Energy Market Overview

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PJM Overview

- PJM Interconnection ensures the reliability of the largest grid in North America by monitoring, controlling and dispatching transmission and generation:
  - First formed in 1927
  - Serves 61 million customers in 13 states and DC
  - Dispatches **206 GW** of generating capacity
  - Utilizes over 60,000 miles of transmission lines and 40,000 buses
- PJM coordinates the continuous buying, selling and delivery of wholesale electricity. PJM's electricity market has some similarity to a stock exchange. It establishes a market price for electricity by matching supply and demand. Reliability is PJMs primary goal.
- MAAC (Mid Atlantic Area Coordinating Council) was the entire PJM region at the start of pool expansion in 2002.

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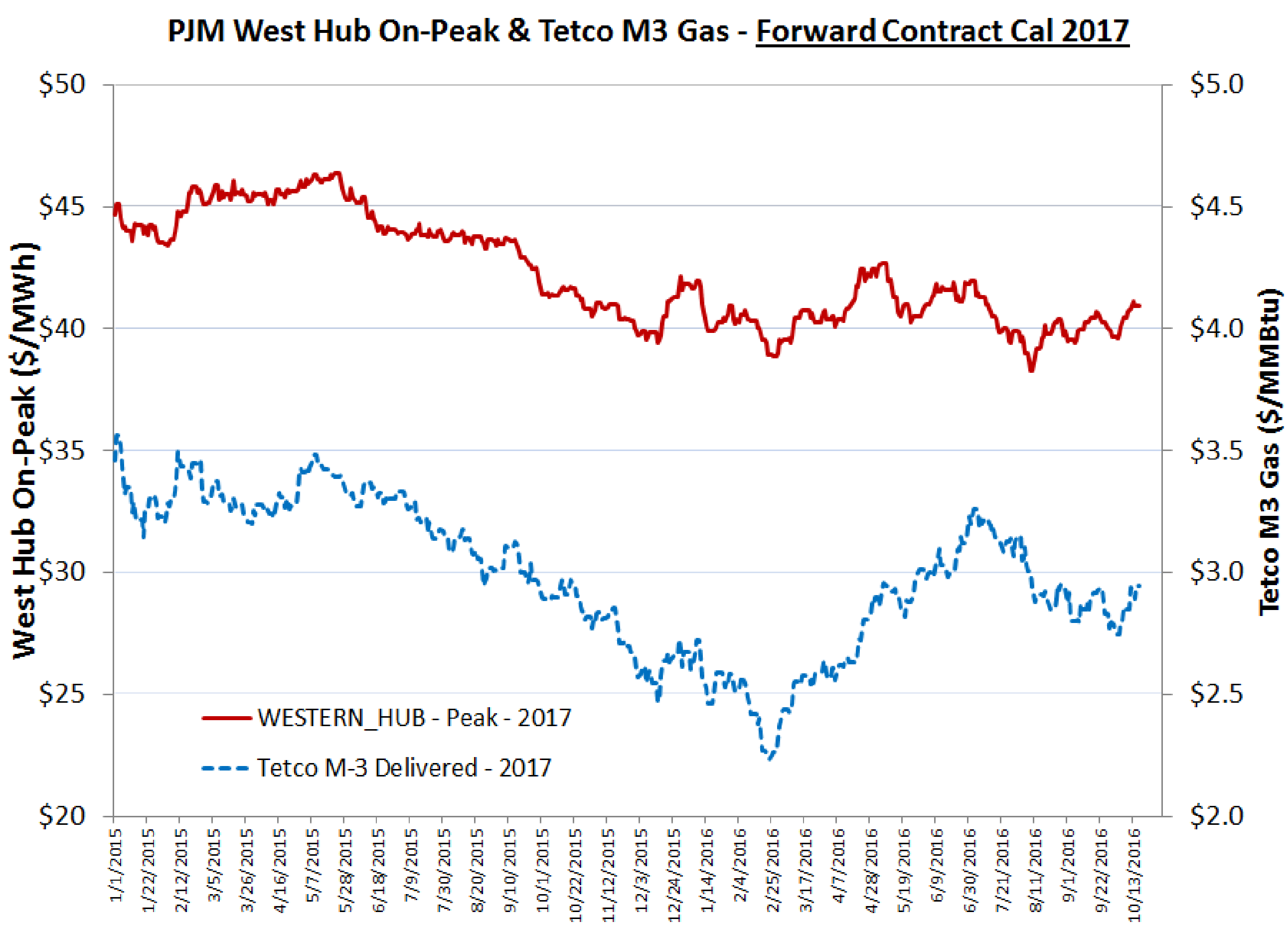
Key Drivers of PJM Wholesale Power Prices

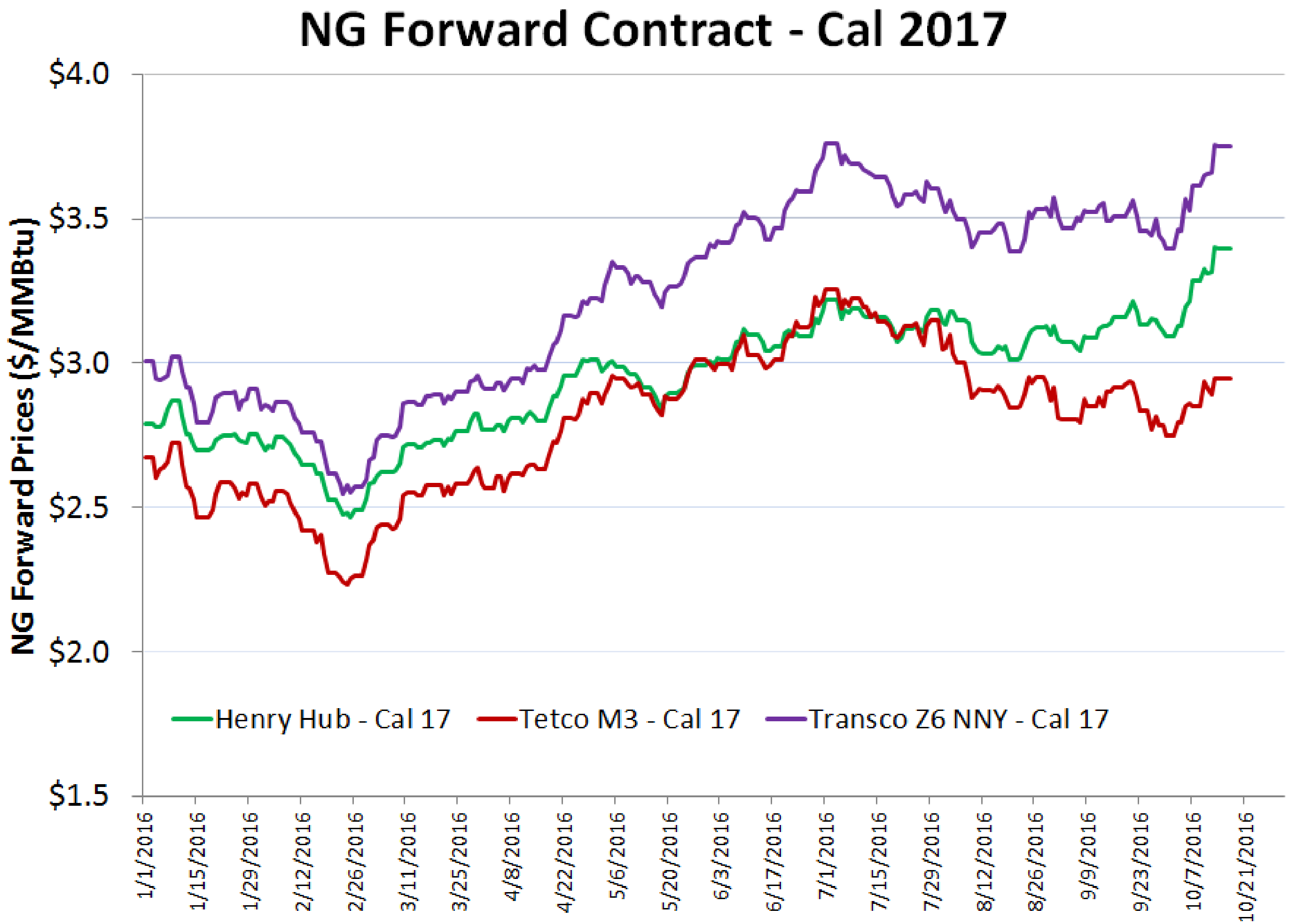
- **Fuel prices—primarily natural gas and coal**
- **Load, weather, and load growth**
- **Generation; including retirements and additions**
- **Types of capacity resources - generation, demand response, energy efficiency, imports/exports**
- **Transmission Congestions – North / South congestions by far the dominating factor in the PJM Classic (MAAC) area**

