ICF White Paper

New England Sets the Pace for Electricity and Natural Gas Integration

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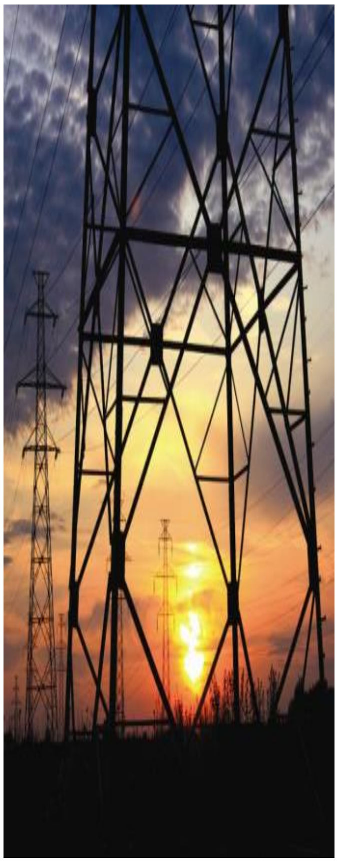

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1. Because of its growing reliance on natural gas-fired generation and increasing gas infrastructure utilization, New England faces important challenges to fuel supply adequacy, electric system reliability and economic competitiveness.
2. Left unaddressed, consumers face the risk of persistently high and volatile natural gas prices that could continue to drive high and volatile electricity prices, and potentially threaten electric service reliability.
3. Recent initiatives that could permit electric distribution companies to subscribe to gas pipeline firm transportation could improve long term planning to the benefit of consumers.
4. By expanding the solution choices to include new gas pipelines, New England stakeholders have the opportunity to stabilize regional energy costs and establish a national model in the efficient integration of natural gas and electric markets, but also materially change the way competitive electricity markets function.

Executive Summary

The emergence of periodic, but persistent, natural gas supply constraints for power generators in New England poses important challenges to stakeholders seeking fuel supply adequacy, electric system reliability and economic competitiveness. Left unaddressed, consumers face the risk of persistently high and volatile natural gas prices that could continue to drive high and volatile electricity prices, and potentially threaten electric service reliability. With good decisions, stakeholders have the opportunity to stabilize regional energy costs and assume a leadership role in the efficient integration of natural gas and electric markets.

The progressive tightness in gas supplies for New England generators is a natural extension of the region's growing reliance on natural gas-fired generation and increased utilization of existing gas infrastructure. While highly utilized infrastructure is a testimony to the efficiency of the competitive wholesale electric market in New England, it is also a signal that market policies and protocols may need revision. In the effort to extract efficiencies and keep costs down, the planning processes that electric grid operators and stakeholders have developed make long term commitments to new firm fuel supply capacity a risky proposition for generators. In so doing these processes effectively vest decisions regarding the region's natural gas infrastructure investments with market participants least likely to make them. In this white paper we discuss some of the key processes that frustrate investment, and potential steps that can support good decision making going forward.

Prompted in part by successive cold winters, ISO-NE and other market participants have recently taken proactive steps to address the increasing frequency of natural gas price spikes that prompt electric price volatility. Among other actions, its Winter Reliability program has been effective in ameliorating resource availability and dampening electricity price spikes, while a Pay-for-Performance Initiative (PI) is intended to incentivize performance and firm fuel capacity in the coming years. The ultimate success of PI for promoting the most cost-effective infrastructure mix will depend on processes and assumptions that consider long term choices, and avoid a bias toward shorter term solutions. Thus far, the set of incentives in these programs has

favored fuel oil, which may or may not be the intended and lowest-cost long-term solution when compared to increased natural gas pipeline capacity.

