



**PENNSYLVANIA SENATE
CONSUMER PROTECTION & PROFESSIONAL LICENSURE COMMITTEE
AND ENVIRONMENTAL RESOURCES & ENERGY COMMITTEE
Statement of Asim Haque on Behalf of PJM Interconnection, LLC**

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For Public Use

I. Introduction

Good morning, Committee Chairs – Senator Yaw, Senator Stefano, Senator Comitta, and Senator Boscola – and members of both the Senate Environmental Resources & Energy and Consumer Protection & Professional Licensure committees. Thank you for the opportunity to appear before you today. My name is Asim Haque, and I am Vice President of State and Member Services for PJM.

PJM Interconnection is a regional transmission organization (RTO) authorized by the Federal Energy Regulatory Commission (FERC). PJM is responsible for the reliable operation of the electric grid serving 65 million customers in 13 states and the District of Columbia. Ensuring a safe and reliable bulk power system – keeping the lights on – is PJM's most important priority. This requires constant system monitoring by skilled operators and real-time coordination with other operating entities and industry sectors.

In addition to its real-time operations responsibilities, PJM also administers the largest competitive, wholesale electricity market in the world and plans the long-term expansion of the high-voltage transmission grid within our footprint. PJM's competitive wholesale markets provide a powerful tool to support reliability by providing financial incentives and encouraging competition to provide electricity where and when it's needed. The markets serve to attract investment in new generation and technology at the lowest cost. PJM's comprehensive Regional Transmission Expansion Plan (RTEP) process identifies the need for changes and additions to the transmission system up to 15 years into the future. This approach makes the transmission planning process more efficient by considering the region as a whole, rather than as individual states or separate transmission zones. Operationally, the system enhancements arising out of the RTEP process reduce emergency procedures and alerts, increase operating margins, and improve the ability to import or export power with neighboring grid systems.

II. Understanding the Differences Between PJM Markets

PJM Interconnection operates several types of competitive wholesale markets through which large volumes of electricity are bought and sold throughout the footprint. The markets underpin PJM's mission of reliability at the lowest-possible cost by giving financial incentives and encouraging competition to provide electricity when it's needed. Each market serves a separate function, but they work in tandem.

The largest of the PJM markets is the energy market, making up the majority of wholesale electricity costs. The energy market operates much like a stock exchange. PJM matches the demand for electricity with offers to provide it. As the market operator, PJM's role is to balance the needs of buyers, sellers and other market participants while monitoring market activities to ensure open, fair and equitable access. The energy market is divided into the Day-Ahead and Real-Time markets. Both markets match offers from power suppliers with bids from power consumers to ensure that suppliers are ready to deliver at the right time and place.

PJM's capacity market (also known as the Reliability Pricing Model, or RPM) is smaller than the energy market on a proportional cost basis. While the energy market addresses near-term electricity needs, the capacity market prepares for future demand. PJM's capacity market secures enough power supplies, three-years ahead, to ensure sufficient

supply for peak demand. This is sometimes referred to as resource adequacy. Each year, PJM holds a competitive auction to obtain these future power supplies at the lowest reasonable price. Capacity is the commitment by resources to deliver electricity or to lower consumption when needed, particularly in an emergency.

Future generation capacity sold at auction is said to “clear” the auction. Cleared generation resources are required to offer power into the energy market during the year in which they are committed. More importantly, generators are also required to serve PJM’s emergency needs whenever called upon in this time period – even in the most extreme conditions. These requirements apply to all resources that clear the capacity auction, regardless of fuel or technology type. The capacity market thus ensures reliable power in the future for the PJM region. In return, the capacity market provides a dependable flow of income to power resources. In all, the capacity market helps generators maintain existing capability, attracts investment in new resources, and encourages companies to develop new technologies and sources of electric power.

The smallest contribution to wholesale market costs comes from the ancillary services markets. Because electricity must be produced and consumed the instant it is needed, PJM dispatchers must continuously match the electricity flowing on the grid with customers’ demand for it. Key elements of this delicate balancing act are regulation resources and reserves, which are called ancillary services. Regulation is a reliability product that corrects short-term, unforeseen fluctuations in electricity use and supply that could affect the stability of the power system. Regulation providers are resources that have the ability to adjust output or consumption in response to an automated signal. Reserves are generation resources that can come online (or end-use consumers that can reduce consumption) within 10 or 30 minutes in the event of an unexpected loss in generation. These operating reserves also help balance the system in emergency situations.

III. Winter Storm Elliott – Emergency Operations

Every year, PJM and its members undertake extensive measures in preparation for the winter operating period. These measures include performing a winter reliability assessment, coordinating those assessments with our neighboring control areas, conducting emergency preparedness drills for PJM staff and stakeholders, and ongoing fuel supply and supply chain coordination with our members. Despite those efforts, extreme weather at the end of 2022 strained electric systems across the United States, including PJM. As that extreme weather spread across the country and into our footprint, PJM operations leadership and Control Room personnel worked nonstop to keep the system stable and to maintain reliability for our customers. PJM employees, a broad swath of our member companies, and even our customers responding to a request for conservation over the holiday weekend combined to keep the lights and heat on under some of the most strenuous operating conditions in the history of the organization.