Forward Contract Cal-17 – Changes Over Time

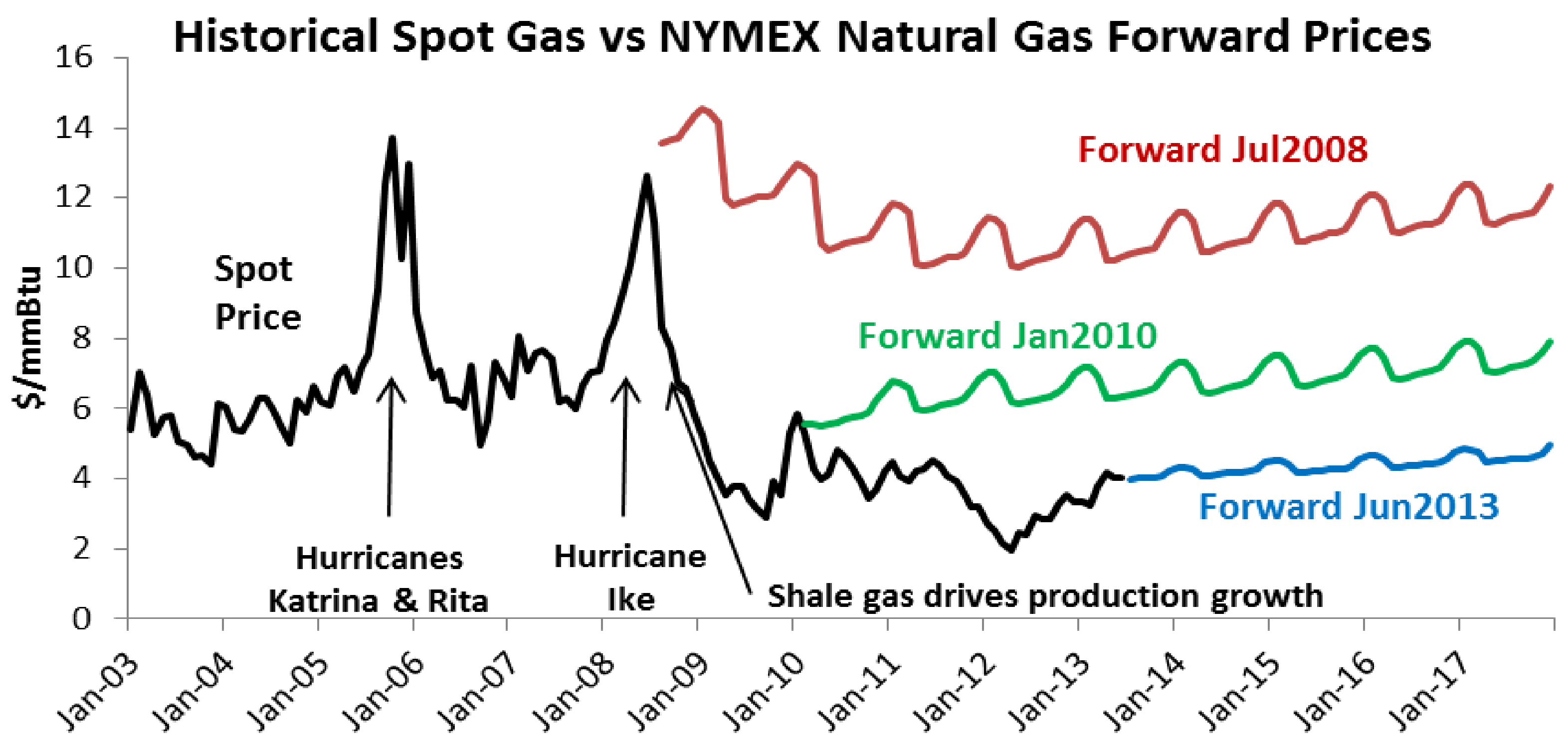
1. **Winter Drives Prices Up** - Forward power & gas prices increased after winter driven by expectation for future winter events and low gas storage levels.
2. **Mild Summer & Gas Production Cause Declines** - Around mid-May forwards began a decline resulting from higher than expected gas production and a mild summer.
3. **Cold Winter Forecast Cause Increases** - Around September power forwards increased over expected winter cold
4. **Mild Winter Starts Declines** - and then declined when winter forecasts turned warm. Gas continued to decline driving up heat rates and sparks.



NG Forward Contract Cal-2017



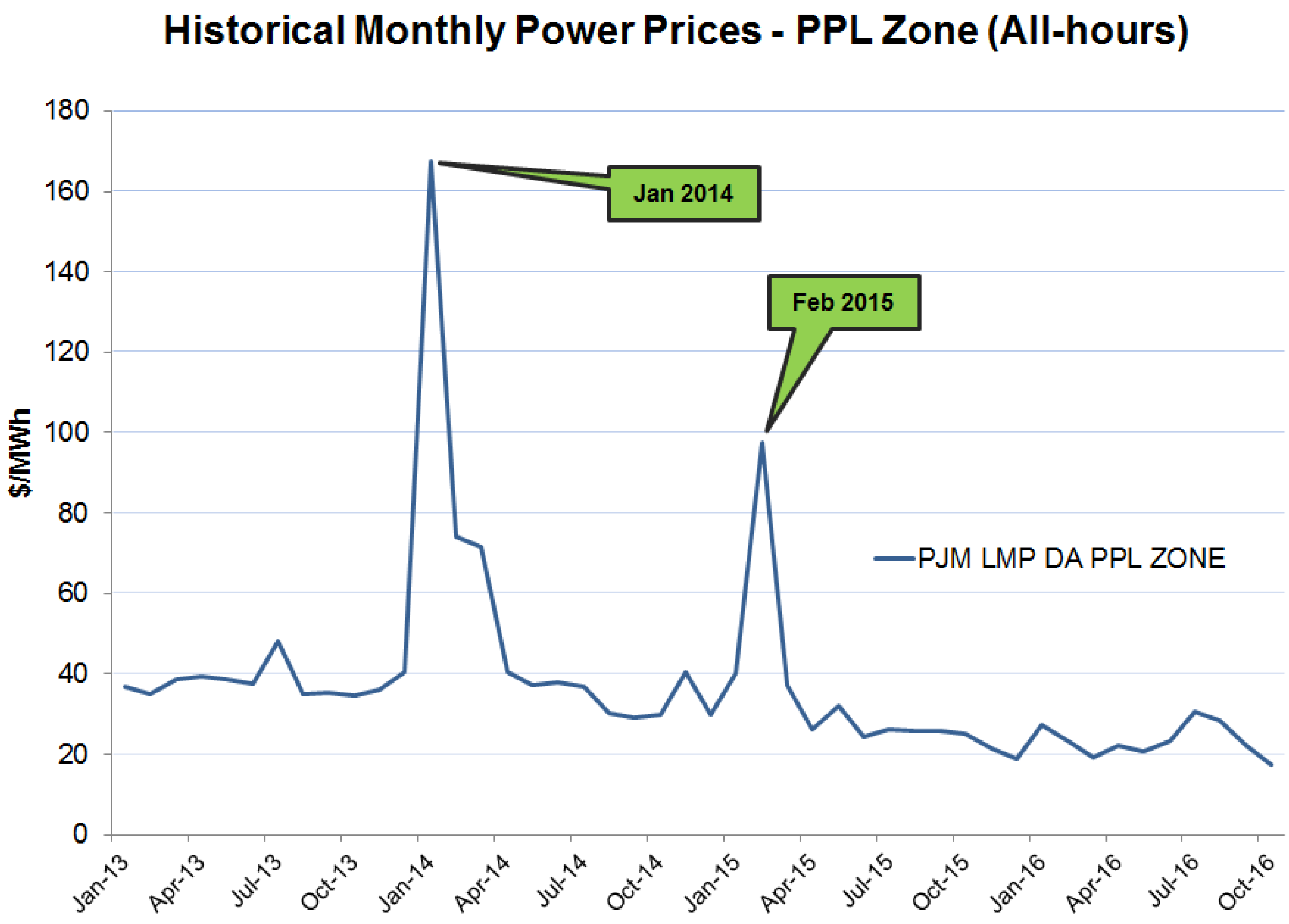
Natural Gas Prices are a Driver of Power Prices



