NGSA
Natural Gas Supply Association

An Analysis of PJM's Winter Storm Elliott Report

Key Insights and New Priorities

FALL 2023

PJM's recent report on Winter Storm Elliott[1] offers valuable insights to help PJM and its stakeholders zero in on the areas requiring the most attention to better prepare the region to withstand future events and maintain reliability through the energy transition.

In its report, PJM examined the significant generator outages[2] and other problems that transpired during Winter Storm Elliott, a period of bitter cold, high winds and blizzard conditions that swept 31 states over the December 2022 holidays.

Natural gas provides the largest share of electricity generation in PJM and is critical to millions of people.[3] **NGSA has been an active participant in multiple forums to engage with our power market customers and other stakeholders to examine ways that we can improve gas generators' ability to procure natural gas when needed.**

PJM's analysis of generator outages provides a real-life blueprint that can help determine where things went wrong and what should be the top priorities to mitigate the problems experienced during Winter Storm Elliott.

PJM found that a wide range of issues contributed to the significant forced outages experienced during the storm across all resources, but the primary impacts were associated with natural gas and coal resources.[4] *See sidebar.*

More than half the outages associated with natural gas generation were attributed to generator equipment failure (53%), "likely resulting from the extreme cold."[5] A third of the natural gas outages (34%) were due to fuel availability with the remaining (13%) attributable to other causes.[6]

If we look at natural gas fuel availability as a percentage of all the outages, including other energy sources, 24% of forced outages were linked to generators having difficulty obtaining natural gas.[7]

HOW DID NATURAL GAS COMPARE WITH OTHER FUELS?

Natural gas makes up about half of the installed capacity in PJM, followed by coal at 24%.

On a Megawatt-hour (MWh) basis* for the period of December 23-25, PJM's data shows:

- 23% of gas units were unavailable
- 20% of coal units were unavailable
- 31% of oil units were unavailable
- 20% of "other" units were unavailable.

*Note: The PJM report states that MWh metrics provide the most accurate picture of the impact.[1]

PJM's report provides some general context for potential causes of the gas availability issues. PJM emphasized that:

- Production drops in the Appalachian Basin likely contributed to a portion of the outages.
- The storm's occurrence during a holiday weekend exacerbated the ability of generators to procure gas on a daily or intra-day basis.
- The presence of firm fuel arrangements reduced the risk of being unable to secure gas when most urgently needed. On the peak day:
  - 16% of generators with firm contractual commitments experienced outages compared to
  - 45% of those without firm commitments experienced outages.[8]

