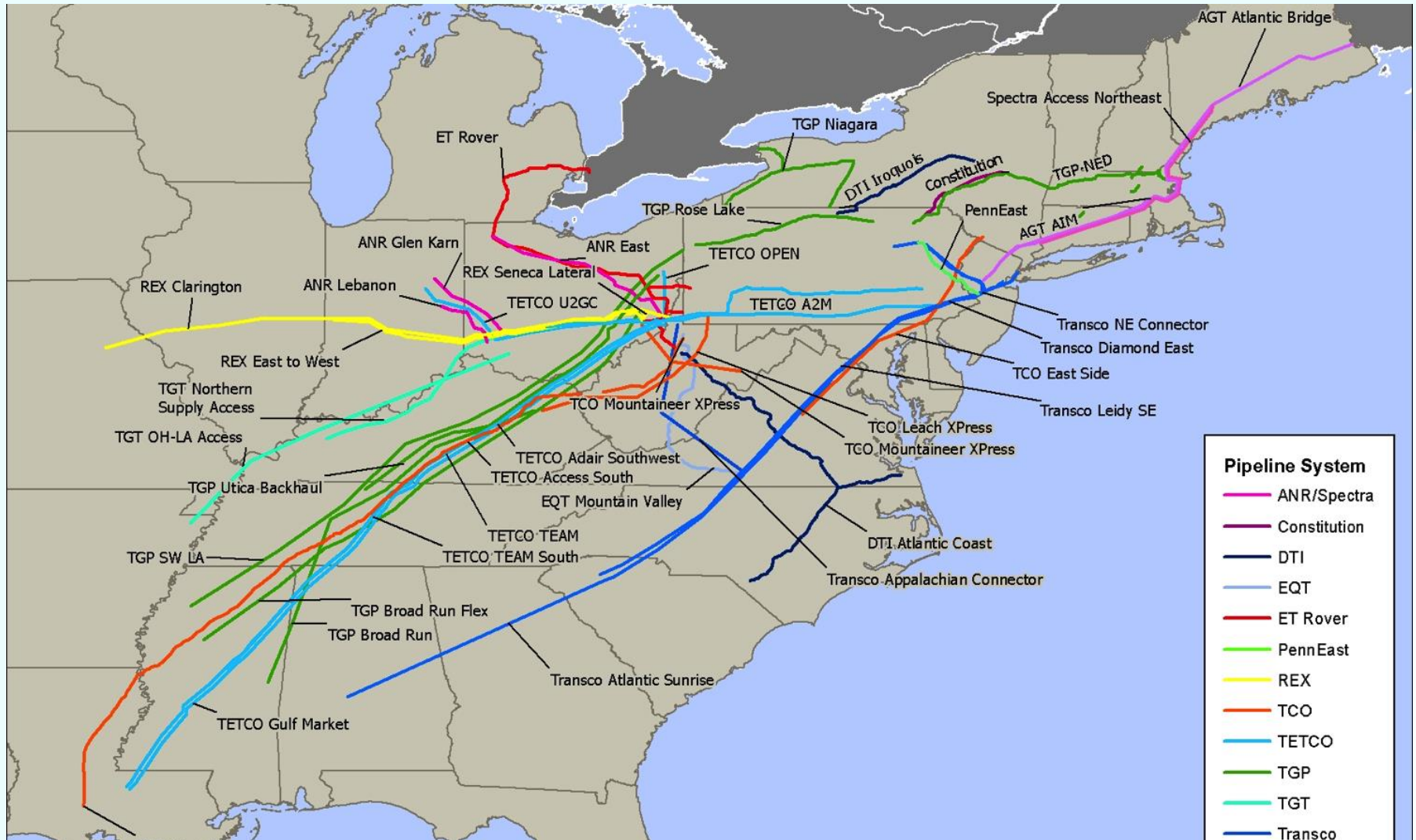
Fuels Renewables



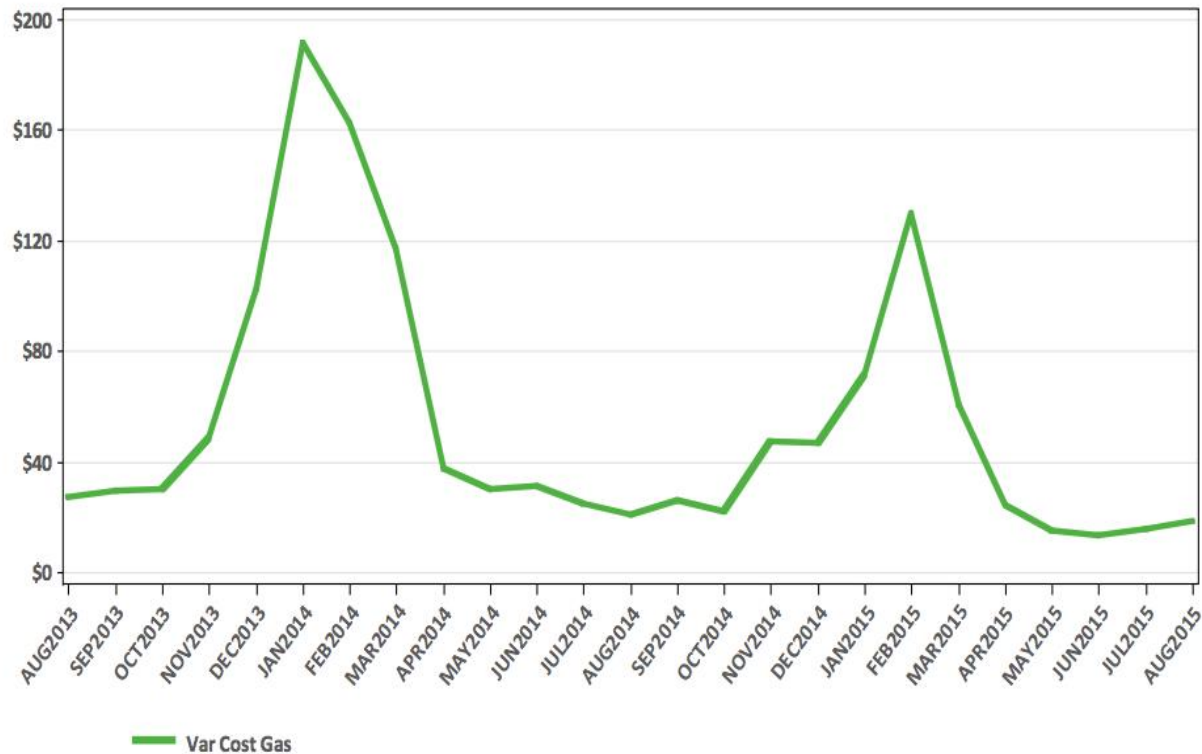
- 55% ■ NATURAL GAS
- 34% ■ NUCLEAR
- 8% ■ RENEWABLES
- 2% ■ HYDRO
- 1% ■ COAL

Updated: 09/05/2015 10:07 AM

27 Bcf/day of Announced Take-Away by 2017 (Bentek/Platts)



Variable Production Cost of Natural Gas: Monthly



Note: Assumes proxy heat rate of 7,800,000 Btu/MWh for natural gas units.

Underlying natural gas data furnished by:



ISO-NE PUBLIC

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How the Expanding Role of Gas Impacts the Region

Natural Gas: Energy for Maine's Future?

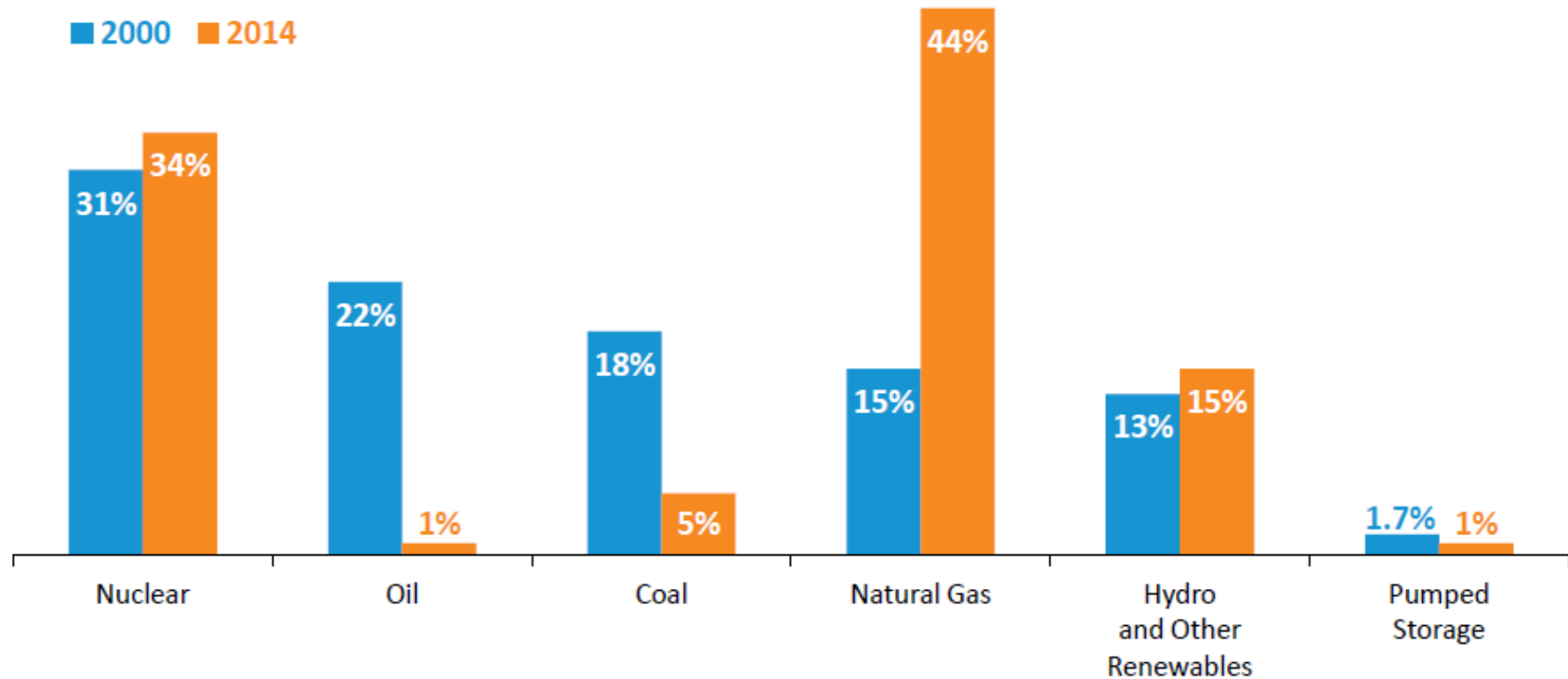
Ray Hepper

VICE PRESIDENT & GENERAL COUNSEL



Fuels Used to Produce the Region's Electric Energy Have Shifted Due to Economic and Environmental Factors

Percent of Total Electric Energy Production by Fuel Type
(2000 vs. 2014)



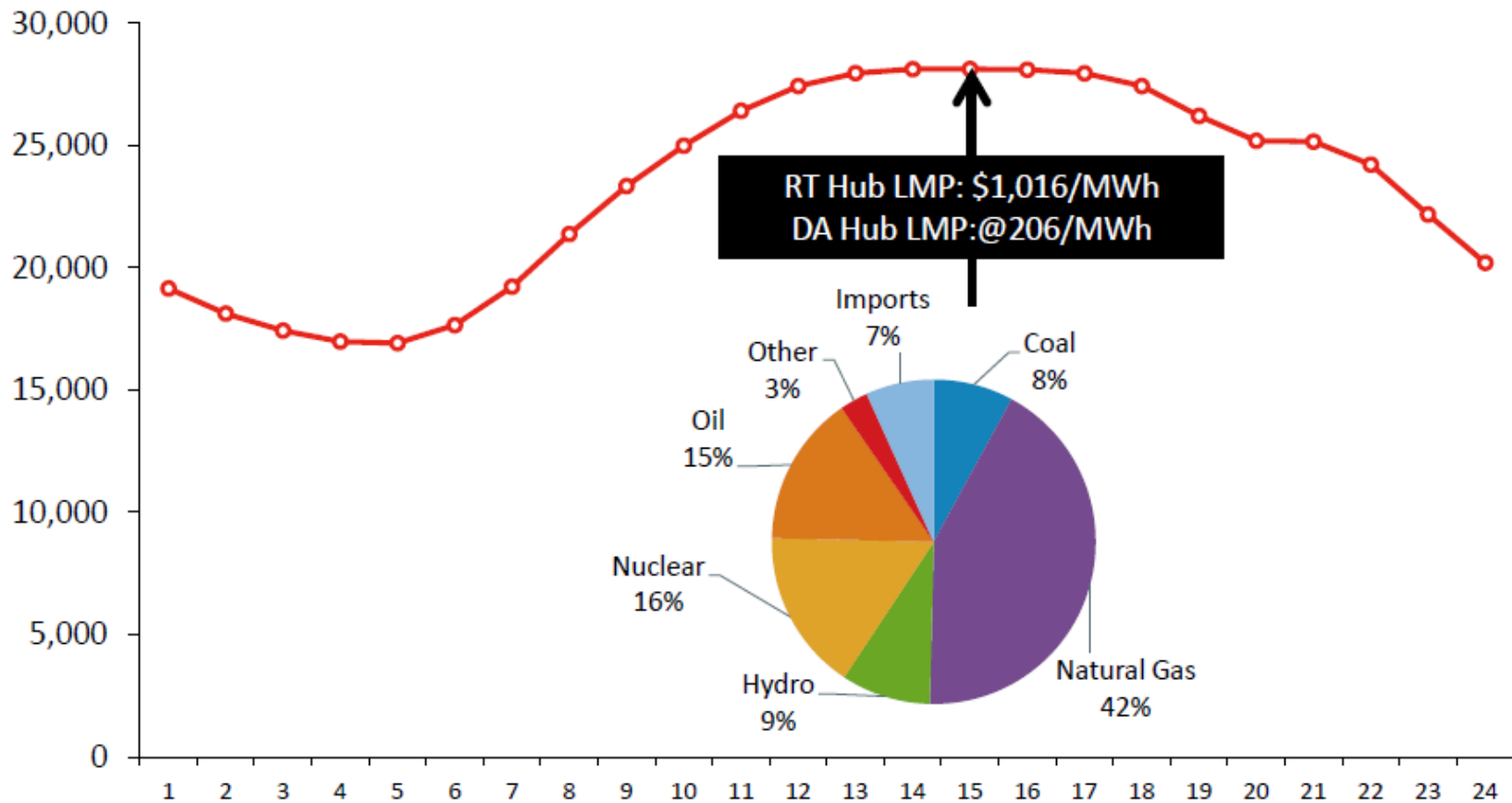
Source: ISO New England [Net Energy and Peak Load by Source](#)

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



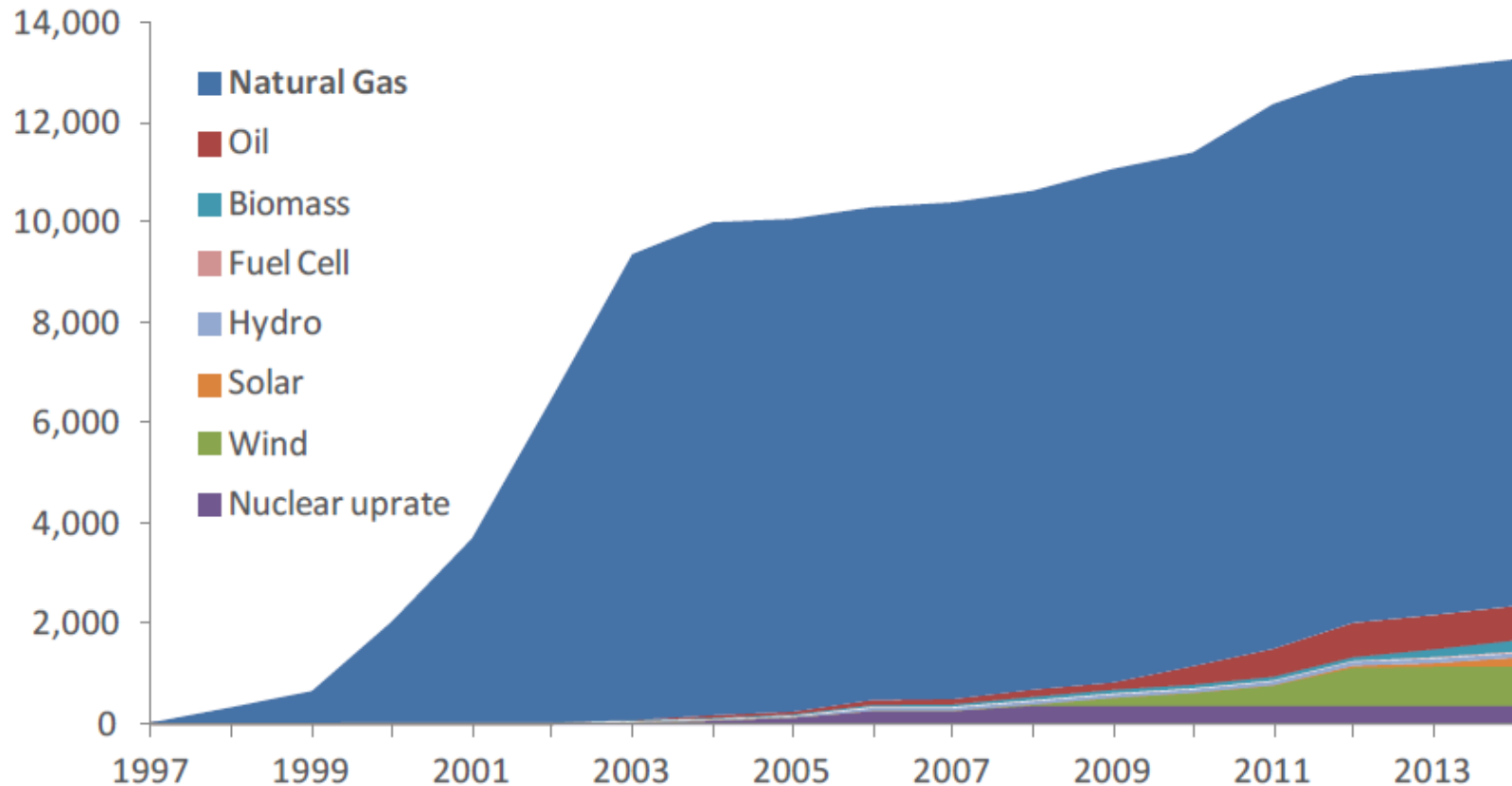
All Resource Types Contributed to Serving Demand at Time of All-Time System Peak