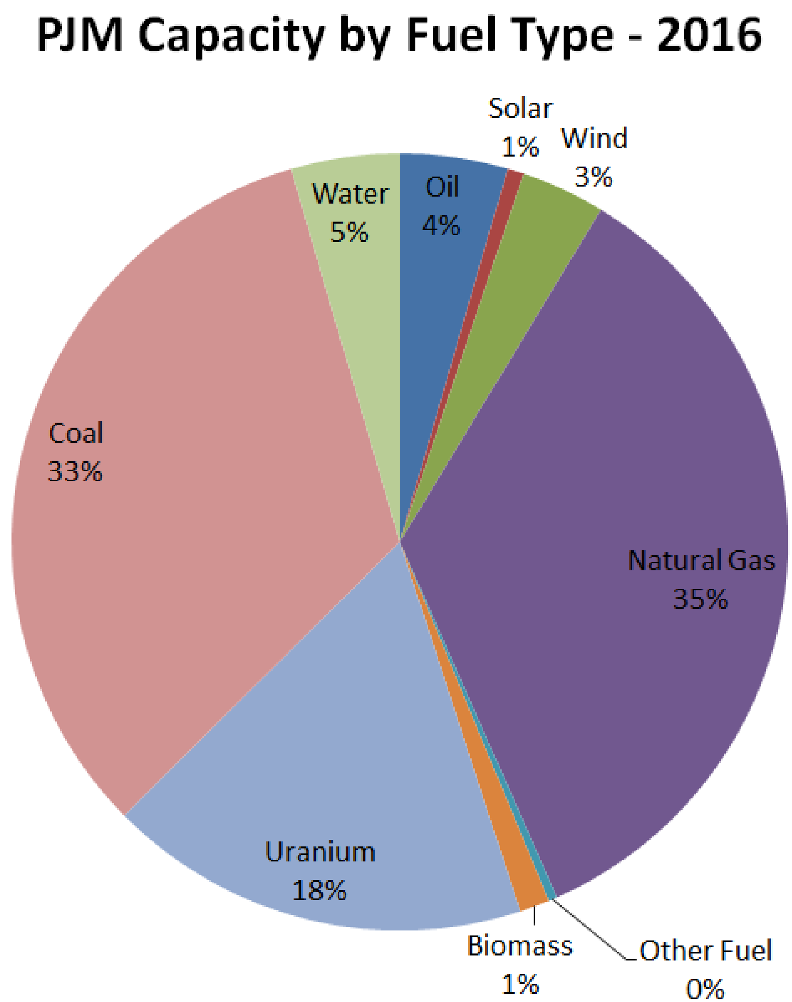
Volatile gas prices are driven by:

- **Supply**—access to shale formations thru technology, drilling activity, hurricane impacts
- **Demand**—weather, economy, storage levels, price comparison to coal
- **Market activity**—trading and hedging

