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

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| Calpine Corporation, et al., | ) | Docket Nos. EL 16-49-000 |
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| v. | ) | |
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| PJM Interconnection, L.L.C. | ) | |
| | ) | ER 18-1314-000 |
| PJM Interconnection, L.L.C. | ) | ER 18-1314-001 |
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| PJM Interconnection, L.L.C | ) | EL 18-178-000 (Consolidated) |

# RESPONSIVE BRIEF OF THE PEOPLE OF THE STATE OF ILLINOIS

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Dated: November 6, 2018

**RESPONSIVE BRIEF OF**
**THE PEOPLE OF THE STATE OF ILLINOIS**

The People of the State of Illinois, by and through Lisa Madigan, Attorney General of the State of Illinois ("the People" or "the Illinois AG"), hereby file this Responsive Brief in response to the briefs, arguments, and comments submitted by various parties addressing the Commission's June 29, 2018 Order Rejecting Proposed Tariff Revisions, Granting in Part and Denying in Part Complaint, and Instituting Proceeding Under Section 206 of the Federal Power Act ("Order").[1] The People filed a Request for Rehearing on July 31, 2018, and the arguments in this Responsive Brief and in the People's Initial Brief are not a waiver or withdrawal of any position taken in the Request for Rehearing.

In summary, the People address the following matters:

1. The People support the proposal of the Independent Market Monitor of PJM to apply the net avoidable cost rate (net ACR) to determine the minimum bids of capacity market participants with new or existing units, and oppose the use of net CONE to determining a minimum bid for new units.
2. The People urge the Commission to investigate and correct the anomalous operation of PJM's capacity market algorithms and assumptions, that on average result in an increase of 13% in the auction the outcome.
3. If the Commission adopts an FRR despite a minimum bid that is not expected to increase bids or market clearing prices, the People request that the Commission vest the authority to opt into an FRR with the states, rather than with the generators.
4. If the Commission adopts an FRR despite a minimum bid that is not expected to increase bids or market clearing prices, the People request that the Commission allow states sufficient

[1] *Calpine Corp. et al. v. PJM Interconnection, L.L.C.* 163 FERC ¶ 61,236 (Jun. 28, 2018) (*hereinafter* "Order").

time to design an effective method to replace the competitive effect of the federal wholesale market, and not limit the time the states have to certify a state method to one year.

5. The People reiterate their request that the Commission adopt a price cap for resources that exit the federal wholesale market.

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## ARGUMENT

### I. A MOPR Floor Offer Based On Net ACR Provides A Workable Path Forward To Assure A Competitive Capacity Market At Reasonable Prices.

The primary goal of the Commission's June 29th Order is to assure that PJM's capacity market, also known as the Reliability Pricing Model or RPM, produces a *competitive price* that reflects generators' costs, provides appropriate price signals for entry and exit, and results in a just and reasonable price paid by consumers.[2] The Commission concluded that "resources receiving out-of-market support are capable of suppressing market prices, regardless of intent."[3] In light of the Commission's concerns about out-of-market subsidies distorting a competitive price, the key questions are: what is a competitive price, can it be identified notwithstanding out-of-market subsidies, and is that competitive price the appropriate Minimum Offer Price Rule ("MOPR") offer floor.

Both PJM Interconnection, LLC ("PJM") and the PJM Independent Market Monitor ("IMM") answered those questions by reference to basic market concepts and data. The administration of the capacity market is entrusted to PJM, with review by the IMM, subject to Commission review. Thus, the development and implementation of a system to determine and monitor competitive bids in the current environment (where state subsidies exist) will be PJM's and the IMM's responsibility. Both PJM and the IMM recommended defining a "competitive price" for existing units by setting the minimum bid at net avoidable cost,[4] but PJM added a different pricing mechanism for "new entrants" and a highly complicated structure based on a

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[2] Order at P 150.
[3] *Id.* at P 155.
[4] See Initial Submission of PJM Interconnection, L.L.C. at 40-46; Brief of the Independent Market Monitor for PJM. A description of net ACR can be found at: PJM OATT at Attachment DD § 6.4(a), 6.7 & 6.8 and Monitoring Analytics, RPM Avoidable Cost Rate Development at 3 (2006) available at http://www.monitoringanalytics.com/reports/Presentations/2006/20061108-rpm-workshop-avoidable-cost-rate-dev.pdf ; See 2018 IMM Quarterly State of the Market Report for PJM: January through March at 255.