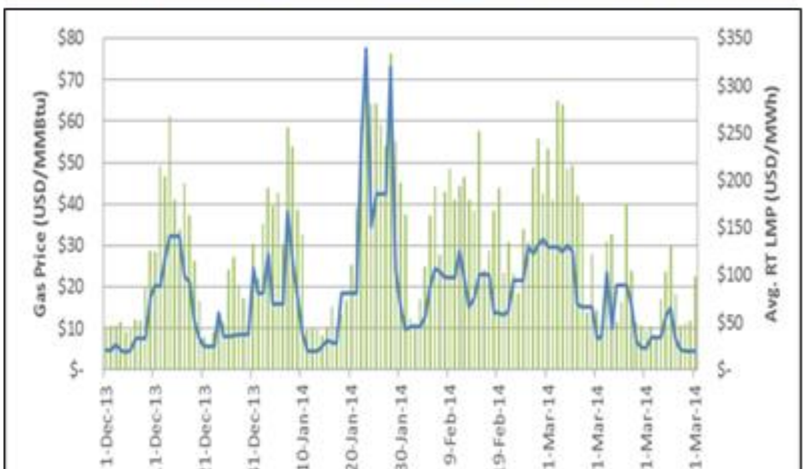
In New England, opinions vary as to whether new natural gas pipeline or other fuel infrastructure is the right answer to changes taking place in the energy market. Some stakeholders believe that increased energy efficiency and renewable energy penetration may provide an achievable and optimal pathway. Others feel that a gas infrastructure solution is the best answer for a reliable gas-fired generation market. The current set of market constructs that guide pipeline capacity investment decisions, however, make new infrastructure difficult to even consider, let alone build, and thereby impede a reasoned consideration of all options. Massachusetts DPU Order 15-37, issued in April 2015, could change that, and add impetus to a trend in other New England states that allows load serving utilities to enter into long-term pipeline transportation contracts. If adopted, this could signal an end to the contracting logjam that has hindered regional pipeline development. More important for consumers though is that such a program is also likely to lead to more defined and comprehensive set of regional and state energy planning processes that help policymakers achieve the most-cost-effective, environmentally sound, and economically efficient solutions.

New England Takes Center Stage on Gas-Electric Integration

New England sits in a leadership position on gas-electric integration because its need for unlocking access to fuel supply may be the most chronic and pronounced of any North American region. By 2017, as coal, oil, and nuclear units retire, nearly half of the region's electricity power will be fueled by natural gas. At the same time, heavy pipeline utilization is constraining access to gas supplies during peak demand periods, driving greater volatility and higher prices. Rising gas prices in turn are causing increased costs and volatility in electricity prices.

These challenges will intensify pressure across the complex web of economic and regulatory interactions between the electricity and natural gas markets to better align and rationalize their operations, in particular the incentives and planning protocols which shape power generator procurement of natural gas and other fuels for their plants. The opportunity for policy innovation is also spurred by the fact that in New England, like certain other North American power regions, electric load serving utilities do not own generation assets.[1] This means that unlike their utility generator counterparts in heavily regulated, vertically integrated power markets, the costs for fuel infrastructure do not receive long term guaranteed cost recovery through electric consumer rates.

Exhibit 1: Correlation of NE Gas and Electric Prices Shows Vulnerability of Generators to Gas Supply Constraints and Prices



Source ISO-NE, SNL

The absence of such fuel cost guarantees encourages gas-fired generators in New England to procure a large percentage of their natural gas on the spot market, and to avoid fixed contracts for set quantities of fuel or infrastructure capacity. This means that natural gas prices figure prominently in setting regional electricity prices. As demonstrated by the close correlation between natural gas and power prices during the 2013-14 winter shown in Exhibit 1, the aversion regional generators have to fixed

[1] With the exception of New Hampshire, where the proposed divestiture of remaining Eversource generation assets is pending legislative action as of the publication date of this paper.

pipeline costs can work to produce low electricity prices when natural gas infrastructure is abundant. On the other hand, it can also be extremely costly when natural gas infrastructure becomes scarce on cold winter days and gas prices rise, pulling electricity prices up in tandem. Partly because of such winter gas price spikes, New England's electricity customers pay the highest costs in the country.[2]

Institutional Disconnects Between Electricity and Natural Gas Market Planning Decisions

In many ways, the challenges posed to expanding natural gas infrastructure and a smooth integration of New England electricity and gas markets are the vestiges of the different approaches that electric and gas planners and operators use to go about their business. These differences, complex as they are, distill to a few key challenges:

- **Short-term vs. Long-term incentives –** Power markets do not provide adequate compensation for the risks of investing in long-term fuel supply solutions that have the potential to match market needs. For example, to obtain regulatory approvals and financing, natural gas pipeline developers require firm fuel purchase commitments that are usually longer than 10 years for new capacity. New England generators, because they are competitively dispatched on a daily or hourly basis and do not have long-term reliable revenues, have little incentive to make such firm, long-term pipeline commitments since the only form of firm payment they receive, the capacity payment, is fairly low and only ranges from 3 to 7 years in duration.
- **Poor investment risk allocation** – This incentive mismatch in turn means that much of the burden to financially back the development of new gas infrastructure in New England falls on the backs of gas-fired merchant generators who are generally ill-suited to wear that risk. There is no mechanism for spreading those risks more widely across other stakeholders, investors, or the consumers who could benefit most from reduced natural gas and electricity price volatility.
- **Absence of adequacy standards** – It is difficult to manage what cannot be measured, and at present there are no common standards for how much firm natural gas infrastructure (or other fuel) capacity a region needs. This stands in stark contrast to other electricity and gas market metrics (power generation capacity, natural gas design-day consumption, and renewable intermittency) that serve as signals to operators for when new infrastructure may be needed. With regard to winter season natural gas supply certainty for generators, there is no standard approach or benchmark. Instead stakeholders are relying on look-backs at spot market prices during stress conditions as a primary indication of market need.

New England's Winter Reliability and Pay for Performance Initiatives: Solution or Crutch?

In the wake of the 2013-2014 Polar Vortex, New England's system operator ISO-NE undertook two initial steps to improve reliability and decrease price volatility: it expanded its Winter Reliability program, which requires dual-fuel power plants to maintain more fuel oil stock before the winter, and it put in place its Pay for Performance Initiative (PI), a series of incentives designed to reward power plant availability during peak electricity demand periods.[3]

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[2] New England's location near the terminus of the North American power and natural gas grids also contributes to the region having higher than average energy costs.

[3] Most notably, under PI, generator capacity payments will now include a performance payment that redistributes penalties assessed on underperforming resources to over performing resources under scarcity conditions.

These steps have been effective so far. New England gas prices — which traded 7 to 15 times higher than Henry Hub during the 2013-2014 Polar Vortex and rose to almost $76/MMBtu at Algonquin Citygate — were only 5 to 7 times higher this past winter and stayed below $22/MMBtu.[4] Capacity prices increased 36% in the most recent ISO-NE Forward Capacity Auction, showing the effects of PI in valuing generator performance and firm fuel supply under scarcity conditions.

Notwithstanding the initial successes of PI, it is also important to recognize that these programs may only be treating the symptoms of regional gas supply constraints, and not providing the best long term solutions. In fact, in some ways, PI may move New England further from addressing the root cause. A key rationale for PI is that its payments and penalties will encourage generators to procure increased firm fuel supplies, which in turn might support the development of new infrastructure that ensures generation during scarcity conditions. Thus far, while the program is entirely technology-neutral, it appears to have led to generators favoring fuel oil over new natural gas pipeline commitments.

ISO-NE generators evaluate the economics of firm fuel supply by comparing firm fuel supply costs with the penalties incurred and opportunity costs arising from lack of fuel during scarcity hours. As shown in Exhibit 2, the combination of costs and penalties under PI is indeed more than sufficient to incentivize procuring firm fuel supplies for dual-fired generators. However, it is insufficient to cover the fixed costs of firm pipeline gas supply.[5]

Exhibit 1: ISO-NE Pay for Performance Initiative Cost Analysis

ISO NE Indicative Costs of Firm Fuel Supply ($/kW-yr)	Capacity Periods	ISO NE scarcity hours during which generator does not have fuel	Penalty Rates ($/MWh)	Lost Opportunity Cost ($/MWh)	Total Cost ($/kW-yr)
$20/kW-yr (dual) $80/kW-yr (gas)	2018/2019 – 2020/2021	10	2,000	1,000	30
	2021/2022 – 2023/2024	10	3,500	1,000	45
	2024/2025 +	10	5,455	1,000	65

So while Winter Reliability and PI undeniably will serve to mitigate some winter price volatility and improve resource adequacy, they may have the combined unintended consequence of leading the market to find equilibrium at a solution that leans more heavily on fuel oil, and could serve as a crutch that allows the long term challenges posed by increasing congestion on regional natural gas pipelines to fester.

Four Steps to Improve Electricity and Natural Gas Alignment

Regardless of the long-term effects of the PI program, better alignment between New England's gas and electric markets could be achieved by integrating four elements into energy planning and operations:

- **Establish regional pipeline capacity adequacy benchmarks –** Having standard approaches for determining whether a power market has an adequate share of generation backed by firm natural gas, or more particularly whether there is even enough infrastructure capacity serving the region, would improve foresight and decision making in all aspects of fuel and resource adequacy planning.
- **Ensure that price signals weigh long term factors** – As Exhibit 2 demonstrates, stakeholders should consider whether solutions like PI are, in effect, costing consumers

[4] See ICF's paper "Return of the Polar Vortex: Cold Renews High Demand, but Some Markets in Better Shape" for a full summary of the region's improved resilience during the winter of 2014-2015.