August 2, 2006: New England Peak-Day Hourly Load
Resource Mix and LMP at Peak Hour



Region Has Not Developed Gas Pipeline Infrastructure to Keep Pace with Growth of Gas-fired Generation

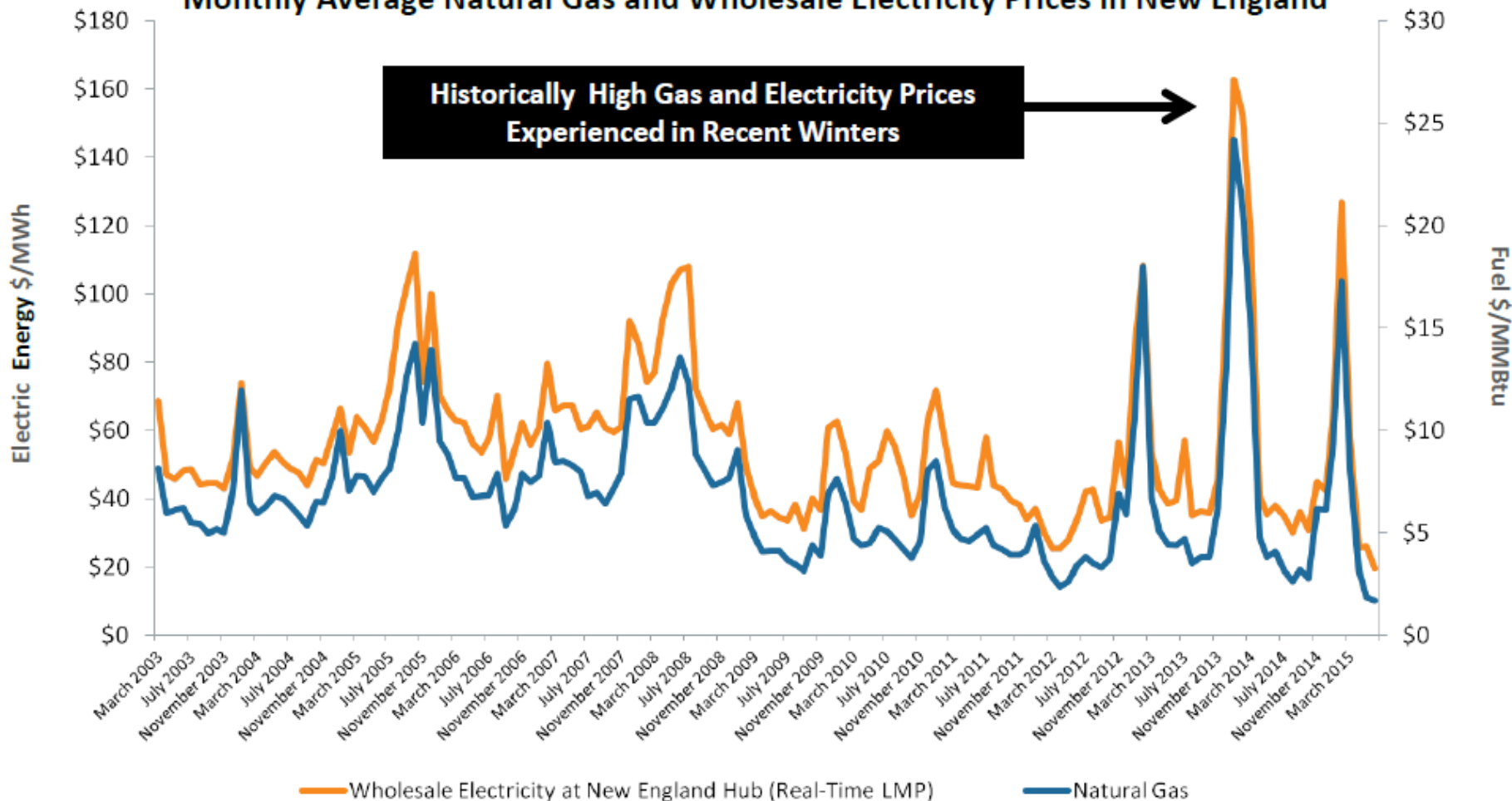
Cumulative New Generating Capacity in New England (MW)



Natural Gas and Wholesale Electricity Prices Are Linked

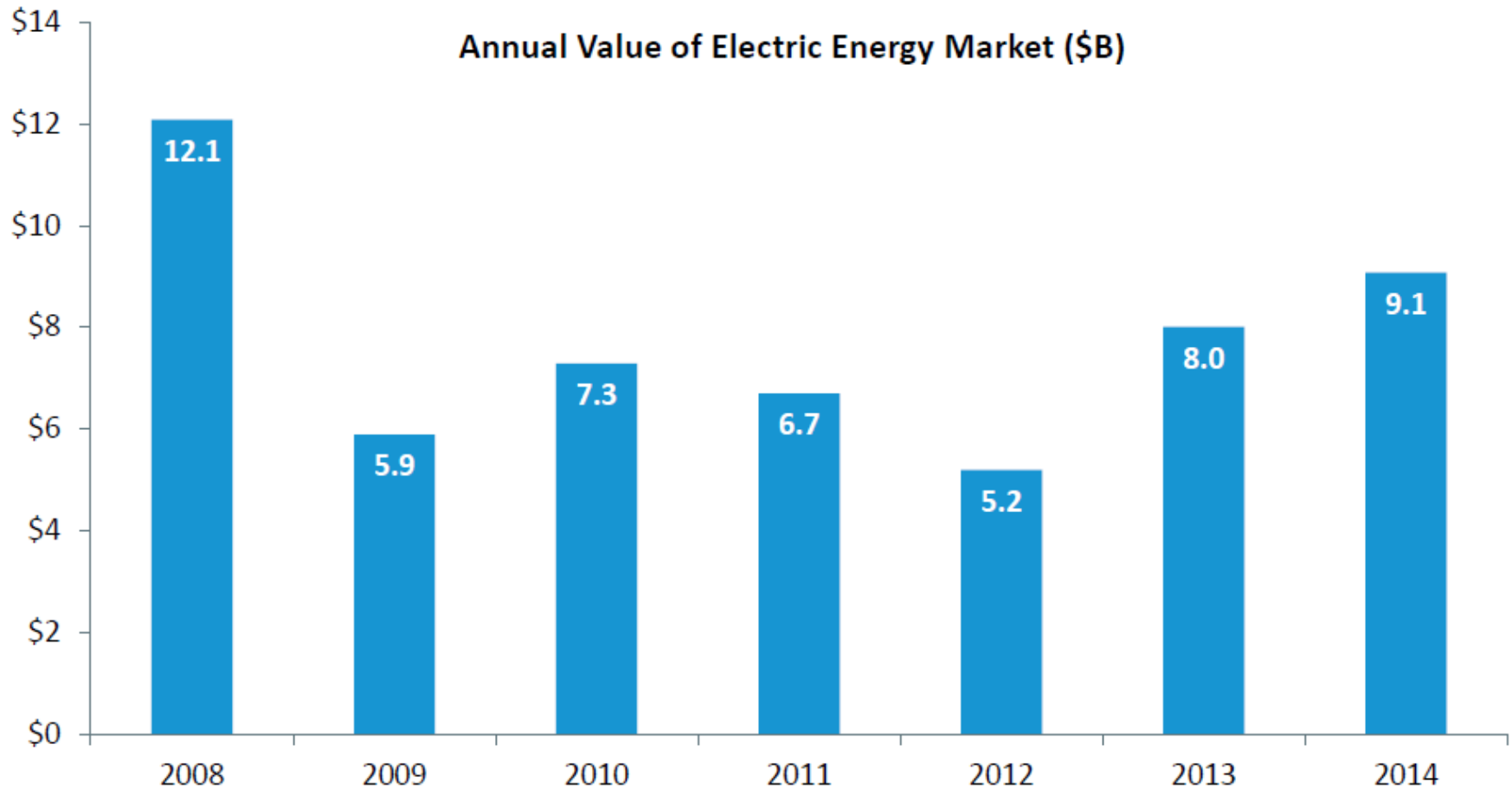
Because of New England's heavy reliance on natural gas as a fuel source, natural gas typically sets the price for wholesale electricity

Monthly Average Natural Gas and Wholesale Electricity Prices in New England



Regional Electric Energy Market Reflects Fuel Cost

Annual wholesale energy market costs have ranged from \$5 billion to \$12 billion

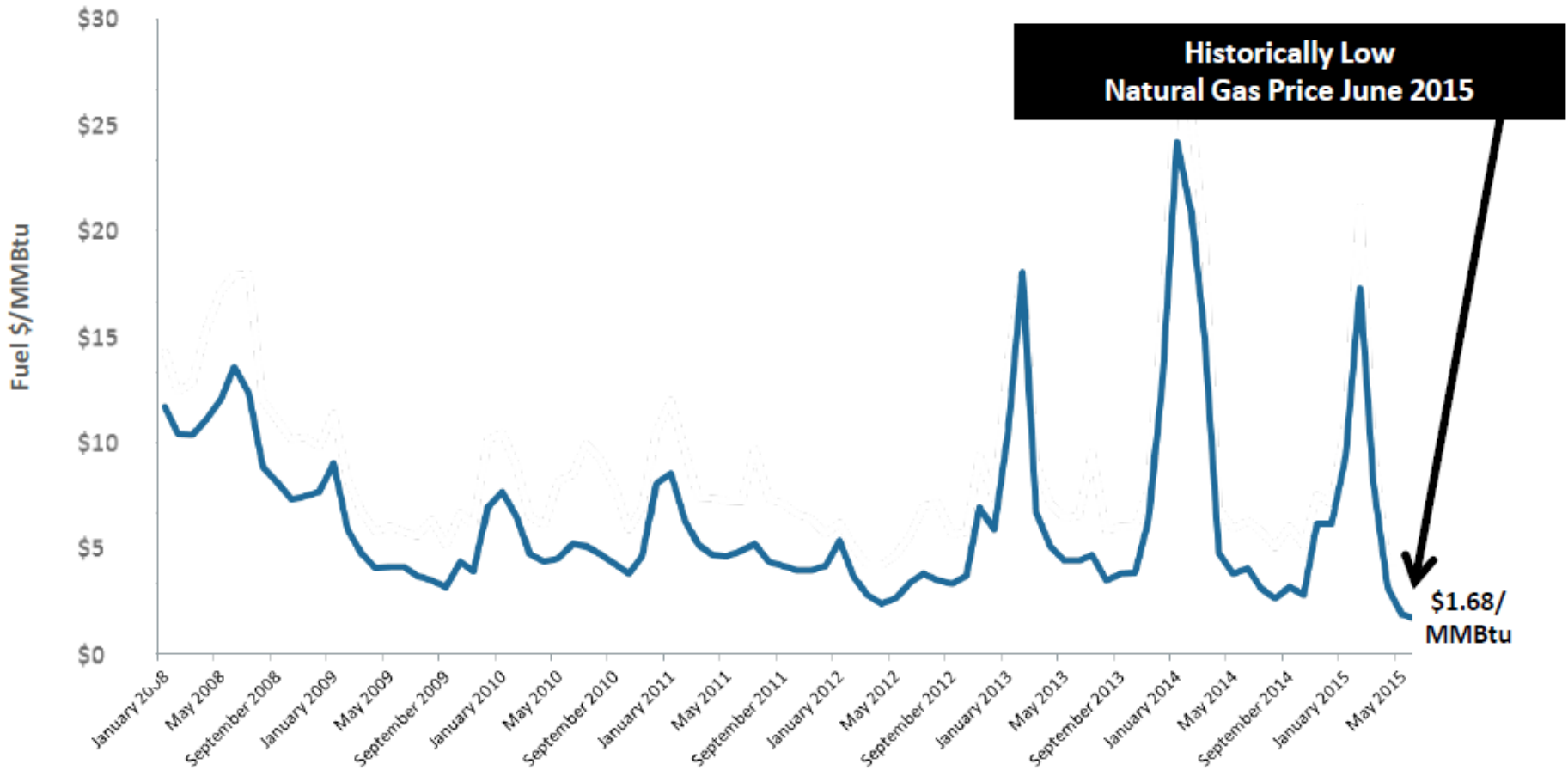


Source: [2014 Report of the Consumer Liaison Group, Appendix C](#)



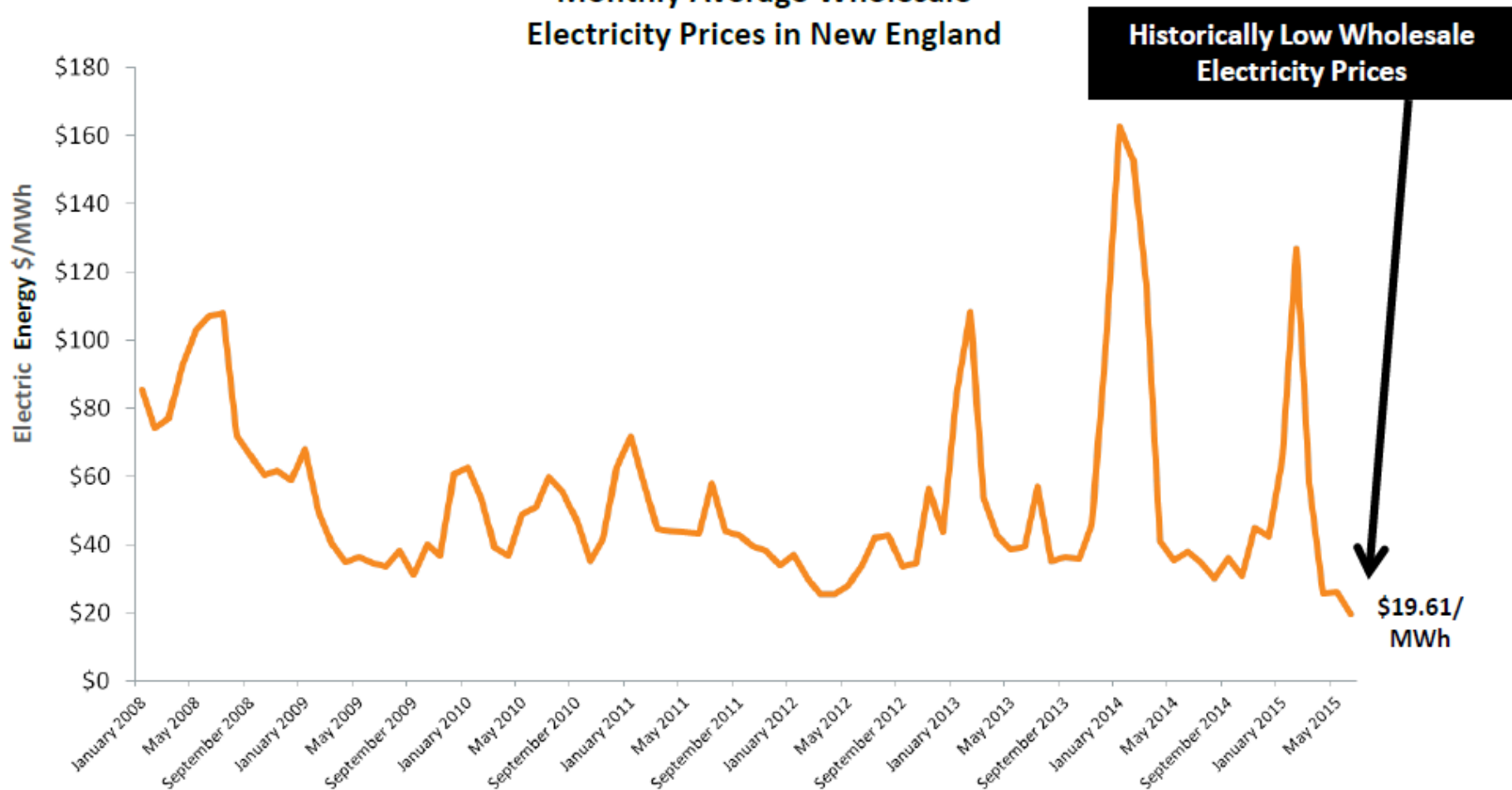
Region Experienced Historically Low Natural Gas Prices Earlier This Summer

