United States Senate

Committee on Energy and Natural Resources

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"Examining the Performance of the Electric Power Systems Under Certain Weather Conditions"

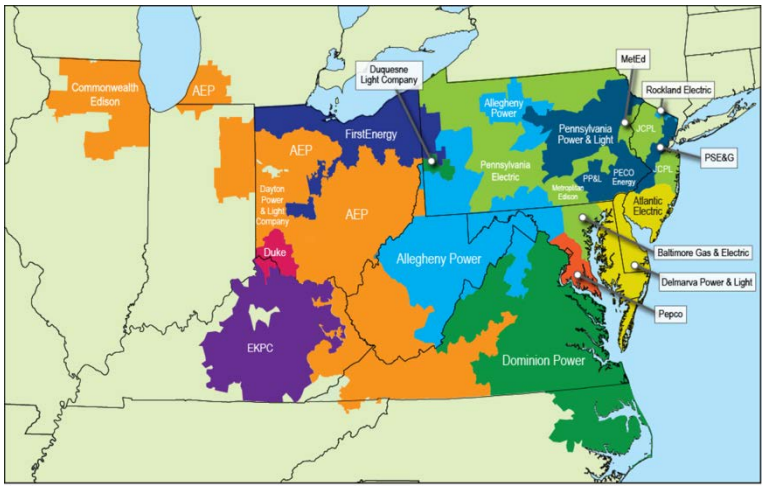
January 23, 2018

As the CEO of the largest electric grid in North America and the largest competitive wholesale electricity market in the world, I am pleased to have the opportunity to testify today on PJM's real-time experience during the recent incidence of prolonged cold weather from December 27, 2017, to January 7, 2018. I also wish to offer our perspectives on the state of the electric grid in the PJM footprint, as well as what PJM believes will be needed in the future to ensure that our nation's need for a reliable and resilient supply of electricity is met efficiently, fairly and cost-effectively. These recommendations address both reforms already underway in PJM as well as larger policy issues that will require consideration by FERC, DOE and other policymakers.

PJM is the independent Regional Transmission Organization covering all or parts of 13 states and the District of Columbia, in an area with a population of more than 65 million. Our role is three-fold:

1. To ensure the reliability of the grid
2. To operate robust competitive wholesale electricity markets that both attract needed investment and yield just and reasonable rates for customers
3. To plan for the expansion and evolution of the power grid in the region we serve

Figure 1. PJM Service Territory and Key Statistics



Key Statistics	
Member companies	1,000+
Millions of people served	65
Peak load in megawatts	165,492
MW of generating capacity	176,569
Miles of transmission lines	82,546
2016 GWh of annual energy	792,314
Generation sources	1,304
Square miles of territory	243,417
States served	13 + DC

We are appreciative of the work of this Committee and its excellent Staff on both sides of the aisle. I personally, along with my Staff, have met on many occasions with Members and Majority and Minority Staff and appreciate your keen interest and helpful interaction with PJM over the years. We also appreciate the support we have received from FERC and DOE, both of which have been keenly focused on ensuring a reliable grid at rates that are just and reasonable to consumers.

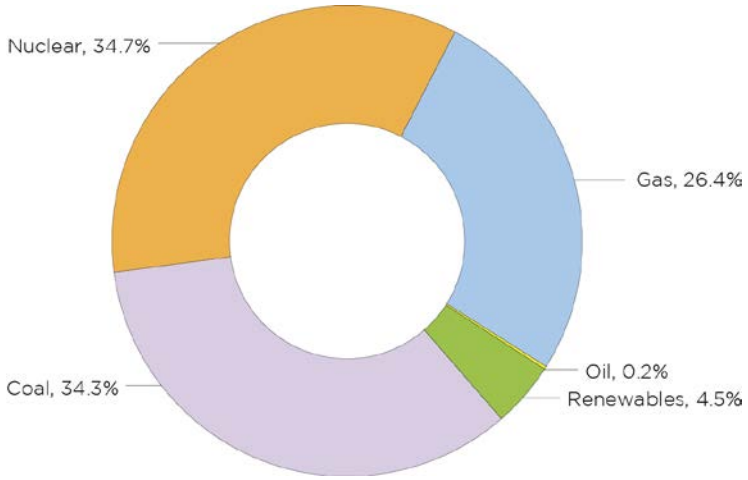
At PJM, we have a very diverse footprint. That footprint includes net-exporting states like Pennsylvania, West Virginia and Kentucky, with their rich resources in coal and natural gas, as well as net-consuming states such as Maryland and New Jersey that have aggressively embraced renewable resources to meet their future needs. Notably, the energy markets have provided benefits to each state in our region, be they states with surplus energy to sell to the rest of the grid or net-consuming states, which depend on the large regional market to ensure that customers have choices in their sourcing of electric generation.