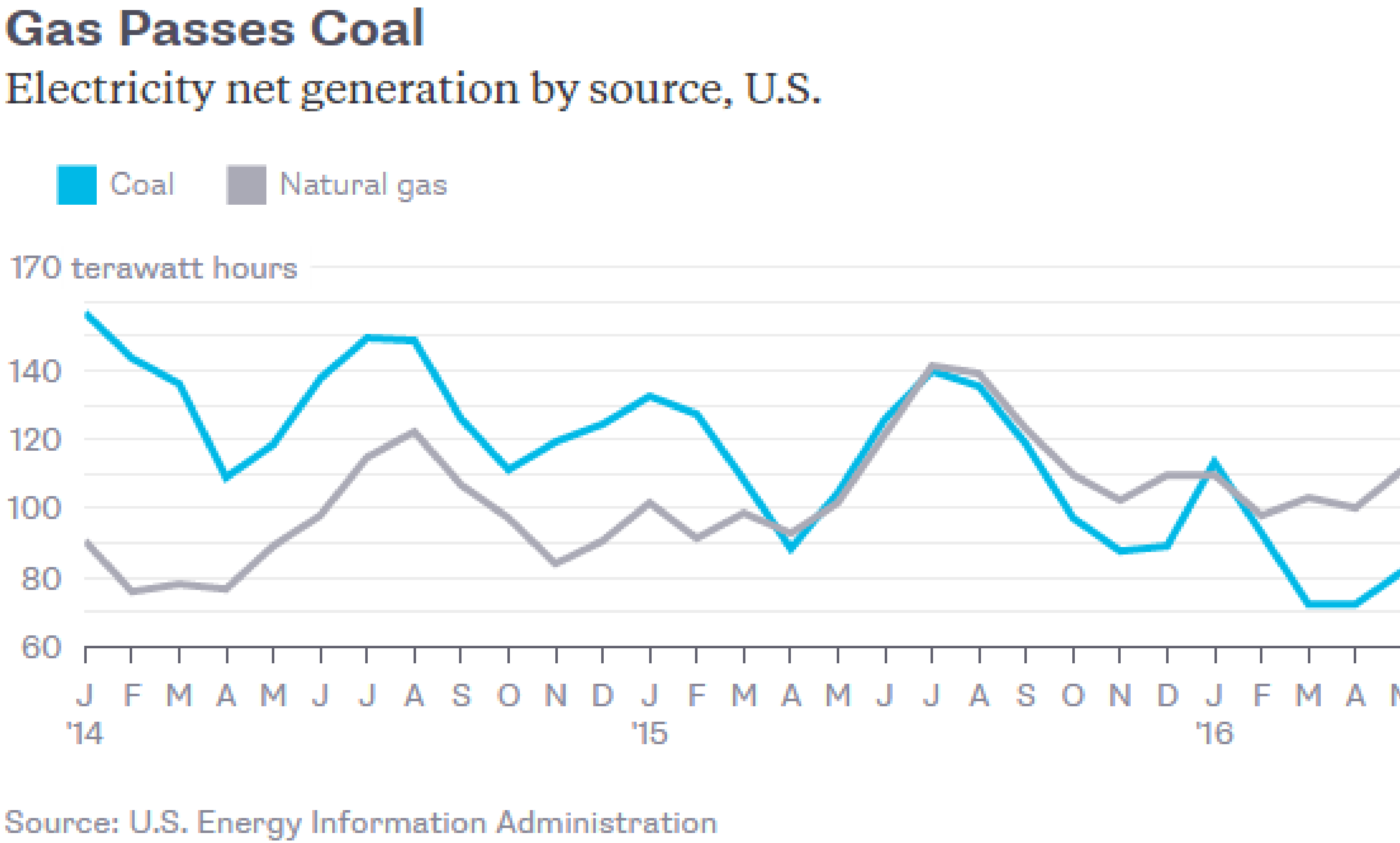
Historical PJM Power Prices



Current Generation Mix - PJM



Natural Gas – Generation Shifting Fast



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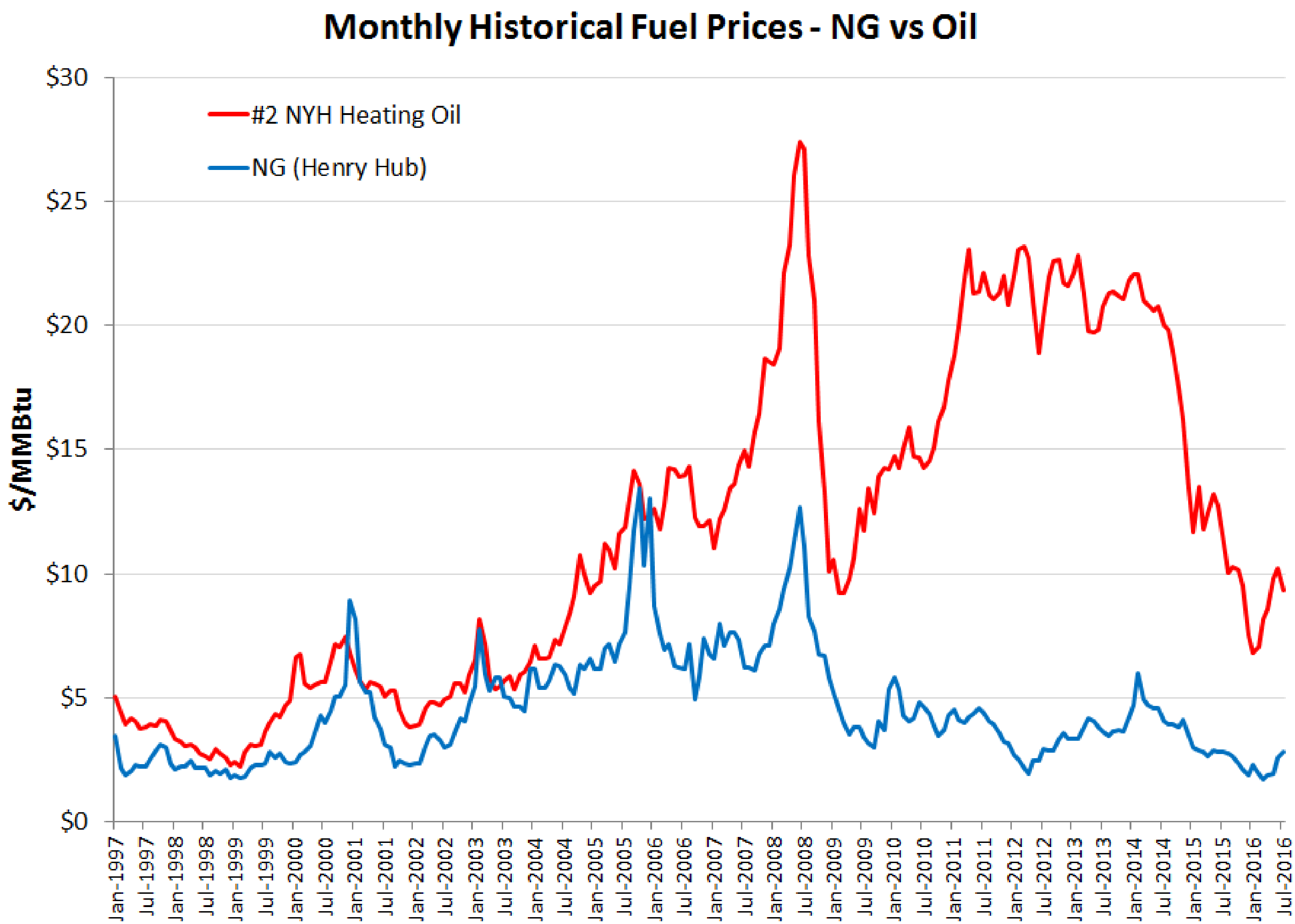
NG Prices Un-correlated to Oil Prices – Post Shale



