

Aligning Gas and Markets: Analysis

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“There cannot be a smart, interactive grid unless the business rules governing the means by which gas is traded and dispatched are in sync with the evolving needs of the electric markets.”

*-EDF FERC Comments,
November 2014*

“We continue to recognize that additional intraday nomination opportunities could promote more efficient use of existing pipeline infrastructure and provide additional operational flexibility to all pipeline shippers, including gas-fired generators.”

*-Final FERC Order #809
April 2015*

Two Crucial Energy Markets

ISO-New England, the regional wholesale electricity market for Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont is increasingly reliant on natural gas.

- Roughly 50% of their electricity comes from gas-fired generators.

The wholesale electricity price is typically dictated by the fuel cost for gas-fired generators.

- Electricity generators buy gas mostly in a secondary market. Their fuel cost is determined by the spot price for natural gas.

Increased natural gas prices will be strongly amplified through the wholesale electricity markets.

Observations re: Basis Differential and Constraint Thresholds

Wyoming Trading Hubs - Mason et al. (April 2014)

Gas generally flows from west to east between these two hubs, so that one may interpret the source of supply as represented by the trading hub in the western part of the state (the Opal trading hub) and the source of demand as represented by the trading hub in the eastern part of the state (the Cheyenne trading hub).

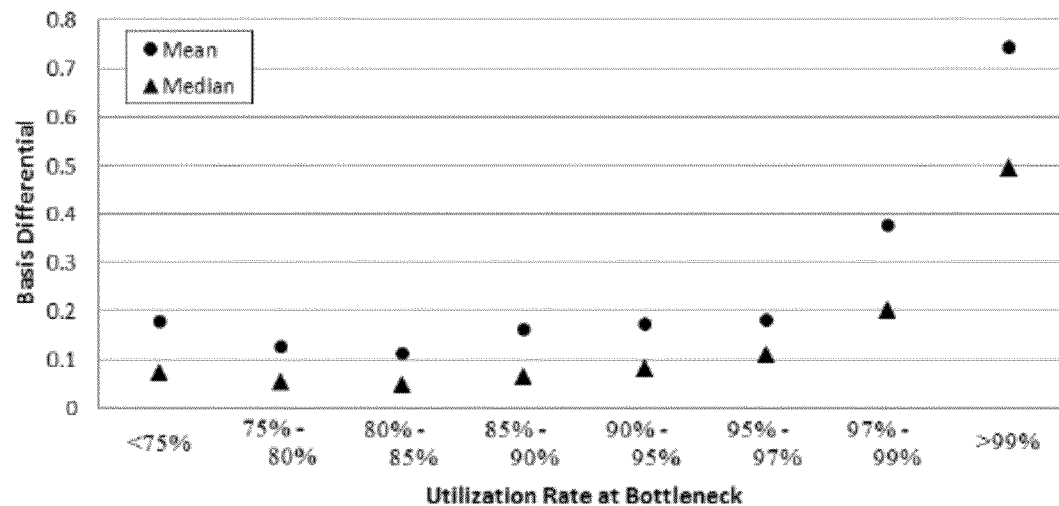


Figure 3: Basis Differential vs. Utilization Rate

When the utilization rate does not exceed 97% we see that the mean basis differential is between \$0.10 and \$0.20, with the median basis differential roughly half the mean value. Once the utilization rate exceeds 97%, however, the basis differential starts to rise rapidly. For observations where the utilization rate falls between 97% and 99%, the mean basis differential is roughly \$0.40 (with a median value of about \$0.20). When the capacity constraint is very nearly binding, i.e., when the utilization rate exceeds 99%, the basis differential increases to nearly \$0.80 on average (with a median value of \$0.50). As a utilization rate in excess of 97% seems likely to signal the imminent potential for capacity constraints to bind, the data suggest

binding capacity constraints can exert a powerful effect on spot prices.

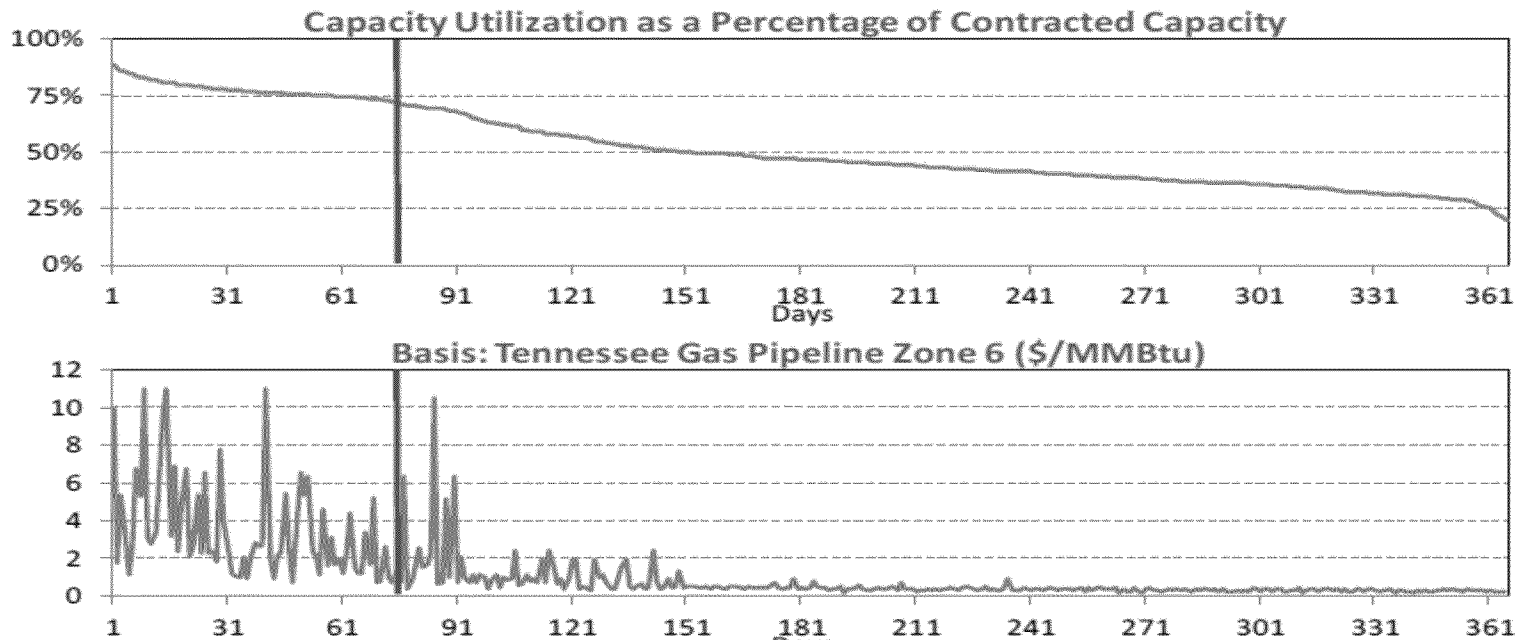
The implication is that capacity constraints (and the associated congestion) can be excessively costly to natural gas market participants. Figure 3 demonstrates the potential for a five-fold increase in the median basis differential if the utilization rate increases from 95% to 99%! As the capacity of the bottleneck