State of the PJM Grid

My testimony will address both the state of the grid today as well as the policy and operational reforms we will need in the future as the grid changes.

The PJM grid today is both reliable and diverse. In terms of energy production, our generation fleet is almost evenly split between coal, natural gas and nuclear resources, with ever-growing penetration of renewable generation and healthy levels of demand response and energy efficiency.

Figure 2. 2016 Fuel Mix (Energy)

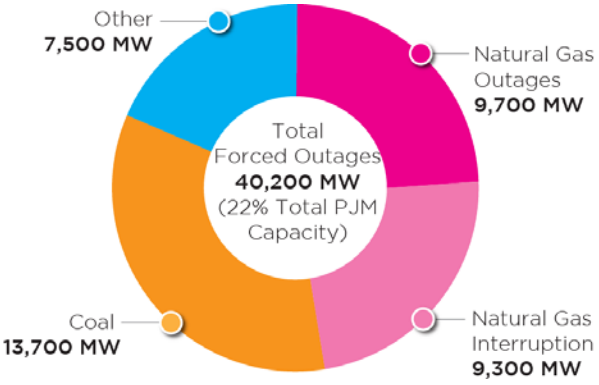


Looking Back: The 2014 Polar Vortex

At PJM, the reliability of the bulk power system is job number one, and we are committed to using all of the sophisticated market, operational and planning tools at our disposal to ensure that the grid remains reliable going forward. The performance of our assets, especially during the recent cold snap, indicates that the grid remains reliable today. As a reference point, I will illustrate how we have progressed from the time of the Polar Vortex in 2014 to today.

The Polar Vortex of 2014 was characterized by multiple days of below-zero temperatures through much of our footprint. I need to be clear, even at the height of the Polar Vortex, we were not facing imminent blackouts. However, the performance of the generation fleet was not where it needed to be at that time to meet system conditions. We saw a significant number of plant outages across the board from generation of all types. This is illustrated in Figure 3, which shows “forced outages” on the peak energy demand hour of the Polar Vortex.

Figure 3. 2014 Polar Vortex Forced Outages – January 7, 2014 Evening Peak (7 p.m.)