"resource carve-out" mechanism that involves repricing capacity and paying resources with no capacity obligation an opportunity cost.[5]

In approving the PJM capacity markets, the Commission's goal is to assure just and reasonable rates, as required by the Federal Power Act.[6] As PJM has pointed out, in this proceeding the Commission's goals must be to ensure both that PJM's capacity market prices are not unreasonably affected and suppressed as a result of out-of-market subsidies, and that resulting capacity prices are just and reasonable for consumers.[7] Both of those objectives are met by rules that recognize the residual nature of the capacity market and recognize that a competitive price should be defined as the avoidable cost less PJM energy and ancillary services ("EAS") market revenues.

While PJM's current MOPR is based on the "cost of new entry" or "CONE,"[8] PJM has recommended that CONE only apply to new resources, while the minimum price for existing resources be set at their avoidable cost net of PJM EAS revenues ("net ACR").[9] By contrast, the IMM recommends that net ACR be used for *all* resources: new and existing, subsidized and not subsidized. The IMM's approach has the benefit of consistency and simplicity, comports with the goals of the capacity market, and will result in the least disruption to PJM's markets and consumer prices. The People of the State of Illinois request that the Commission adopt the IMM proposal to address the capacity market issues identified in its Order,[10] and reject PJM's highly complex and ultimately unreasonable Resource Carve-Our proposal. A MOPR, or minimum offer based on net ACR can be expected to enable subsidized resources to participate in the

[5] Initial Submission of PJM Interconnection, L.L.C. at 50-75.
[6] 16 U.S.C. § 824d(a), (e).
[7] Initial Submission of PJM Interconnection, L.L.C. at 4.
[8] PJM OATT, Attach. DD, §5.14(h)(1).
[9] Initial Submission of PJM Interconnection, L.L.C. at 40, 46-47.
[10] Summary of the Sustainable Market Rule Proposal of the Independent Market Monitor (Oct. 31, 2018).

market on the same terms as other resources and avoid unreasonable price suppression, eliminating the need for the FRR-Alternative the Commission proposed in its Order.

In its Order, the Commission found PJM's use of the MOPR to address *only some* subsidized generation unjust and unreasonable. It found that the

> record shows that out-of-market support to existing resources is significant enough to affect the price in the market, and therefore the entry and exit of resources. … Thus, out-of-market support to existing resources may allow even uncompetitive resources, for whom a competitive offer would be significantly higher than zero, to submit low or zero priced offers into the capacity market.[11]

The Commission concluded that there is not "any substantive difference among the types of resources participating in PJM's capacity market with the benefit of out-of-market support,"[12] indicating that new and existing units as well as units using different fuel sources be treated similarly. While PJM's current MOPR includes conditions and limitations that the Commission rejected,[13] the Commission found the minimum offer procedure itself to be necessary to prevent uncompetitive, low bids in PJM's RPM.[14] The challenge now is to design a minimum bid or other proxy for a competitive bid that is consistent with the residual nature of the capacity market and that will achieve the market's and the Commission's goals.

The IMM suggests abandoning the MOPR terminology, calling his approach the Sustainable Market Rule,[15] but the IMM proposal satisfies the Commission's direction that a

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[11] Order at P 151.

[12] Order at P 155.

[13] The MOPR was developed in a different environment and for different issues than those present today. The original MOPR was developed to address new construction incented by state subsidies, and the fear of buyer-side market power. *PJM Interconnection, L.L.C., PJM Power Providers Group v. PJM Interconnection, L.L.C.*, 135 FERC ¶ 61,022 at P 6 (Apr. 12, 2011). See also Calpine Complaint Requesting Fast Track Processing, page 15, (filed March 21, 2016). While the MOPR has been the subject of multiple amendments over the years, and has been implemented differently in the different RTOs, see, *e.g., NextEra Energy Res., LLC v. FERC,* 898 F.3d 14 (D.C. Cir. 2018), the Commission concluded that as presently designed, a MOPR that is limited to only some resources may not be effective. *E.g.,* Order at P 158.

[14] Order at P 158.

[15] Brief of the Independent Market Monitor for PJM at 9,11.

minimum price, "with few or no exceptions, should protect PJM's capacity market from the price suppressive effects of resources receiving out-of-market support by ensuring that such resources are not able to offer below a competitive price."[16] The IMM's proposal would set a minimum price for all resources by defining a competitive price as net ACR. This consistent approach incorporates a competitive effect by using resource-wide costs, and reflects the residual nature of the capacity charge by reducing the resource's ACR by the unit's EAS revenues based on applicable expected locational prices payable to the unit.[17] The IMM proposal furthers the Commission's goal of assuring that subsidized resources do not submit capacity offers that are non-competitive, or below their unsubsidized cost.