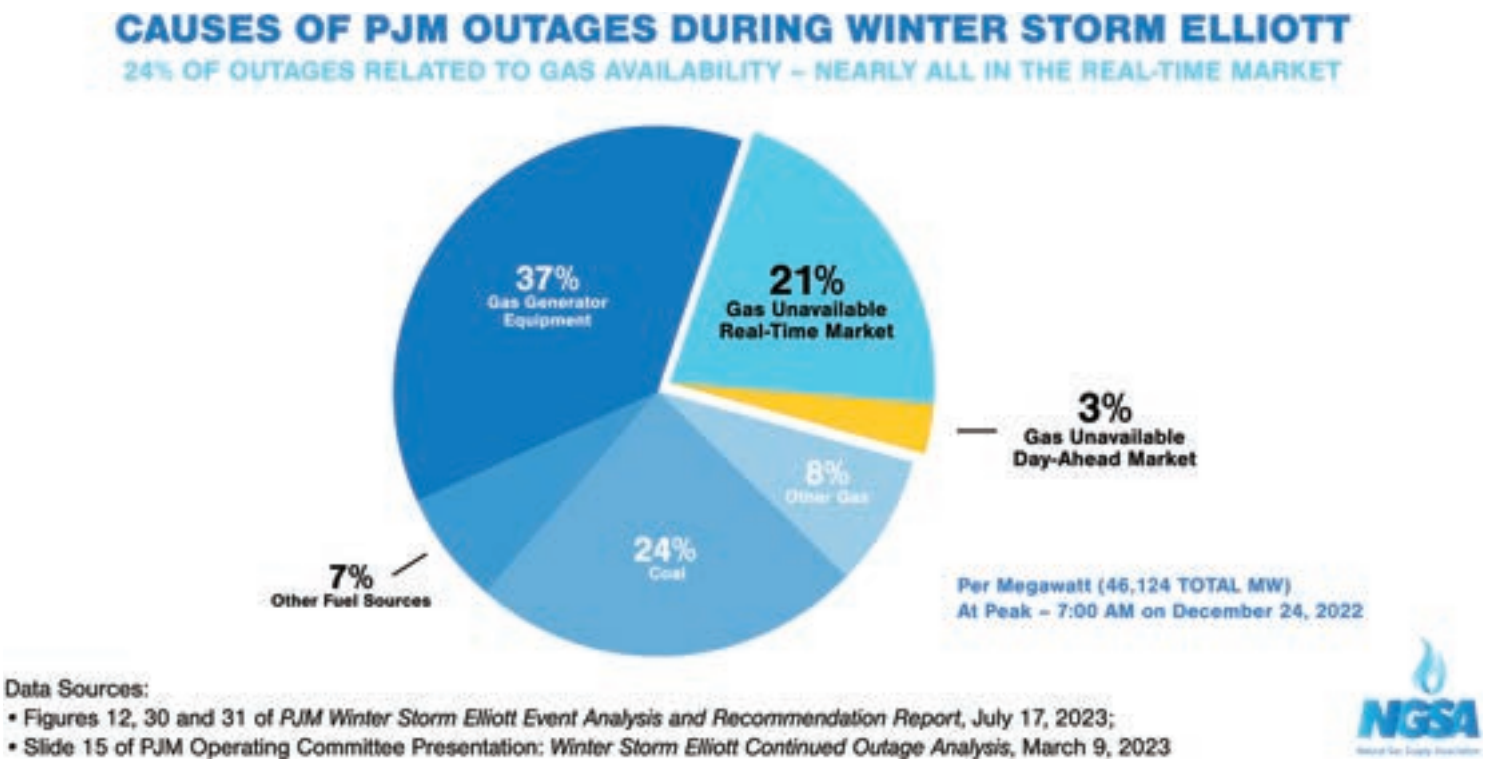
[1] PJM Winter Storm Elliott: Event Analysis and Recommendation Report (July 17, 2023) ("PJM's Report").
[2] PJM notes that the forced outage rate in Winter Storm Elliott was 24% compared to 22% in the 2014 Polar Vortex. When comparing gas outages as a percentage of total gas capacity, PJM notes that the percentage of gas outages experienced in Winter Storm Elliott was actually lower than the percentage seen in the Polar Vortex. Gas unit outages in Elliott were approximately 13% (11,000 MW) of total gas generation capacity at the peak hour on Dec. 24 compared to 19% (9,300 MW) of total gas generation capacity during the Polar Vortex.
[3] See Figure 29 of PJM's report reflecting natural gas represented 46% of total capacity for the 2022/2023 delivery year.
[4] See Figure 38 of PJM's Report.
[5] See page 2 of PJM's Report.
[6] See Figure 31 of PJM's Report.
[7] See Figure 30 of PJM's Report.
[8] See Figure 44 of PJM's Report. For a more complete picture of what created fuel availability challenges, it would be helpful to have a more granular breakdown of the contract portfolio relied upon by generators that experienced fuel availability issues and to document whether: (1) there was a physical deliver issue with a gas supplier, processor, pipeline or LDC allocation priority issue: (2) generators had access to storage to manage unexpected supply shortfalls in supply or pipeline constraints; and (3) other end-users were able to fare better and if so, what they relied upon to better manage their supply needs.

As we explore where we should focus the majority of our time examining ways to improve upon gas-electric coordination, by far the most insightful data is provided in PJM's chart comparing how many of the generator gas outages occurred in the Day-Ahead Market versus those that occurred in the Real-Time Market.

- PJM shows that during the peak of the event, 71% of gas outages occurred in the Real-Time Market.[9]
- When examining just gas generation that experienced outages due to gas supply issues, PJM's initial analysis showed that **an astounding 89% of those outages were associated with calls to run in the Real-Time Market.**[10]
- Thus, as shown on the chart below, when examining gas outages as a percentage of total system outages at the peak of the storm: 21% of outages were gas generators called on in the Real-Time Market while **less than 3% were associated with generators in the Day-Ahead Market.**

The outage data underscores why it is essential for generators to be able to pre-plan and pre-arrange gas purchases to greatly improve their ability to secure fuel and transportation. **The vast majority of the gas generators that had at least one day to procure fuel by clearing in the Day-Ahead Market did not experience gas supply issues, even though there were production declines and the event occurred over a holiday weekend.**[11]