New England Trading Hubs

Black & Veatch for NESCOE-April 2013

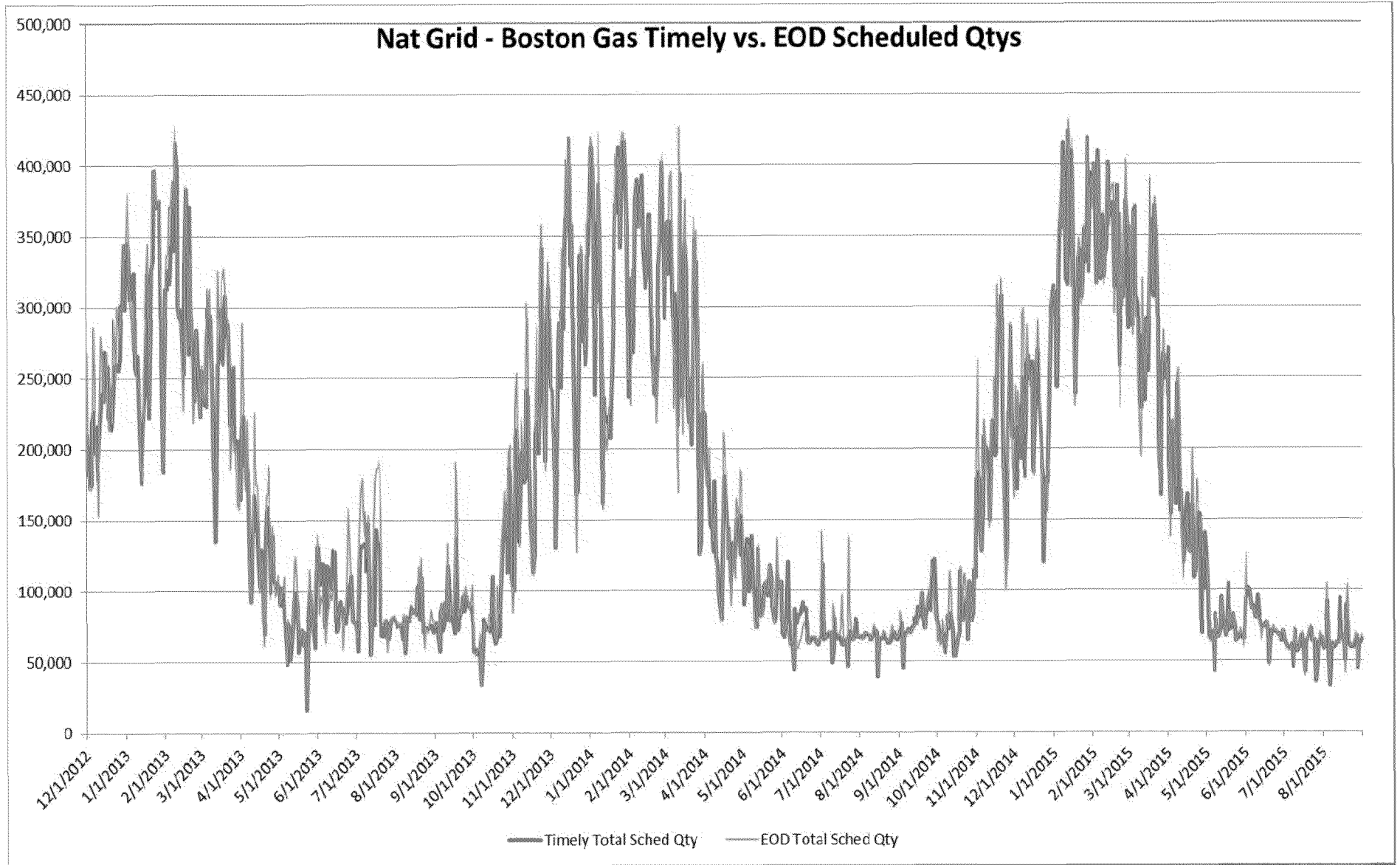
As shown in Figure 10, when total deliveries in East Massachusetts approach 75% of existing contract capacity serving the sub-region, regional gas price basis (measured at the Tennessee Gas Pipeline Zone 6 pricing point) spikes up. To reflect these dynamics that are characteristic of the New England market, Black & Veatch constructed an “Existing Constraint Capacity” threshold, which is 75% of existing contracted capacity. The red line in Figure 10, illustrates this “Existing Constraint Capacity” threshold, highlighting the relationship between gas pipeline capacity utilization and basis. Review of utilization factor and basis spikes for other sub-regions lead to similar observations.

Figure 10: Capacity Utilization vs. Basis: Eastern Massachusetts, 2010-2011 Gas Year

