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June 1, 2017

Asim Z. Haque
Chairman, Public Utilities Commission of Ohio
Public Utilities Commission of Ohio
180 East Broad Street
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Steven T. Nourse
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Re: *In the Matter of the Application Seeking Approval of Ohio Power Company's Proposal to Enter into an Affiliate Power Purchase Agreement for Inclusion in the Power Purchase Agreement Rider, Case No. 14-1693-EL-RDR; In the Matter of the Application of Ohio Power Company for Approval of Certain Accounting Authority, Case No. 14-1694-EL-AAM*

Dear Chairman Haque:

In accordance with Section III.B.2 of the December 14, 2015 Joint Stipulation and Recommendation, I am submitting AEP Ohio's 2017 State of the Market Report for the Commission's consideration.

Thank you for your attention to this matter.

Respectfully Submitted,

//s/ Steven T. Nourse

cc: Parties of Record

State of the PJM Capacity and Energy Market June 2017

*A whitepaper presented by
AEP Ohio*



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Executive Summary

AEP Ohio is a longtime participant in the PJM markets, and recognizes the potential benefits associated with a market paradigm for both capacity and energy. However, AEP Ohio also believes that there are shortcomings in both the capacity and energy markets in PJM that fail to provide proper incentives for long term capital investment. We also believe that grid resilience, especially as it relates to gas supplies and fuel diversity, is an important area which has not been recognized by PJM until recently.

The topics in this year's whitepaper only partially overlap with the 2016 whitepaper. Last year, the Capacity Performance product had just begun functioning within the PJM markets. The Clean Power Plan still looked like it would be implemented soon. And the unregulated subsidiary of AEP still owned approximately 8,000MWs of generation in Ohio. The emphasis in the 2017 whitepaper is:

Wholesale Prices. Wholesale prices decreased significantly from 2015 to 2016, dropping from \$56.00/MWH to \$47.50/MWH for an average wholesale customer. This was largely driven by lower natural gas costs and a mild weather pattern throughout the year.

Capacity. Starting in June 2016, PJM began adopting new rules associated with the FERC-approved Capacity Performance (CP) product. In general, the new rules impose greater reliability requirements for generating units during emergency conditions, while imposing higher penalties for failure to perform during these emergency events. PJM has yet to declare an emergency event under the new CP construct. But AEP Ohio believes the potential penalties associated with non-performance greatly outweigh the benefits associated with the new paradigm.

Energy. PJM's energy market design is more liquid and closer to a competitive market than the capacity construct. But it is not without challenges. Volatility in 2016 was somewhat muted because of generally mild weather and low natural gas prices. But historically, the energy market has been extremely volatile, correlating with the commodity price of natural gas. AEP Ohio believes price formation in the energy market is muted, largely because PJM fails to properly include the higher energy prices for all resources that are scheduled on higher risk days.

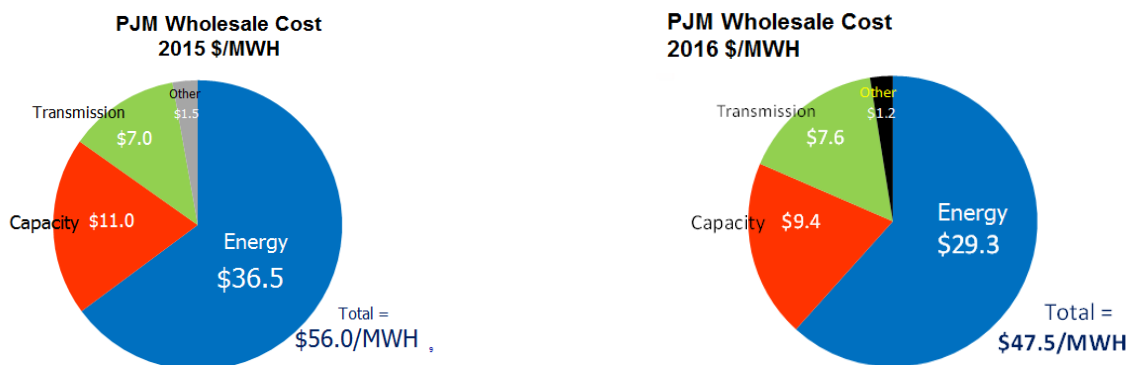
Grid Resilience. Natural gas is the predominant fuel for new capacity in the coming years. In the long run this increases the risk factors on the system due to lack of fuel diversity and the need for additional gas infrastructure to supply these gas units. AEP Ohio supports PJM in their effort to understand and address these resilience issues.