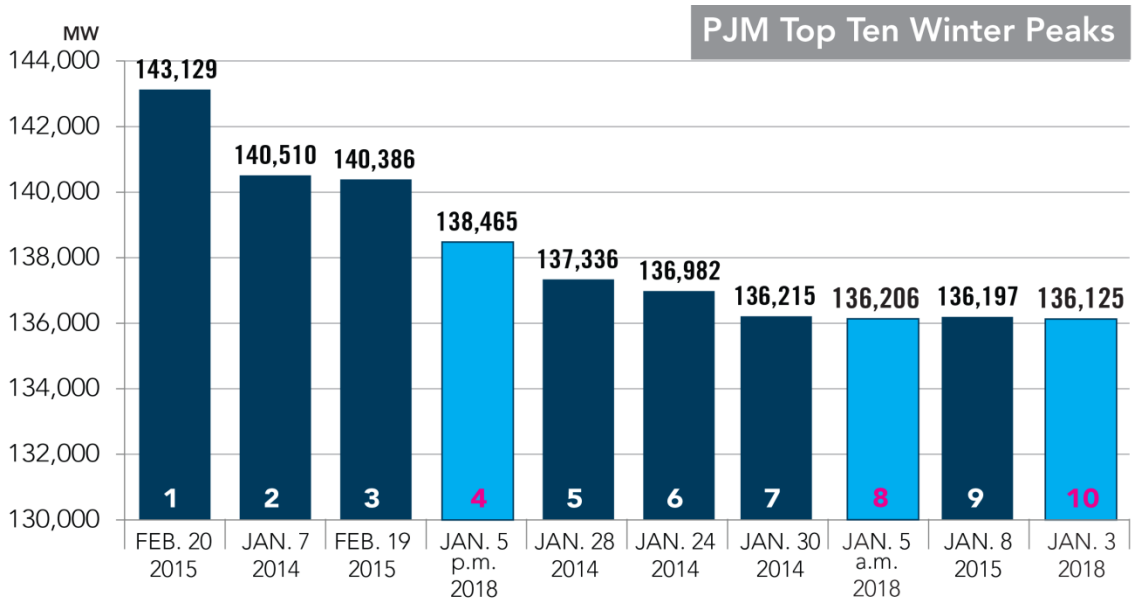


With FERC's support, we were able to implement key reforms by instituting a performance-based incentive and penalty system, which was designed to ensure that generators are available when required.

The December-January Cold Snap

During the recent cold snap from December 27, 2017, to January 7, 2018, we experienced three of our top 10 winter peak demand days of all time (Figure 4). Overall, the grid and the generation fleet performed well. Even during peak demand, PJM had an abundance of reserves and capacity.

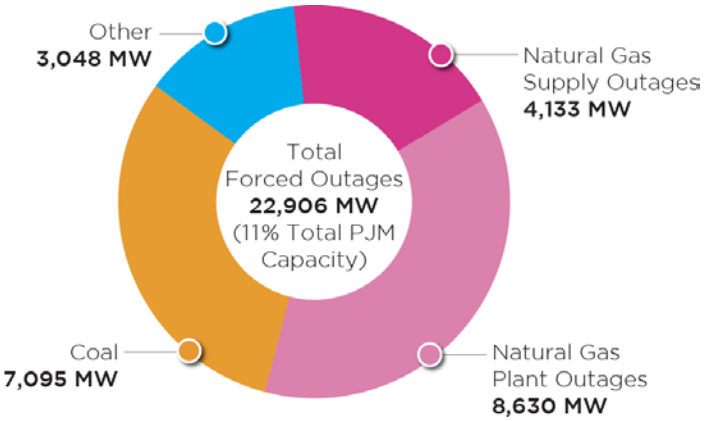
Figure 4. Top Ten PJM Winter Peaks



I want to address what the preliminary data reveals as to unplanned generator outages (what the industry refers to as "forced outages"). Before presenting the data, the term "forced outages" needs to be put into context. Generating units of all types are complex machines. They operate under stressed conditions during extreme temperatures and, by definition, these complex machines have parts that can fail. These mechanical failures in many cases are transitory –the mechanical failure is often promptly repaired so that the generator can quickly return to service.

We have generating reserves available precisely because generators can experience forced outages during stressed conditions (i.e., additional generation beyond the specific demand at any given point in time). Preliminary data (Figure 5) shows that overall forced outages during the peak demand hour of the recent cold snap were about half what they were during the Polar Vortex.

Figure 5. 2018 **Cold Snap Forced Outages — January 6,** 2018 Morning Peak (9 a.m.)



In most respects, the recent cold snap was much milder than the Polar Vortex — the temperatures were not as low, the wind chill was much less, and the demand for electricity was lower, in part due to the cold snap occurring during a holiday week. On the flip side, the cold snap did last for much longer, which led to some degrading of generator performance over time.

In short, there are many factors that drove improved performance, including enhancements PJM and its member companies have put in place in the years since the Polar Vortex, such as deployment of more efficient generation resources, increased investment in existing resources, improved performance incentives, enhanced winterization measures and increased gas-electric coordination.

As a result of our capacity and Energy Markets, we have seen significant new entry of a variety of fuel types. We have seen almost 40,000 MW of new generation since the inception of the capacity market. These include a diverse mix of new resources including new highly efficient natural gas units such as those being developed in Ohio; the Longview merchant coal plant in West Virginia; and innovative energy storage and demand response technologies such as deployed at the Shedd Aquarium in downtown Chicago. Although we have seen over 20,000 MW of coal retirements, the average age of the coal units that have retired was over 50 years. In short, the markets have helped to incent new efficient generation of all fuel types and help to retain existing generation needed to serve electric needs of customers in our footprint.