For those called on to start in the Real-Time Market, if a generator is unable to flow its gas outside of the FERC-approved NAESB cycle and cannot run in the time specified in PJM's tariff, they will likely be categorized as a forced outage.[12]



[9] See Figure 36 of PJM's Report.
[10] See Slide 15 of PJM Presentation at March 9, 2023 Operating Committee Meeting, Winter Storm Elliott Continued Outage Analysis, https://www.pjm.com/-/media/committees-groups/committees/oc/2023/20230309/20230309-item-04a—winter-storm-elliott-outage-data-review.ashx.
[11] We recognize we cannot ignore the 3% of the documented outages that occurred for gas generators that made firm gas commitments and cleared the Day Ahead market, and we should also work to address solutions for those outages, but PJM's data shows the greatest impacts can be had by addressing Real-Time procurement issues.
[12] The amount of time a generator has prior to producing power after notification by PJM varies by type of unit but typically, for gas units, they have one hour or less unless a generator has a specific parameter limitation in place. (See www.pjm.com/-/media/committees-groups/committees/elc/postings/20150612-june-2015-capacity-performance-parameter-limitations-informational-posting.ashx?la=en). However, interstate pipeline tariffs only commit to providing nominated gas to be delivered to a shipper under the timeframes specified in the NAESB cycle approved by FERC, in which the shortest wait time for an intraday nomination is 3 hours. (See https://www.energyknowledgebase.com/topics/gas-nomination.asp). While pipeline no-notice service can be scheduled outside of the NAESB cycle, it is a ratable service.

The stark contrast in generator fuel availability outages between Day-Ahead and Real-Time Markets should focus our immediate attention on gas-electric challenges that occur when gas generation is called to run in the Real-Time Market. Some of the issues to address include:

- Finding ways to ensure that sufficient resources are cleared in the Day-Ahead Market as well as finding ways to reduce the unanticipated need to call on significant resources in real time, particularly during a critical event.
- Taking additional steps to ensure that PJM's market structure fully incentivizes gas generators to take the steps necessary to be prepared to run in real time.
- Ensuring that generators have the ability to update their operating parameters in real time.
- Examining ways to ensure more natural gas is available in real time, such as investing in additional pipeline and storage capacity when needed to support power market flexibility requirements.

Without preparedness and advance gas planning, the practice of dispatching gas generators in real time places them in a perilous position of scrambling for gas during emergency conditions, typically when most firm pipeline capacity is already being fully utilized by its subscribers and tight market conditions are prevalent in both markets.

Gas availability in real time becomes even more challenging when a generator is attempting to fulfill its start-up time commitments, which may be one hour after notification from PJM for some combined cycle units and as little as 6 minutes for peakers unless the unit has other operating parameters in place. During constrained periods, pipelines are unlikely to be able to offer flexibility beyond what they are committed to providing pursuant to their tariff and the

FERC-approved NAESB cycle. This is true even for those shippers that hold firm transportation contracts who will remain bound to the nomination/delivery schedules and ratable takes required in a pipeline's tariff.

During a major winter event, a pipeline typically will issue an operational flow order that requires that shippers adhere to the tariff and the FERC-approved nomination cycle delivery times. During normal operating conditions, pipelines strive to provide flexibility to customers that goes above and beyond their tariff specifications. In extreme weather conditions, that level of flexibility diminishes, especially on constrained pipeline systems. This can hinder a generator that may have relied on that flexibility when setting its operating parameters. While there are issues with the ability to update operating parameters in real time, PJM is actively working with its stakeholders on ways to clarify and ensure that there are no barriers to generators updating their operating parameters under these conditions.

While the ability to procure gas during the Real-Time Market is most severely hampered during emergency cold weather events, these challenges are likely to increase and expand beyond cold-weather events as the power grid transitions and calls upon natural gas generators more frequently in real time to help balance renewable energy fluctuations. The key to providing pipeline flexibility to accommodate these real time fluctuations for weather events as well as for supporting intermittent energy resources hinges on having sufficient infrastructure in place.

In conclusion, PJM's data should be used to guide efforts and to prioritize addressing Real-Time Market issues, which is the area in which the largest short-term impact can be made to improve gas-electric coordination and bolster reliability.