State Initiatives. Multiple states in PJM have either approved or are considering subsidized payments to generators located in their states. FERC, PJM, and other RTOs are all examining how the markets account for the generation supported by these state subsidies. AEP Ohio

supports the right of states to implement policy initiatives, and is optimistic that stakeholders and PJM can find a means to reasonably incorporate these initiatives into the market.

AEP Ohio recognizes that there is a place within PJM for generation supported both by the market and by traditional cost-of-service regulation. But we also acknowledge that each stakeholder in the region has a unique viewpoint of how this can be accomplished. Future stakeholder discussions will likely be ponderous and contentious. In the meantime, long-term decisions regarding retirements and construction of new generation resources must be made continually while trying to anticipate ever-changing tariff rules. AEP Ohio is prepared to meet these challenges as we try to build our utility for the future service of our Ohio customers.

Comparison of Wholesale Prices – 2016 vs 2015



The pie charts above show the total average wholesale market cost for serving load in 2016 (excluding distribution costs).

- **Energy** comprises the largest portion of the all-in cost to serve. And because of a combination of mild weather and lower natural gas prices in 2016, the cost of energy declined from \$36.50/MWH in 2015 to \$29.30/MWH in 2016.
- **Capacity** prices (expressed here in \$/MWH on the charts rather than \$/MW-day) were also down slightly due to the change in clearing prices from the capacity auction, discussed in more detail below.

- **Transmission** costs per MWH are up somewhat due to continued investment in replacing aging infrastructure on the transmission system. However, transmission costs comprised only 16% of the overall wholesale costs in 2016.
- **Other** costs include ancillary services such as black start, regulation, and spinning reserves.

PJM Capacity Market

Key Observations

- The Capacity Performance product includes potentially large non-performance assessments.
- Improvement in long-term price signals is unlikely.
- Improved reliability during emergencies is untested.
- Current rules do not provide an integrated plan for fuel, plant, or ancillary service diversity and resilience.

Capacity Performance. During the January 2014 polar vortex, PJM experienced an all-time winter peak load combined with unprecedented generator outages.¹ This series of events caused PJM to revisit the capacity market rules, with the objective of providing greater reliability during peak emergency events. Ultimately, PJM created a new product – Capacity Performance (CP) – which FERC approved beginning in June 2016².

Under the new CP rules any resource (generation or demand response) that qualifies as a capacity performance resource is expected to be available on a 24x7 basis throughout the year (except for planned maintenance). There are no force majeure exceptions, no fuel supply exceptions, and no special seasonal considerations for demand response.

The intent of the CP rules is to improve reliability within the PJM footprint. A resource that fails to perform during emergency hours will incur an assessment of approximately \$3,500 per MWh³, compared to the previous rules which only measured average performance over the course of a year. PJM did not declare any emergency events in the first year of CP.

¹ Docket No. AD14-8-000 Statement of Michael Kormos, EVP-Operations PJM. April 1, 2014.

<http://www.pjm.com/~media/documents/reports/20140331-testimony-of-michael-kormos-regarding-polar-vortex-ferc-20140401.ashx>

