

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

Enhanced Price Formation in Reserve Markets of PJM Interconnection, L.L.C.)	Docket Nos. EL19-58-000
)	
PJM Interconnection, L.L.C.)	ER19-1486-000

**COMMENTS OF THE INSTITUTE FOR POLICY INTEGRITY AT NEW
YORK UNIVERSITY SCHOOL OF LAW**

Pursuant to the Federal Energy Regulatory Commission’s (“Commission” or “FERC”) April 1, 2019 Notice of Filing,¹ and March 29, 2019 2019 Notice of Filing,² the Institute for Policy Integrity at New York University School of Law (“Policy Integrity”)³ hereby files these comments in the above captioned proceeding.⁴ Policy Integrity is a non-partisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy.

On March 29, 2019, PJM Interconnection, L.L.C. (“PJM”) filed, under Federal Power Act Section 206,⁵ proposed revisions to the Amended and Restated Operating Agreement of PJM Interconnection, L.L.C. (“Operating Agreement”) in order to revise the mechanism by which PJM procures and prices operating reserves.⁶ PJM’s filing explains that the existing approach to procuring and pricing operating reserves results in unjust and unreasonable rates for the following reasons:

- it fails to provide certain resources—in particular, what PJM terms “Tier 1 resources,” or those resources that have additional generating capacity after economic dispatch—

¹ Notice of Filing, Docket No. EL19-58-000 (April 1, 2019).

² Notice of Filing, Docket No. ER19-1486-000 (March 29, 2019).

³ No part of this document purports to present New York University School of Law’s views, if any.

⁴ Pursuant to Rule 214 of the Commission’s Rules on Practice and Procedure, 18 C.F.R. § 835.214, on May 14, 2019, Policy Integrity timely filed a doc-less motion to intervene.

⁵ 16 U.S.C. § 824e.

⁶ Enhanced Price Formation in Reserve Markets of PJM Interconnection, L.L.C., Docket No. EL19-58-000 (filed Mar. 29, 2019) (“PJM Filing”). PJM also filed conforming changes to its Open Access Transmission Tariff pursuant to Section 205 of the Federal Power Act in Docket No. ER19-1486-000.

the proper incentive to act as operating reserves when called upon to do so and so requires inefficient out-of-market operator action;⁷

- it fails to value reserves beyond a minimum level, the minimum reserve requirement (“MRR”), despite the fact that additional operating reserves will enhance the reliability of the system;⁸
- it fails to sufficiently value resources that can flexibly respond to unexpected system conditions including load changes, generation variability from wind and solar resources, and unplanned outages of other generating resources;⁹
- it provides inadequate price signals to signal reserve shortages by using an artificially low reserve price cap (“Penalty Factor”);¹⁰ and,
- it fails to properly align day-ahead and real-time reserve markets, leading to inadequate forward procurement and inefficient arbitrage opportunities.¹¹

In response to these identified inefficiencies, PJM filed a proposed replacement rate that, if accepted by the Commission, would make a number of changes to the PJM operating reserve market, including:

- adopting a pricing mechanism for all synchronous reserves that provides incentives to perform;¹²
- increasing the maximum price paid for operating reserves to \$2000/MWh;¹³
- adopting a downward sloping operating reserve demand curve to recognize the value of reserves beyond the MRR;¹⁴ and,
- aligning the day-ahead and real-time reserve markets.¹⁵

As explained further in the comments below, Policy Integrity supports PJM’s conclusion that the rules and practices by which PJM procures and prices operating reserves are unjust and unreasonable due to the inefficiencies of the current approach. Policy Integrity generally supports PJM’s proposed revisions to correct these inefficiencies, and urges the Commission to fix, pursuant to Section 206,¹⁶ just and reasonable alternative rules that draw on PJM’s proposal. At the same time, Policy Integrity recommends that, when fixing a just and

⁷ PJM Filing at 5-6, 15-23.

⁸ *Id.* at 7, 32-38.

⁹ *Id.* at 7-8, 36-38, 49, 70-72.

¹⁰ *Id.* at 8, 27-32.

¹¹ *Id.* at 9, 38-43.

¹² *Id.* at 10, 43-48, 82-90, 94-96.

¹³ *Id.* at 10, 48-53.

¹⁴ *Id.* at 12-14, 53-66.

¹⁵ *Id.* at 14, 76-80.

¹⁶ 16 USC § 824e(a).

reasonable alternative, the Commission adopt three changes to PJM’s proposal:

- The Commission should order an interim review of the parameters PJM has proposed to use to set the operating reserve demand curve to ensure their continued accuracy;
- The Commission should require PJM to more clearly specify the eligibility criteria for resources that would participate as operating reserves; and,
- The Commission should adopt corresponding revisions to PJM’s capacity market, the Reliability Pricing Model (“RPM”), that take into account the interactions between the RPM and the operating reserve changes PJM is proposing.

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I. The Current Design of the Operating Reserve Market Is Unjust and Unreasonable Because It Provides Inefficient Price Signals for Resources to Participate as Reserves

1. Operator Actions and Out-of-Market Payments Distort Market Prices

Under the current design of PJM's reserve market, system operators regularly undertake manual actions to ensure grid reliability. Among other actions, they manually assign reserves out-of-market and manually change ("bias") the load forecast used by energy-reserves optimization software to account for forecast uncertainties. While those actions are currently needed for reliable energy provision,¹⁷ they are not transparent from the perspective of market participants.

In addition, operator actions can distort market prices and thereby investment signals. An example of distortive out-of-market operator actions is load biasing. Historically, only a fraction of Tier 1 resources performs when called upon. At the same time, the optimization software does not account for that non-responsiveness in its calculation of reserves on the system.¹⁸ System operators manually bias the load forecast to ensure the system procures sufficient reserves that will respond to PJM's dispatch signals. The amount of biasing is based on each operator's personal judgement. As a consequence, the effectiveness of biasing depends on the accuracy of the operator's prediction concerning Tier 1 units' behavior. Unless system operators can consistently predict with perfect accuracy, they will overprocure or underprocure Tier 2 reserves, and thus cause too high or too low of reserve prices

¹⁷ For instance, Christopher Pulong notes in his affidavit that "if the MWs of positive bias actually applied by operators were removed from the balance, PJM's real-time [Energy Management System] would have shown the, system short on reserves in over 29 percent of the five-minute intervals making up that year." PJM Filing, Attachment E ¶ 12 ("Pulong Aff.")