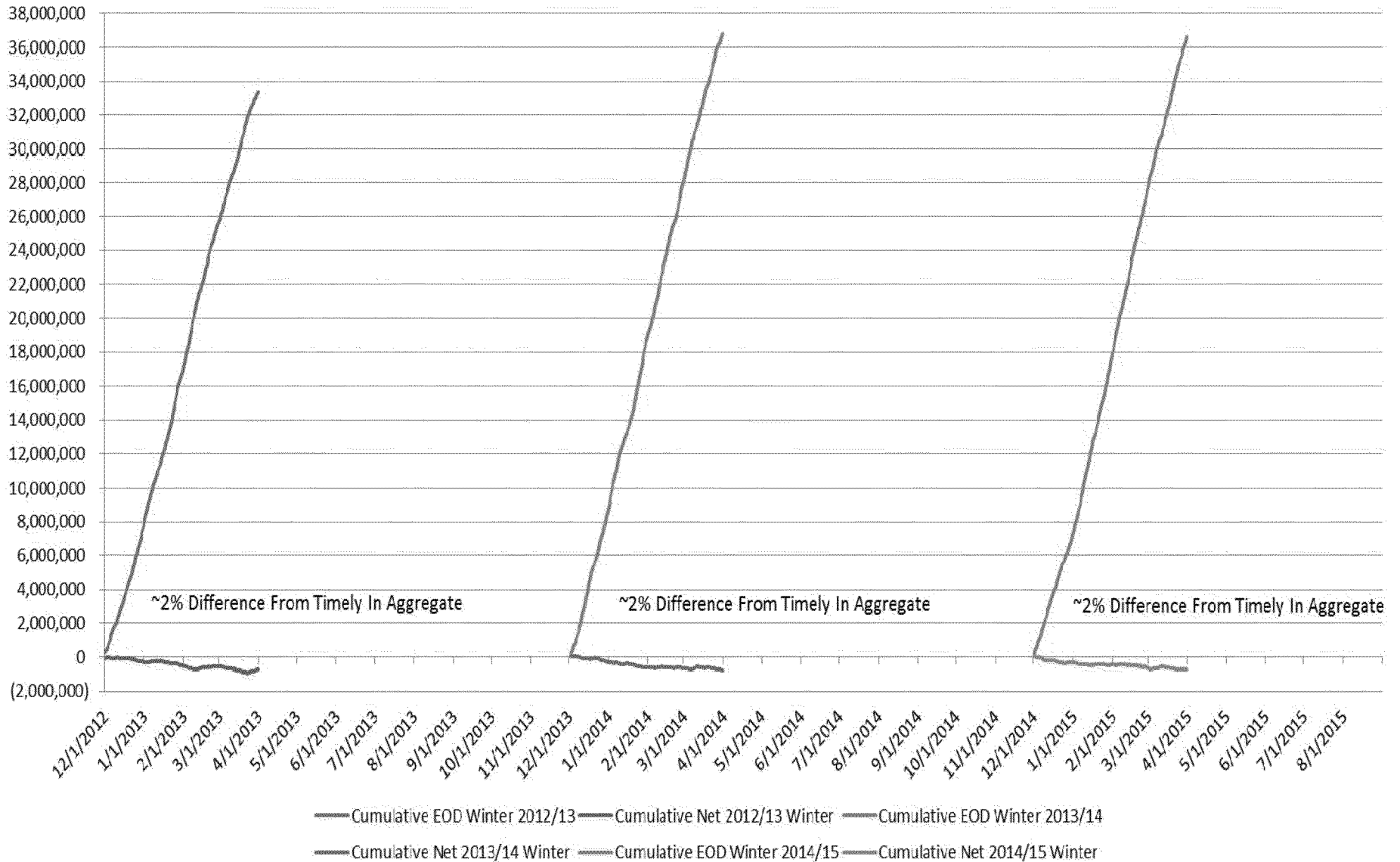


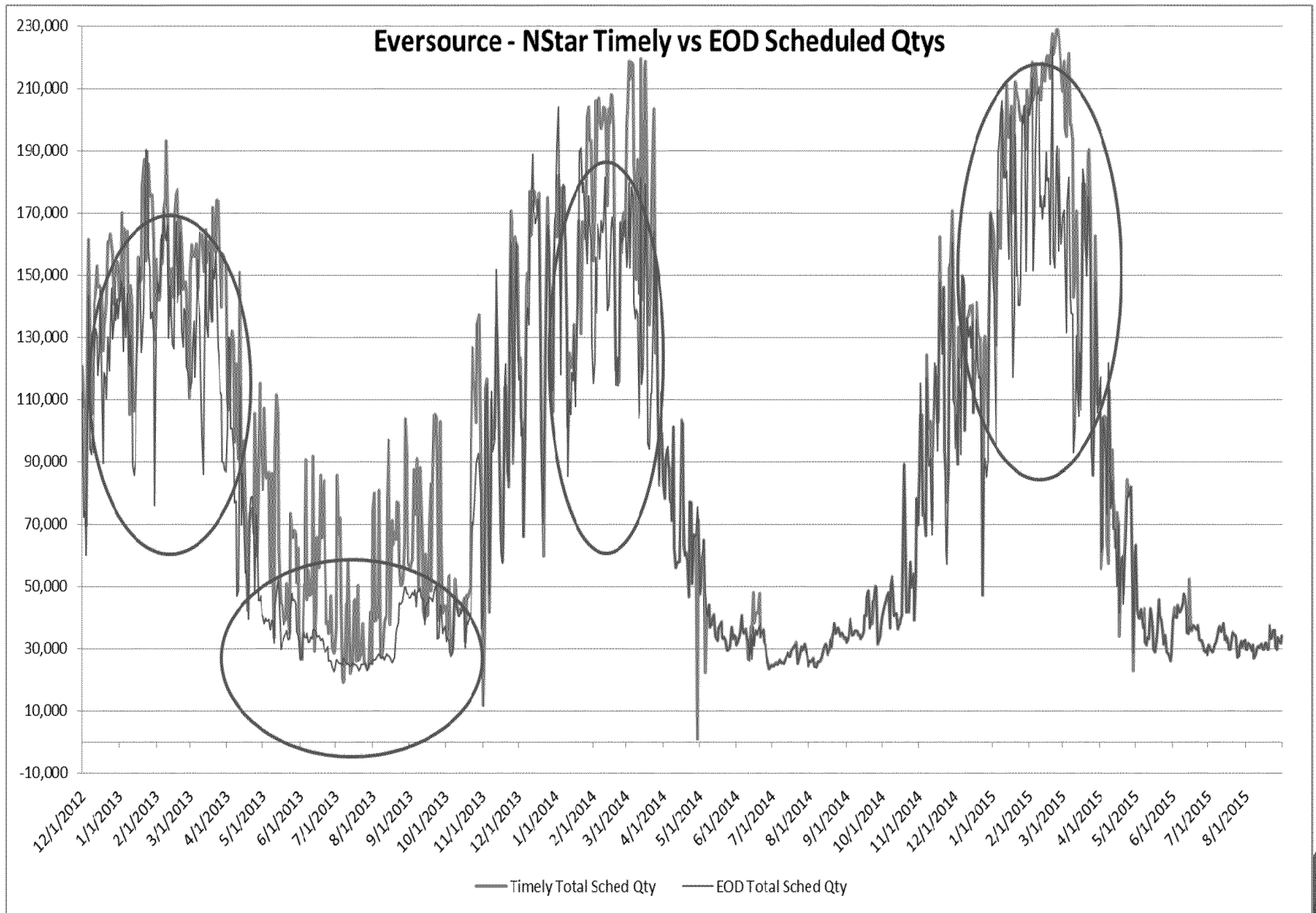
Skipping Stone New England Analysis

(undertaken to support regional policy discussions)