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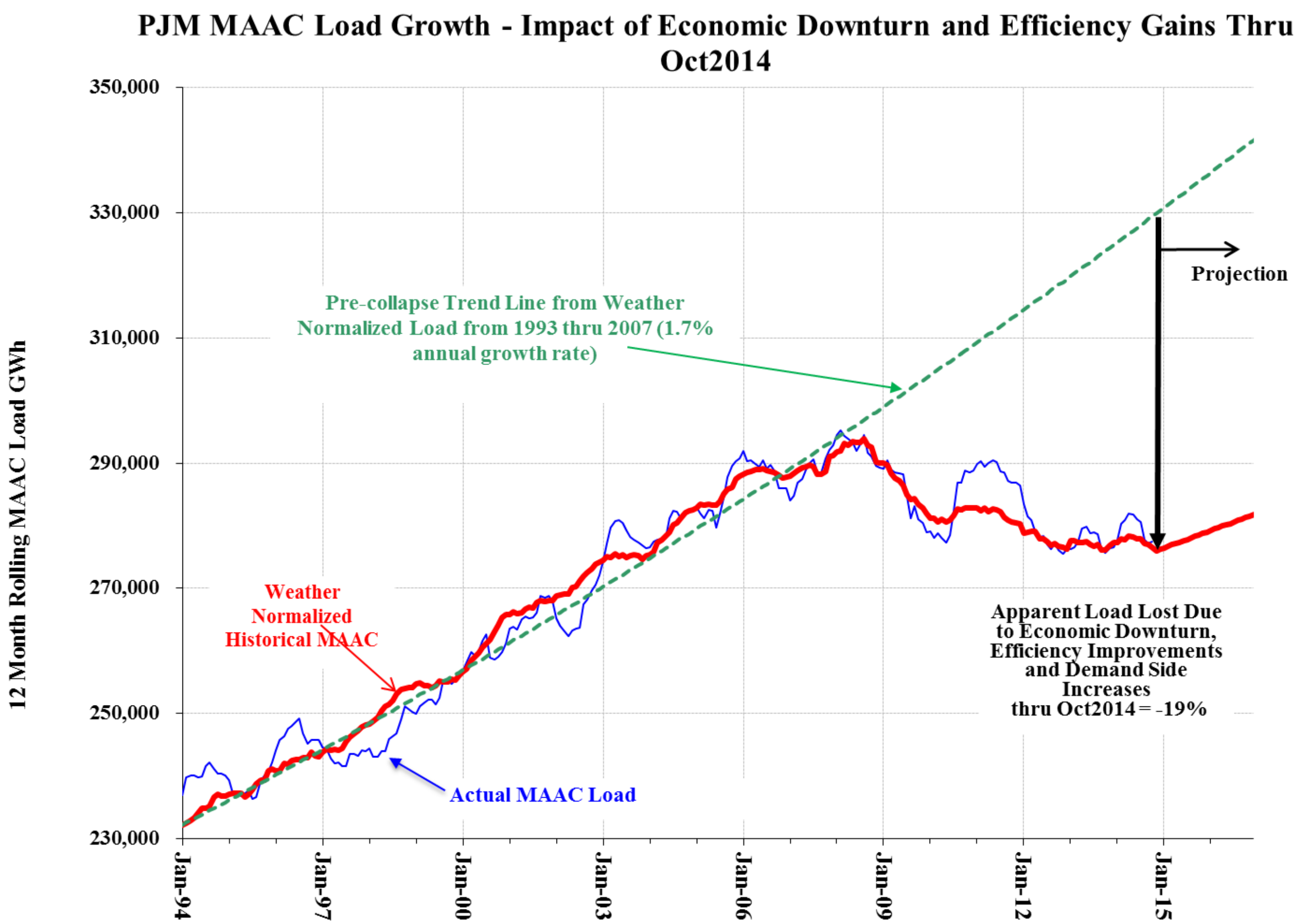
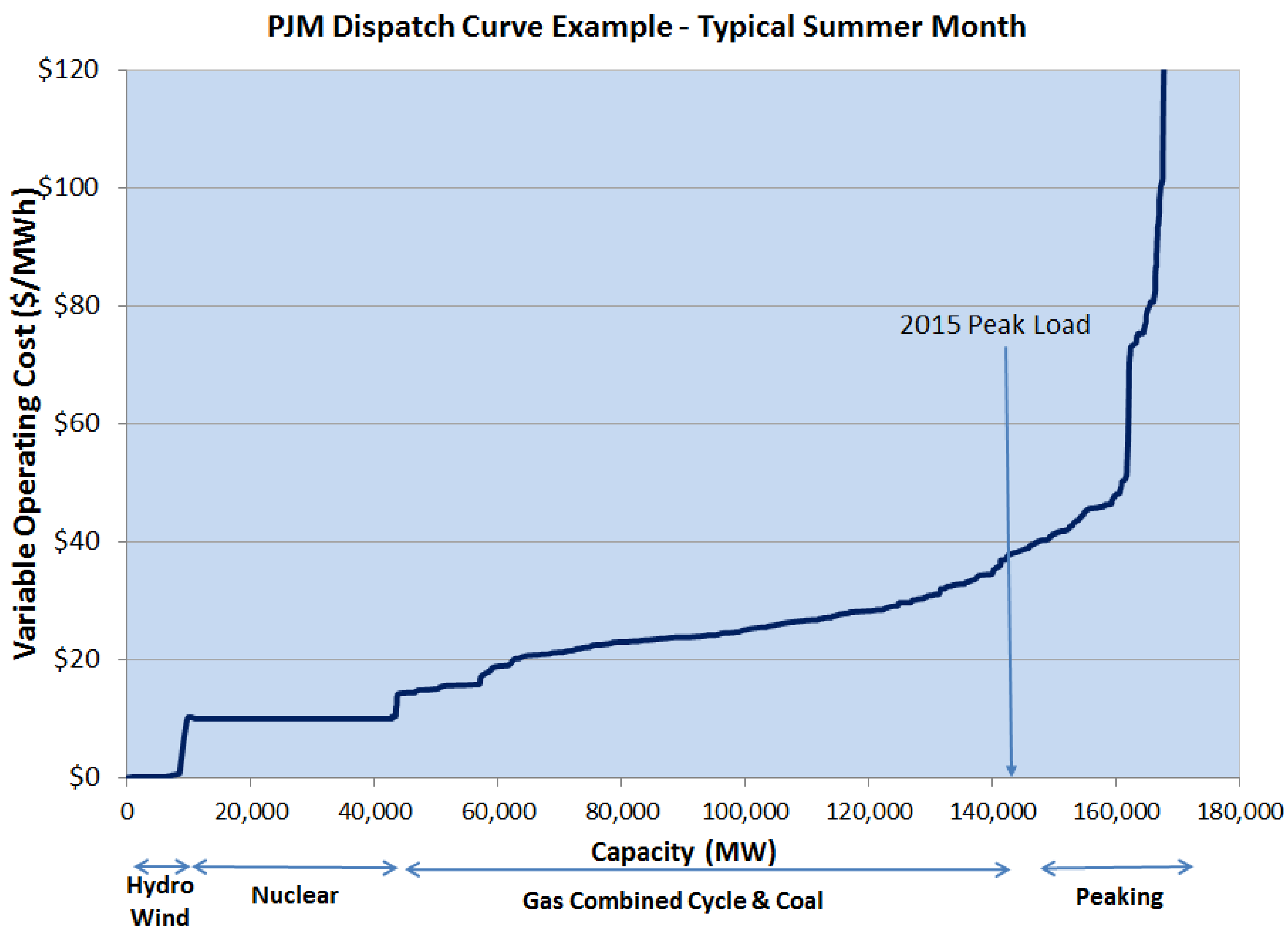
Another driver - Negative load growth since 2008