¹⁸ Under the current reserve market rules, Tier 1 resources are defined to be synchronized resources that are not economic in the energy market, whereas Tier 2 resources are synchronized resources that would clear the energy market auction but are withheld from the energy market by PJM in order to provide reserves. The two types of synchronized reserves are treated differently in terms of the payments they receive and the obligations that are imposed on them. In particular, "Tier 1 does not have an obligation to respond and is not given a true assignment of reserves. It is only an estimate of what response a unit is technically capable of, but not a guarantee it will achieve it." Pulong Aff. ¶ 24. Often, Tier 1 resources do not have economic incentive to perform.

compared to the optimal procurement.¹⁹ Given the complexity of the problems that operators face, combined with the short timeframe during which they must act, perfect predictions are unlikely and thus reserve prices will be biased.

Moreover, load biasing by system operators overlooks alternative cost-effective approaches to procuring reserves in the face of uncertainty regarding the performance of Tier 1 resources. In particular, Tier 1 resources do not consistently perform when called upon because they do not have an economic incentive to do so—in most cases they will cover their costs of generating energy if they respond but will not earn any profit for doing so. Giving Tier 1 resources appropriate economic incentives to perform could be cheaper than procuring additional resources through load biasing. However, in their current form, out-of-market interventions by system operators do not provide appropriate incentives, and will thus often lead to outcomes that are not cost-minimizing. When the generation and reserve assignments are not cost-minimizing, the markets are not efficient, leading to unjust and unreasonable rates.²⁰

Prices can be distorted not only through suboptimal assignment of generation and reserve resources, but also through payments made by PJM to generators out-of-market. Out-of-market payments often accompany the out-of-market actions of system operators. These payments are not included in the price signals and can magnify market price distortions. “Uplift payments” that are made to ensure resources do not operate at a loss when following PJM dispatch instructions represent one form of out-of-market payment. In general, out-of-market payments that are not related to “non-convex costs” (start-up and shut-down costs, indivisibilities, economies of scale, or minimum supply requirements) depress clearing prices

¹⁹ Adam Keech comments in more depth on the possible price suppression resulting from biasing. *See* PJM Filing, Attachment D ¶¶ 50-54 (“Keech Aff.”).

²⁰ *See PJM Interconnection, L.L.C.*, 167 FERC ¶ 61,058, at PP 69-71 (2019) (finding PJM’s approach to incorporating fast-start resources into real-time dispatch unjust and unreasonable because it fails to minimize costs).

and mute scarcity signals.²¹ Muted scarcity signals lead to underinvestment in resources that are capable of providing the services sought by the market.

Out-of-market payments are extraordinarily high in PJM's reserve market.²² The potential for those payments is particularly visible in the instances of reserve scarcity, which are largely caused by caps on reserve prices (the reserve price cap is referred to as the "Penalty Factor" for historic reasons). Currently, the Penalty Factor is set at \$850/MWh. If not enough reserve resources are procured when this maximum price is reached, operators use out-of-market actions to meet the reserve requirements.²³ It is up to the judgement of individual system operators what combination of actions to use to satisfy the reserve needs. In general, however, PJM procures resources costing several times more than the \$850/MWh while the market price is kept at the maximum allowed Penalty Factor of \$850/MWh.²⁴ As a result, uplift payments are made for all resources with costs above \$850/MWh that are nonetheless called to act as reserves.

Currently, PJM's reserve market is dependent on out-of-market operator actions and out-of-market payments that accompany those actions. At the same time, some out-of-market operator actions could be avoided through improved market design. Consequently, the current rates are not just and reasonable.²⁵

²¹ Out-of-market payments that result from operator actions at costs above the Penalty Factor allow the artificially depressed price to perpetuate.

²² For instance, in 2018, the out-of-market payments to Tier 2 synchronized reserves in the RTO zone were almost as high as the total payments that those resources received through clearing prices. In the Mid-Atlantic Dominion sub-zone, the price to total cost ratio was 56.7 percent. *See* MONITORING ANALYTICS LLC, STATE OF THE MARKET REPORT 2018: DETAILED ANALYSIS 470 (2019), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2018/2018-som-pjm-volume2.pdf ("STATE OF THE MARKET REPORT").

²³ The actions incorporate procuring demand response, emergency energy from neighboring regions, or generation resources located within PJM with costs above the Penalty Factor.

²⁴ *See* Keech Aff. ¶ 12.

²⁵ *See Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice of Proposed Rulemaking, 157 FERC ¶ 61,213, at PP 34-37 (2016) (proposing to find that existing practices for pricing fast-start resources is unjust and unreasonable because they contribute to unnecessary uplift).

2. Tier 1 Reserves Payment Rules Distort Prices

Currently, the Operating Agreement requires paying Tier 1 resources the market clearing price in the Tier 2 synchronized reserve market whenever the non-synchronized reserve market clearing price rises above zero.²⁶ But, Tier 2 resources are obliged to perform and face penalties when they fail to do so, while Tier 1 resources have no performance obligation and show low operational performance.²⁷ As a result, this pricing mechanism provides the same payment to differently situated resources, and, therefore, is unduly discriminatory or preferential.²⁸

The pricing of Tier 1 resources at prices determined for Tier 2 resources also creates economic distortions. Paying Tier 1 and Tier 2 resources the same price while penalizing only Tier 2 resources for non-performance creates incentives for resources to try to be cleared as Tier 1 and not Tier 2 reserves. Such incentives can lead to resources distorting the parameters of their bids when they expect the non-synchronized reserves to clear at positive prices. The administratively imposed equality of price between Tier 1 and Tier 2 resources also does not reflect the relative differences in value that the two types of reserves bring given that Tier 2 resources are much more reliable from the perspective of the system.²⁹ By failing to recognize the true value of Tier 1 and Tier 2 resources, the current reserve market rules are unjust and unreasonable.³⁰

²⁶ See STATE OF THE MARKET REPORT at 445.

²⁷ STATE OF THE MARKET REPORT at 462 (“In 2018, 67.2 percent of the DGP adjusted market solution’s estimated tier 1 MW actually responded during synchronized reserve events of 10 minutes or longer while 32.8 percent of DGP adjusted tier 1 estimated MW did not respond during spinning events”).