The capacity market was developed to stabilize the PJM markets by compensating generation for being available when necessary to meet customer demand and providing a revenue stream to supplement energy and ancillary services revenues.[18] The essential goal of the capacity market is to provide necessary revenue when other sources of PJM market revenue prove insufficient to cover a generator's avoidable cost, being the cost that can be eliminated by not engaging in or no longer performing an activity, such as offering to be a capacity resource.[19] As demonstrated in the Comments of the Illinois Commerce Commission, since its adoption,

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[16] Order at P 158.

[17] Brief of the Independent Market Monitor for PJM at 15-16.

[18] *PJM Interconnection, L.L.C.*, 117 FERC ¶ 61,331 at ¶ 144 (Dec. 22, 2006) ("The revenues earned in the energy market will affect the price for capacity: capacity market revenues (and thus, the importance of capacity markets in eliciting adequate infrastructure) will be reduced as energy market revenues increase. That is, expected revenue from the energy and ancillary service markets will reduce the height of the demand curve, and thus, reduce the prices and revenues received by resources in the capacity market. Thus, to the extent that energy market revenues increase, capacity market revenues could be reduced proportionately so that the overall rate remains just and reasonable.") (*hereinafter* "Original RPM Settlement Approval").

[19] See Monitoring Analytics, RPM Avoidable Cost Rate Development at 3 (2006) *available at* http://www.monitoringanalytics.com/reports/Presentations/2006/20061108-rpm-workshop-avoidable-cost-rate-dev.pdf.

PJM capacity charges have increased as energy prices have decreased, showing the residual nature of the capacity market.[20]

Both PJM's and the IMM's approach to existing resources will achieve competitive capacity bids that are high enough to cover the cost of generation for the resource class after netting expected PJM revenues.[21] The IMM correctly recommends that the administratively set minimum bid, set at net ACR, be agnostic to whether a resource is new or existing. Clearly, a resource that is bidding into the capacity market expects to have incurred its development costs prior to providing capacity in the delivery year. Those costs are no longer avoidable, and should not affect the calculation of the minimum bid.[22] New resources are the same as existing resources in that the only relevant costs for capacity purposes are avoidable costs.

The IMM has asserted that the effect of using net ACR to determine the minimum capacity bid will be "zero to insignificant" for renewable resources, nuclear resources, and cost of service. PJM included ACRs for existing resources in its Initial Submission at page 46, but did not show the relevant revenues. PJM reported the net ACRs for existing on-shore wind, solar and hydro renewable resources as zero dollar ($0.00), indicating (1) that EAS revenues are expected to be sufficient to cover their avoidable costs and (2) that a competitive, minimum bid would not be an obstacle to participation by those resources in PJM's capacity construct.[23] For existing nuclear resources, such as the one receiving "zero emission credits" in Illinois,[24] the ACR for a dual unit resource was reported as $593 per megawatt-day. When the net revenues from the IMM's State of the Market report for January -June, 2018 are compared to the ACR, it

[20] Comments of the Illinois Commerce Commission at 10. See also Monitoring Analytics, 2018 Quarterly State of the Market Report for PJM: January through June at page 18, Table 1-10.
[21] IMM Summary of SMR at 2.
[22] Brief of the Independent Market Monitor for PJM at 16-17.
[23] Initial Submission of PJM Interconnection, LLC at 46 (Table 3).
[24] The Quad Cities plant located in Illinois currently receives zero emission credits from Illinois consumers.

is apparent that there should be no minimum price obstacle to existing nuclear resources' participation in the RPM. The State of the Market Report shows that for 2018, the Quad Cities plant, a dual unit plant, is expected to receive $596 in PJM EAS revenues.[25] The revenues for other existing nuclear plants for 2018 range from $24.43 per megawatt-hour (Braidwood) to $37.91 per megawatt-hour (Calvert Cliffs), which translate to $583.32 and $909.84 per megawatt-day, close to or exceeding the PJM reported ACR for both single and dual nuclear units.[26] Provided the minimum bid obligation is satisfied, these resources can pursue their bidding strategy to achieve the revenues they seek from the current capacity construct.

In its table showing its proposed net CONE for new resources, PJM included market revenues that were "the lowest zonal [Energy and Ancillary Services] value estimated for each resource class type over the past three calendar years."[27] It is unreasonable to under-state revenues, which has the effect of increasing the minimum offer price to a level that no longer reflects a resource's actual capacity revenue needs. Accordingly, the Commission should recognize that in setting the minimum price to net ACR, the ACR values contained in Table 3 on PJM's Initial Submission must be netted against actual locational marginal prices for the area the particular resource is located.