Monthly Average Natural Gas Prices in New England



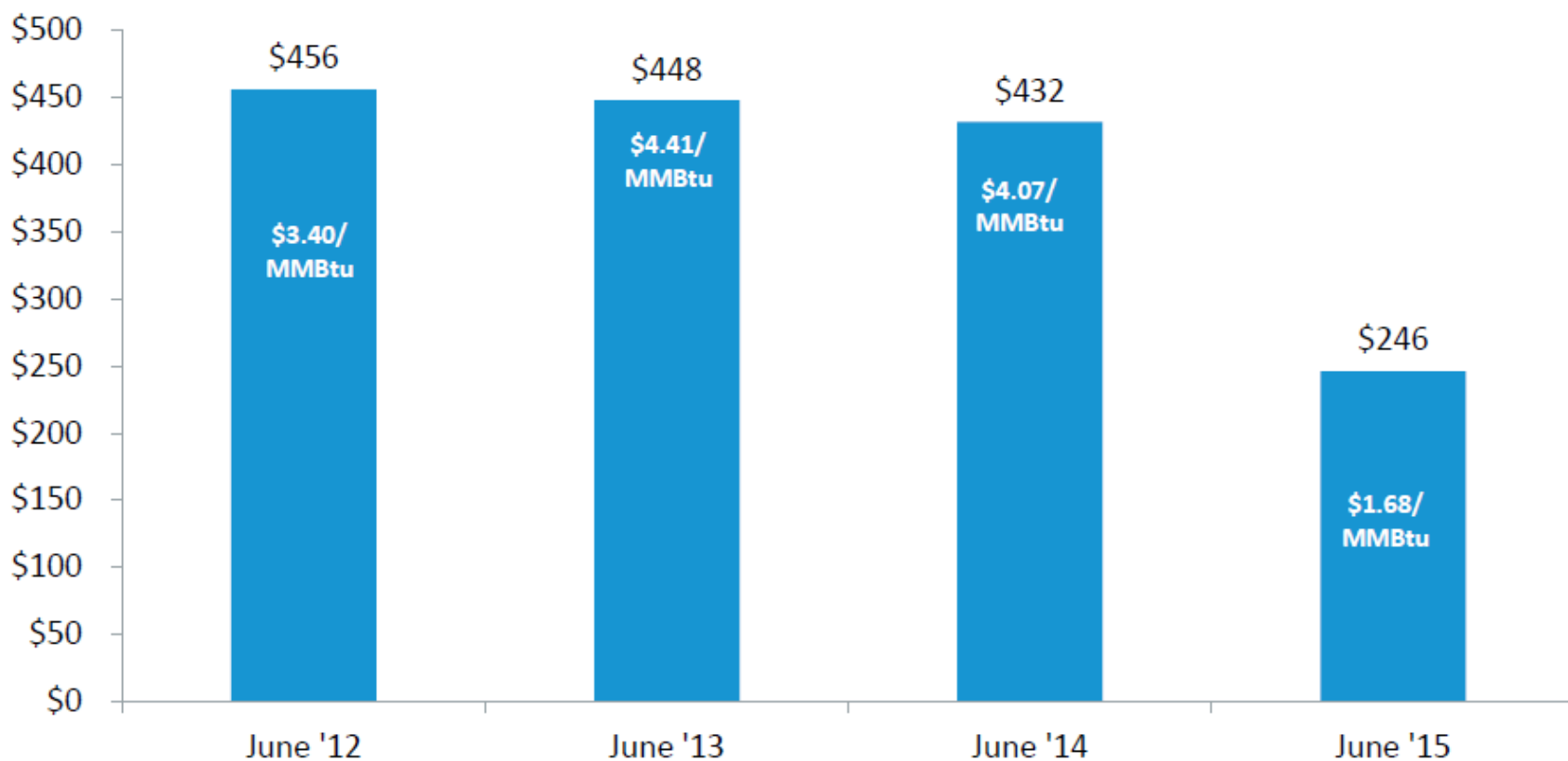
Earlier this Summer the Region Experienced Historically Low Wholesale Electricity Prices

Monthly Average Wholesale Electricity Prices in New England



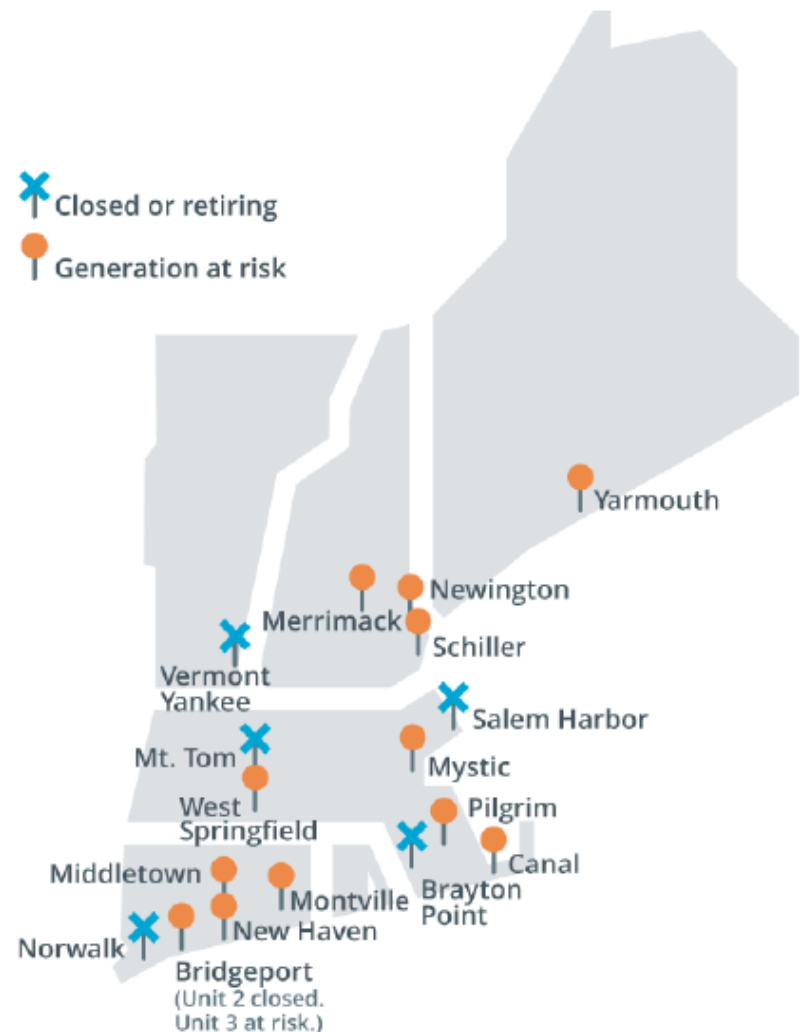
Value of June Electric Energy Market Fell Dramatically with Lower Monthly Average Gas Prices

Value of Electric Energy Market for Month of June (\$M) and Monthly Average Natural Gas Prices in New England



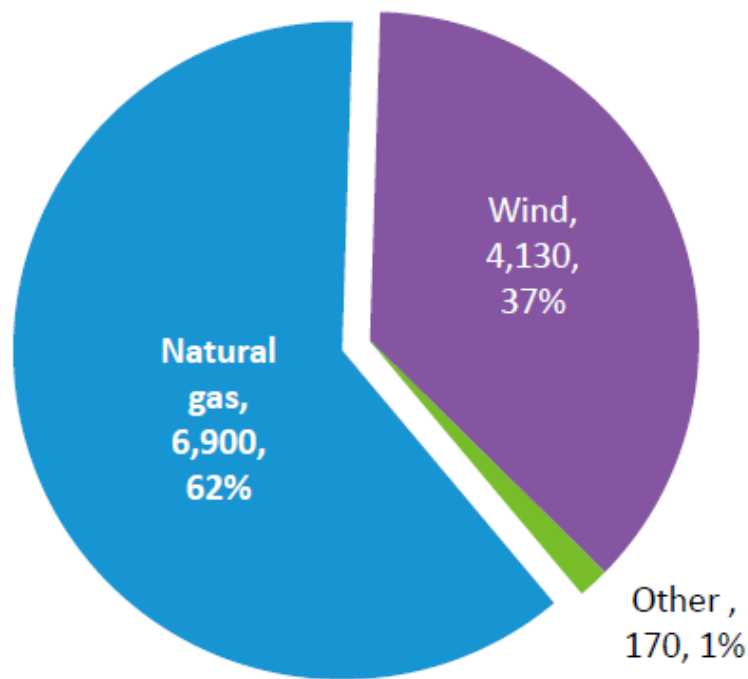
Numerous Factors Make Winter Operations Challenging

- From 2007-2012, region experienced **increased forced outages** (specifically fossil-steam units) **and poor fleet response** during stressed system conditions
- Region is increasingly reliant on resources with **uncertain performance and availability**
- Natural gas resources **lack firm gas transportation or fuel storage** and rely on “just-in-time” fuel
- Region has **lost and is at-risk of losing substantial non-gas resources**

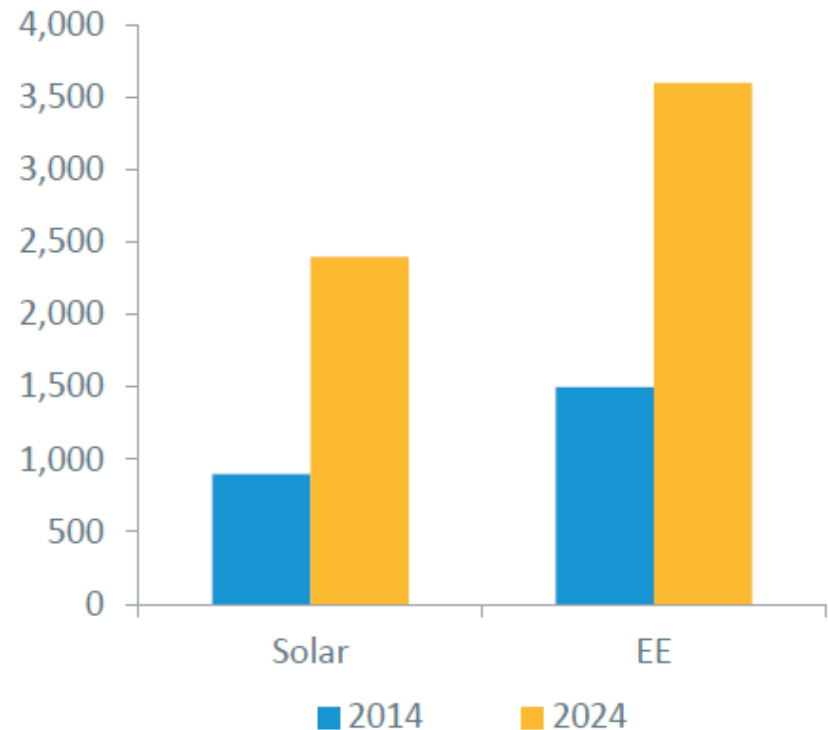


Developers are Proposing to Build Various Types of Resources

ISO Generator Interconnection Queue
by Resource Type (MW)



Existing and Forecast Solar and Energy Efficiency in 2024 (MW)



Source: ISO Generator Interconnection Queue (September 2015)
FERC Jurisdictional Proposals Only
Note: Many of the proposed natural gas includes dual-fuel (oil) capability

2015 ISO Solar PV Forecast, nameplate capacity, based on state policies.
2015 CELT Report, EE through 2014 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2024 includes an ISO-NE forecast of incremental EE beyond the FCM.



Winter Programs And Pay-for-Performance Provide Reliability

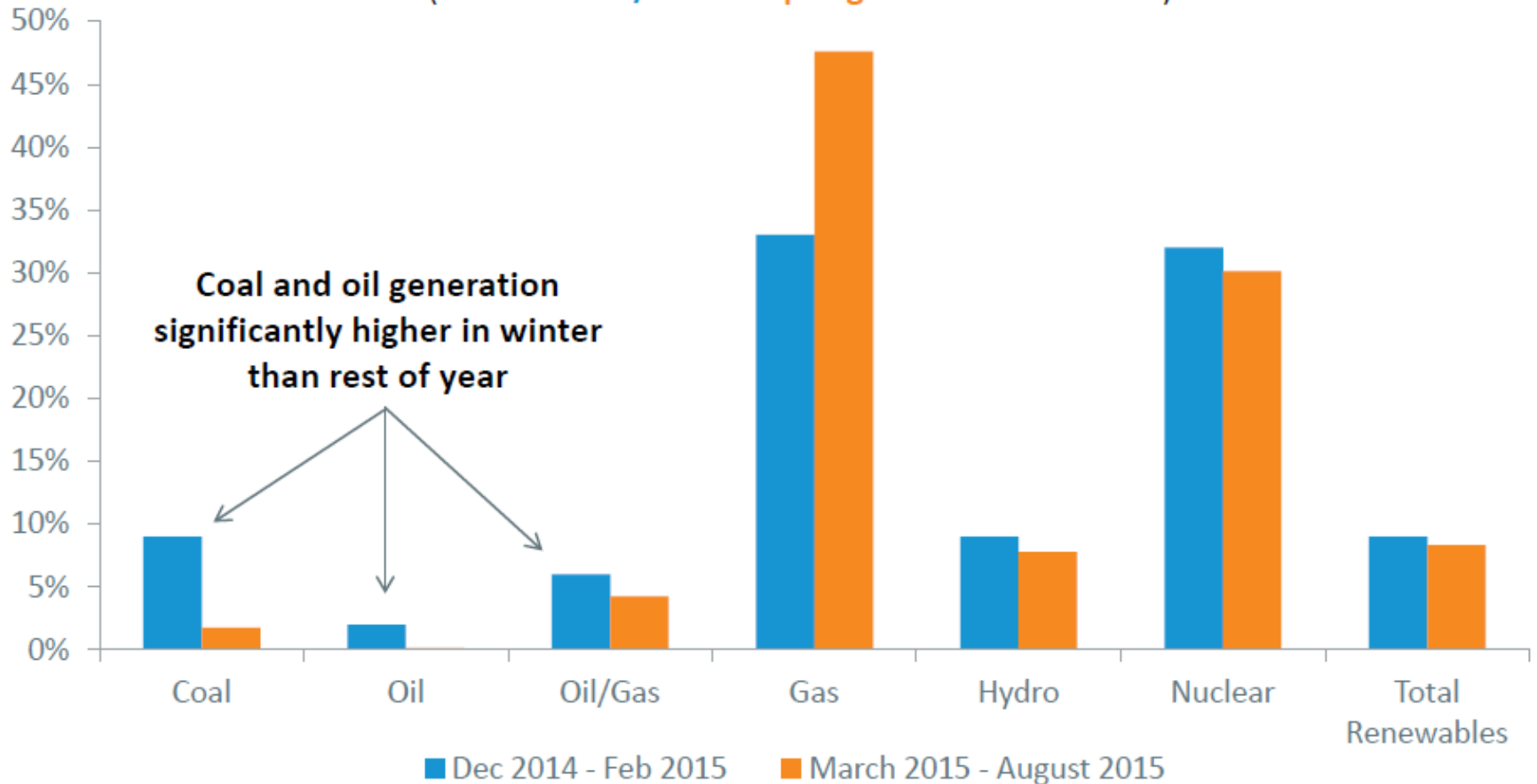
- **Winter programs** were created for past two winters to **strengthen fuel adequacy** when pipelines are constrained and generators have difficulty replenishing oil supplies in the middle of winter
- In early 2014, the ISO filed the **Pay-for-Performance (PFP)** capacity market design which ties capacity payments to resources' performance during stressed system conditions
- PFP is a **comprehensive, long-term, market-based solution** to improve resource availability and performance during stressed system conditions, and goes in effect in 2018
- **Additional winter programs have been developed to improve reliability until PFP goes in effect**

Winter Program and Pay-for-Performance May Impact Future Oil Use

- **Coal and oil utilization in winter is higher** due in part to limited natural gas availability
- **PFP provides developers with *flexibility*** to select the most competitive and highly-reliable resource types and technologies
 - **Rewards operational investments** that improve performance: Firm-fuel or dual-fuel arrangements, ramp capabilities, etc.
- **PFP provides incentives for investment** that is
 - Low-cost and highly reliable (*nearly always operating*); or
 - Highly flexible and highly reliable (*gets online quickly and reliably*)

Coal and Oil Generation Use is Significantly Higher in Winter than Rest of the Year

Percent of Total Electric Energy Production
(Winter 2014/15 and Spring and Summer 2015)



ISO New England Remains Focused on Reliability and Efficient and Effective Markets

- New England's generation fleet is changing rapidly – older, fossil fuel-fired units are retiring and reliance on natural gas for power generation is increasing
- Natural gas capacity constraints have resulted in higher gas and wholesale electricity prices over the past few winters
 - The generator interconnection queue suggests that more natural gas/dual fuel generation will be developed in coming years
- Winter reliability programs and Pay-for-Performance will provide improved reliability



Maine Natural Gas Conference

October 8, 2015

New England States Committee on Electricity

NESCE

NESCOE is New England's Regional State Committee, governed by a Board of Managers appointed by each of the New England Governors to represent the collective views of the six New England states on regional electricity matters