²⁸ 16 U.S.C. § 824e(a) (requiring FERC to hold rules unlawful if they are unduly discriminatory or preferential); *Calpine Corp.*, 163 FERC ¶ 61,236, at P 68 n. 112 (2018) (“undue discrimination can also occur when a seller charges the same rate to differently-situated customers”).

²⁹ See *Pilong Aff.* ¶¶ 22-26.

³⁰ *Wholesale Competition in Regions with Organized Electric Markets*, Order No. 719-A, 128 FERC ¶ 61,059, at P 72 (2009) (“the Commission found that existing RTO and ISO market rules that do not allow prices to rise sufficiently during an operating reserve shortage to allow supply to meet demand are unjust and unreasonable” because “these rules may not produce prices that accurately reflect the true value of energy in such an emergency”).

In addition, the optimization algorithm that PJM currently uses does not properly account for positive Tier 1 prices. As the Market Monitor explains, “the ancillary services market solution treats the cost of estimated Tier 1 synchronized reserve as \$0, even when the non-synchronized reserve market clearing price is above \$0.”³¹ Because the optimization algorithm behaves as if the price of Tier 1 reserves were zero even when the price is positive, it cannot minimize the total cost of primary reserves whenever the non-synchronized reserve market clearing price is above \$0. In other words, the algorithm does not pick the efficient levels of various types of reserves, which distorts prices and fails to correctly value the reserves on the system.³² Consequently, the current reserve market rules are unjust and unreasonable.

3. The Reserve Market Ignores the Value of Reserves Beyond the MRR

Under the current reserve market design, prices are formed as if reserves in excess of the MRR largely represent no value for the system.³³ This pricing approach is wrong. As is well explained in a report filed by Dr. William Hogan and Dr. Susan Pope as an attachment to PJM’s filing, the social value of incremental operating reserves relates to the decrease in probability that, given a level of operating reserves, PJM’s consumers will nonetheless experience a loss of load.³⁴ Because it does not correctly recognize the value of incremental reserves, the current market design is unjust and unreasonable.³⁵

³¹ STATE OF THE MARKET REPORT at 460.

³² To account for the fact that higher Tier 1 prices automatically translate into increased costs of Tier 1 procurement, the optimal solution would likely swap some of the resources between the energy and reserve markets. This would lead to a decreased Tier 2 clearing price, increased energy prices, and decreased total costs compared to the current solution that ignores non-zero prices of Tier 1 resources.

³³ Currently, PJM pays up to \$300/MWh for up to 190MW of reserves above the MRR.

³⁴ See PJM Filing, Attachment C (William Hogan and Susan Pope, PJM Reserve Markets: Operating Reserve Demand Curve Enhancements (2019)) (“Hogan & Pope”) at 15-17.

³⁵ See *Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 825, 155 FERC ¶ 61,276, at PP 105-108 (2016) (finding certain shortage pricing mechanisms unjust and unreasonable when they “fail to reflect adequately the value that a [reserve] resource provides to the system”).

4. *The Proposal Will Diminish the Problems Associated with Current Reserve Market Price Formation Described Above*

i. PJM's Proposed Reforms Will Decrease the Need for Out-of-Market Actions and Improve Reserve Market Price Formation

Out-of-market operator actions are not transparent for market participants and can lead to distorted prices. Currently, PJM's reserve market relies on out-of-market operator actions to function smoothly; however, some of those actions could be avoided through improved market design.³⁶ PJM's proposal improves market efficiency by limiting the need for two types of operator actions.

The first type of operator action that will be limited by the proposal is the biasing of forecasts used by optimization software.³⁷ PJM's proposal will ensure better performance of synchronized reserves by consolidating Tier 1 and Tier 2 resources and imposing a uniform obligation to perform. Consequently, the proposal will reduce the need for manual load biasing by operators as the biasing is largely driven by Tier 1 resources' low responsiveness to PJM dispatch signals.

Second, under PJM's proposal, the actions that operators undertake during reserve shortage events to meet the minimum reserve requirement will be needed less frequently. By increasing the Penalty Factor to \$2000/MWh and adding a downward sloping operating reserve demand curve beyond the MRR, the proposal is likely to decrease the occurrence of scarcity situations, reducing the need for out-of-market actions by operators.

Out-of-market payments can magnify the market price distortions. While some out-of-market payments are unavoidable due to the non-convexity of power generation costs,³⁸ the proposal will reduce those out-of-market payments that are associated with reserve shortages.

³⁶ See Part I.1. for description of the out-of-market actions undertaken by PJM operators.

³⁷ See STATE OF THE MARKET REPORT at 463; Keech Aff. ¶ 6; Pilon Aff. ¶¶ 8-17.

³⁸ See e.g., D. A. Shiro et al., *Convex Hull Pricing in Electricity Markets: Formulation, Analysis, and Implementation Challenges*, 31 IEEE TRANSACTIONS ON POWER SYSTEMS, no. 5, September 2016; STATE OF THE MARKET REPORT at 213.

By increasing the Penalty Factor, the proposed changes will lower the frequency of reserve shortages and lower the out-of-market payments that would have been paid to generators during a shortage event.³⁹

As a result, the proposal improves efficiency and so can help remedy the unjust and unreasonable approach to procuring and pricing operating reserves.⁴⁰

ii. The Proposal Will Eliminate Distortions Associated with Tier 1 Reserves Payment Rules

As described in Part I.2, the current pricing rules for Tier 1 resources are discriminatory to Tier 2 resources, lead to inefficiencies in the relative pricing of Tier 1 and Tier 2 resources, and potentially will result in distorted bidding. Additionally, the optimization algorithm disregards the Tier 1 pricing rule, causing the market clearing not to be cost-minimizing.

PJM's proposal consolidates Tier 1 and Tier 2 resources into a single synchronous reserve product while appropriately accounting for resources' different costs. It therefore eliminates the relative pricing problem and the problem that the optimization algorithm could lead to distorted prices because it ignores some of the costs. By improving pricing, the proposal will increase the economic efficiency of the reserve market.

iii. The Proposed Reserves Demand Curve Will Better Reflect the Value That Reserves in Excess of MRR Provide

Under the current reserve market design, prices are formed as if reserves in excess of the MRR provide no value to the system. Introducing a downward sloping demand curve for reserves, as PJM has proposed, will lead to better valuation of incremental reserves beyond the level required by the MRR, improving market efficiency. PJM proposes to value the

³⁹ Uplift payments are calculated as a difference between the generator's cost of service and the Penalty Factor. Therefore, an increase in Penalty Factor automatically decreases the individual out-of-market payments.