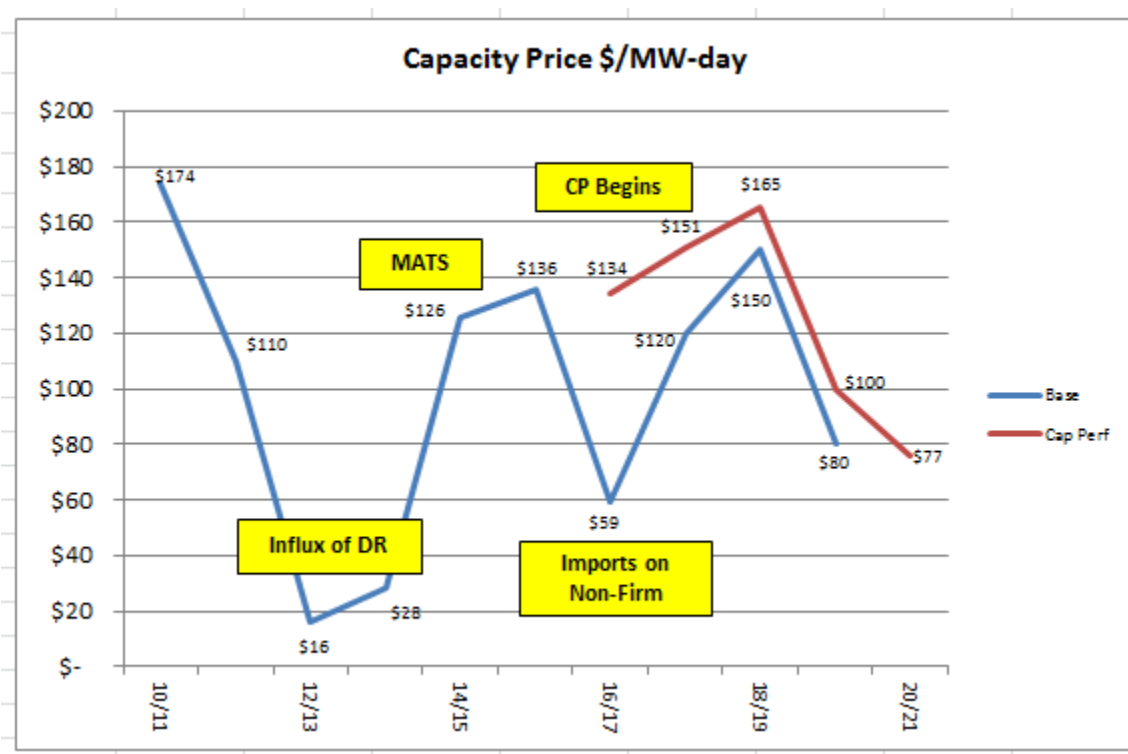
² Docket No. ER15-623. CP rules were incorporated starting June 2016, with roughly 60% of the capacity required to abide by CP criteria, ramping up to 100% by delivery year 2020/21 (in the May 2017 RPM auction).

³ Non-Performance Assessment Rate for CP Resources (\$/MWh) = [LDA Net CONE (\$/MW-day) * 365]/30. The Net Cone value for AEP is \$281.49. (\$281.49/MW-Day*365/30 = \$3425)

<http://www.pjm.com/~media/markets-ops/rpm/rpm-auction-info/2018-2019-bra-planning-parameters.ashx>

History of Price Changes and Causes (Graph 1). Although intended as an incentive to build new gas-fired generation resources, RPM has historically cleared at prices well below the cost of constructing a new gas unit (Cost of New Entry or CONE), which is currently estimated to be about \$300/MW-day. The reasons for the low clearing prices range from high reserve levels within the footprint to the economics of the gas market, which allow more efficient gas units to currently make enough revenues in the energy market to earn an adequate return well below the \$300/MW-day Net CONE level.

Graph 1



In May 2017 PJM held its Capacity Auction for 2020/21. This was the first year that 100% of the capacity was required to qualify as Capacity Performance in order to participate in the auction. The 2020/21 auction cleared at \$76/MW-day for the Rest-of-Market (AEP's) region, significantly below the \$100/MW-day price for 2019/20. The key contributors to that outcome were:

- **Load Reduction.** PJM actually reduced the load forecast by 3,000MWs from the 2019/20 auction. And projections for the future remain stagnant year over year.
- **New Capacity.** New capacity construction that cleared in the 2020/21 auction was approximately 2,350MWs. This was down approximately 3,000MWs from the new generation that cleared for 2019/20, but still significant in a no-load-growth environment.

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AEP Ohio Whitepaper

- **High Reserve Margin.** Despite the lower clearing price, PJM still procured over 23% reserve margin for 2020/21.
- **Demand Response Still Significant.** Demand response decreased from 9,500MWs in 2019/20 to 7,000MWs for 2020/21. But this was not as significant a decline as most analysts expected with the new requirement to be available on a 24x7 basis.

Results from 2015/16 through 2020/21 initial and incremental auctions are posted in the table below.