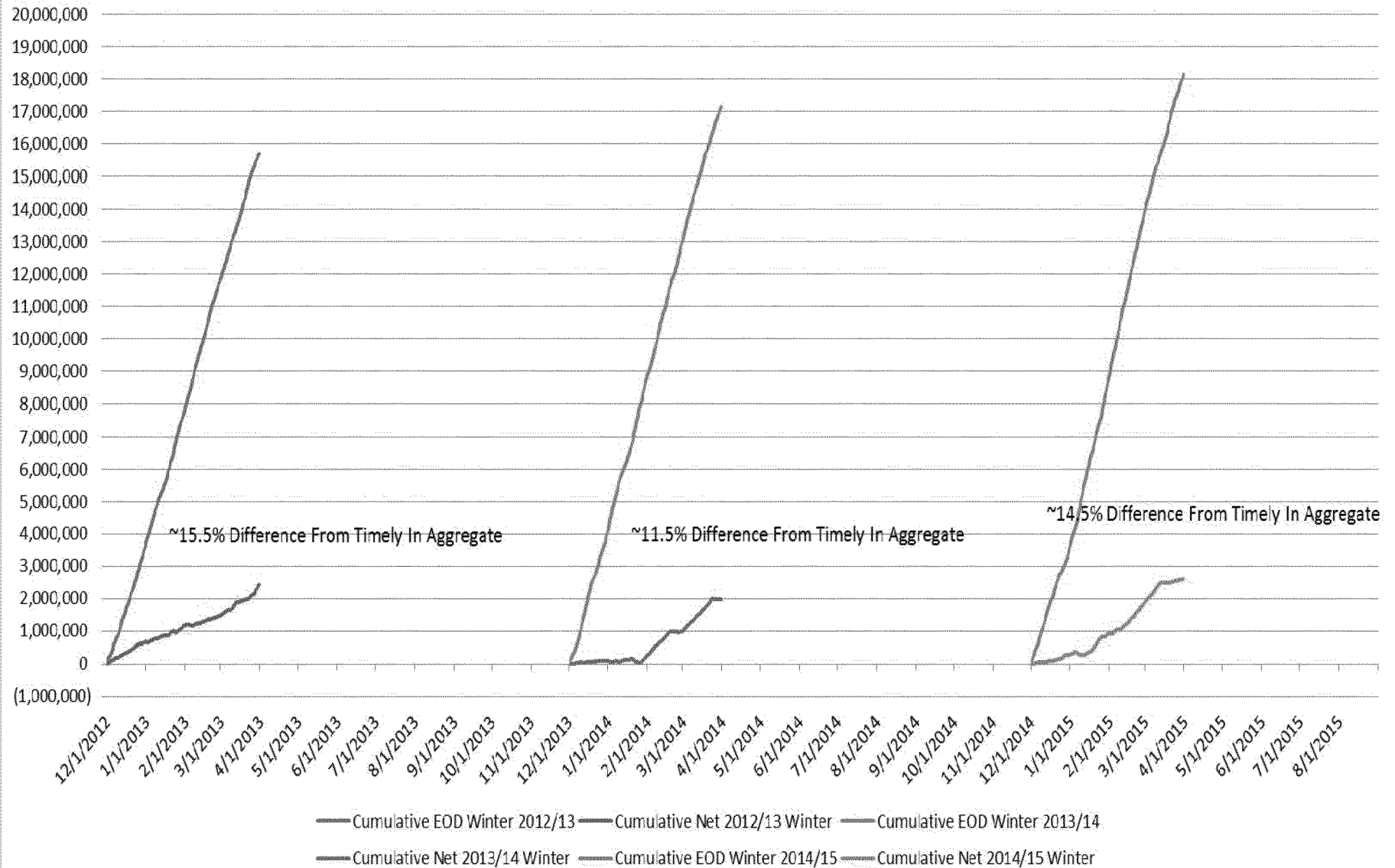


Nat Grid - Boston Gas Cumulative EOD Scheduled and Showing Gas Left on Pipe or (Excess Scheduled) vis Timely Nominated and Scheduled