Winter Storm Elliott, dubbed a bomb cyclone and “historic Arctic outbreak” by the National Oceanic and Atmospheric Administration (NOAA), impacted a large portion of the United States in the later part of December 2022. PJM was most impacted by the storm system through the weekend of December 23–25. PJM saw an unprecedented 12-hour average temperature drop of 29 degrees on December 23. The storm and its frigid temperatures then brought the lowest-recorded high temperatures on December 24 for Washington D.C., Philadelphia and Baltimore. The extreme weather and historically high demand for power, coupled with unusually high generation outages, resulted in a number of PJM emergency procedures, including the deployment of demand response to reduce load and an RTO-

wide Call for Conservation, the first such appeal since the 2014 Polar Vortex. Despite the advance planning for the winter storm by PJM and its members, the power supply mix was much tighter than PJM expected.

In the days leading up to the storm's arrival in the PJM footprint, PJM notified its members of the approaching frigid temperatures with a Cold Weather Advisory for the Western Region of the PJM footprint effective December 23 through December 25. A few days later, the advisory was expanded to include all of PJM. Introduced in 2022, a Cold Weather Advisory conveys expectations that PJM members will implement freeze protections, such as windbreaks, shelters or temporary heaters, and report operating limitations to PJM. Cold Weather Alerts followed, first for the Western Region and then for all of the PJM region by December 23. The Cold Weather Alert calls for specific measures to prepare for imminent weather, including review of deferrable maintenance, fuel limitations and enhanced communication with PJM, specifically regarding anticipated difficulties procuring fuel in the spot market that would result in unavailability of generation.

Going into the weekend, PJM forecasters were concerned about the unpredictability of demand given the extreme weather converging with the holiday weekend. To account for the uncertainty of the conditions, PJM set up the operating day with 155,750 MW of available generation that Friday. That well exceeded the PJM load forecast peak of about 127,000 MW for the day. Friday's actual peak load was approximately 10% above PJM's forecast. Drivers of the load forecasting challenge included extreme cold temperatures, an unusually rapid temperature drop, and different load behavior than expected over a holiday weekend.

Elliott was unprecedented for that time of year, given the severe temperature drop and resulting spike in load. The record-breaking plunge of 29 degrees over 12 hours on December 23 surpassed the previous PJM record of a 22-degree drop during the 2014 Polar Vortex. As cold weather gripped the PJM region December 23 and power needs spiked, PJM began seeing high levels of forced generation outages. PJM implemented emergency procedures, including calls for synchronized reserves, an RTO-wide Maximum Generation Emergency Action and a call on demand response.

As temperatures fell, power demand rose to a peak of about 135,000 MW Friday evening. Around the same time, forced outages reached as high as 34,500 MW. Shortly before midnight Friday, PJM issued a Call for Conservation for the entire footprint, asking consumers to cut back on their energy use where possible between the hours of 4 a.m. on December 24 through 10 a.m. on December 25.

The demand continued after the peak on December 23 and into December 24. Even the valley, or low-point of demand, on December 24 was significantly greater than any other peak, or high-point of demand, for that date in a decade. The valley is crucial because that's when PJM can usually cycle generation units offline and authorize owners to replenish the pond levels at their hydroelectric facilities.

Generation outages further expanded to an initially estimated level of nearly 46,000 MW by Saturday morning. Factoring in a number of reserve generators that missed scheduled start times Saturday morning or operated at less than capacity, combined with PJM's inability to replenish pumped storage based on the lack of availability of generators overnight, PJM was missing approximately 57,000 MW of its generation fleet by the morning peak of December 24, the coldest day of the holiday weekend. More than 90% of the forced outages came with no notice or less than one hour's notice. That meant that PJM Control Room dispatchers were calling generators to bring them online, only to be told for the first time that the unit was not available.

Starting Saturday morning, more than 30 PJM members and stakeholders amplified PJM's Call for Conservation through social and traditional media. PJM believes that consumer response to the conservation request may have helped to remove stress from the system as electricity demand leveled off over the course of Saturday, with peak demand coming in less than what was forecast. Altogether, calls for conservation, a Maximum Generation Action and demand response are believed to have eased operating conditions through the December 24 morning peak of about 129,000 MW and the evening peak that day of about 126,000 MW. PJM was able to come out of its Maximum Generation Emergency at 10 p.m. on Saturday night, meet the morning peak on December 25, and end all emergency procedures at 10 p.m. Sunday.

IV. Winter Storm Elliott – Market Impacts

After the 2014 Polar Vortex, PJM modified its capacity market by adding Capacity Performance requirements to generators that clear the capacity auction. These requirements are intended to incentivize generators to better perform in extreme conditions. These requirements include the concept of Performance Assessment Intervals (PAIs), which are triggered during specific protocols invoked as part of PJM's published emergency procedures. During PAIs, PJM measures generator performance in line with the capacity they have committed. Capacity resources are assessed penalties for underperformance and provided bonuses for over-performance. Bonus payments are paid exclusively through the penalties collected from underperforming capacity resources and are not collected from customers.