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Base	\$136	\$59	\$120	\$150*	\$80*	N/A
Capacity Performance	N/A	\$134	\$151	\$165	\$100	\$77
1st Incremental	\$43	\$60	\$84	\$27	N/A	N/A
2nd Incremental	\$136	\$31	\$27	N/A	N/A	N/A
3rd Incremental	\$163	\$5	\$36	N/A	N/A	N/A
*2018/19 and 2019/20 20% of market cleared under the prior rules. This was called Base Capacity. In the table these two years are on the same line as the regular RPM auction results from the earlier years.						

Historically, the volatility in the clearing price has been caused by multiple factors:

- **Demand Response.** Until the advent of Capacity Performance, PJM historically had promoted the use of summer-only demand response to fulfill capacity objectives that were formally met by year-round generation resources. Under this paradigm, PJM had as much as 12,000MWs of Demand Response clear in the capacity auctions. With the requirement that all capacity meet the CP 24x7 criteria by June 2020, DR cleared for that year dropped to approximately 7,000MWs.
- **Imports.** Up to 7,500MWs of capacity outside of the PJM footprint has cleared in the auction historically. Some of these imported MWs have come from as far away as

Louisiana. Although historically PJM did not impose significant deliverability requirements on these imports, PJM and the stakeholders have taken significant steps to improve the deliverability and reliability of these MWs. The import situation is made complicated by a proposal from MISO to supply these capacity imports from a slice-of-system in the MISO territory rather than from the specific committed unit. This docket (EL17-16) is currently at FERC. AEP Ohio disagrees with the MISO proposal, and supports the PJM proposal as being necessary for reliability.

- **Retirements.** Roughly 15,000MWs of coal units retired leading up to the enforcement of the MATS rules in 2015. Much of that generation has been replaced by new gas plants.
- **Speculative Bidding.** The CP rules do nothing to prevent speculative bidding in the auction. Market participants continue to offer into the Base Residual Auction (BRA or initial auction) and receive the clearing price, and then buy out of their position in the subsequent incremental auctions, which have historically cleared at a fraction of the BRA price. Even the PJM Market Monitor has made note of this, issuing two reports in which he observes that up to 30% of the offers in the capacity market from DR were bought back in the incremental auctions.⁴ PJM filed recommendations to FERC to address this issue in 2014⁵, but to date FERC has not issued an Order.

AEP Ohio's view is that the additional assessments⁶ associated with the CP product, without changes to the underlying market design, will not reduce volatility or increase reliability in the long term. This is because the basic premise of the auction process remains: it provides a one-year price for a physical asset that is intended as a 30-year investment.⁷ This inherent volatility was again evident in the last two capacity auctions.

The basic problem with the auction process is that once a unit is built, it cannot afford 'not to clear'. So despite the higher penalties associated with the new CP product, the existing generator cannot take the risk of recognizing those higher potential penalties in the offer – the unit still has to clear or it gets nothing, and the owner is incented to offer at or near zero. Therefore, historically over 80% of the offers in the PJM auctions have been at or near zero.

⁴ IMM Analysis of Replacement Capacity for RPM Commitments: June 1, 2007 to June 1, 2013. Page 7, table 6 shows 10,780MW of UCAP DR initially cleared for delivery year beginning June 1, 2013 and 3,314MW replaced before the delivery year ($3,314/10,780 = 30.7\%$).
http://www.monitoringanalytics.com/reports/Reports/2013/IMM_Report_on_Capacity_Replacement_Activity_2_20130913.pdf

⁵ EL14-48

⁶ A 1,000 MW unit that incurred a tube leak at the beginning of a 10-hour emergency event could be penalized \$35 million for a single outage. If that same unit received capacity revenue of \$59/MW-day, its annual revenue from the capacity market would be just \$21.5M.

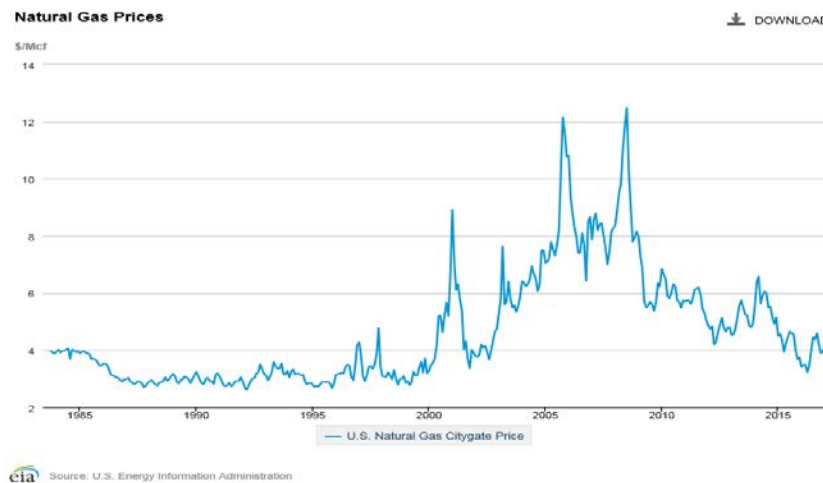
⁷ The PJM Tariff actually requires new generator offers to reach a certain point in their construction and approval requirements before they are allowed to offer into the auction.