Figure 6. Efficient Types of Generation

(From left to right: Longview Merchant Plant, Oregon Clean Energy Center, Shedd Aquarium)

However, this is a time for all of us to be proactive. We need to ensure a strong 21st-century grid and to look forward to address issues that are just on the horizon. I outline those below.

Key Ingredients: The Recipe for Going Forward

Although I can assure you that the grid is reliable today and that we have many tools at our disposal to continue to ensure overall bulk electric system reliability, our work is not done and we cannot become complacent. Rather, we have been keenly focused on key initiatives to ensure not just a reliable grid, but a resilient grid, and to ensure that we are properly valuing those resources that are providing the grid with key reliability and resilience attributes.

There is often confusion as to how the terms "resilience" and "reliability" relate to each other. Reliability of the bulk power system is a very specific term focused on ensuring the delivery of service to end-use customers. The Congress, in the Energy Policy Act of 2005, defined reliable operation of the electric grid as:

"(O)perating the elements of the bulk-power system within equipment and electric system thermal, voltage and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements."

The operative words in this definition involve operating the system "*within equipment and electric system thermal, voltage and stability limits*." PJM works to meet this definition in our operations every day and has systems in place to ensure this level of reliability.

By contrast, we view grid resilience as a different concept, focusing more on keeping the grid functioning, no matter what the cause of the event, and planning, operating and ensuring grid restoration should such an extreme event occur. We used to worry about equipment failure, now we have to worry about hacking, terrorist attacks, even intentional interference. Those concerns lead us beyond reliability and into resilience.

As an analogy, think of an automobile: There are basic safety standards in place today that are designed to protect the driver when he or she is operating the vehicle at certain speeds and under certain predictable and recurring conditions. We do not require that cars be designed to protect the driver from any risk no matter how severe. Yet the electric grid, which is so critical to our national economy, needs to plan for, operate through, and quickly recover from events, no matter how severe. That has been our focus, and we appreciate that this has become a targeted focus at the federal level.

We believe there are a number of initiatives that can be undertaken in this area. Many, such as establishing protocols around reserve levels, conservative operations, planning and system restoration are actively underway in PJM, in consultation with our states and stakeholders. But there are certain broader policy areas that I wanted to bring to the Committee's attention and that we may address in our comments to FERC. These potential initiatives include:

1. Bringing Gas-Electric Coordination to the Next Level. As natural gas becomes a more dominant fuel in the PJM footprint, our dependence on the natural gas pipeline infrastructure has grown significantly. In the past, the region PJM serves was primarily coal dependent. The customers of the natural gas pipeline system in our footprint were almost exclusively local gas utilities and large industrial customers who used natural gas in their industrial processes. During that time, the principal demand on the pipeline system was heating load in the winter. By contrast, today's customers of the natural gas pipeline system include natural gas-fired electric generators whose demand for natural gas fluctuates by time of day rather than simply by season, as was the case with gas utilities serving customers for home or commercial heating.

   The level of communication and coordination between our operators and the operators of the natural gas pipeline system is much improved, and it is an activity on which we expend considerable effort. But in our view, it is time to bring the coordination between these two industries to the next level. To reach this next

level we believe it is important that FERC, DOE, and, in some cases, this Committee look into some key dichotomies in the regulation of these vital infrastructures.

For instance, the electric industry is subject to mandatory physical and cybersecurity standards determined and enforced ultimately by FERC. The natural gas pipeline industry is subject to different, high-level voluntary guidelines in these areas issued by the Transportation Security Administration augmented with yet a different level of regulation by the Pipeline and Hazardous Materials Safety Administration. I say this not to impugn work that the pipelines have done in this area but to point out that the two industries face vastly different compliance obligations, particularly in the area of cybersecurity. By definition, these dichotomies will inevitably hinder an optimal integrated and coordinated approach to common threats from both physical and cyberattack. Whether or not we need to change the regulatory structures around physical and cybersecurity between these two industries is an issue I will leave for you as policymakers. But I'd be remiss if I didn't point out the differences and how those differences can challenge all of us in reaching the next level of gas-electric coordination.