⁴⁰ *New York Independent System Operator, Inc.*, 167 FERC ¶ 61,057, at P 35 (2019) (directing NYISO cure its unjust and unreasonable pricing rules by allowing start-up costs of fast-start resources to be reflected in prices in order to reduce "out-of-market uplift payments, which provide a less transparent price signal than compensating resources through market clearing prices that reflect the marginal cost of production").

additional reserves based on their effect on the probability that PJM's actual reserves in real-time will fall below the MRR and the associated requirement of some form of operator intervention.⁴¹ While this formulation of the demand curve is different from the value-of-lost-load approach presented by Hogan and Pope and thus does not represent the socially optimal approach, it will still improve market efficiency. Because PJM is required to meet the MRR regardless of price, including through the use of out-of-market actions, PJM's goal is to avoid the reserves falling below MRR levels. And, even if PJM's demand curve does not fully represent the value of reserves for society, adopting the proposed curve instead of the current one is still a reasonable approach given PJM's reliability obligations.⁴²

The exact shape of the downward sloping part of the demand curve might need to be refined over time. If the Commission decides to adopt PJM's proposal, the Commission should order an interim review of the rules that establish the curve design parameters. This review should be based on experience with the new design and accumulated research. In particular, an interim review should evaluate whether PJM's computations of the uncertainties and of the associated value of incremental reserves based on historical data are correct, or whether a forward-oriented approach is needed for determining the shape of the demand curve. A forward-looking approach might be warranted given the quick changes in the composition of generation resource types.⁴³

In addition to better reflecting the value of incremental reserves, a downward sloping demand curve will also curb the ability of generation owners to profitably exert market power. While a downward sloping demand curve does not completely prevent resources from increasing prices by withholding generation, they are less likely to find that action profitable

⁴¹ Hogan & Pope at 4.

⁴² Importantly, as Hogan and Pope find, the results of the two approach will not lead to starkly different outcomes. *See* Hogan & Pope at 47.

⁴³ For similar reasons, PJM should consider a forward-looking approach to calculating expected energy and ancillary services revenue as part of its capacity market, as is discussed in Part III, *infra*.

because the quantity of reserves that will clear decreases with an increase in the clearing price. In other words, when resources that face a sloping demand curve offer generation at prices above their marginal costs, the amount of generation that clears the market can decrease even in the absence of competitors. This is different from the outcome with a vertical demand curve and limited competition, where higher offers directly translate to higher prices.⁴⁴ PJM's proposal can therefore improve the competitiveness of the reserve market, further increasing market efficiency.⁴⁵

iv. The Proposal Will Partly Alleviate the Missing Money Problem While Relying on the Energy Market to Provide Efficient Investment Signals

PJM's proposal uses nested reserve regions and reserve products.⁴⁶ For example, the Mid-Atlantic Dominion ("MAD") sub-zone is nested in the PJM-wide zone, and resources located in the MAD sub-zone count towards reserves in both the MAD sub-zone and the PJM-wide zone. However, resources located outside MAD do not count towards reserves in the MAD sub-zone. Similarly, 10-minute synchronized reserves can be used to meet the 10-minute synchronized reserve requirement, the primary reserve requirement, and the 30-minute secondary reserve requirement, whereas 10-minute non-synchronized reserves can be used to meet the primary reserve requirement and the secondary reserve requirement, and 30-minute non-synchronized reserves can be used to meet only the secondary reserve requirement.

The use of such nested products allows prices to form in a consistent manner across the

⁴⁴ For a more detailed discussion of the relationship between the slope of the curve and profitability of withholding, see Section II in Eric Hildebrandt, *Potential Effectiveness of the Demand Curve Approach for Mitigation of Local Market Power in Capacity Markets*, Department of Market Monitoring, CAISO (2009), <http://www.caiso.com/Documents/CAISODepartment-MarketMonitoringDemandCurveAnalysis.pdf>.

⁴⁵ The numbers presented by the Market Monitor concerning market concentration for Tier 2 reserves suggest that under the current design there is potential for non-competitive conduct. *See* STATE OF THE MARKET REPORT at 466.

⁴⁶ The current operating reserve market design follows this nested approach but includes fewer nested product categories and allows resources to receive payment for only up to 2 products simultaneously. PJM Filing at 11-12.

PJM territory and across cleared products, recognizing that one unit can simultaneously provide different types of reserves and to different regions.⁴⁷ According to PJM's proposal, in extreme situations, quick-responding synchronized reserves in the MAD sub-zone could receive up to \$10,000/MWh as a reserve resource by supplying all the nested markets while the Penalty Factor for individual markets would still be \$2,000/MWh. As PJM's proposal allows energy prices to reflect scarcity on the reserve markets, the high potential reserve prices allow energy market prices to exceed the cap PJM places on energy market bids.

During reserve shortage events, PJM's proposal can lead energy prices to increase beyond the level permitted under the current design. However, the effect on total consumer costs of procuring energy and reserves is uncertain because of the relationship between the energy, ancillary services, and capacity markets. Bids into the capacity market reflect the expected costs that generators will not cover with their revenue from the energy and ancillary services markets. As the maximum allowed energy and reserves prices increase, the revenue resources receive from those markets will likely increase. As a result, capacity market bids and clearing prices will decrease.⁴⁸ Consequently, PJM's proposal is likely to decrease the relative importance of capacity markets for cost recovery. Given the potential inefficiencies associated with the administrative elements in the design of PJM's capacity market,⁴⁹ the shift of revenue from capacity markets to the energy and ancillary services markets can improve price signals and increase market efficiency.

It is worth noting that the proposal partly avoids increasing the incentives to exert market

⁴⁷ See Hogan & Pope at 23-24.

⁴⁸ Whether the total decrease in capacity payment exceeds the increase in energy costs will depend on whether the resources that profit the most from increases in energy prices would be inframarginal in the capacity market without the change in the pricing schedule. Moreover, this intended mechanism may be undermined without corresponding changes to PJM's RPM rules as discussed in Part III, *infra*.

