NATURAL GAS MARKET VOLATILITY IN THE NEW ENGLAND – IMPACTS OF PIPELINE CAPACITY CONSTRAINTS

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Overview

New England (NE) energy price has been greatly volatile due to the pipeline capacity constraints. Specifically, average natural gas price in winters 2014 and 2015 in New England are the highest ($24.19 and $9.34 MMbtu in January 2014 and 2015 respectively, from Energy Information Administration) in the continential U.S despite its proximity to Marcellus/Utica supply basin, the leading natural gas supply in the U.S. The region has greatly suffered from such a dramatic price volatility because of the unbalanced supply-demand, particularly in extreme winter and summer period. Since 2000, natural gas has become a dominant fuel for home heating and power generation in the New England; currently it represents 46% of the electricity generation in New England in 2013 and is forecast to rise to 55% in the next five years. This rising gas-fired power together with the extreme weather, higher efficiency and lower carbon dioxide emissions than other alternative fuels such as coal or oil are the major factors driving demand for natural gas in New England. Meanwhile, the declining imported gas from Canada, the lack of local underground storage and particularly insufficient gas pipeline capacity are all attributed to an instable gas supply in the New England, which has adversely caused **peak load problems, price volatility and electric grid unreliability** in the region. In other words, New England has been faced with the urgent need of expanding gas infrastructure to store and transport natural gas from neighboring low-priced production places to high-demand markets to meet extreme demand in peak season, mitigate the big regional price basis differential and increase reliability of gas-fired electricty system.

Methods

To assess impacts of inadequate pipeline capacity on wholesale natural gas and electricity price in New England, this study investigates both market structure and pricing issues by answering the **research questions** as follows:

1. *How much is additional pipeline capacity needed to solve the infrastructure bottleneck in the NE?*
2. *Where is critical infrastructure investment needed to solve natural gas delivery constraints in NE?*
3. *How do market structure, supply-demand factors and regulatory framework affect wholesales gas and electricity price and infrastructure investment in NE?*
4. *What is the optimal solution? The cost and benefits between pipeline expansion and other alternatives?*
5. *How should the region fund the additional infrastructure investment and how can the NE learn from other regions such as Florida, New York to address physical delivery constraints successfully?*

The paper is organised with three main parts including industry analysis, empirical research and policy recommendations. **The first part** focuses on analyzing natural gas industry performance and the pipeline shortage situation in the NE. Employing **Micheal Porter's five forces**, this part will highlight the competitive landscape, market structure and regulatory issues. A juxtapose of the natural gas market in New England with a more vertically integrated market like Florida and New York will also be included to further understand the system bottlenecks and the role of an incentive scheme for firm pipeline transporation contract.

The second part, the empirical one, will focus on **quantifying the economic impacts** of building additional pipeline capacity on regional development by using **benefit-cost analysis** and the **Input-output (I-O) models**. Furthermore, this part of the study also **forecast short-term natural gas price volatility** based on the **GARCH/ARCH model**. With historical time-series data and expected pipeline capacity additions to be made by approved pipeline expansion projects, the study will **predict future natural gas price trends in NE under different demand scenarios** until 2017.
In fact, the price of wholesale natural gas depends on key variables including demand growth, the state of the economy, weather, production levels, pipeline capacity, storage levels, and alternative fuel prices, which will be grouped in the **right-handed side of the regression equation**. In the context of recent fall of oil price, demand and price of natural gas has been declining significantly in this winter 2014/15 as more dual-fuel power plants in New England has switched to use oil rather than gas to generate electricity. Therefore, oil price will be included in the forecast model as the alternative fuel prices.
Finally, the study will presents the major findings and recommendations to address industry challenges as well as discuss future research directions.

Results

First of all, at least **2bcf/d** of additional pipeline capacity is required to eliminate the natural gas price differential between New England and southern-Western regions.

Secondly, the New England natural gas market has been **fragmented;** Very few major market players, particularly power generators have enough monetary incentive to invest in pipeline expansion projects. This is because the short-term peak demand for few months in winter and summer time does NOT secure enough economic benefits to cover expensive investment in gas pipeline expansion. As a result, pipeline capacity expansions do not have the financial backing to go forward, although ample and low-priced natural gas supply is available less than 300 miles away in the Marcellus.

Thirdly, New England has **improper electric market design**. Power generators, the largest consuming sector of natural gas in New England, do not hold firm pipeline capacity, relying on interruptible transportation services offered by the pipelines. In contrast, natural gas-fired power generators are compensated for or obligated to purchase firm/long-term pipeline transportation capacity in other regional electric markets such as Florida.

Fourth, there has been **lack of operation coordination between natural gas and electricity market**. Scheduling requirements for the electric and natural gas industry are not synchronized. As a result, power generators cannot provide enough notice to secure it although natural gas supply and pipeline transportation capacity may be available. Conversely, power generators that are dispatched on short notice and draw on the pipeline system without proper notice can compromise the operational integrity of the pipeline and reduce delivery reliability to firm transportation customers.

Conclusion

1. Pipeline and storage capacity are of great importance to maintain price stability and reliability of power system in the long run.
2. Create the appropriate financial incentives (or conversely financial penalties) for natural gas-fired power generators to secure more reliable natural gas supplies such as firm pipeline transportation services or LNG.

3. Address operational issues (such as coordinated nomination and dispatch procedures) that improve operational reliability and transparency.

Data Sources and References

Historical data on natural gas supply, consumption and storage level are provided by Energy Information Administration (EIA), Federal Energy Regulatory Commission (FERC), New England States Committees on Electricity (NESCOE); Data on heating degree days (HDD), and cooling degree days (CDDs) are obtained from the National Weather Services; Data on weekly, monthly, spot and future natural gas price are obtained from the New York Mercantile Exchange (NYMEX); Data on price for crude oil, or coal can be adopted by the West Texas Intermediate (WTI) traded in the NYMEX.

Besides state-level data from EIA, DOE, FERC, NESCOE, the study also takes reference from reports on similar issues released by energy associations such as: American Gas Association (AGA), America's Natural Gas Alliance (ANGA), Northeast Gas Association (NGA); and and energy consulting firms such as:

Gordon van Welie (2014): Infrastructure Need- Electricity and Natural Gas Interdependcies, ISO- NE
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