2. Balancing the Need for Transparency With the Need to Protect Critical Infrastructure. Although a hallmark of RTO operations and our planning process has been transparency, in the future, we believe a balance needs to be struck in this area. On the one hand, transparency in detailing to stakeholders the need for particular grid improvements is very important, and on the other, we do not want to inadvertently publicly release highly sensitive information about vulnerabilities on the grid.

   To date, the regulators and the RTOs have addressed this issue through labeling highly sensitive grid information as Critical Electric Infrastructure Information (CEII). But the CEII rules utilized at FERC and at the state level are designed around a "right to know" approach, with some verification of the bona fides of the requestor. Yet, the federal government doesn't approach classified information this way. Rather, that system is based on the provision of access based on a demonstrated "need to know." It may be time to consider evolving our release of a limited set of highly sensitive infrastructure information from a "right to know" to a "need to know" basis. We think this can be accomplished in a manner that also allows the opportunity at the appropriate time for customers and the public to examine (and potentially challenge) the costs of any grid upgrade through the regulatory process. But for this balance to be workable, we will need direction from FERC — as much of its regulatory regime to date has, understandably, been driven by moving toward greater transparency without a corresponding focus on tightening rules around CEII.

3. Properly Valuing the Reliability Attributes of Generation Resources. Focusing on physical infrastructure is clearly important, for the reasons I outlined above. But without a compensation system that properly values the attributes that any particular resource brings to the grid, we will inevitably frustrate many of these other initiatives and fail to properly attract the capital this capital-intensive industry needs to make some of these critical investments, particularly those needed to ensure a resilient generation fleet.

   Specifically, we have proposed key reforms in how we compensate generating units that are needed to serve the demand for electricity. Today, we operate under a set of rules written in a vastly different time that limit the ability of certain generating units to set prices in a given hour. These units are still compensated for their costs to operate, but because they are not able to set clearing prices, those clearing prices are artificially lower than they should be in those hours. This has a price-suppressive effect on all generating units, including nuclear and coal generation, as well as natural gas and renewable generation. Price formation reforms in this area were specifically recommended by the DOE in its comprehensive August 2017 analysis. This type of reform, along with reforms to pricing during certain times when we are approaching temporary shortage conditions, would, in our view, go a long way toward properly compensating *all* generation needed to serve demand.

We understand that we carry the burden to justify these pricing changes to FERC, our regulator. We have begun a stakeholder process on this issue. But to avoid the potential for delay, we feel it would be helpful for the Commission to impose some process timelines around this debate, at least at the stakeholder level, so these issues can get to the regulator and not languish. We all respond better when we have some realistic deadline in front of us. It is for this reason that we have continued to seek a deadline from the Commission for the filing of price formation reforms that each region of the nation feels it needs to address its unique challenges. We continue to believe that resolving these kinds of pricing issues is as important to ensuring a resilient fleet as are some of the more operational and infrastructure-focused reforms I outlined above.

The recent cold snap has demonstrated this need very clearly. We pay what we call "out-of-market payments" to generators for their costs to run when we call on them for reliability purposes. These costs are not currently reflected in PJM's energy pricing. While out-of-market payments have improved since the Polar Vortex (approximately $16 million per day) we still saw significant payments during the recent event (approximately $4 million per day). By contrast, on a typical day, out-of-market payments may be approximately $400,000 to $500,000. This further demonstrates the need to improve pricing for those generators that we must run for reliability but also need to be paid out-of-market payments.

Conclusion

Steven Covey, in his book "The 7 Habits of Highly Successful People" reminds us that:

"The main thing is to keep the main thing, the main thing."

At PJM, I am pleased to report that we have laser-like focus on issues associated with reliability, resilience and proper pricing of the generation and demand response resources that are needed to keep the lights on for the 65 million Americans that depend on us. I have outlined above some very specific recommendations that we have raised with FERC and DOE and are considering raising again as part of suggesting a proposed path forward for the Commission on these important issues. We value our close working relationship with this Committee on both sides of the aisle in this process. Accordingly, I reaffirm PJM's commitment to be a resource that can bring to the table independent unbiased information and recommendations for policy initiatives in these important areas in order to ensure that we can evolve the grid to meet the nation's growing demand for a resilient electric grid at just and reasonable rates.