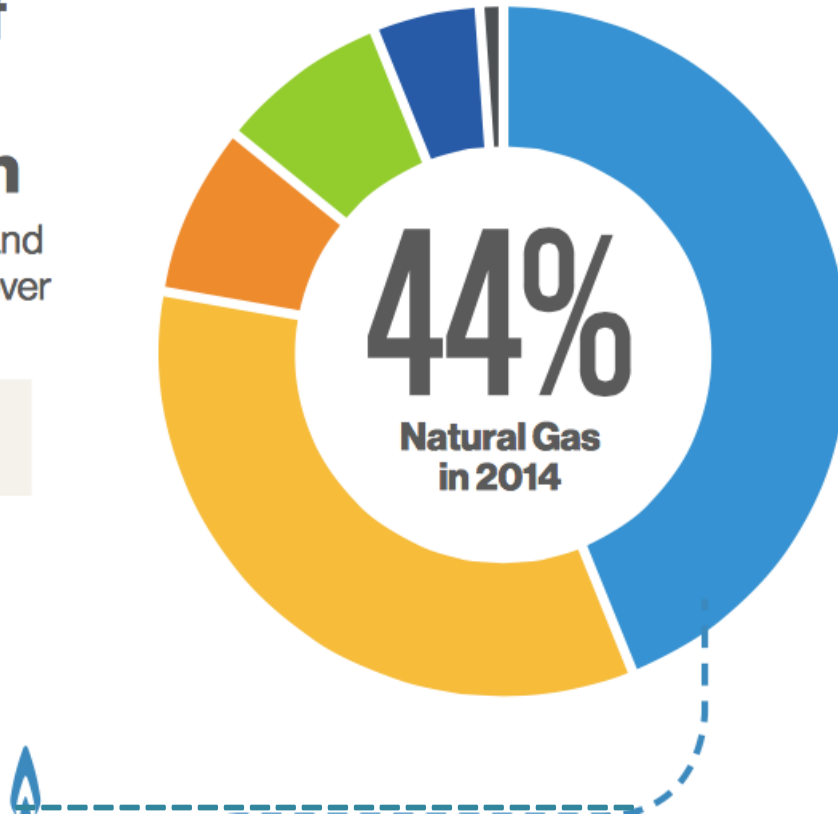
- **Focus:** Resource Adequacy, System Planning & Expansion
- **Resources:** 6 full-time staff with diverse disciplines & experience. Consultants, primarily for transmission engineering & independent studies
- **More information** including filings & comments:
 - www.nescoe.com
 - Twitter @NESCOEStates







New England: Dramatic Changes in the Energy Mix from Oil and Coal to Natural Gas

Sources of Electricity Production

Major shift from oil and coal to natural gas over the past 15 years

View the real-time fuel mix at iso-ne.com

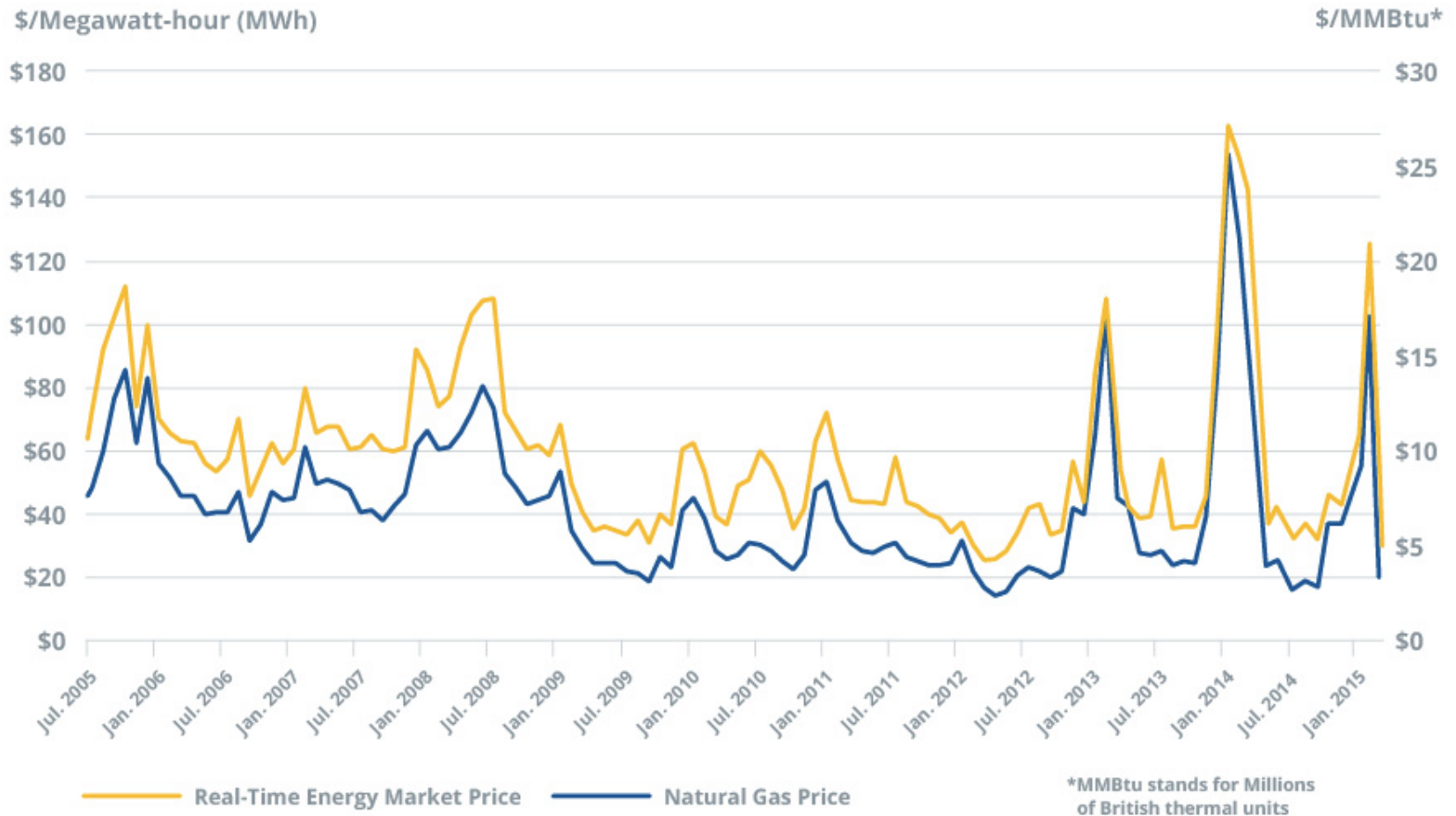


		NET ENERGY	
		2000	2014
	NATURAL GAS	15%	44%
	NUCLEAR	31%	34%
	RENEWABLES	8%	9%
	HYDRO	7%	8%
	COAL	18%	5%
	OIL	22%	1%

Dramatically reduced coal/oil operations

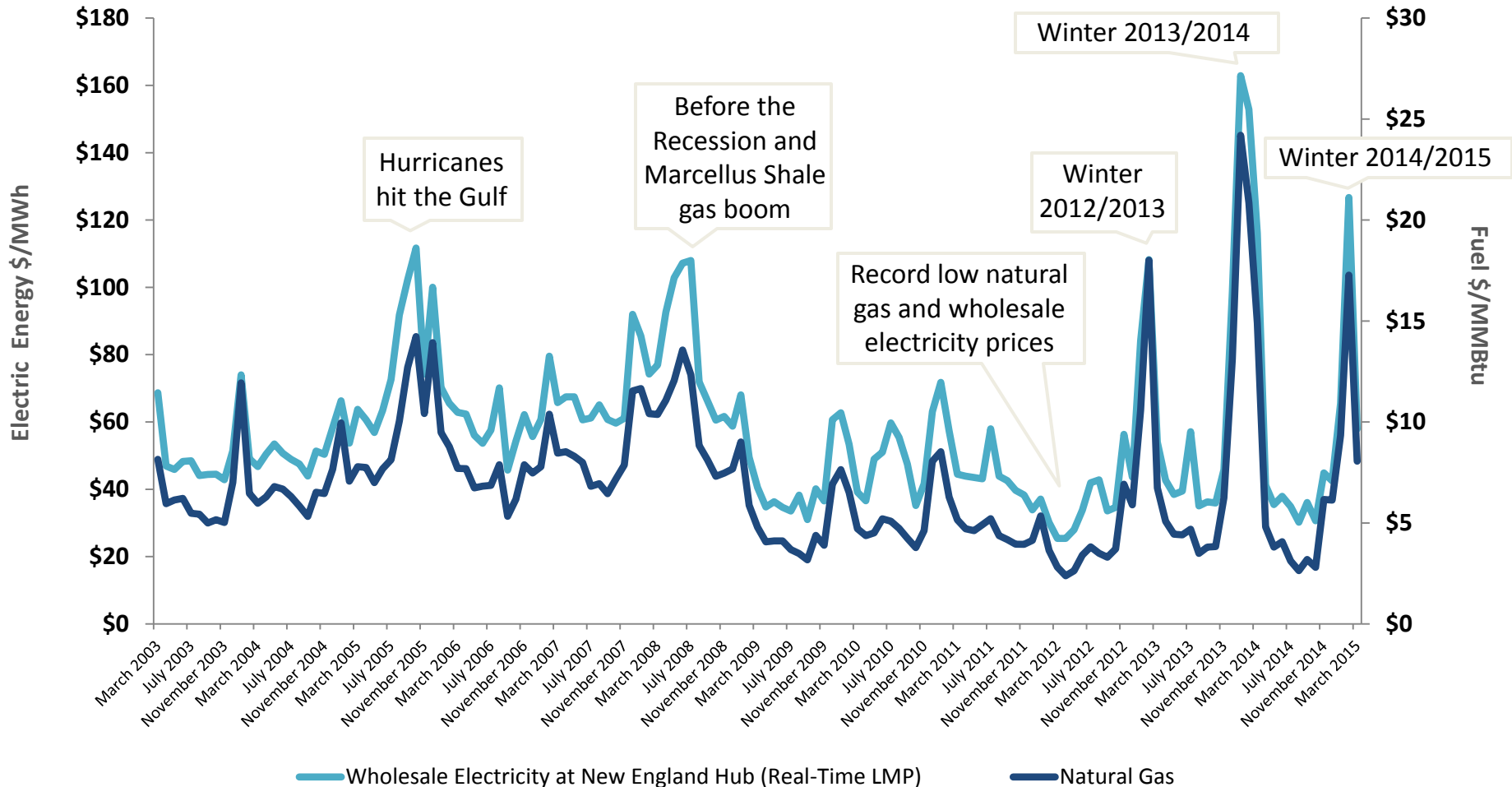
As New England consumers have learned...

Natural Gas and Wholesale Electricity Prices are Linked



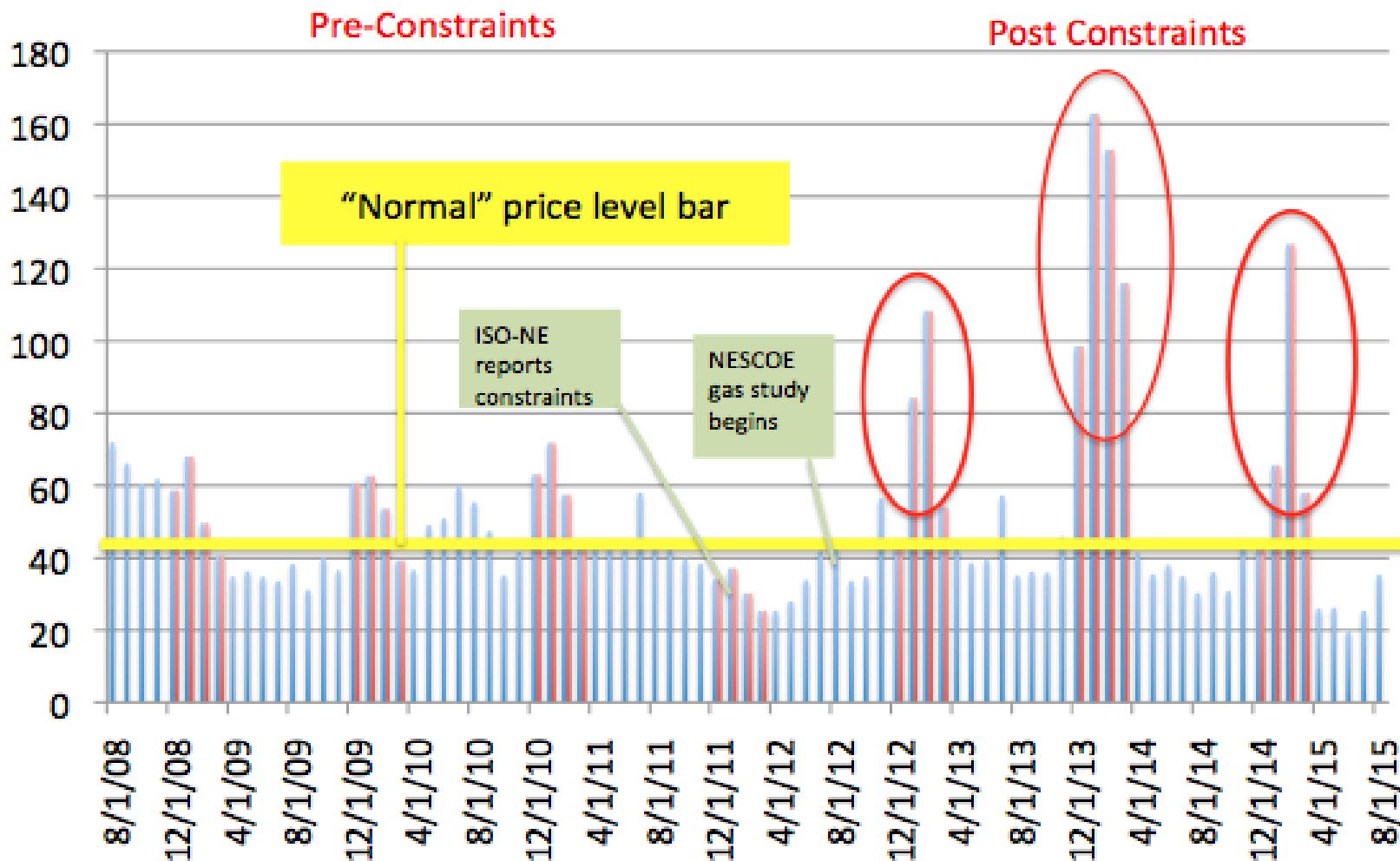
The Region has Experienced Volatile Gas and Electric Prices the Past Few Winters

Monthly Average Natural Gas and Wholesale Electricity Prices in New England



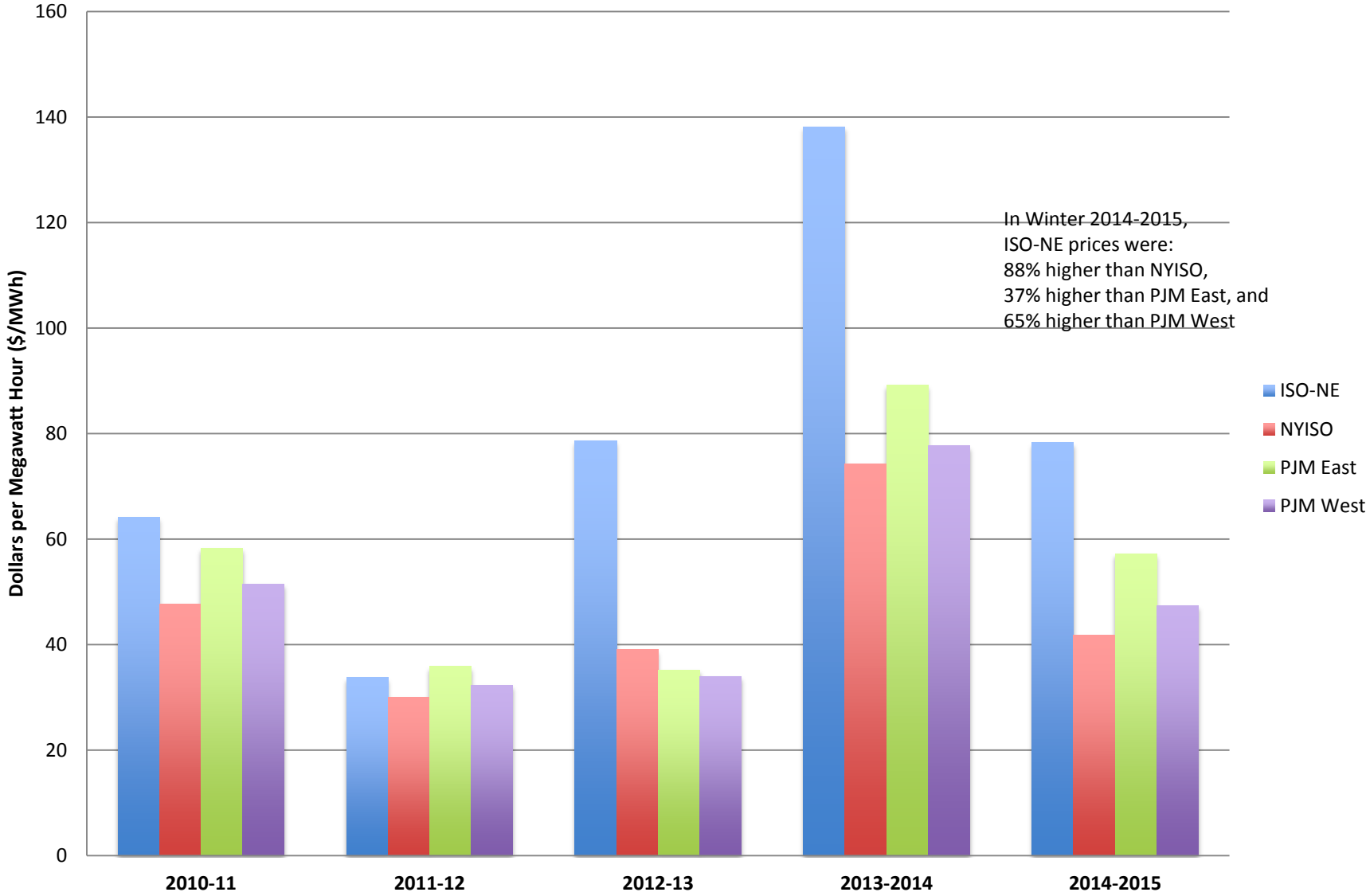
Slide courtesy ISO-NE

Monthly Average RT LMP's (\$/MWhr)