⁴⁹ See *e.g.*, Docket No. ER19-105 (on periodic review of variable resource requirement curve shape and key parameters); Docket No. EL16-49 (on potential revisions to the PJM Reliability Pricing Model concerning the Minimum Offer Price Rule); Docket No. EL17-32 (on seasonality in capacity markets).

power, which is normally easier if the energy market bid caps are higher. Under PJM's proposal, energy prices can rise beyond the bid cap without changing resources' capability to exercise market power by bidding higher than \$2,000/MWh. That mechanism is explained further in the Hogan and Pope report.⁵⁰

II. The Commission Should Require a Process for Establishing Eligibility to Participate in Reserve Market

PJM reasons that the current operating reserve market rules are unjust and unreasonable, in part, because they do not provide sufficient incentive for resources to operate flexibly.⁵¹ PJM explains that the need for flexibility will increase as the share of intermittent resources on the system increases.⁵² However, PJM's proposal does not clearly permit a number of resources types that are technically capable of providing reserves to do so. As a result, the proposal would not sufficiently address the resource flexibility concerns that PJM has identified.

Neither PJM's current Operating Agreement, nor PJM's proposal specify the types of resources that would be eligible to participate as reserves. Under PJM's proposal, synchronized, non-synchronized, and secondary reserves are defined to include those resources that are "capab[le] of . . . be[ing] converted fully into energy" within the required timeframe specific to that reserve type.⁵³ These definitions depend on a judgment about what resources are deemed capable of providing energy when called upon; however, neither the proposed Operating Agreement language nor PJM's filing identify any particular criteria by which PJM will make such an evaluation.⁵⁴

⁵⁰ See Hogan & Pope at 25-26.

⁵¹ PJM Filing at 7-8.

⁵² PJM Filing at 71.

⁵³ PJM Filing, Attachment A (defining Synchronized Reserves, Non-Synchronized reserves, and Secondary Reserves)

⁵⁴ Similarly, PJM's proposal would apply a reserve must-offer requirement to all resources "capable of providing . . . Reserve as specified in the PJM Manuals." See Operating Agreement, Schedule 1, sections 1.10.1A(j)(i)(1) (Generation Capacity Resource must offer requirement to supply Synchronized and Non-

While PJM has not explicitly provided any criteria or process by which capability will be judged, PJM does appear to have prejudged the eligibility of certain resource types. PJM's filing explains that a number of resource types would be excluded from being eligible to participate as reserves by default. In particular, PJM's filing states that wind, solar, and nuclear units would not automatically be deemed eligible.⁵⁵

However, while these resources types have not historically provided operating reserves, research demonstrates that each resource type is technically capable of doing so. Xcel Energy can operate its wind fleet as a dispatchable resource that is capable of providing ancillary services including frequency response and reserves.⁵⁶ Recent analysis from Energy & Environmental Economics on behalf of TECO Energy and First Solar demonstrates that solar resources are capable of providing ancillary services like reserves, and at high penetrations of such resources may have a financial incentive to do so.⁵⁷ Flexible operation of nuclear power is technically feasible (even if it is not currently common),⁵⁸ and is of increasing interest to

Synchronized Reserves) and 1.10.1A(m)(i)(1) (Generation Capacity Resource must-offer requirement to supply Secondary Reserve). However, PJM has not specified the criteria by which it will evaluate which resources it deems "capable."

⁵⁵ PJM Filing at 81-82; *see also* PJM Interconnection, L.L.C., *Proposal for Must Offer Requirements 4* (Oct. 12, 2018), <https://www.pjm.com/-/media/committees-groups/task-forces/epfstf/20181012/20181012-item-07a-sr-must-offer-requirements.ashx>. The eligibility status of energy storage resources is not currently clear. PJM Manual 11 includes Energy Storage Resources as categories of resources that would not be eligible to provide Tier 1 and Tier 2 synchronized reserves. Manual 11 at 76, 78. However, PJM's recent filing responding to the Commission's request for additional information regarding PJM's Order No. 841 compliance filing suggests storage resources would be eligible to provide operating reserves. *See* PJM Interconnection L.L.C., Response to April 1, 2019 Request for Additional Information at 9, Docket No. ER19-469-000 (May 1, 2019).

⁵⁶ Michael Goggin et al., Wind Solar Alliance, *Customer Focused and Clean: Power Markets for the Future 45-46* (2018), https://windsolaralliance.org/wp-content/uploads/2018/11/WSA_Market_Reform_report_online.pdf; U.S. Dep't of Energy, *Maintaining Reliability in the Modern Power System 18* (2016), <https://www.energy.gov/sites/prod/files/2017/01/f34/Maintaining%20Reliability%20in%20the%20Modern%20Power%20System.pdf>.

⁵⁷ Energy & Environmental Economics, *Investigating the Economic Value of Flexible Solar Operation* (2018), <https://www.ethree.com/wp-content/uploads/2018/10/Investigating-the-Economic-Value-of-Flexible-Solar-Power-Plant-Operation.pdf> (discussing dispatchable operation of solar resources including for operating reserves).

⁵⁸ Sonal Patel, *Flexible Operation of Nuclear Power Plants Ramps Up*, POWERMAG (April 1, 2019), <https://www.powermag.com/flexible-operation-of-nuclear-power-plants-ramps-up/?printmode=1>.

nuclear operators.⁵⁹ Moreover, some advanced reactor technologies, such as the small modular reactors forthcoming from NuScale Power, are capable of flexible operation specifically aimed at responding to variations in output of intermittent resources.⁶⁰ To the extent PJM’s reserve market rules—or practices interpreting those rules—create barriers to the participation of resources like wind, solar, and nuclear that are technically capable of providing operating reserves, such rules are unjust and unreasonable.⁶¹

In its filing, PJM states that it will allow such resources to participate as reserves if they notify PJM of such capability.⁶² But, PJM’s exception process is not sufficient to address eligibility concerns. PJM has not identified criteria by which it will make such an evaluation. PJM’s manuals allow resources to request an exception but the only process specified is for resources to send a request by email.⁶³ Neither PJM’s business practice manuals nor the form instructing resources to request an exception by email specify any criteria by which PJM will evaluate a resource’s request.