PJM Energy Market

The PJM energy market is a short-term market characterized by day-ahead offers followed by real-time dispatch and settlement adjustments. Although the energy market is more mature and has fewer significant problems than the capacity market, there are still multiple complications inherent in this market.

- **Financial Participants.** PJM allows financial market participants to offer virtual transactions into the day-ahead energy market. Although these are purely financial transactions, PJM clears them as if they were MWs of generation or load. These virtual transactions have a significant impact on the market clearing, and affect both day-ahead generation commitments as well as real-time dispatch decisions. Specifically, in 2016 virtual transactions averaged over 39,000MWs per hour, over 28% of the average of all supply cleared in the day-ahead energy market.⁸
- **Gas/Electric Coordination.** Natural gas prices have had a profound effect on the energy market over the last five years. Coal energy production has declined from approximately 55% in 2007 to approximately 34% in 2016,⁹ and gas capacity has overtaken coal capacity cleared in the capacity market. Although the downward pressure on energy prices inherent from these economics has been good for the consumer in the last few years, a historic look at gas prices shows the volatility of this commodity. Graph 4 shows city-gate gas prices from 1985-2016.¹⁰ It demonstrates the historic volatility of the gas industry.

Graph 4



⁸ 2016 SOTM at Table 3-12, page 111.

⁹ 2016 SOTM at Table 3-8, page 105.

¹⁰ U.S. Energy Information Administration

- **Renewables.** Wind, solar, biomass and hydro generation are a small (<5%) but growing part of the PJM generation footprint.¹¹ Not counted in these percentages is that increasing numbers of customers are installing solar panels and other Behind-the-meter generation. And this is having a significant impact to PJM's load growth. The challenge facing PJM dispatch with these resources is the lack of control over their output. As has been experienced in ERCOT, when the wind blows, the energy from these resources is free, but can swiftly create significant transmission congestion. Solar can provide valuable capacity on summer afternoons, as long as there is no cloud cover. But it typically does not provide any capacity to meet winter peaks, which occur largely in the early morning and evening when solar conditions tend to be poor.
- **Demand Response.** While DR clears approximately 7,000 MWs of capacity in the PJM market today, it does not have the same day-ahead bidding requirements or operating requirements as generation. Further, under the CP construct, summer-only DR was eliminated for 2020/21.
- **Price Formation.** Typically PJM dispatches units from least cost to highest cost, with the highest incremental cost unit setting the day-ahead and real-time energy prices. However, in times of high loads or outages, PJM will call on additional generating units to be running over and above the generators cleared in the market. And PJM accounts for those costs in uplift – not in energy pricing. This creates scenarios where the energy prices on high load days are actually sometimes below energy prices on more normal days. PJM stakeholders have recognized this inconsistency, and PJM has agreed to undertake a stakeholder process to examine this issue in 2017. AEP Ohio supports this initiative.

Grid Resilience

On March 30th, 2017, PJM issued its 44-page whitepaper entitled 'PJM's Evolving Resource Mix and System Reliability' (link attached in footnote below¹²). In the paper, PJM stated their position that the RTO has a reliable balance of fuel diversity at this time. But PJM acknowledged a concern on long term fuel and grid resilience (deliverability on gas pipelines, operational flexibility, and ancillary services including black-start).

¹¹ In 2016 renewables accounted for less than 5% of total energy production in PJM. 2016 SOTM, Table 3-8, page 105.