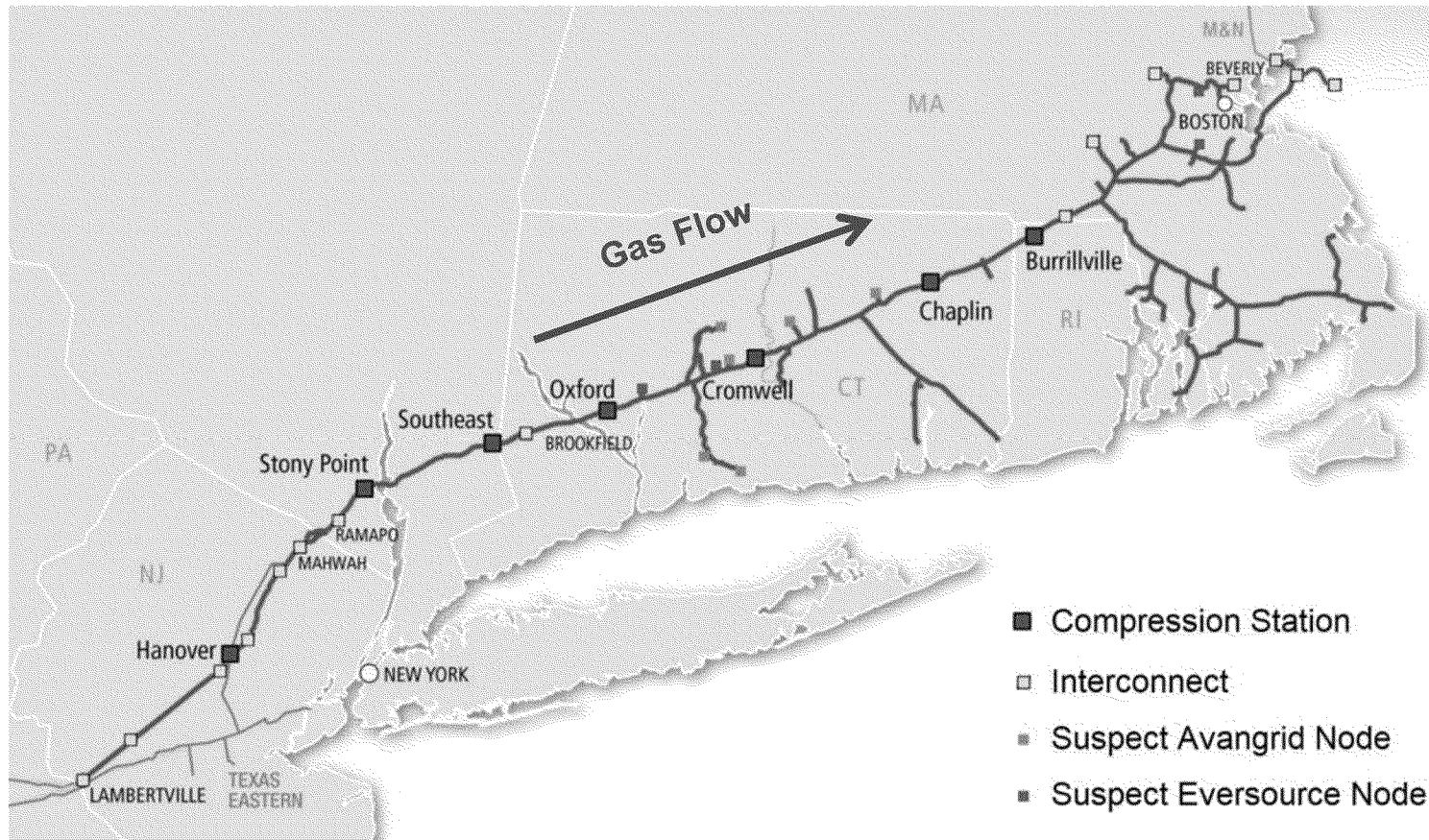




Eversource - NStar Cumulative EOD Scheduled and Showing Gas Left on Pipe or (Excess Scheduled) vis Timely Nominated and Scheduled



Algonquin Pipeline



Distinctive Patterns

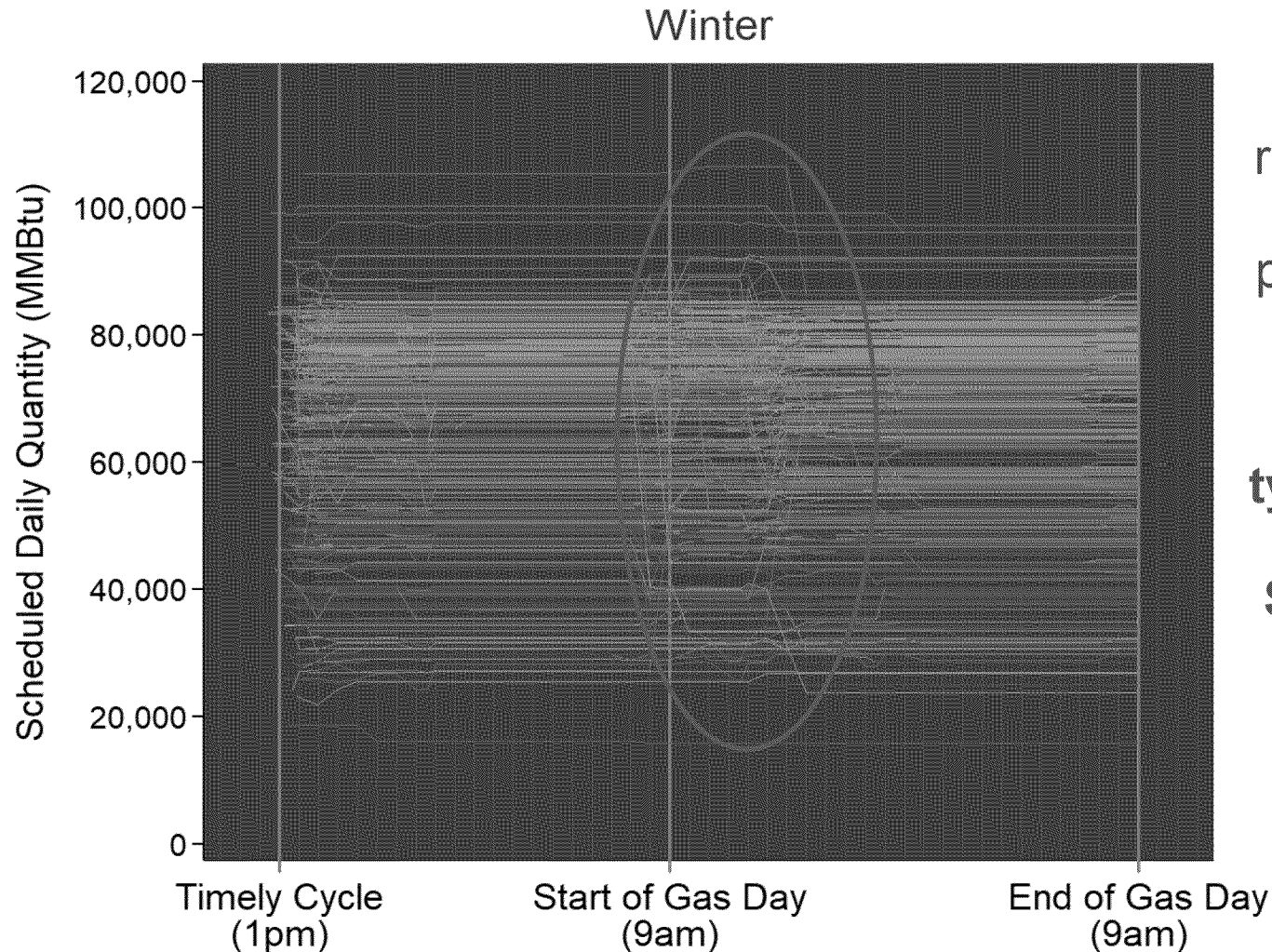
Study examined 8 million data points – three years of scheduling data from the Algonquin pipeline (August 1, 2013 through July 31, 2016).

Discovered that local gas utilities owned by two companies – Eversource and Avangrid – routinely scheduled large deliveries ahead of time, then sharply reduced those orders at the last minute.

- Other utilities consistently made slight adjustments both up and down, throughout the day, averaging +/- 5 to 15% in either direction.
- Eversource and Avangrid regularly made large *downward* adjustments averaging 10 to 50% in *final hours* of the trading day.

This “down-scheduling” consistently came too late for pipeline companies to make that capacity available to anyone else, effectively limiting available gas supply in the wholesale market.