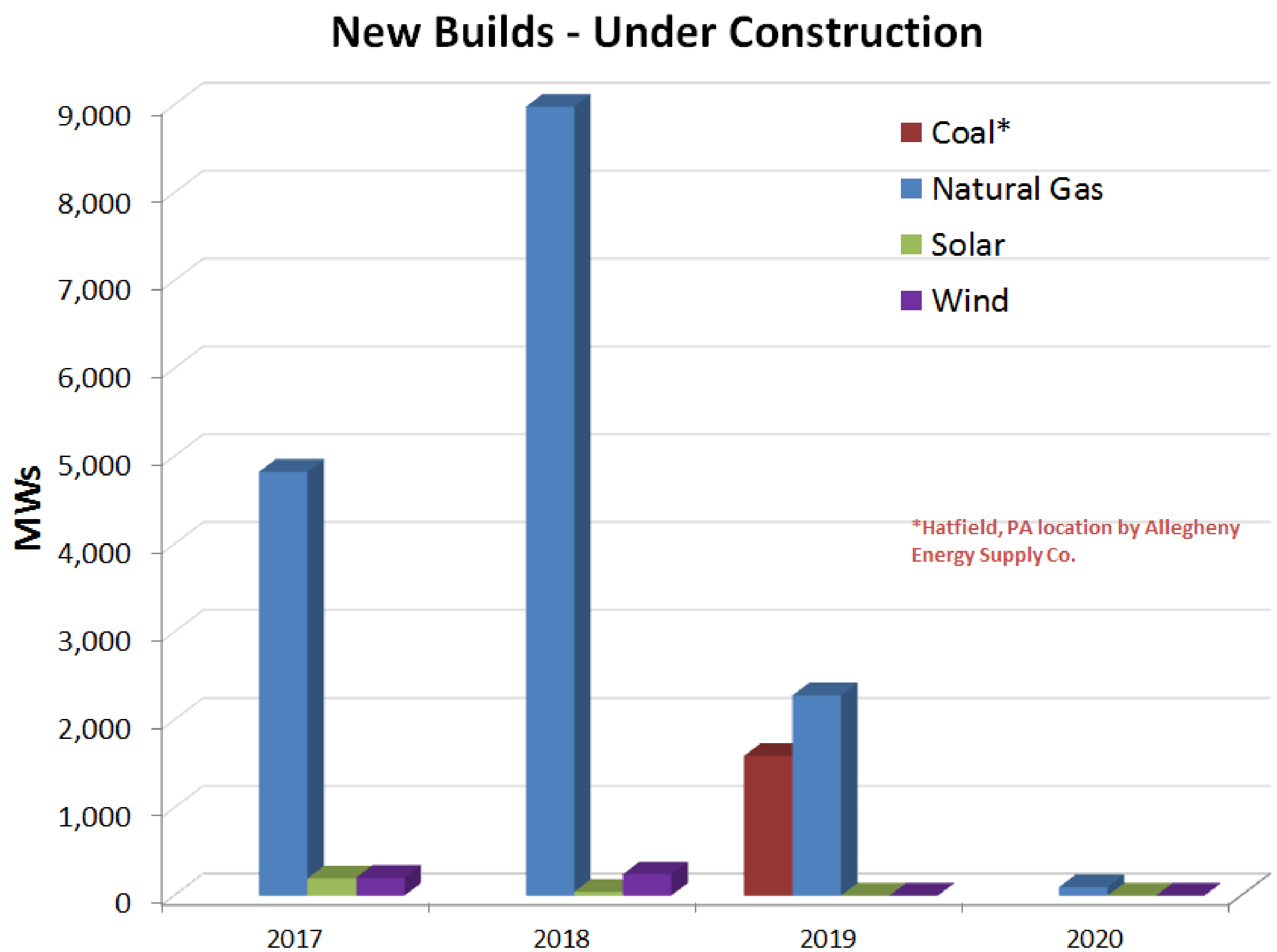


PJM Hourly Energy Price Determination

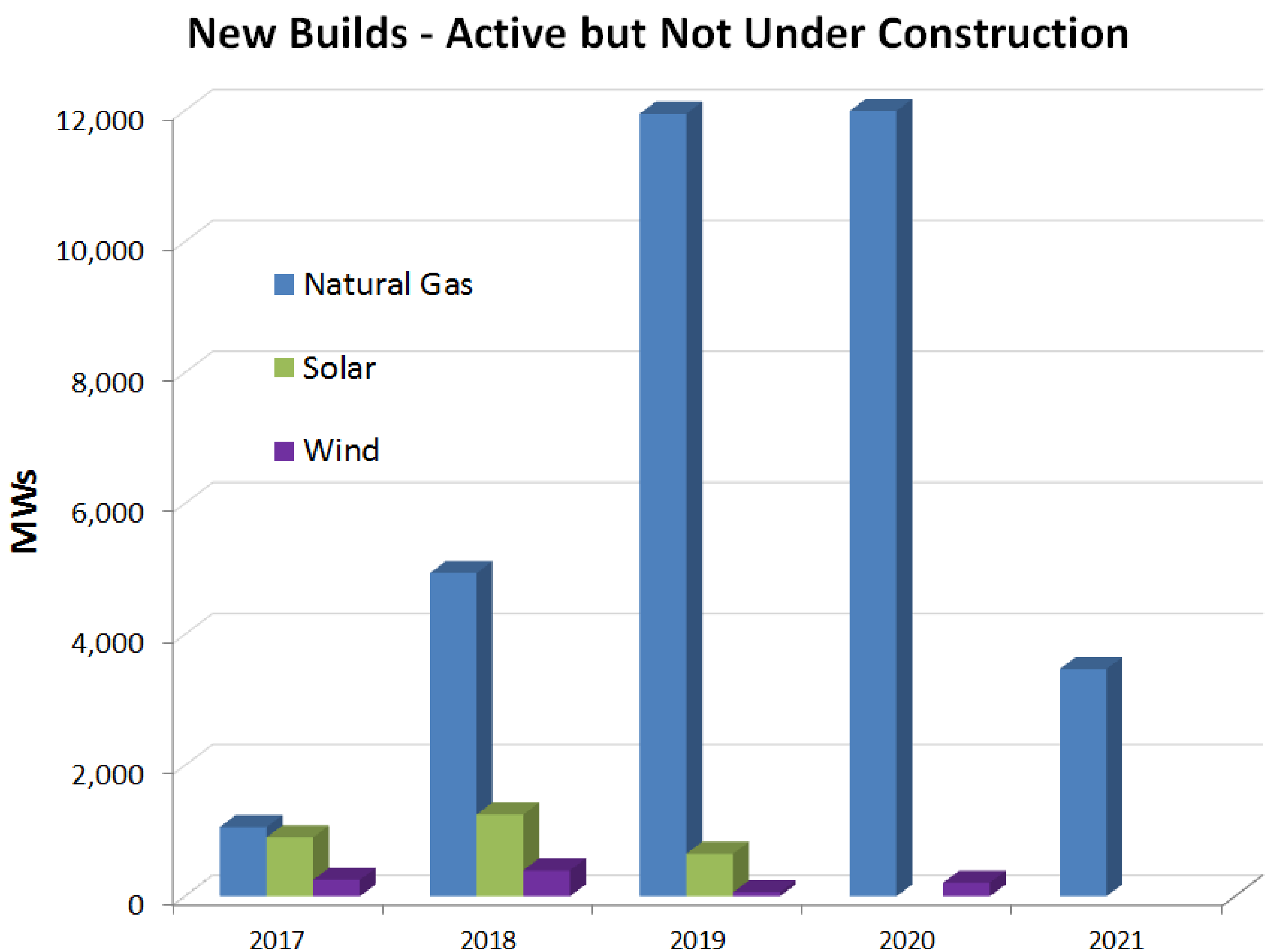
Scheduling and Dispatch to Meet Load Obligations



New PJM Generation – Under Construction (Per ISO)



New PJM Generation – Active Project (Per ISO)



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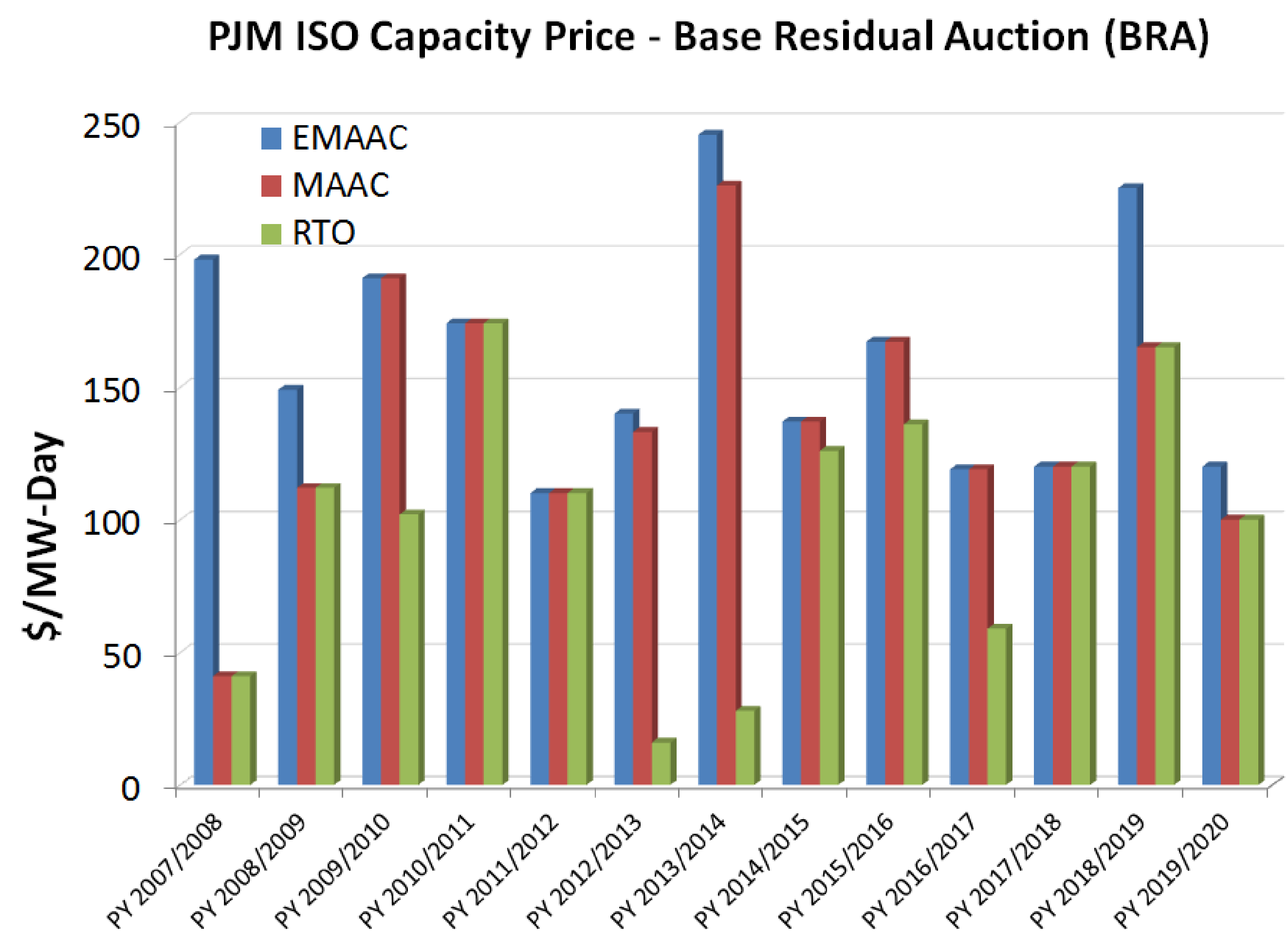
PJM ISO Capacity Prices ($/MW-Day)