Monthly Average RT on-peak LMP's through August, 2015, data per ISO-NE

Winter Season (Dec-Feb) Average Electricity Prices - Wholesale 2010 – Current (March 2015)

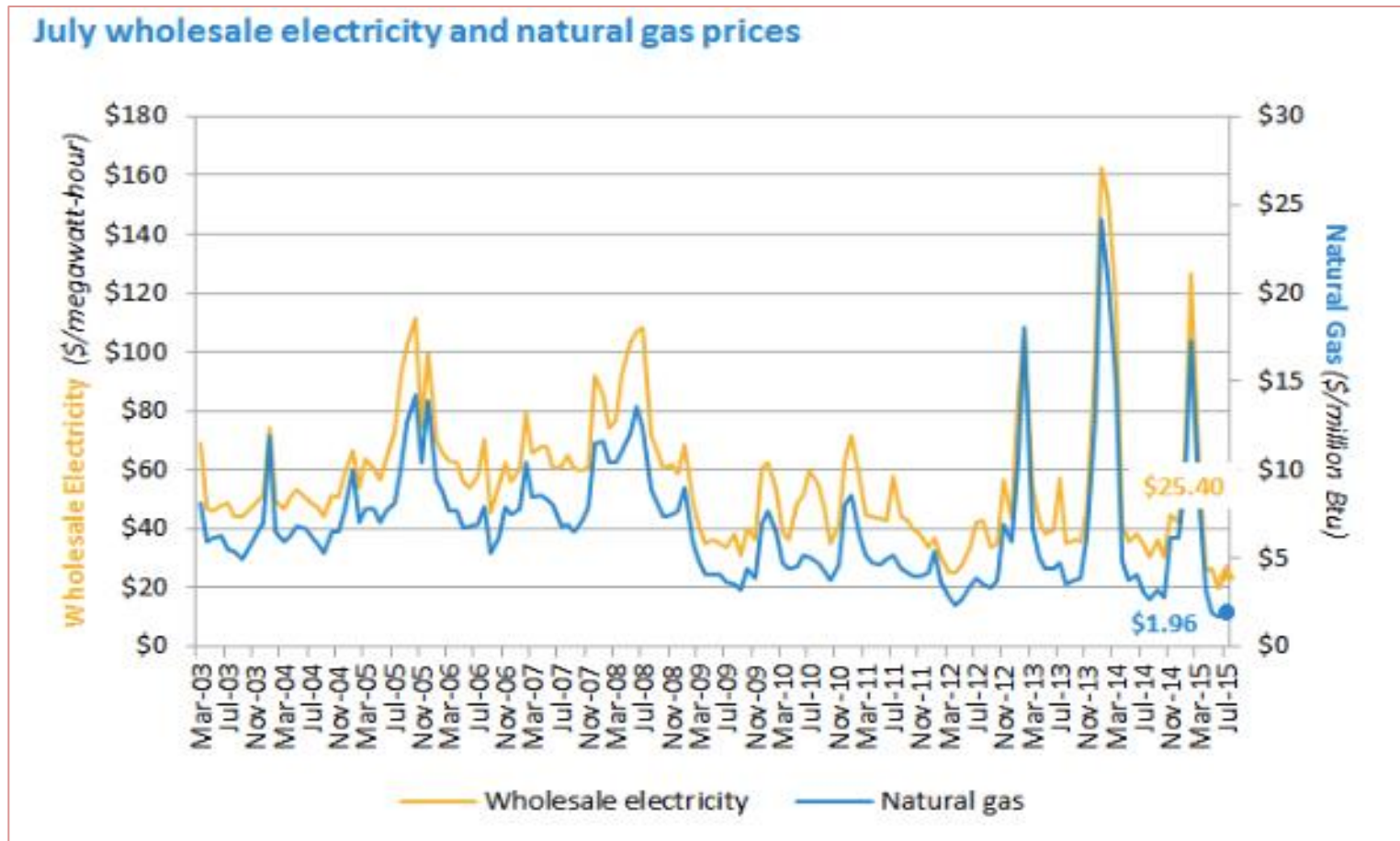


In Winter 2014-2015,
ISO-NE prices were:
88% higher than NYISO,
37% higher than PJM East, and
65% higher than PJM West

- ISO-NE
- NYISO
- PJM East
- PJM West

Source: ISO New England, New York ISO, PJM Interconnection

Non-Winter Prices Reach All-Time Lows



Power plants (oil/coal) that do not run regularly and/or only earn low profits when operating do not earn money to offset costs forcing retirement decisions

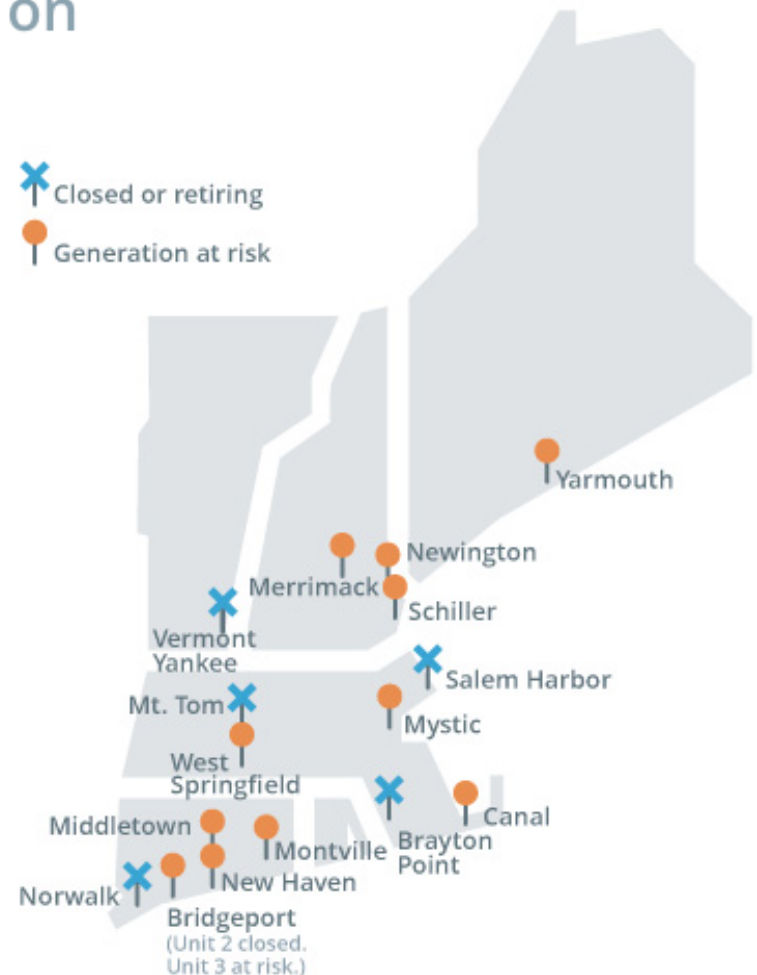
Retirements

Tomorrow's Energy Mix: Resources on the Way OUT

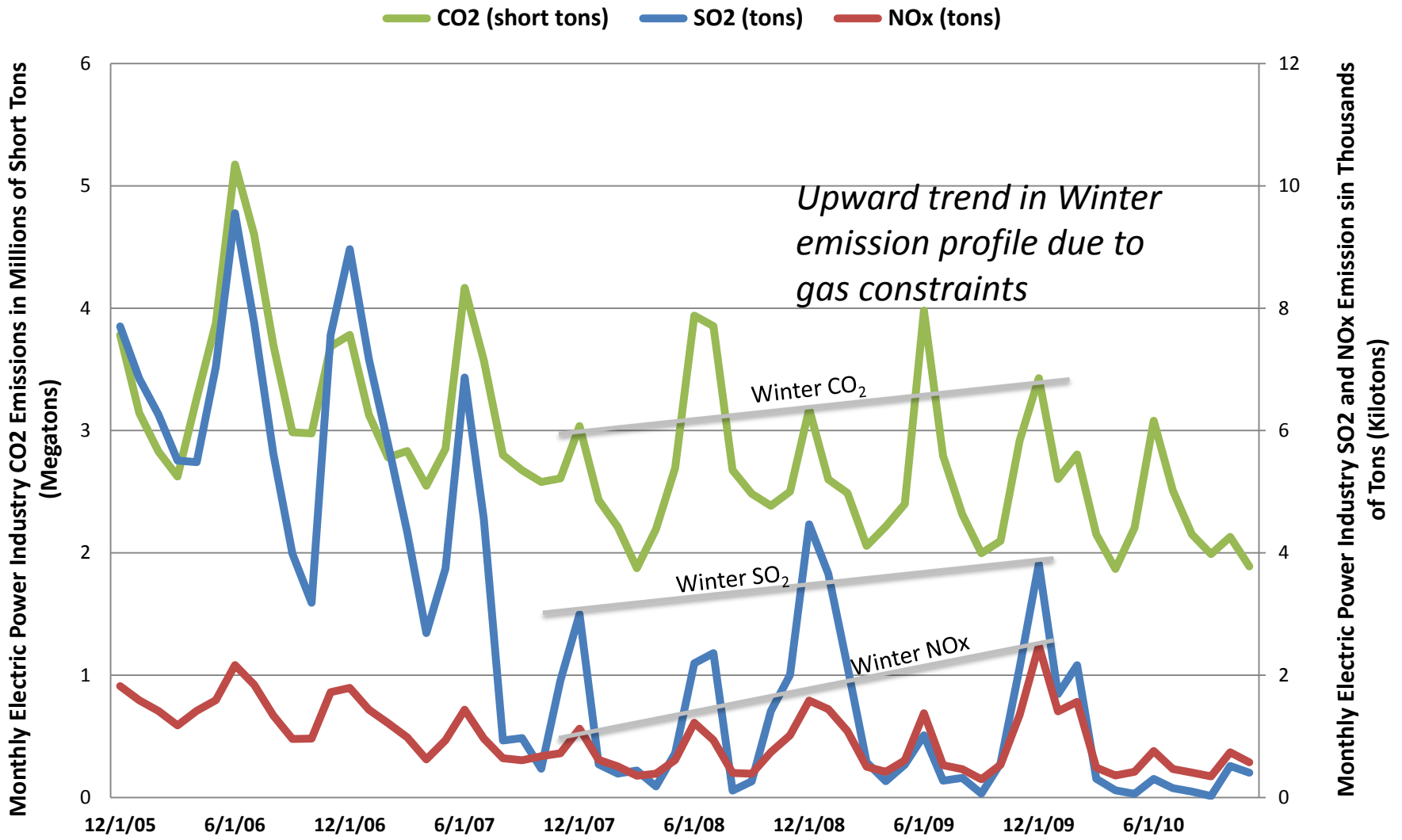
Several of the region's oldest generators—and some of its largest—have already ceased operations or plan to exit the markets by 2018. They take with them over 3,500 MW of regional capacity. Notable exits include:

- Brayton Point Station (1,535 MW from oil and coal)
- Salem Harbor Station (749 MW from oil and coal)
- Vermont Yankee (604 MW from nuclear power)
- Norwalk Harbor Station (342 MW from oil)
- Mount Tom Station (143 MW from coal)

About 6,000 MW more of New England's oil and coal capacity will be over 40 years old in 2020—some substantially older—and at risk of retirement, according to a 2012 ISO analysis.



New England Electric Power Industry Monthly Air Emissions: 2010-2014



Source: U.S. Environmental Protection Agency

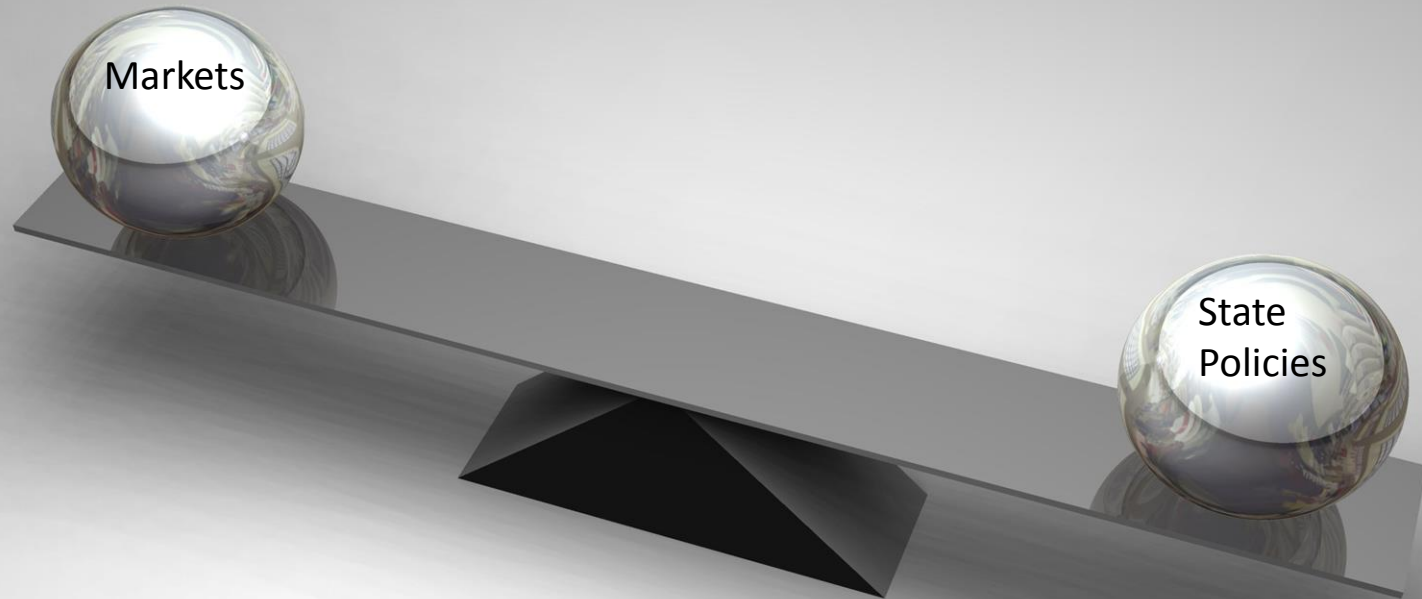


New England Governors

April 2015

“New England continues to face significant energy system challenges with serious economic consequences for the region’s consumers. . . . **The economic, system reliability, and environmental consequences of inadequate energy infrastructure require action. Cost-effective investment in new natural gas infrastructure and the continued integration of clean energy resources are important to resolving these challenges.** With these infrastructure investments, and continuing aggressive investment in other clean energy solutions such as energy efficiency and distributed generation, our region can reduce energy costs and thereby attract new businesses and jobs for our hard-working citizens.”

In all things, balance.



Some State Activities, Progressing in Parallel

- **Multi-State Clean Energy RFP** – www.cleanenergyRFP
- **Connecticut DEEP** comment opportunity closed Sept. 30 on three proceedings to procure resources pursuant to Public Act 15-107, *An Act Concerning Affordable and Reliable Energy*.

The Act authorizes DEEP to procure a range of resources - natural gas, energy efficiency, renewable energy, large-scale hydropower, and energy storage. The Act authorizes selection of the most cost-effective energy resources through an open and competitive process.

On gas: “DEEP is working on issues related to procurement for natural gas resources, and is evaluating options for coordinating the solicitation of natural gas resources with other states who have legal authority and interest in doing so, consistent with the strategic approach set forth by the New England Governors. DEEP expects to provide an opportunity for public comment on a request for proposal for natural gas resources this fall, with more details and questions to consider.”

- **Maine and Rhode Island** have enabling laws, with a Maine regulatory process ongoing.

- **Massachusetts**

- **EDCs and Gas Capacity:** DPU issued an order on October 2nd finding that it has “authority pursuant to G.L. c. 164, § 94A to review and approve contracts for natural gas pipeline capacity filed by electric companies.” DPU 15-37

Standard of Review: “...EDC must demonstrate that the proposed contract (1) results in net benefits for the Massachusetts EDCs’ customers at a reasonable cost, and (2) compares favorably to the range of alternative options reasonably available to the EDC at the time of acquisition of the resource or contract negotiation (e.g., pipeline capacity, local storage, electric transmission). An EDC must show that the price of the resource is competitive and that the contract satisfies other non-price factors such as reliability of service and diversity of supply.

Filing Requirement: “.. an EDC seeking Department review and approval of a gas contract must include with its filing materials that demonstrate a competitive and transparent procurement, that avoid conflicts of interest, and that allow for consideration of procurement by entities other than EDCs.”

- **LDCs and Gas Capacity:** DPU approved LDC - Boston Gas, Baystate Gas, Berkshire Gas - Capacity Contracts with Kinder Morgan.

- **Broad legislative proposals under discussion.**

- **New Hampshire**

In mid-September, PUC Staff released report of its investigation into potential approaches involving NH's electric distribution companies to mitigate the high and volatile electricity prices that have affected electricity markets in NH and other New England states in recent winters

“we view Access Northeast and Northeast Energy Direct (NED) as two very cost-effective projects that will moderate future winter electricity prices though the numbers clearly indicate that NED will provide the greatest benefits to regional electricity customers. Nonetheless, **Staff's principal recommendation in this report is that if the Commission chooses to participate in a regional procurement of gas capacity (whether pipeline or LNG) for the benefit of electricity consumers it should condition that participation on the procurement being conducted through an open and transparent process that is demonstrably competitive and results in the lowest possible cost to consumers**”

“Staff has concluded that the Commission may hold that New Hampshire EDCs have authority to enter into gas capacity contracts for the benefit of gas-fired generators, if such a proposal were to be made by a New Hampshire EDC.”