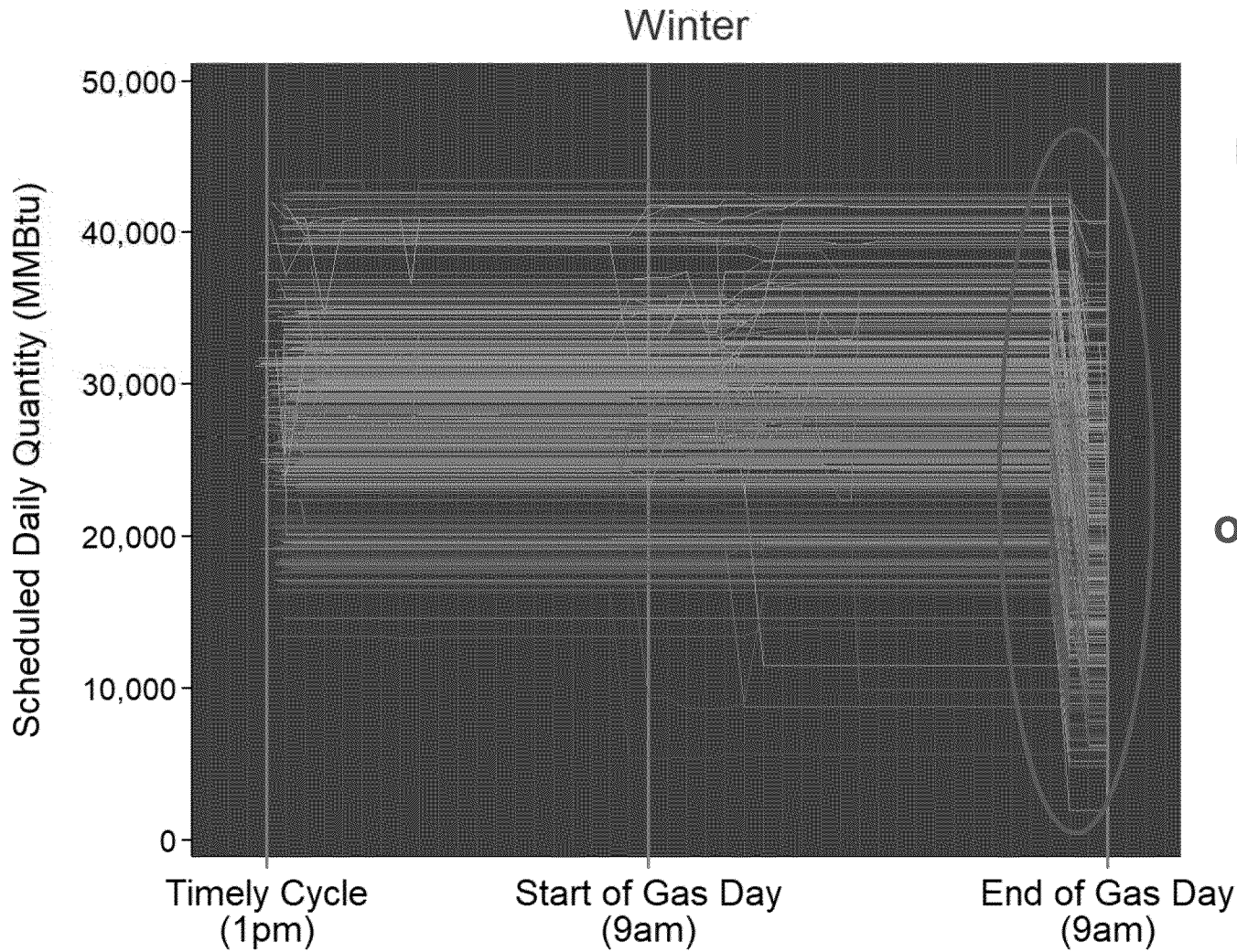
Typical Scheduling Pattern



Each line represents one scheduling period and gas day.

Changes are typically made close to the START of the gas day.