[5] The estimated indicative cost for natural gas pipelines, as shown in exhibit 2, approximately $80/kw-year for a 10-hour period of deficiency, exceeds that of dual fuel oil back up and even the potential penalty levels for these hours.

in the long term by failing to create price signals that might achieve the optimal infrastructure balance.

- **Optimize infrastructure investments by drawing on all industry solutions** – Transmission of electricity and gas supply to generate it are increasingly serving as substitutes for one another in terms of resource adequacy. The best solution depends on the situation. Power grid planners currently do not always have access to the best information as they make choices, nor do they have the ability to act on them, and they need to.
- **Maintain equitable compensation mechanisms for competing infrastructure** – Electricity and natural gas grid infrastructure investment decisions face a major disparity: investments in power transmission that provide long term reliability are accorded cost recovery certainty, whereas investments in fuel supply alternatives that would do the same thing are not. This discourages capital investments in fuel infrastructure even where it would be more economic than an electric infrastructure alternative. Giving generators equitable opportunity to recover prudent investments in fuel supply on similar terms as transmission investments would benefit electricity consumers and fuel infrastructure providers alike.

Incorporating facets of the above could support better decision making by industry operators and stakeholders. It is not clear however, how such changes would be initiated or what forum would serve for considering them.

The Path to Socializing Resource-Adequacy Infrastructure Investments

The role that structural disconnects discussed above have had on lagging pipeline infrastructure development may have led to an April 23, 2015, joint statement by all six New England Governors that expressed many of the concerns raised by the current status quo:

> "In January, ISO New England, the region's power system operator, reiterated that New England is challenged by a lack of natural gas pipeline infrastructure and is losing non-gas power plants, both of which threaten power system reliability. As a result, New England is now relying on greater use of fuel oil to maintain reliability. Such a trend is to our detriment, as fuel oil has a higher cost, a higher emissions profile and its increased use will reverse progress on New England's environmental objectives."[6]

That joint statement was followed four days later by Massachusetts DPU Order 15-37, which seeks stakeholder input on whether electric distribution companies should be permitted/required to subscribe to long-term natural gas pipeline contracts as a means of furthering new development, and how to pay for it across a broader base of customers who would benefit. This is sometimes referred to as "socializing" the costs of new infrastructure. Although other New England states have and are moving toward similar initiatives, adoption by Massachusetts could have far-reaching implications because of the state's size and impact on the regional gas market.

Many questions remain to be answered before such a program could realistically be implemented. One group of questions concerns the basic mechanics, such as: who commits to the pipeline contracts, how will regulatory prudency be determined, and how will costs be recovered? More important, perhaps, are the broader policy questions of how such a program affects and integrates with the workings of a competitive power market: decisions regarding socialized pipeline (or other energy) capacity, the chosen transporters, volume commitments, pricing and utilization will all shape the future electric market. So how do stakeholders establish processes for making the best decisions? And will such processes signal an undesirable shift back to a more regulated New England market in which some central planning is deemed necessary to ensure reliable and affordable power?

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[6] "New England Governors' Statement: Regional Cooperation on Energy Infrastructure," April 23, 2015.

The structural disconnects that arose in the movement to a competitive New England market deferred many of these questions to merchant generators and left gaps in how grid operators or regulators could intercede if deemed necessary. As time passes and gas-fired generation grows, we are witnessing both positives and negatives to a competitive commodity market. The good news for consumers is that Order 15-37 and other initiatives like it, in seeking to address a specific question about pipelines, may also bridge past disconnects and spur the establishment of enhanced planning forums and processes that support better, more comprehensive decision making for electric markets in the future.

Closing Thoughts – Proven Objectives, New Approaches and Best Practices

Reliable, affordable power is the objective of every electric grid regulator. With North American gas-fired power generation set to grow even further, the challenges to achieving those objectives in New England are being seen in other parts of the country. The growth trend will encourage and may even force long-term thinking and new approaches. Innovative initiatives underway in New England create the opportunity to smooth the transition to greater gas-electric integration, and in so doing create a blueprint upon which other regions can build.

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