This lack of clarity raises two concerns. First, it can create substantial uncertainty that serves as a barrier to reserve market participation. Licensing restrictions can create legal barriers for resources such as nuclear plants to provide reserves without sufficient advanced planning, which would require additional certainty.⁶⁴ Long-term contracting terms may limit

⁵⁹ *Id.*

⁶⁰ See Katie Fehenbachr, *Nuclear Can Be Friends With Renewables—If It’s Modular*, GREENTECH MEDIA (June 23, 2017), <https://www.greentechmedia.com/articles/read/nuclear-can-be-friends-with-renewables>.

⁶¹ *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127, at PP 19-20 (2018) (holding unjust and unreasonable “market rules that limit the services that electric storage resources are technically capable of providing [because they] may create barriers to the participation of electric storage resources in the RTO/ISO markets . . . [that] reduce competition and market efficiency”).

⁶² PJM Filing at 82.

⁶³ PJM Manual 11 at 76-77; See PJM, *Communication Process for Consideration of Some resources for Tier 1 Synchronized Reserve* (May 3, 2017), available at <https://www.pjm.com/-/media/markets-ops/ancillary/communication-process-for-consideration-of-some-resources-for-tier-1-synchronized-reserve.ashx?la=en>

⁶⁴ EPRI, *ELECTRIC POWER SYSTEM FLEXIBILITY: CHALLENGES AND OPPORTUNITIES* 15 (2016), <https://www.epri.com/#/pages/product/3002007374/?lang=en-US>.

the financial incentive for resources such as wind and solar to provide reserves without a clear signal that such revenue is possible.⁶⁵ Second, PJM's failure to specify criteria by which eligibility requests will be evaluated leaves too much discretion to PJM.⁶⁶

In order for PJM's reserve market rules to be just and reasonable, they must ensure that all resources technically capable of providing operating reserves are eligible to do so without facing unnecessary participation barriers. To that end, the Commission should require PJM to include in any replacement rate a transparent process by which all resources—including wind, solar, nuclear resources—may demonstrate that they are capable of providing reserves and the criteria by which PJM will evaluate such requests.

III. The Commission Should Include Corresponding Capacity Market Changes in Any Replacement Rate

PJM's proposal fails to adequately address the extent to which increasing energy and ancillary services revenue will affect the RPM. As a result, without corresponding changes to the capacity market, PJM's proposed reserve market changes risk distorting prices in other markets, inefficient market outcomes, and, therefore, unjust and unreasonable rates. The Commission should include a transition mechanism that takes into account these interactions when fixing a just and reasonable replacement to PJM's current market rules.

1. By Failing To Account for the Interaction Among the Energy, Ancillary Services, and Capacity Markets, PJM's Proposal Will Lead to Unjust and Unreasonable Capacity Market Outcomes

The RPM includes a number of administratively determined components such as the capacity demand curve, minimum and maximum offer prices, and non-performance penalties,

⁶⁵ Goggin et al. at 24 (explaining how contractual barriers limit renewable incentives to participate in reliability services markets).

⁶⁶ See *New York Indep. Sys. Operator, Inc.*, 155 FERC ¶ 61,037, at PP 17-18 (2016) (finding tariff language permitting RTO discretion regarding public policy transmission projects based on a report submitted to the RTO for its "consideration and determination" to be "unclear as to what the report will entail and the level of detail and support the report must contain," and to be "overly broad and vague as to the nature and scope of such action, and therefore, unjust and unreasonable"); see also *PJM Interconnection, L.L.C.*, 150 FERC ¶ 61,122, at P 52 (2015) ("The Tariff, however, contains no criteria or other method by which PJM will make the determination").

each of which rely on expectations about the energy and ancillary services markets. Because all these components affect the amount and mix of capacity procured in the capacity auctions, and the resulting market prices, it is crucial that PJM adopt accurate assumptions in order for the markets to yield just and reasonable outcomes.

All of these components depend on the Net Cost of New Entry (Net CONE) of a reference technology, which is the total annual revenue that a new generation resource of the reference type would need to recover its capital investment and fixed costs, net of the resource's other revenues including, primarily energy and ancillary services revenues.⁶⁷ To calculate Net CONE, PJM subtracts historic energy and ancillary services prices ("EAS Offset") from the gross cost of new entry.⁶⁸ But, because an EAS Offset that is based on historical revenues would be lower than the actual revenues in the initial years of the current proposal, the new Net CONE calculations for these years will overestimate the true Net CONE, leading to inefficiencies in the capacity market and, in turn, inefficiencies in the energy and ancillary services markets.

There are at least three different ways overestimating Net CONE could cause inefficiencies:

- (1) **VRR Curve.** Net CONE helps set the demand curve ("VRR curve"), which establishes the amount of capacity to be procured.⁶⁹ Overestimating Net CONE would lead to a VRR curve that overvalues additional capacity. Consequently, it would exacerbate the "chronic oversupply of generation resources" that PJM already faces,⁷⁰ and yield additional, inefficient capacity procurement, which the Commission has deemed to be unjust and unreasonable.⁷¹
- (2) **MOPR.** Under PJM's Minimum Offer Price Rule ("MOPR"), Net CONE establishes the minimum bid price that certain resources are required to use when

⁶⁷ PJM Tariff Attachment DD at section 5.10(a)(iv)-(vi)..

⁶⁸ PJM Tariff Attachment DD at section 5.10(v).

⁶⁹ *PJM Interconnection, L.L.C.*, 123 FERC ¶ 61,015, at P 2 (2008) (The estimate of net CONE affects the height of the demand curve. . . . Raising the value of net CONE, thus . . . shifts the entire VRR curve upward, resulting in higher capacity prices at every capacity level until the curve crosses the horizontal axis.").

⁷⁰ *PJM Interconnection, LLC*, 167 FERC ¶ 61,029 at P 1 (2019) (Glick, Comm'r *dissenting*).