Eversource Scheduling Pattern

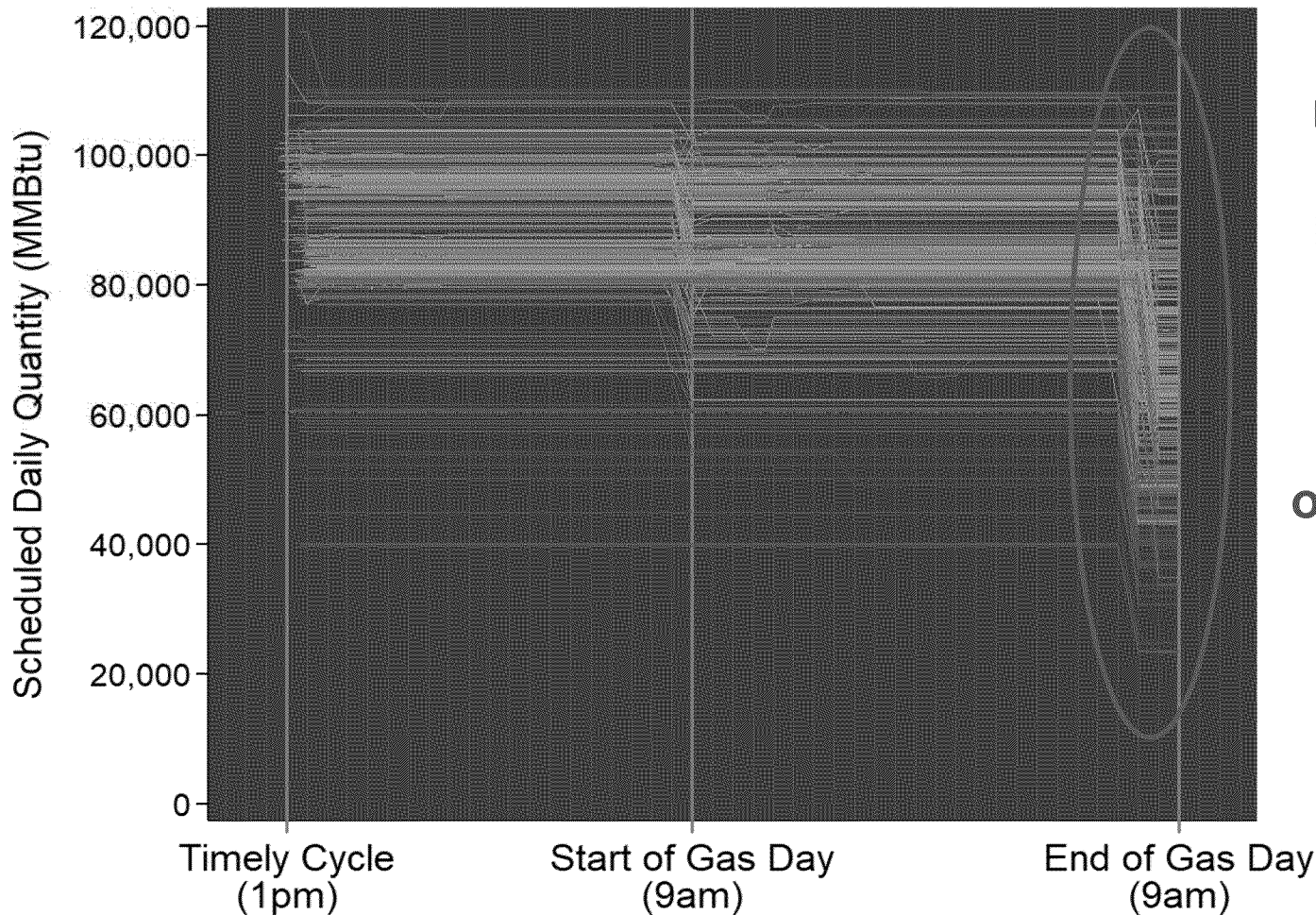


Each line represents one scheduling period and gas day.

Big changes consistently occur near END of gas day.

Avangrid Scheduling Pattern

Winter

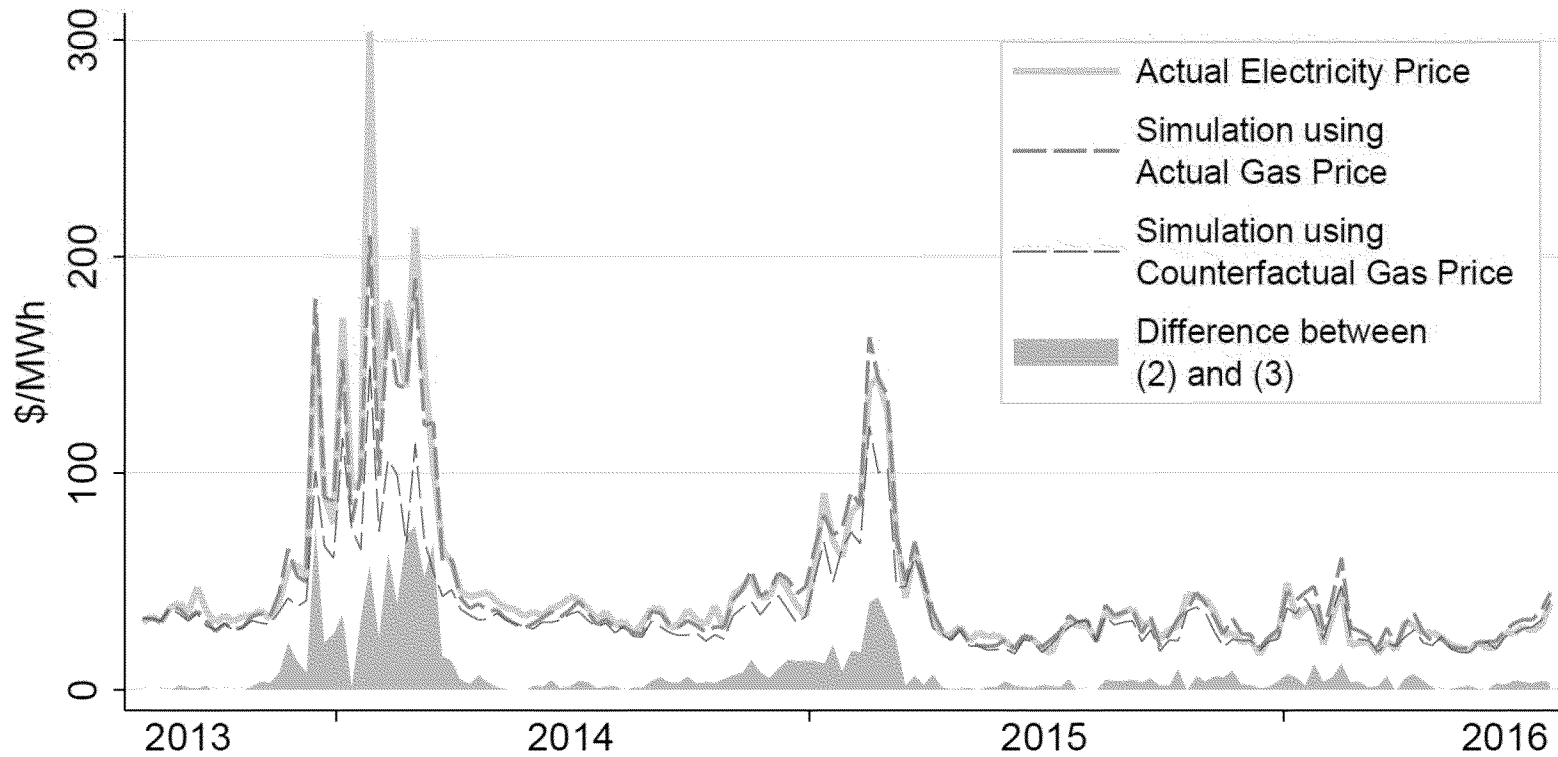


Each line represents one scheduling period and gas day.

Big changes consistently occur near END of gas day.

Extreme Amplification

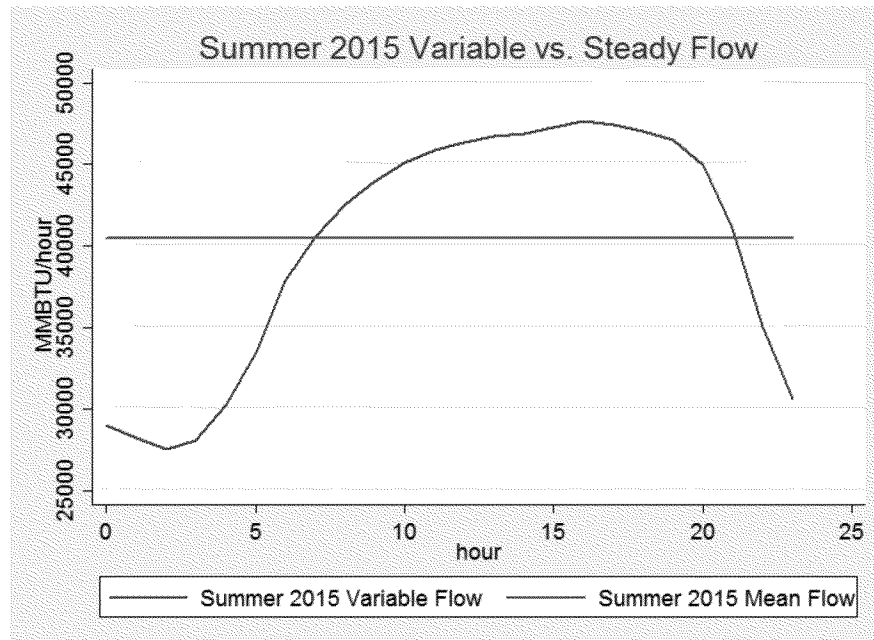
Electricity price with actual vs. counterfactual gas price