MAINE NATURAL GAS CONFERENCE


OCTOBER 2015

Managing Natural Gas Risks

Rumford Power

Heidi Leslie

Executive Vice President, Legal, Regulatory & Public Affairs

A solid blue decorative bar at the bottom of the slide, which is wider on the right side and tapers to the left.

Rumford Power

- 265 MW combined cycle natural-gas power plant in Rumford, Maine
- Developed by Energy Management Inc. and online since October 2000
- Consists of a GE 7FA gas turbine and a heat recovery steam generator
- Natural gas is supplied through a lateral on the Portland Natural Gas Transmission system
- Acquired by Emera Energy in November 2013
- Strong operational performance - available to serve the region's electric needs over 95 percent of the time in 2014



Operating Rumford Power

10 AM Rumford Power decides whether to “self-schedule” or bids its energy economically into the Day Ahead Market (DAM)



7-9 AM Seek gas quotes for same day & next day	10 AM Onward If Rumford has self-scheduled, it works to procure gas for the next day. Otherwise it waits for its Day Ahead Commitment
12 – 1 PM Receives DAM commitment	After 1 PM If DAM commitment, procures gas. May be possible to get next day gas but usually needs to wait for next same day gas cycle

Effect of Dispatch and Gas Price Volatility

Rumford Power bids into Day Ahead Market (DAM) based on **expected** gas prices from the morning. **But gas prices can change throughout the day.**

Rumford is Dispatched

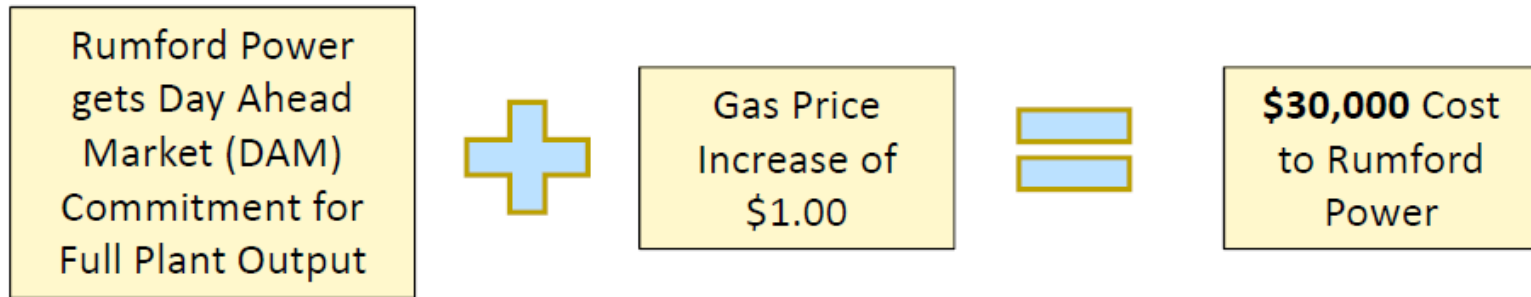
May have to pay **more** for gas than the morning quote.

Rumford is NOT Dispatched

If already procured gas, may have to sell back into the market – sometimes at a price **lower** than the purchase price. Sometimes cannot sell gas back at all.

Rumford Power bears gas price volatility risk that is difficult to hedge because of its low frequency of dispatch, or capacity factor.

Dispatch/Gas Price Volatility Examples



Real-Life Examples

- During Winter 2013/2014 there were days when gas prices changed by \$20 in one day at a price of \$600 K to Rumford Power
- During Summer 2015 there were days when Rumford Power could not sell its gas back to the market at all
 - In that case, Rumford hopes that it can park its gas on the pipeline

Recent market changes to allow hourly reoffers have helped.

Solutions?

- Rumford Power stands to lose with PFP but the plant serves an important market function
 - Rumford can balance wind resources
 - Rumford can serve base load requirements
- These functions will become more important over time as more intermittent resources such as wind come onto the grid, and older, less efficient plants are retired
- Solutions? Gas and power coordination is a complex issue and solutions may differ at each meter and at each plant. Some general possibilities include...

...**Cheaper gas** in the region could help

...**Energy-only purchase power agreements (PPAs)** could keep efficient power plants like Rumford Power, while ensuring that long-term gas contracts are put in place

Effect of Pay for Performance

- The ISO's Pay for Performance (PFP) market design goes into effect in 2018
- Under PFP, plants which are not running when a shortage event occurs lose a significant amount of their capacity payments under the Forward Capacity Market
- It is highly likely that Rumford Power will not be running during a shortage event because it has not been dispatched based on economics
 - Once a shortage event occurs, there is not enough time to ramp up from a cold start, e.g. major transmission outage

Under Pay for Performance, Rumford Power could lose more than 100% of its capacity payments. But, short of removing Rumford Power from the capacity market via a static/dynamic delist, or retirement there is limited ability to mitigate the financial exposure associated with PFP.



Getting Natural Gas Right

**Ivy Frignoca
Senior Attorney
Conservation Law Foundation
October 13, 2015**



Climate Change
**The Defining Challenge of
our Age**

*“Without additional mitigation efforts beyond those in place today, and **even with adaptation**, warming by the end of the 21st century will lead to high to very high risk of **severe, widespread, and irreversible impacts globally.**”*

IPCC Climate Change 2014 Synthesis Report

clf

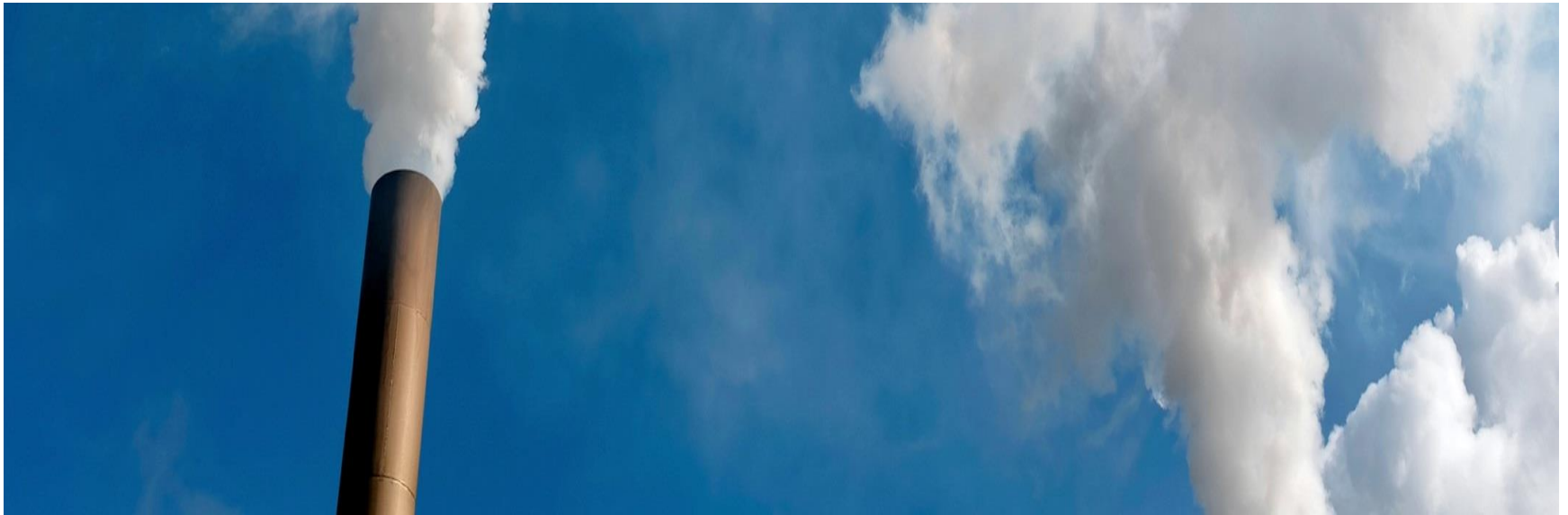
conservation law foundation

For a thriving New England

Legal and Policy Basis for Getting Gas Right

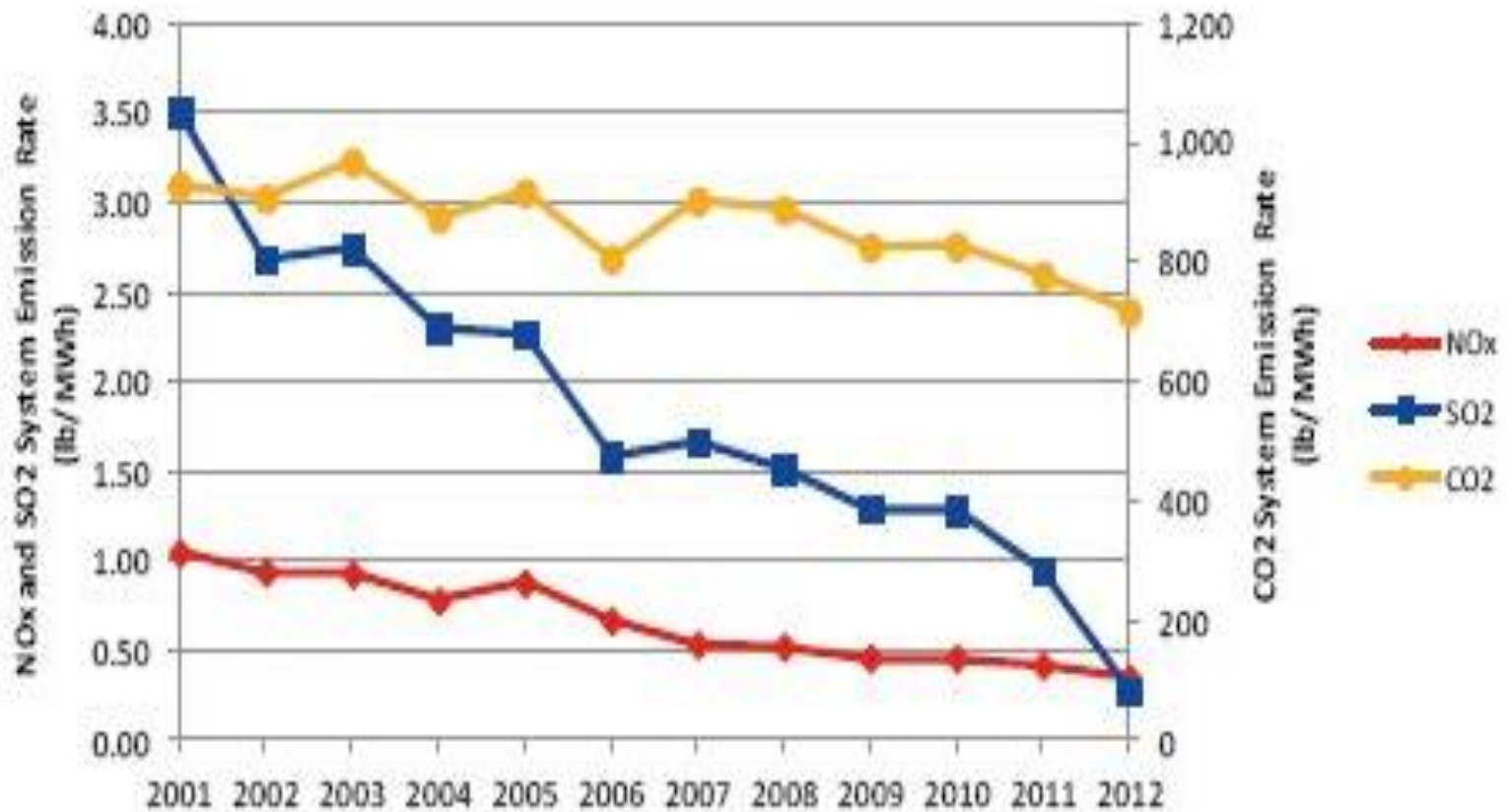
Regional GHG Emissions Goals and Mandates

- Reductions from all sectors of the economy to reach a target of a 25% reduction of Greenhouse Gas (GHG) emissions by 2020 and an 80% reduction by 2050.
- Mandatory in MA and CT



Natural Gas: Not a Panacea

Figure 5-2: 2001-2012 ISO New England System Annual Average NOx, SO2, and CO2 Emission Rates (lb/MWh)



Possible Mitigation Strategy for Generators



Footprint Power Case Study

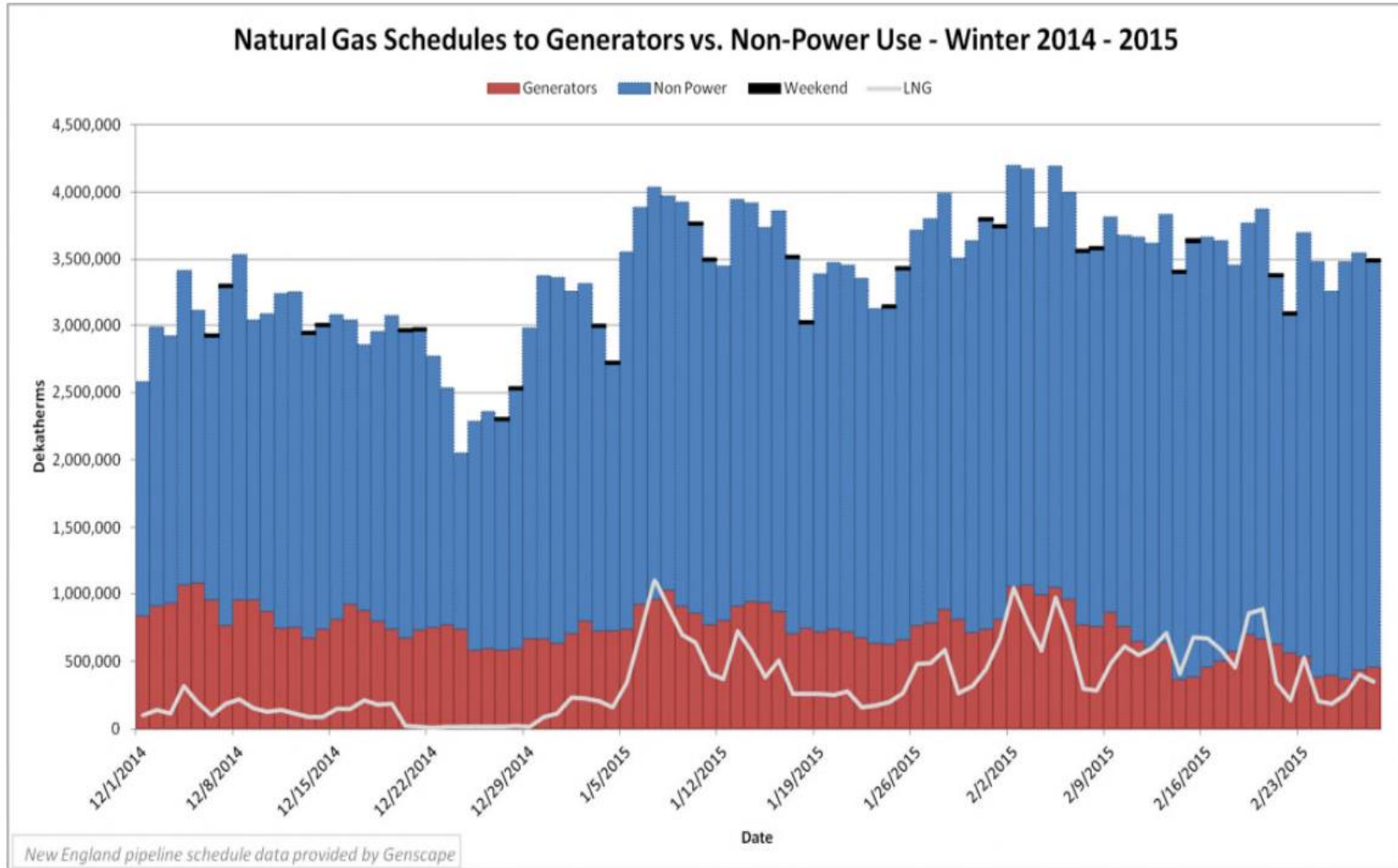
- Former Salem Harbor Coal Plant
- CO2 emissions reductions consistent with regional policy goal
- Require closure by 2050

How Much Gas Is Too Much?