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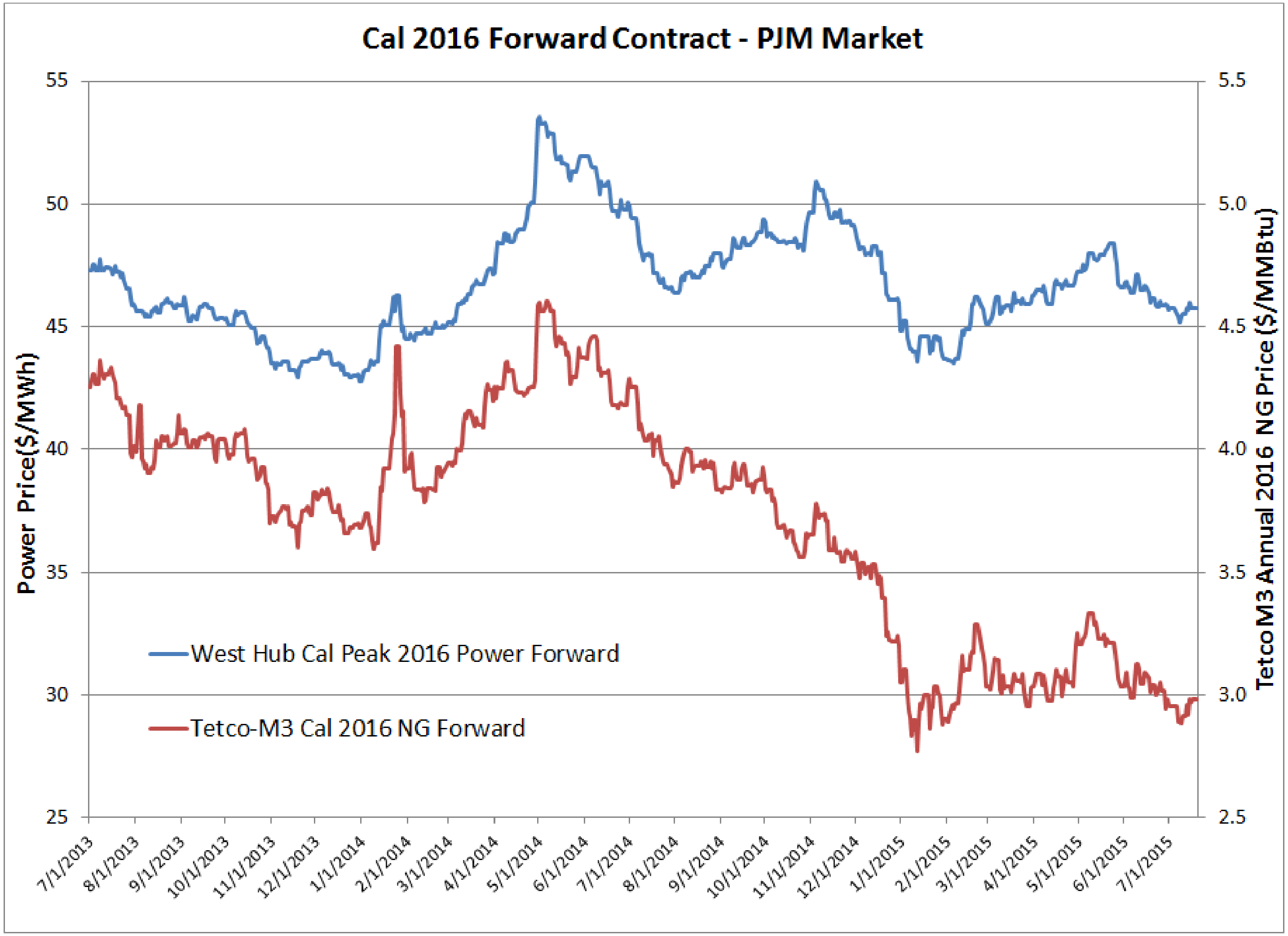
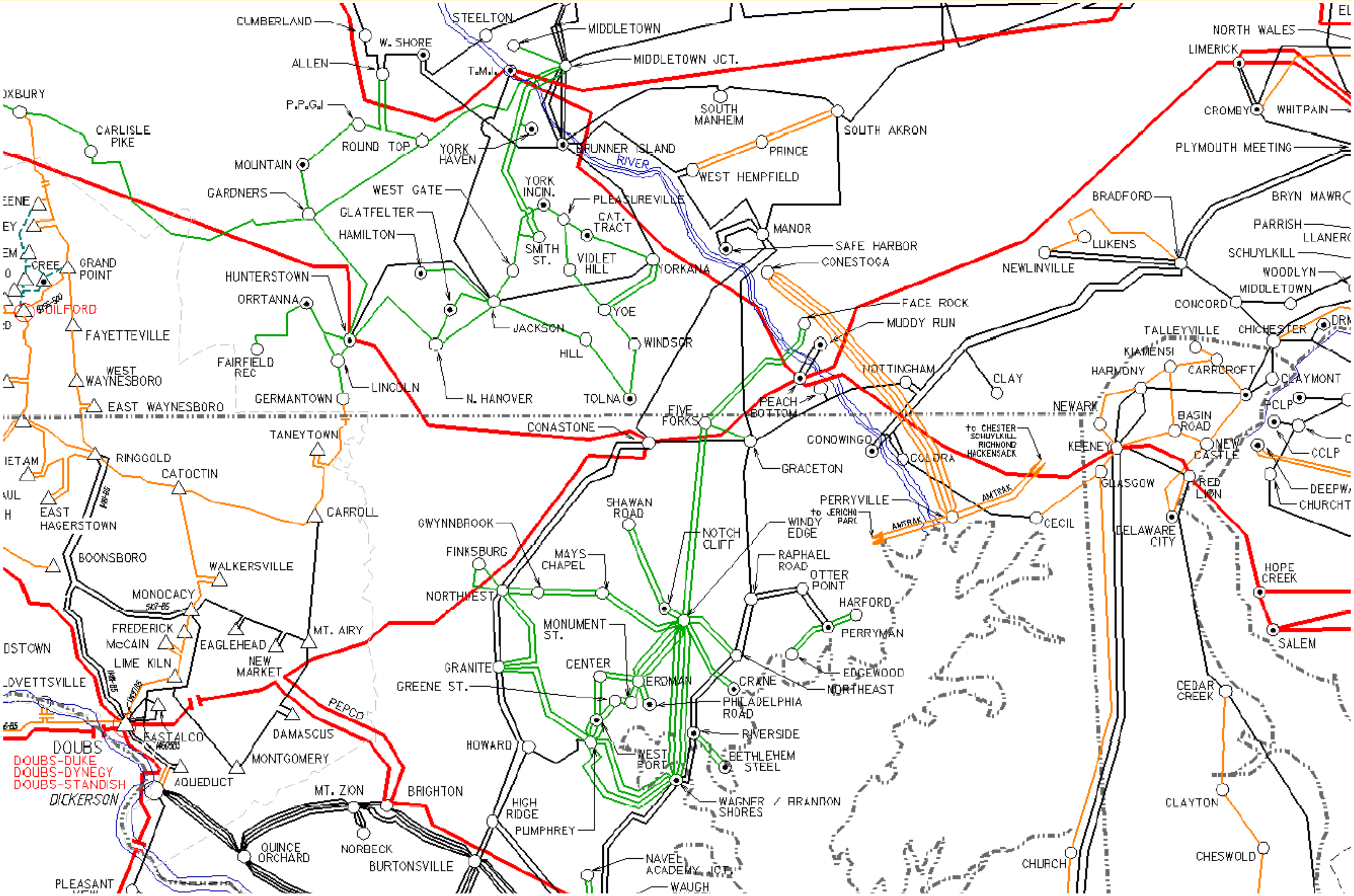
Appendix