⁷¹ *PJM Interconnection, L.L.C.*, 147 FERC ¶ 61,108, at P 68 (2014) (rejecting PJM proposal due, in part, to "significant undesirable effects such as . . . unnecessarily raising the cost of capacity through the acquisition of excess capacity").

bidding into the capacity market.⁷² Overestimating Net CONE would lead to minimum offer prices at a level higher than necessary to address buyer-side market power, or other price distortions, prohibiting resources from bidding at the level that PJM deems to be competitive,⁷³ which the Commission has deemed to be unjust and unreasonable.⁷⁴

- (1) **Market Offer Caps.** Net CONE is used to establish capacity market offer caps intended to limit the exercise of market power.⁷⁵ Overestimating Net CONE would allow resources to submit higher capacity market bids than would be appropriate, exacerbating concerns that the capacity market suffers from market power.⁷⁶

2. The Interaction Between the Capacity, Energy, and Ancillary Services Markets Means that Inefficiencies in the Capacity Market Will Yield Unjust and Unreasonable Energy and Ancillary Services Rates

PJM's failure to more closely incorporate changing energy and ancillary services revenue into the RPM design undermines not only the capacity market itself, but also the ancillary services and energy markets. As explained above, the capacity market is affected by the

⁷² PJM Tariff Attachment DD at section 5.14(h)(3).

⁷³ The underlying assumption that Net CONE represents a competitive bid may not be correct. See James F. Wilson, *Forward Capacity Market CONEfusion*, 23 ELECTR. J. 25 (2010). However, even using PJM's flawed approach to establishing competitive bids, underestimating the EAS Offset will result in over-mitigation of resources.

⁷⁴ *PJM Interconnection, L.L.C.*, 161 FERC ¶ 61,252, at P 43 (2017) ("Precluding certain resources that are not exercising market power from making a competitive offer may result in both undue discrimination against those resources and unjust and unreasonable rates because the auction potentially results in a higher clearing price than if those resources had participated."); *New York State Pub. Serv. Comm'n et al.*, 158 FERC ¶ 61,137, at PP 33-34 (2017) (rejecting application of MOPR to resources that receive revenue from retail demand response programs because that revenue is "actually for providing services that are separate and distinct from" FERC-jurisdictional capacity payments, and that application of the MOPR would create unnecessary and inefficient barriers to entry); see also *NextEra Energy Resources v. FERC*, 898 F.3d 14, 20 (D.C. Cir. 2018) ("If those resources 'are not reflected in the Forward Capacity Market, then the Forward Capacity Market may send an incorrect signal to construct new capacity that is not needed.' This would lead the market to procure redundant capacity."). This concern would only be exacerbated if FERC accepts PJM's proposed expansion of the minimum offer price rule because under PJM's proposal, expected energy and ancillary revenue is used to establish minimum prices for a wider variety of units. See *Initial Submission of PJM Interconnection, LLC*, Docket Nos. EL16-49-000, ER18-1314-000, EL18-178-000 (filed Oct. 2, 2018).

⁷⁵ See PJM Tariff, Attachment DD at section 6.4; *PJM Interconnect L.L.C.*, 154 FERC ¶ 61,151, at PP 2-5 (2016) (describing PJM's market power screen and offer cap rules). Note that for some resources, market seller offer caps are determined based on the Avoidable Cost Rate less PJM Projected Market Revenues for that resource. PJM Tariff, Attachment DD at section 6.4. Because historical energy and ancillary services revenue are also used to establish the market offer cap under this approach, PJM Tariff, Attachment DD at section 6.8(d), the same concerns would apply for resources subject to the net Avoidable Cost Rate approach.

⁷⁶ Monitoring Analytics, *Analysis of the 2021/2022 RPM Base Residual Action 2* (Aug. 24, 2018), http://www.monitoringanalytics.com/reports/Reports/2018/IMM_Analysis_of_the_20212022_RPM_BRA_Revised_20180824.pdf ("[T]he market design for capacity leads, almost unavoidably, to structural market power in the capacity market. The capacity market is unlikely ever to approach a competitive market structure in the absence of a substantial and unlikely structural change that results in much greater diversity of ownership").

energy and ancillary services markets. The capacity market in turn also affects energy and ancillary services market outcomes by producing a resource mix that will be available to supply energy and reserve demand.⁷⁷ By underestimating Net CONE and overprocuring capacity, PJM's proposal will dampen energy and ancillary services price signals needed to encourage the entry and operation of those flexible resources PJM claims it has designed its preproposal to incentivize. As Commissioner Glick recently explained, "[b]y retaining too many resources, PJM dulls the price signals in the markets for energy and ancillary services . . . , impairing their ability to incentivize the services we actually need to reliably operate the grid."⁷⁸ As a result, PJM's proposal is an incomplete remedy to the unjust and unreasonable features of the current Operating Agreement that PJM has identified in its filing.

3. The Proposal's Increase of Energy and Ancillary Services Revenue Without Offsetting Capacity Market Revenue Risks Unjust and Unreasonable Double Payment

The Commission has recognized that a just and reasonable ancillary services market reform requires an RTO's capacity market to take into account the increased energy and ancillary services revenue that resources will receive as a result of the reform. For example, in its order establishing shortage pricing, the Commission considered the potential for customers to be charged twice due to the overlap of the capacity market and excess energy and reserve market revenue that would be created due to shortage pricing.⁷⁹ The Commission relied on the fact that capacity market procurement would be adjusted downward based on increasing energy & ancillary services revenue in order to reject challenges to its requirement that RTOs make ancillary services market changes.⁸⁰

⁷⁷ SYLWIA BIALEK & BURCIN UNEL, CAPACITY MARKETS AND EXTERNALITIES: AVOIDING UNNECESSARY AND PROBLEMATIC REFORMS 5 (2018).

⁷⁸ *PJM Interconnection L.L.C.*, 167 FERC ¶ 61,029, at P 2 (2019) (Glick, Comm'r, *dissenting*).

⁷⁹ *Wholesale Competition in Regions with Organized Electric Markets*, 125 FERC ¶ 61,071, at P 189 (2008).