During Winter Storm Elliott, generators were subject to 277 five-minute PAIs over the 23 hours that emergency procedures were in effect during the December 23–24 period. Analysis of Capacity Performance requirements, including penalties and bonuses, are being refined and reviewed. Given the number of underperforming generators, preliminary estimates of total penalties are between \$1 billion and \$2 billion. However, the final calculation process will take several months. PJM will process excusals for generators as well as documentation of replacement generation, which are allowed under Capacity Performance. Given the potential for individual generators being subject to significant penalties, PJM is currently working through the billing timeline to account for any non-payment risk and PJM liquidity concerns.

Evaluating the effectiveness of Capacity Performance will be part of PJM's comprehensive analysis of Winter Storm Elliott. This review will also include analysis of impacts to energy and congestion markets and a review of extreme-cold-weather load forecasting. PJM plans to report results, along with recommendations and actions, in spring of 2023.

V. Energy Transition in PJM – Resource Retirements, Replacements and Risks

Much of the electric industry in our nation is going through a significant transition. Federal policies combined with certain state policies and corporate preferences are shifting the grid away from emitting-generation resources toward generation with little-to-no carbon emissions. Our generation queue, largely dominated by renewable resources, is evidence that we are in fact in a transition. Driven by these industry trends and their associated challenges, PJM

developed the following strategic pillars to ensure an efficient and reliable energy transition: facilitating decarbonization policies reliably and cost-effectively; planning/operating the grid of the future; and fostering innovation. In light of these trends and in support of these objectives, PJM is continuing a multiphase effort to study the potential impacts of the energy transition. The first two phases of the study focused on energy and ancillary services and resource adequacy in 2035 and beyond. This third phase, captured in our recently released report entitled, [PJM Energy Transition: Resource Retirements, Replacements and Risks](#), focuses on resource adequacy in the near term through 2030.

Maintaining an adequate level of generation resources, with the right operational and physical characteristics, is essential for PJM's ability to serve electrical demand through the energy transition. Our research highlights four trends that we believe, in combination, present increasing reliability risks during the transition due to a potential timing mismatch between resource retirements, load growth and the pace of new generation entry under a possible "low new entry" scenario.

- 1 | The growth rate of electricity demand is likely to continue to increase from electrification coupled with the proliferation of high-demand data centers in the region.
- 2 | Thermal generators are retiring at a rapid pace due to government and private sector policies, as well as economics.
- 3 | Retirements are at risk of outpacing the construction of new resources, due to a combination of industry forces, including siting and supply chain, whose long-term impacts are not fully known.
- 4 | PJM's interconnection queue is composed primarily of intermittent and limited-duration resources. Given the operating characteristics of these resources, we need multiple megawatts of these resources to replace one megawatt of thermal generation.

Our analysis also considers a "high new entry" scenario, where this timing mismatch is avoided. While this is certainly a potential outcome, given the significant policy support for new renewable resources, our analysis of these long-term trends reinforces the importance of PJM's ongoing stakeholder initiatives and the urgency for continued, combined actions to de-risk the future of resource adequacy while striving to facilitate the energy policies in the PJM footprint. The potential for an asymmetrical pace in the energy transition, in which resource retirements and load growth exceed the pace of new entry, underscores the need to enhance the accreditation, qualification and performance requirements of capacity resources.

VI. Conclusion

PJM serves a region made up of diverse states with complex policies impacting the bulk electric power grid. These policies include Renewable Portfolio Standards, carbon cap-and-invest programs, electrification goals and offshore wind auctions. Cumulatively, these policies are driving the next energy transition in PJM, marked by an increase in renewable generation and energy storage, along with retirements of traditional thermal generation. As we continue on this transition, it is important to recall that the grid has successfully endured multiple energy transitions in the past. PJM has reliably and effectively weathered these transitions due in large part to the value that comes with being a regional transmission organization with a robust planning process, efficient capacity market design, access to fuel and geographically diverse generating resources, and a highly resilient network of transmission facilities.

Indeed, the PJM system as it stands today is a reliable system with an enviable capacity reserve margin. Despite PJM's healthy reserve margins, however, recent winter storms (Uri 2021, Elliott 2022) have provided a sobering reminder of the critical role that resource adequacy will play through the energy transition. Further, for the first time in recent history, PJM could face decreasing reserve margins should these trends – high load growth, increasing rates of generator retirements, and slower entry of new resources – continue. The amount of generation retirements appears to be more certain than the timely arrival of replacement generation resources and demand response, given that the quantity of retirements is codified in various policy objectives, while the impacts to the pace of new entry of the Inflation Reduction Act, post-pandemic supply chain issues, and other externalities are still not fully understood. The composition and performance characteristics of the resource mix will ultimately determine PJM's ability to maintain reliability. It is critical that all PJM markets effectively correct imbalances brought on by retirements or load growth by incentivizing investment in new or expanded resources.

I thank you for the opportunity to present my testimony today. I look forward to any questions you may have.