Appendix

Polar Vortex 2014: Impact On 2016 Forward Power and Gas



Major Congestions – North / South



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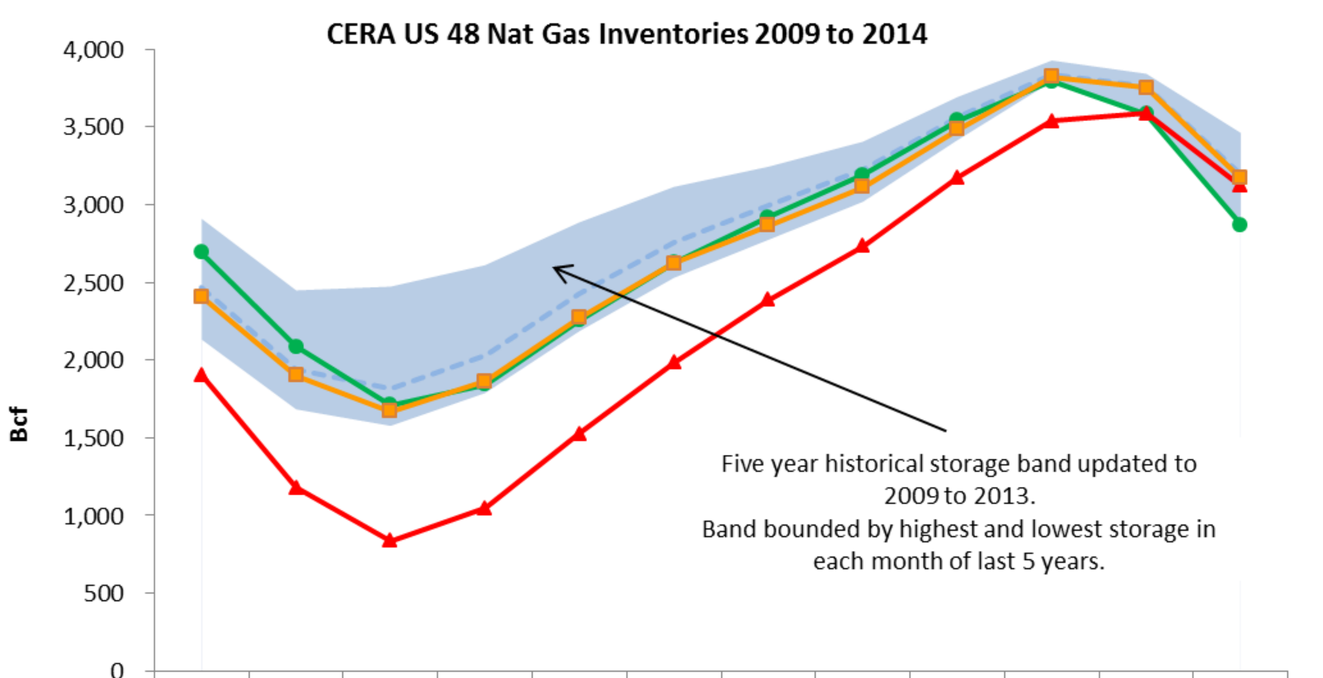
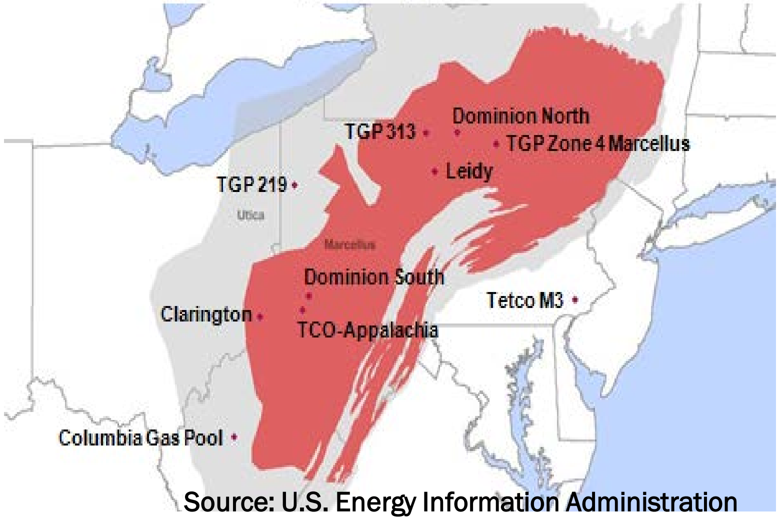
Winter 2014 leaves gas storage levels lowest since 2003 – recovery was strong



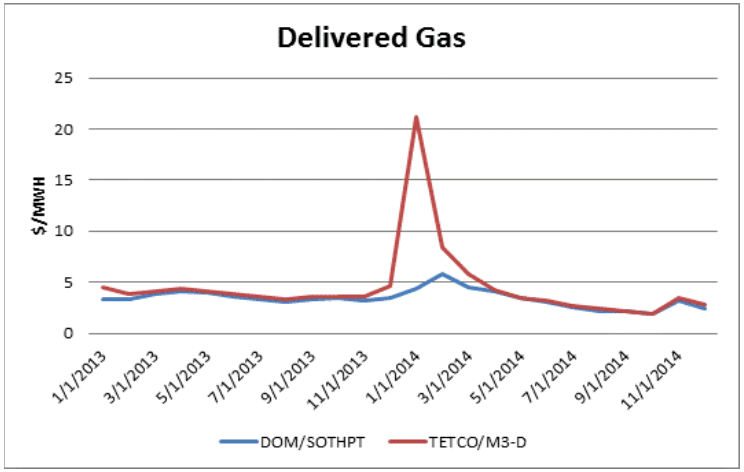
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5 Yr High	2,910	2,449	2,473	2,611	2,887	3,115	3,245	3,406	3,693	3,929	3,843	3,462
5 Yr Low	2,133	1,683	1,577	1,788	2,187	2,530	2,775	3,019	3,416	3,793	3,583	2,869
5 Yr Avg	2,469	1,940	1,814	2,033	2,425	2,754	2,999	3,226	3,561	3,837	3,766	3,197
2013	2,693	2,088	1,710	1,844	2,256	2,626	2,920	3,192	3,544	3,793	3,583	2,869
2014 Proj	1,905	1,180	837	1,046	1,524	1,984	2,389	2,735	3,176	3,539	3,586	3,123
2015 Proj	2,408	1,901	1,669	1,864	2,272	2,622	2,866	3,114	3,486	3,822	3,752	3,172

Gas Prices in the Marcellus Region and Northeast vary by season and impact power prices

- Gas prices in the Marcellus region stay low most months.
- During winter, high gas demand and pipeline constraints cause prices outside the Marcellus in the Northeast to go high.
  - On high priced days power prices in the East increase.
- During periods of low loads, especially in spring and fall, M3 prices are close to Marcellus region prices – prices in Baltimore region are higher.



Source: U.S. Energy Information Administration



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