⁸⁰ *Id.* at P 201 ("TAPS and others also recommend examining the need for capacity markets under shortage

PJM's proposal fails to recognize that the Commission required the ancillary services markets and RPM, when viewed together, to limit double payment by consumers. Therefore, PJM's proposed market rules are inconsistent with the Commission's directive when establishing key components of PJM's operating reserve market, and, as a result, the Commission cannot find the proposal to be just and reasonable without changes.⁸¹

4. The Existing Mechanisms for Linking RPM Outcomes to Energy and Ancillary Services Market Revenues Are Not Sufficient to Address These Concerns

PJM argues that by using historical data to calculate the EAS Offset, the capacity market rules will eventually incorporate the additional energy and ancillary service revenues expected to result from reserve market changes.⁸² However, the fact that inefficient price signals will be time-limited is not a reason to permit this proposal to move forward without corresponding changes to the RPM.⁸³

The Commission's reasoning for accepting the historical average approach demonstrates why it is not sufficient to address the relationship between the reserve market changes, capacity market prices and, ultimately, energy and ancillary services market prices. The Commission has reasoned that "the continued use of a three-year average of historical revenues from energy and ancillary services markets is appropriate because *the cyclical changes in net revenues are likely to average out*."⁸⁴ However, for a systematic change such as a change in ancillary services markets that are explicitly designed to result in higher ancillary services revenue, changes are not cyclical and so will not average out. The

pricing and whether customers would be charged twice. *Under all existing capacity market rules, the revenues earned from the sale of energy and ancillary services are accounted for in the calculation of capacity payments so that customers will not be double charged*").

⁸¹ *Sw. Power Pool, Inc.*, 152 FERC ¶ 61,226, at P 67 (2015) ("the proposal is inconsistent with the Commission's directive in the October 2012 Order conditionally accepting the Integrated Marketplace. Thus, SPP has not shown its proposal will result in just and reasonable rates").

⁸² PJM Filing at 68-70.

⁸³ *See New York Indep. Sys. Operator, Inc.*, 158 FERC ¶ 61,064, at P 55 (2017) (rejecting a transition mechanism that "will delay efficient market signals").

⁸⁴ *PJM Interconnection, L.L.C. PJM Power Providers Grp.*, 135 FERC ¶ 61,022, at P 48 (2011).

Commission has also explained that a historical price methodology can be appropriate because while “[t]here may be more than one method that provides a reasonably accurate forecast . . . [t]he relevant question here is whether PJM's proposed method is likely to provide a reasonably accurate forecast.”⁸⁵ The Commission has since expressed reservations about the accuracy of an EAS Offset calculated based on historic prices.⁸⁶ That concern is even more acute given the significant and abrupt energy and ancillary services market revenue increases expected as a result of the proposed reserve market changes.. Because of the proposed market changes, the EAS Offset will not, for a significant period of time, provide a "reasonably accurate forecast." As a result, the Commission’s previous acceptance of the historic average approach in tariff filings PJM has made under Section 205 does not serve as precedent here, where the Commission is responsible for fixing just and reasonable market rules.

5. A Just and Reasonable Replacement Rate Would Include a Mechanism to Better Account for Additional Energy and Ancillary Services Revenue as a Result of Operating Reserve Market Changes

As a result of these potential inefficiencies, the Commission should require PJM to adopt corresponding capacity market changes when fixing a just and reasonable replacement rate that draws on PJM’s operating reserve proposal. The Commission could require PJM to move to a forward-looking approach to calculating the EAS Offset. The Commission has approved the use of forward-looking energy and ancillary services revenues to set administratively determined components in other RTO capacity markets.⁸⁷

⁸⁵ *PJM Interconnection, L.L.C. PJM Power Providers Grp.*, 137 FERC ¶ 61,145 (2011).

⁸⁶ *PJM Interconnection, L.L.C.*, 143 FERC ¶ 61,090, P 181 (2013) (rejecting complaints about historical averaging approach to EAS Offset as “outside the scope of this proceeding” but “*strongly encourag[ing] PJM to initiate a stakeholder process that addresses concerns over the lagging nature of Energy and Ancillary Services Revenue Offset calculations*”).

⁸⁷ *See, e.g., Astoria Generating Co. L.P. and TC Ravenswood, LLC*, 140 FERC ¶ 61,189, at P 86, 101-105 (2012) (explaining NYISO’s forward-looking methodology to calculate energy and ancillary services revenues in net CONE and rejecting complaint that NYISO should have instead used a methodology that relies on historic prices).

Alternatively, the Commission could direct PJM to develop a transition mechanism. A number of potential transition mechanisms were developed by PJM and the Market Monitor as part of the PJM reserve market stakeholder process.⁸⁸ The Commission can look to these proposals as a starting point for crafting a just and reasonable transition mechanism.

The Commission has previously accepted a transition mechanism to address the linkage between the RPM and ancillary services market revenue when ancillary services market changes were expected to result in significant additional energy and ancillary services revenue. When PJM incorporated scarcity pricing into its market, that change was expected to significantly increase the amount of energy and ancillary services revenue that resources would receive. In its order approving PJM's compliance filing, the Commission accepted as just and reasonable a transition mechanism that included an EAS Offset true-up to address the additional expected scarcity revenue.⁸⁹

IV. Conclusion

Policy Integrity commends PJM for identifying inefficiencies in its current approach to procuring and pricing operating reserves that render the Operating Agreement unjust and unreasonable. The Commission should adopt a replacement rate that follows the general approach PJM has outlined in its proposal. At the same time, to ensure that the operating reserve market is just and reasonable, the Commission should fix a replacement rate that includes some changes to PJM's proposal. The Commission should incorporate a required interim review of the performance of the revised reserve market rules and, in particular, PJM's method for establishing the downward sloping demand curve. The Commission should require PJM to adopt criteria that specify how resources that are technically capable of

⁸⁸ PJM, PRICE FORMATION 15-16 (Dec. 14, 2018), <https://www.pjm.com/-/media/committees-groups/task-forces/epfstf/20181214/20181214-item-04-price-formation-paper.ashx>; MONITORING ANALYTICS, RESERVE MARKET DESIGN AND ENERGY MARKET PRICE FORMATION 21 (Nov. 1, 2018), http://www.monitoringanalytics.com/reports/Presentations/2018/IMM_EPSTF_Reserve_Market_Design_and_Price_Formation_20181101.pdf.

⁸⁹ *PJM Interconnection, L.L.C. PJM Power Providers Grp.*, 126 FERC ¶ 61,275, at PP 41, 45 (2009).

providing reserves but that are not subject to a must-offer requirement are able to become eligible. And the Commission should require PJM to adopt a transition mechanism that takes into account the connection between energy and ancillary services revenue and the RPM.

Respectfully submitted,

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