¹² <http://www.pjm.com/~media/library/reports-notice/special-reports/20170330-pjms-evolving-resource-mix-and-system-reliability.ashx>

Summary of the whitepaper:

- **Overall Focus.** The focus is on grid resilience. PJM tried to differentiate reliability from this new concept of resilience. PJM says they can meet the statistical criteria for loss-of-load probabilities for several years due to their current resource mix and capacity reserves. But PJM acknowledged that they need to review the grid for resilience in the long run as they increase their reliance on gas and renewables for future capacity requirements.
- **Not Addressed in This Whitepaper.** The whitepaper did not address transmission planning, state interventions, specific fuel economics, or capacity/energy market effects. PJM will be issuing a separate whitepaper on transmission planning by the end of 2017.

As a follow-up to the whitepaper on grid resilience, on April 19th PJM held a symposium called Grid 2020 on Fuel Diversity and Resilience. Panelists from multiple stakeholder groups were represented in the day-long conference. In summary, the panels said:

- **Risk in Markets.** Fuel risks need to be incorporated into both capacity and energy markets in PJM.
- **Resilience in Planning.** In the future PJM will need to look at reliability incorporating a resilience factor.
- **Security.** The industry (both gas and electric) needs to improve the security around cyber and physical attacks.
- **State Subsidies.** All the markets in PJM need to be protected from externalities (i.e. state subsidies).

The first three bullets were universal; the last bullet was more polarized. With panelists either seeking market protection from state interactions, or seeking the accommodation of state initiatives in the market design.

Next Steps. The whitepaper and the symposium were a kickoff to further discussions among PJM and its stakeholders. There will be another Grid 2020 in September which will focus specifically on grid security from a physical and cyber standpoint.

AEP Ohio Supports. AEP's Executive VP Mark McCullough participated on the fuel diversity panel at Grid 2020. AEP shares PJM's concerns about the resilience associated with the gas supply lines. And we believe PJM should take initiatives in assuring the transition to more gas and renewable generation keeps the grid reliable in the long run.

State Initiatives

The issue of state initiatives has most recently come to the foreground with the Illinois legislative action allowing for Zero Emission Credits (ZECs) for certain nuclear units within

Illinois owned by Exelon. This type of action is not isolated to a single state, but appears to be prevalent among several states in both PJM and other RTOs. New Jersey, Pennsylvania, and Ohio are also considering similar actions.

These states have determined that the RTO markets may not be valuing the attributes their state's constituents desire (e.g. the Illinois legislature desires to have large base load resources with zero carbon emissions located in their state). Most of the initiatives at this time are targeted toward preserving the economic viability of certain nuclear units in the states. But the scope for the future will also include other attributes for renewables, fuel diversity, and other political objectives.

FERC Technical Conference FERC has taken notice of these actions. On May 1-2, 2017, FERC convened a Technical Conference to discuss the effect state initiatives may have on the markets in New England, New York, and PJM. There were several divergent opinions on how to address the issue. But the reality is that state and federal initiatives are already having an effect on both the energy and capacity markets.

PJM stakeholders also hold varying viewpoints associated with incorporating state objectives. Most of the independent power producers (e.g. Calpine and NRG) strongly advocated to ban any kind of state interference with market mechanisms. Other entities (e.g. AMP, ODEC, and Consumer Advocates) are more supportive of state initiatives and do not feel these initiatives would be mutually exclusive from effective market signals.

As the Technical Conference was coming to a close, PJM issued two whitepapers with their proposals to address state actions and the markets.

- **Emissions Adder in Energy Market.** One of the PJM whitepapers proposed an emissions adder to generation located in specific states which value zero emission supply. This is a simple approach that has much intuitive appeal. But it is not clear how PJM's proposal would affect neighboring states that may not share the same zero-emission objectives.
- **Minimum Offer Price in Capacity Auction¹³.** The second recommendation proposed by PJM deals with state subsidies through the capacity auction. In general, the PJM approach would apply a Minimum Offer Price Rule (MOPR) to generation receiving state subsidies and require these units to offer in at this higher MOPR price. This higher MOPR price would be used to set the clearing price in the auction. Although

¹³ Currently, PJM's Minimum Offer Price Rules (MOPR) apply only to new units constructed under a regulatory regime. The MOPR rules contain exemptions for regulated entities that are within certain net-long or net-short positions. The current rules were approved by FERC after New Jersey and Maryland created initiatives to build new generation in their states. In addition, a complaint filed at FERC by Calpine in March, 2016, is pending before the FERC in which the complainants have argued that a MOPR requirement should be imposed on all generators receiving any form of non-market financial support.

this also has some initial intuitive appeal, there is uncertainty over what comprises a subsidized unit, and what impact this may have on customers.