Conclusion from Paper

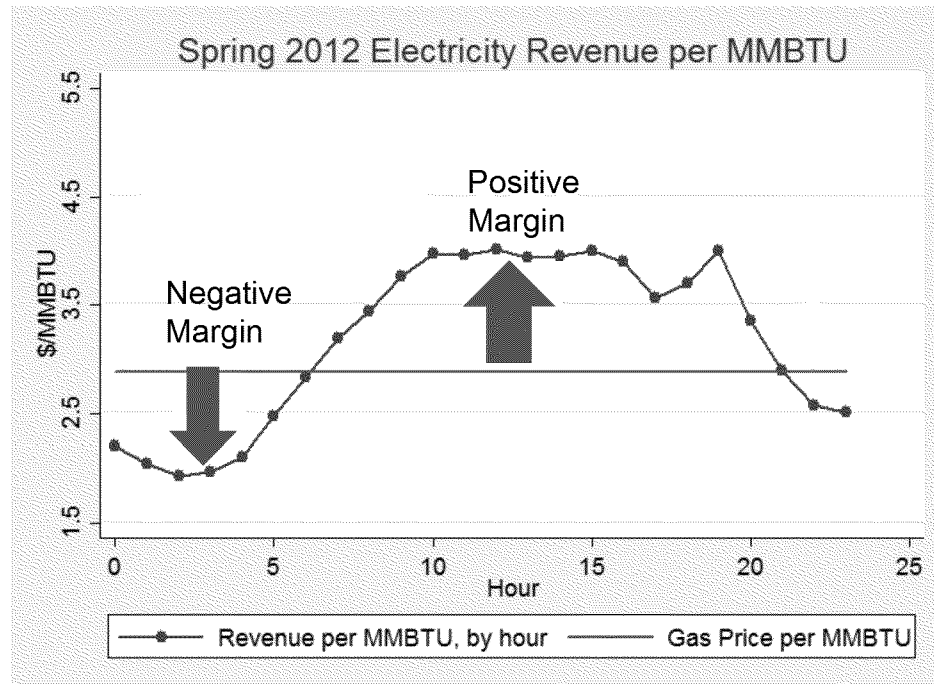
Pipeline market reforms that facilitate more flexible contracting mechanisms, more frequent scheduling cycles, and act to prevent capacity withholding, or impose a cost for capacity withholding and create a publicly-available record of capacity withholding; all of which will serve to better align the gas transport and electricity markets, could help to create more liquid markets in which firms find it more difficult to exert market power.

Market rules need to be updated to enhance gas/electric coordination, reliability and grid transformation.



The gas market design generally assumes uniform hourly (i.e., ratable) flow for the average day (flat red line above). Flow used by generators is far more shaped over the course of the day (blue shaped line) to match electrical output with load.

Natural gas and electric markets do not price and value fuel supply for flexibility attributes, yet flexibility is the paradigm of the evolving electric grid.



The value of and cost for generators to obtain gas over the course of the day varies, yet generators face structural challenges and are sometimes impeded in accurately reflecting that variation in the organized markets.

Particularly in Organized Electric Markets, natural gas services do not reflect the variation in services and pricing seen in the wholesale electric markets. This expresses itself in pipeline requirements for ratable flow even when it would be possible for shippers to vary receipts and deliveries such that they are in balance hourly, but are nonetheless non-ratable. Even in vertically integrated markets, the ratable flow requirement frustrates sub-day scheduling of gas to meet sub-day demand for gas-fired electric generation.

For the most part, there is no partial-day non-ratable take “market” for gas; therefore there are no price signals to inform exactly what combination of natural gas facilities and services are required to meet the variable demands of natural gas-fired generation - demands that will only increase as the electric grid integrates more renewables and relies more heavily on natural gas generation to meet electricity demand.

NAESB Process -


NAESB WGQ Proposed Definition 1.2.[z1]

A Shaped Nomination is a nomination in which a Service Requester provides both a daily quantity and a quantity for each hour of the Gas Day, with each hour beginning at the start of the hour (e.g. 10:00 AM).

NAESB WGQ Proposed Standard 1.3.[z1]

Where a Transportation Service Provider offers a service under its tariff, general terms and conditions, and/or contract provisions which expressly provides for a Service Requester (SR) to submit a Shaped Nomination, the SR should submit its nomination for that service as a Shaped Nomination using NAESB WGQ Standard No. 1.4.1 (Nomination). Receipt of service expressly providing for the use of a Shaped Nomination may require additional coordination with interconnected parties.

A SR utilizing other services that do not expressly provide for the use of a Shaped Nomination should not be required to submit a Shaped Nomination nor does this standard prescribe any affect for services that do not expressly provide for Shaped Nominations.



“Gas and electric wholesale markets should be economically and operationally coordinated so that products and services in each market generate effective and actionable price signals in and across these two markets, and so that appropriate, right sized, investments are called forth in a timely manner. Market rules, wherever possible, should be aimed at establishing self-correcting market structures that will further serve to support the generation of appropriate price signals that will incentivize market players to meet established policy goals..”

*-EDF FERC Comments,
October 2014*

Conclusions

- Generators are not able to efficiently buy variable sub-day services and are somewhat restricted to what they can bid based on daily index pricing for natural gas supply.
- Shaped flows would allow generators to schedule varying flow quantities of gas for delivery the next day that correlate to their anticipated output levels.
- With updated scheduling and pricing regimes, sub-day flexibility on the gas side can be efficiently priced (enhancing allocative efficiency) providing benefit to pipelines, generators, flexibility service providers and consumer savings.
- Price formation increases innovation, product definition and spurs investment.
- In New England, standards and fostering transactions for services generators need and are willing to contract with pipelines is key to resolving the commercial stalemate and maintains allocative efficiency; a superior and market-based solution to RTO-controlled rate-based capacity (allowed only by Commission waiver).