- Approximately 50% current generation fleet is gas
- Proposed Generation In Queue-57% gas plants/42% renewables
- ISO-NE has identified overreliance on natural gas generation as a reliability threat

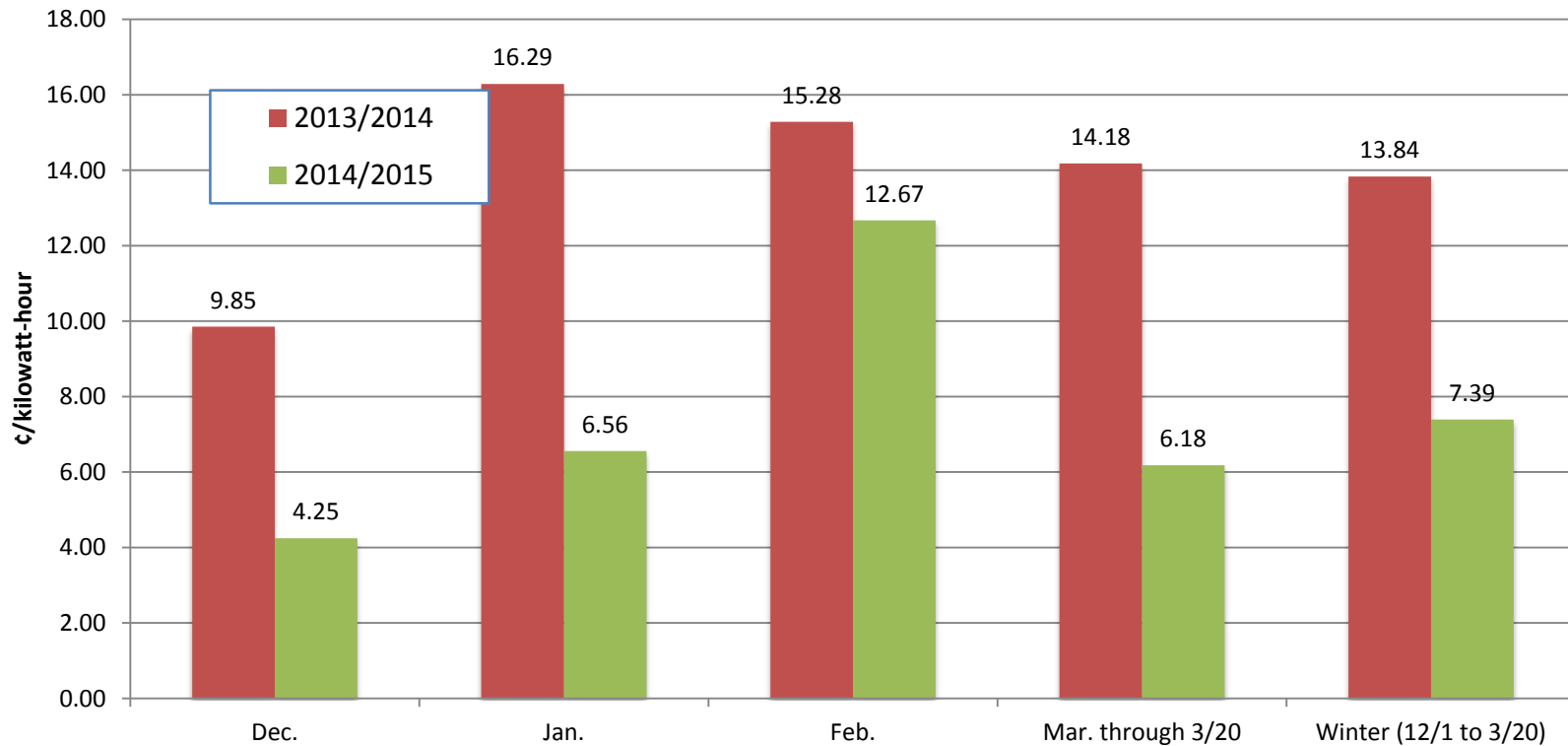


Existing Pipeline System Improving Deliverability and Ensuring Adequate Supply- Winter 2014-2015



Wholesale Electricity Prices Substantially Reduced- Winter 2014-2015

ISO-NE Real-Time Wholesale Prices
(Monthly Average LMPs, Internal Hub)



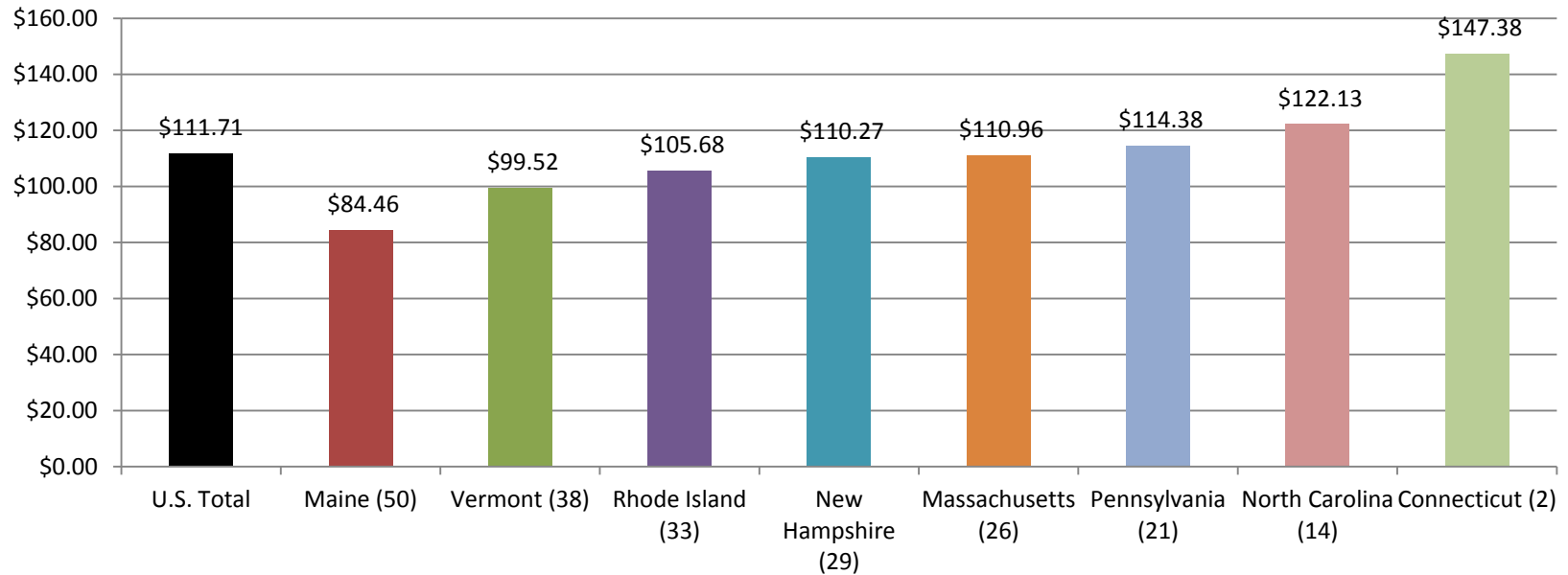
Fact: Maine Has Lowest Electricity Bills in U.S.

Average Residential Customer Monthly Electric Bill in 2014, by State*
(and rank of bill amount among 50 U.S. states and D.C.)



Source: Energy Information Administration

*2014 retail electric prices and 2013 average electric consumption (most recent data)

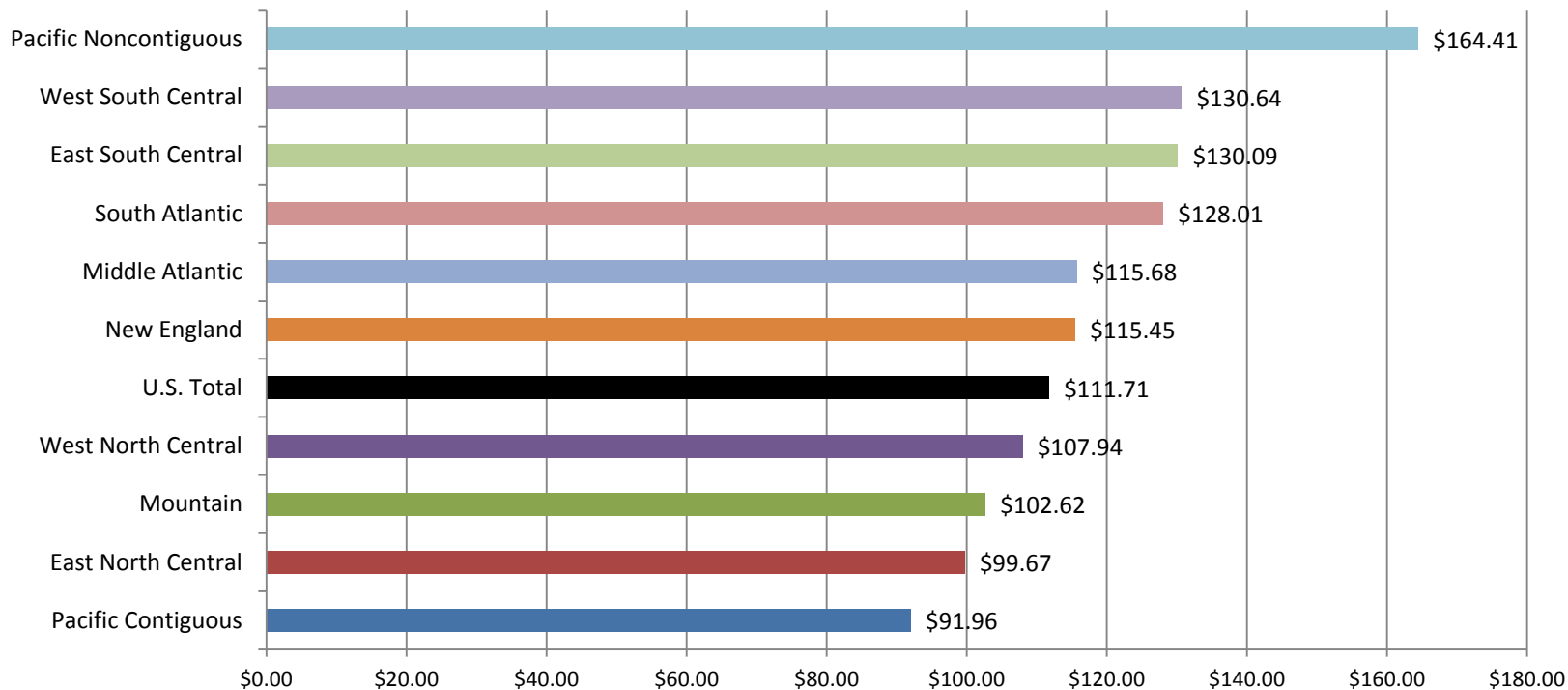


Fact: New England Electricity Bills Just Above U.S. Average

Average Residential Customer Monthly Electric Bill in 2014, by Region*

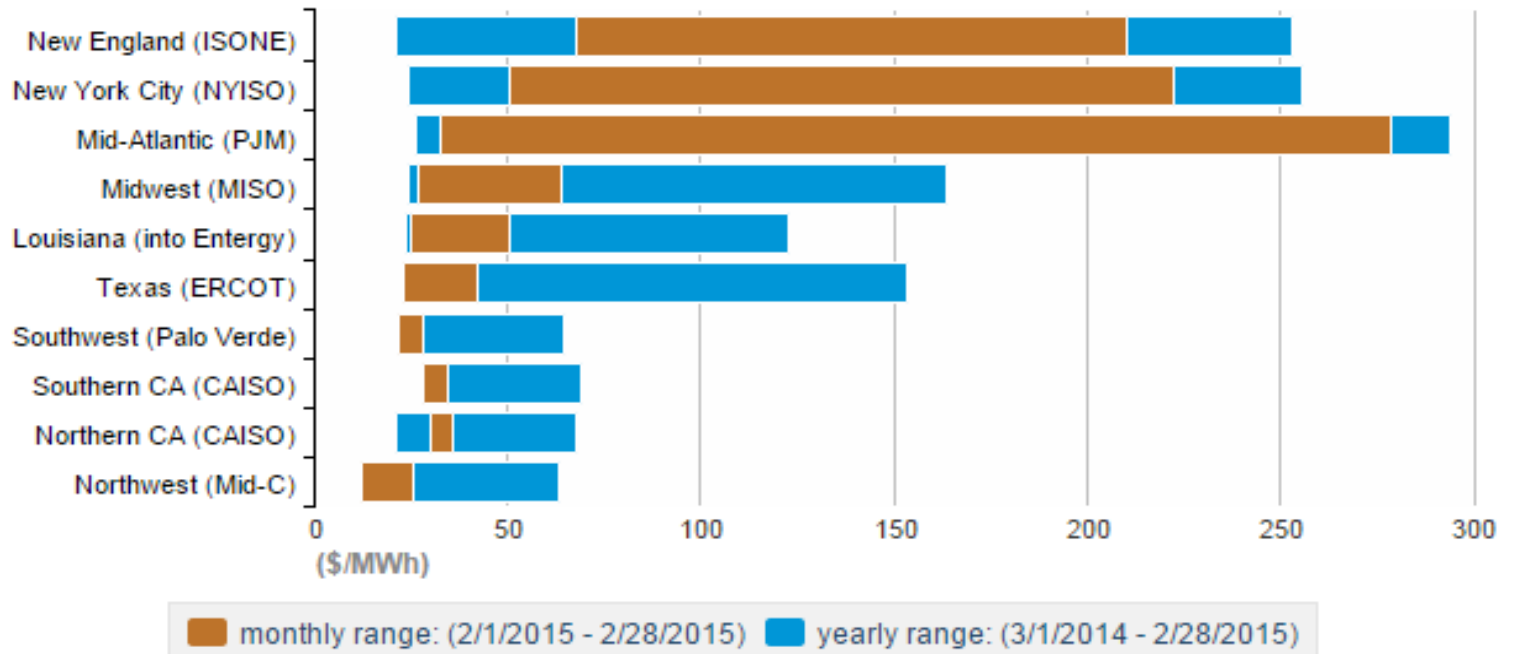
Source: Energy Information Administration

*2014 retail electric prices and 2013 average electric consumption (most recent data)