Ongoing Stakeholder Processes. Even with only limited experience with the Capacity Performance product, PJM and its stakeholders have initiated another task force to evaluate potential additional changes to RPM. Much of this activity is in response to the state initiative issue.

Within PJM, the stakeholder process moves at a deliberate pace. Stakeholder initiatives often take many months to reach a definitive conclusion. In addition, the Stakeholder process is controlled by sector-weighted voting, which gives several smaller interest groups significant voting power. The AEP operating companies (including AEP Ohio) own 10-15% of load, generation, and transmission facilities in PJM. Yet because of the governance rules, AEP has a cumulative voting impact of less than 2% in sector-weighted voting. AEP's voting power is equal to that of smaller utilities in AEP's sector that do not even own generation.

Conclusion

AEP Ohio has divested, or is seeking to divest, all its de-regulated generation in Ohio. The company takes the position that cost-of-service regulation inherently takes a long-term view of investments necessary to maintain proper fuel diversity, plant type diversity, transmission needs, and reliability. This results in reduced market volatility and consumer benefits in the longer run. In the experience of AEP, state utility commissions have largely considered the risks, costs and benefits accruing to retail customers as a result of long term planning. This has been made clear over the last year by state initiatives in New York and Illinois, and under consideration in multiple other states.

Finally, AEP Ohio is supportive of PJM actions addressing the long term fuel diversity and grid resilience on the system. This is the right thing to do, and will assure the lowest price and reliable operation of the grid into the future.

Appendix

Characteristics of Capacity Market Design

The PJM Reliability Pricing Model Capacity Market (RPM) was approved by the Federal Energy Regulatory Commission (FERC) in 2007. Within the RPM, the Base Residual Auction (BRA) is an annual capacity auction that sets prices and quantities for a single-year product, three years in advance. Although the intent of the construct is to provide incentives for continued investment,

- It does not provide multi-year revenue stability.

- It does not offer any protection from price volatility.

The basic auction design involves both an administrative demand curve and a partially-mitigated supply curve. The demand curve was negotiated in the original 2006 FERC settlement and re-negotiated in a stakeholder process in 2015. The curve is based on a PJM load forecast and target reserve margins. The curve is steep, such that a small change in the supply curve causes a significant change in clearing prices.¹⁴

The entire demand curve is constructed around the cost of constructing a new natural gas combustion turbine. And it is designed around the promotion of a single fuel source: natural gas. There are no rules to ensure a diversity of capacity resources or diversity of fuel.

The supply curve for the BRA is based on offers submitted during the annual auction. These offers are submitted only once at the beginning of the auction (in contrast to a descending clock auction where suppliers can make decisions on whether to participate as prices decline). However, suppliers that submit offers above a certain price¹⁵ must submit their offer to the PJM Market Monitor for review to determine if it is cost-based. Historically this happened infrequently. But an increasing number of older units have been offering above the trigger point, as they determine they will have to retire if they do not receive sufficient revenues from the capacity market clearing price.

Once a generation unit is cleared in the BRA, there is no guarantee for clearing at the same price in future auctions. Therefore, an offer into the capacity performance construct means a commitment to construct a real physical asset with a useful life of 20-30+ years, but with only a one-year price guarantee.

Vertically integrated utilities that have both load obligations and generating assets can opt out of the RPM auction as long as they meet the reserve margin set by PJM. This alternative is called a Fixed Resource Requirement (FRR). Even though FRR entities do not have to participate in the BRA, they are held to the same operating requirements and non-performance assessments as the entities participating in the BRA. AEP's regulated operating companies in PJM and Duke Energy Kentucky currently are the only entities choosing to meet their load and reserve obligations under an FRR capacity plan.

¹⁴ In its 2014 review of the capacity market, the Brattle Group recommended a change in the curve shape to be consistent with a more gradual decline in reliability value at higher reserve margins. AEP supported the recommendations, which were largely adopted by PJM.

<http://www.pjm.com/~media/documents/reports/20140515-brattle-2014-pjm-vrr-curve-report.ashx>

¹⁵ For the 2020/21 BRA, this level was approximately \$250/MW-day.

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Summary: Report electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company