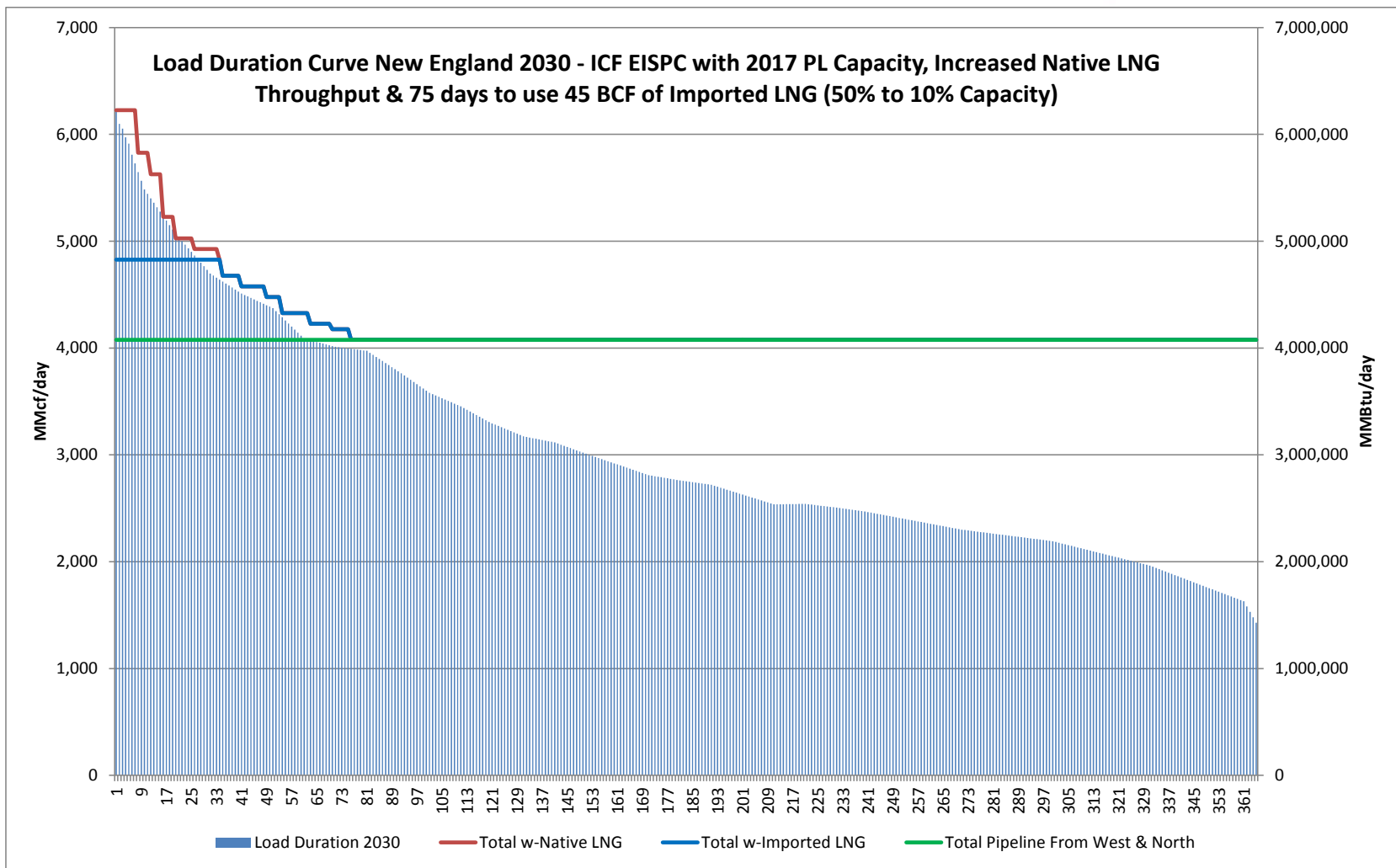


Plentiful Gas Supply Does Not Mean Lower Electricity Prices

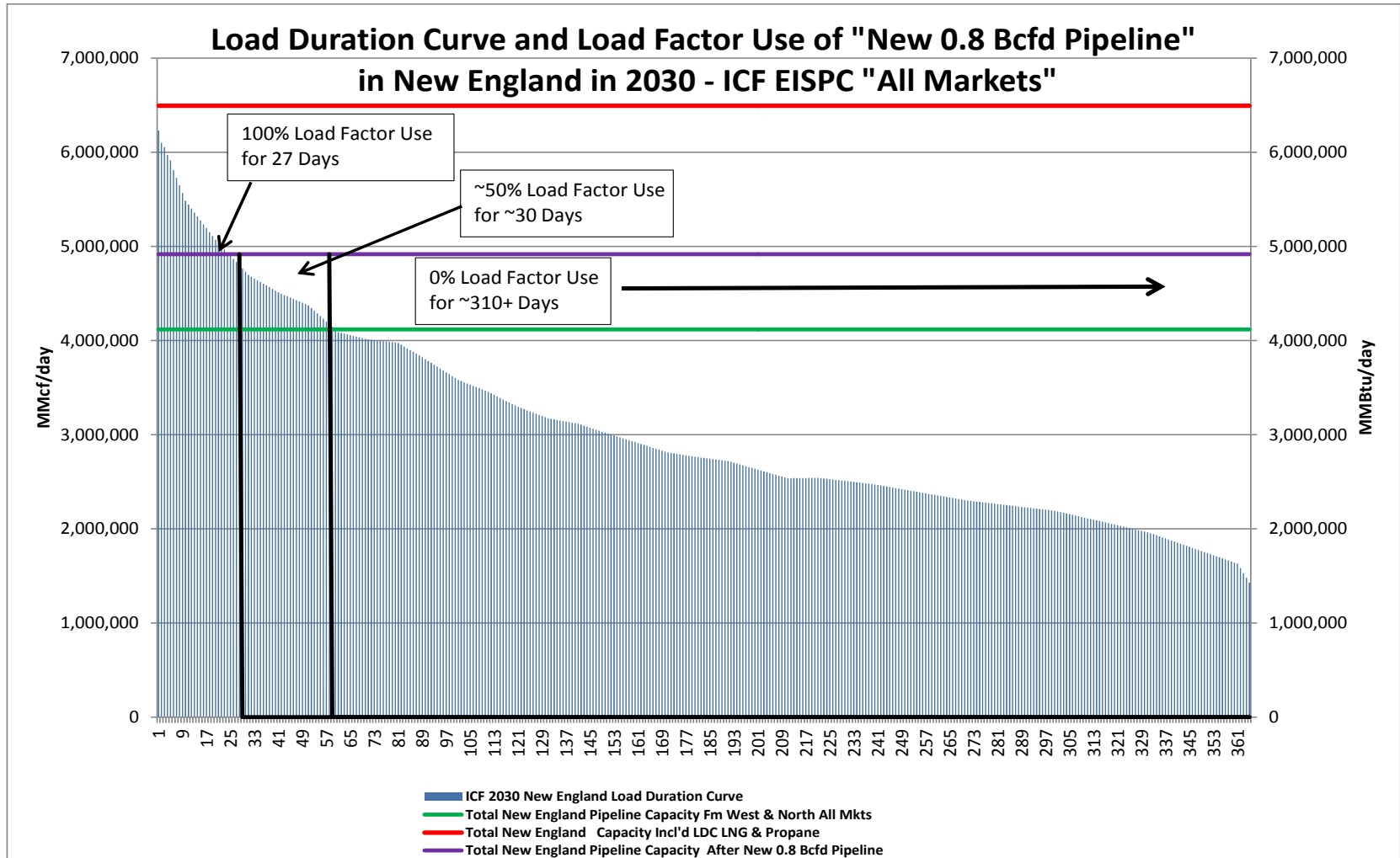
Monthly and annual range of wholesale electricity prices for selected regional trading hubs, February 2015



CLF Report: LDC Storage and LNG Imports Resolve Need Through 2030 More Economically than New Pipeline



CLF Report: New .8bcf/d Pipeline Means Excess Capacity in 2030 and 0% Load Factor for 310 Days





Gas Fired Electricity Generation and Firm Transportation Contracts

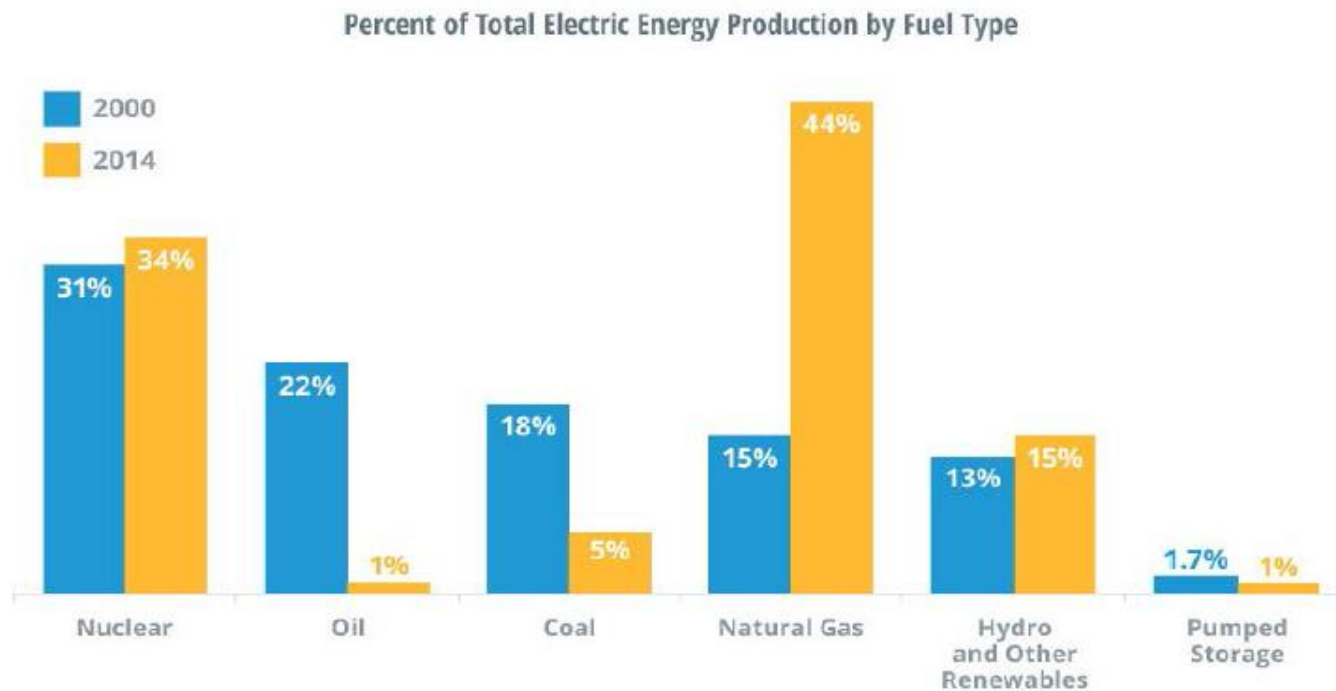
Sarah B. Tracy, Partner
Pierce Atwood, LLP
October 8, 2015





New England Electric Energy Production by Fuel Type 2000 vs. 2014

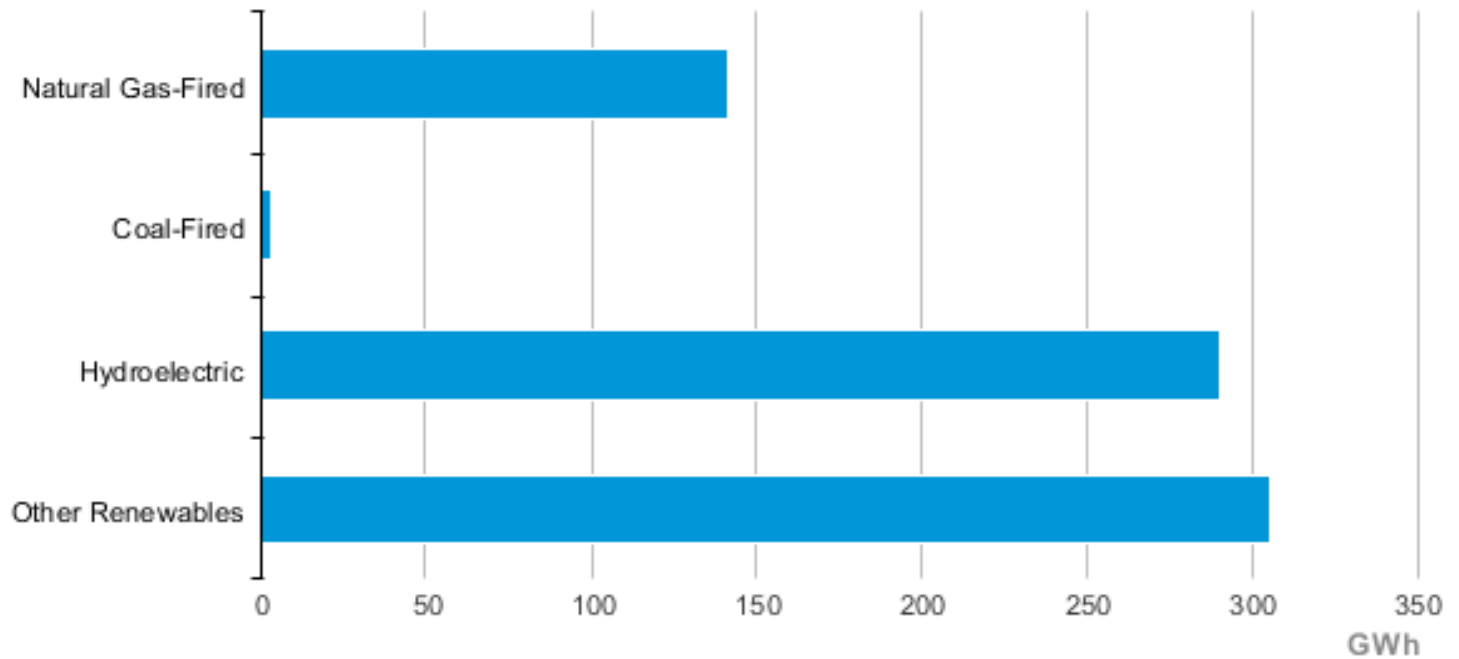
Resource Mix



Source: <http://www.iso-ne.com/about/what-we-do/key-stats/resource-mix>



Maine Net Electricity Generation by Source, Jun. 2015



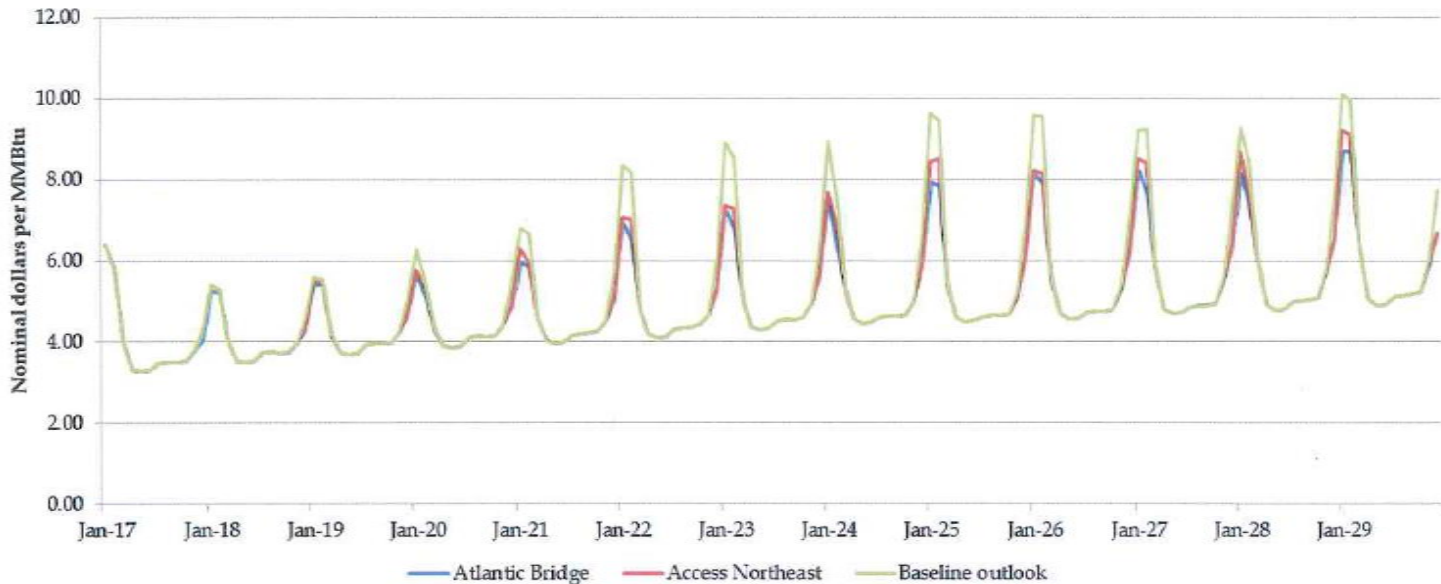
Source: Energy Information Administration, Electric Power Monthly



Natural Gas Prices: Baseline vs. Atlantic Bridge or Access Northeast ECRC

REDACTED PUBLIC VERSION

Figure 18. Monthly average Algonquin Citygate gas prices, under the MECRA Baseline outlook and with Atlantic Bridge or Access Northeast

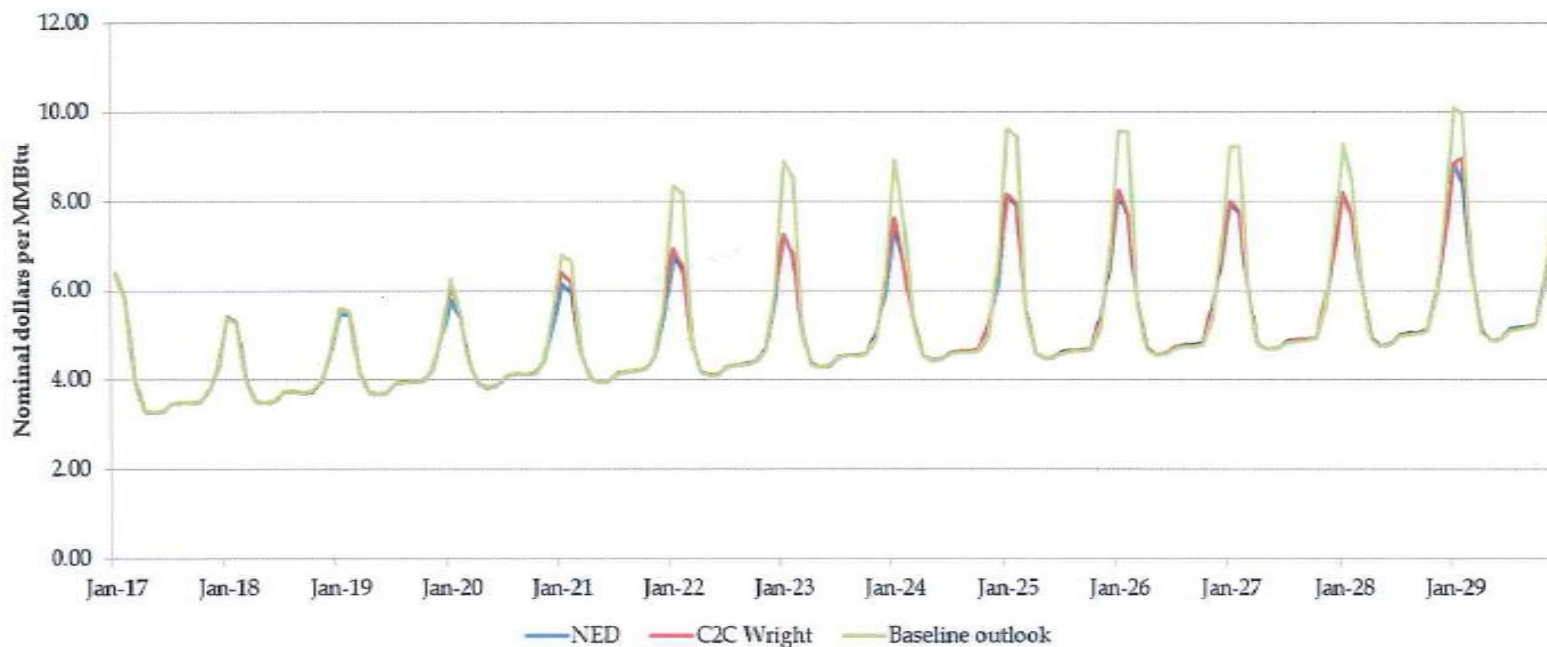


Source: 6/20/2015 LEI Report (2014-00071) at page 29 (public version)



Natural Gas Prices: Baseline vs. NED or C2C Wright

Figure 16. Monthly average Algonquin Citygate gas prices, under the MECRA Baseline outlook and with NED or C2C Wright



Source: 6/20/2015 LEI Report (2014-00071) at page 28 (public version)



Conclusions of London Economics Report in ECRC Proceeding

- ECRC proposals would reduce wholesale gas prices
- ECRC proposals would reduce wholesale electricity prices
- Maine's gas consumption was approximately 7% of the total New England gas consumption in 2014
- Maine's electricity consumption was approximately 9% of the total consumption in New England in 2014
- Maine would pay 100% of the costs of an ECRC
- Relative to the costs of an ECRC, the benefits are too small for Maine and cannot offset the cost of firm transportation to the State



Benefits to Natural Gas Fired Generators?

- Reduce costs of natural gas supply (although this is generally a pass-through)
- Reduce price volatility of supply
- Increase reliability of natural gas supply
 - Firm transportation commitment rather than interruptible service
 - Supply diversity associated with accessing more liquid trading points
- Avoid generators having to post credit assurance typically required of contractual parties to precedent agreements
- Assumes that firm transportation from ECRCs or other agreements are available to generators and depends upon location of generators
- Need to keep in mind overall cost benefit analysis and accordingly, regional solution may make more sense