As proposed by the IMM, a consistently applied "competitive price" or "minimum offer" should allow subsidized resources to fairly compete with non-subsidized resources and obviate the need for an extra-market process, such as the FRR-Alternative or PJM's proposed Resource Carve-Out and RCO. Setting the minimum bid at net ACR, recommended by the IMM and by

[25] 2018 IMM State of the Market Report, January -June, Section 7, Table 7-17 (showing average forward LMP (locational marginal price) of $24.85 per megawatt-hour. Multiplying the megawatt-hour rate by 24 hours equals the megawatt-day revenue. Available at: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2018/2018q2-som-pjm-sec7.pdf

[26] *Id.* and Initial Submission of PJM Interconnection, LLC at 46. The ACR for an existing single unit nuclear resource was reported to be $631.00.

[27] *Id*. at Attachment B, Affidavit of Adam J.Keech on behalf of PJM Interconnection, L.L.C. at P 21.

PJM for existing resources, is fair to resources and will not unduly drive up capacity bids, which can be especially problematic in zones with clear market power issues. To the extent that net ACR is zero, or substantially less than recent clearing prices, subsidized resources will neither undercut prices nor be unreasonably excluded from market participation through unreasonably high bids. To the extent state-favored resources do not clear the capacity market under the IMM's Sustainable Market Rule due to net ACR or the resource's own bidding strategy, states can take appropriate action outside the context of the capacity market with no further PJM involvement.[28]

The People of the State of Illinois request that the Commission adopt the IMM's proposal to address the effects of state subsidies on PJM's capacity market.

## II. Even If A MOPR Is Correctly Set, Analysis Of The Algorithms Underlying PJM's Capacity Market Demonstrates That Continuing Errors And Anomalies In The Capacity Market Design And Market Power Will Distort And Drive Up The Final Capacity Price, Resulting In Unjust And Unreasonable Capacity Prices.

The People of the State of Illinois identified significant market failures in the ComEd zone serving northern Illinois in their Initial Brief.[29] The Illinois Commerce Commission ("ICC") expressed similar concerns in its Comments, declaring that PJM's BRA is "inherently flawed." The ICC showed how capacity prices on a per megawatt-hour basis have fluctuated over the last 12 years, but now make up more than 21% of the total price per MWh.[30] Ultimately the ICC argued that other proceedings to modify PJM prices outside the RPM (including the Energy Price Formation Senior Task Force) will directly affect the inputs to the

[28] *Id.* at 8-9.
[29] Initial Brief of the People of the State of Illinois at 5-15.
[30] Comments of the Illinois Commerce Commission at 10.

RPM, including the net ACR calculation. The ICC asserted that the changes proposed in the June 29 Order do not address the fundamental problems facing PJM's capacity and other markets.[31]

The People agree that the Commission's decision in this docket should recognize that the RPM is "a complex, administratively determined mechanism for pricing and procuring capacity [that]… contains numerous administratively determined non-market features such as its Variable Resource Requirement ("VRR") curve, price caps, a MOPR, cost of new entry ("CONE") fluctuations, and significant performance requirements/penalties."[32] The People have closely examined the planning parameters, the algorithms, and the capacity prices in the ComEd zone, and it is evident that the current capacity construct does not produce a competitive or reasonable price for Illinois consumers. The adoption of minimum prices, even if based on net ACR as proposed by the IMM, will not cure the deficiencies in PJM's capacity market.

Any analyses of the effect of out-of-market payments and of a minimum price must understand how the RPM works, including how its automatic algorithms select among bids. While that foundational information has not been provided or discussed to date by Calpine and the other Petitioners in EL 16-49 or by PJM, the attached Reply Affidavit of Robert McCullough demonstrates that even if minimum bids are administratively required, market power coupled with smaller and smaller capacity zones (or locational delivery areas, "LDAs") and an upwardly biased algorithm, overstate market prices.[33]

Mr. McCullough identified four areas where the RPM fails to operate in a transparent, just, and reasonable manner. He testifies that:

a. There is little basis for the underlying algorithm in economic theory;

[31] *Id.* at 7-11
[32] *Id.* at 7.
[33] Reply Affidavit of Robert McCullough at P 30-31; P 42

b. The algorithm is basically undocumented and major players in the market disagree on the operation of central elements;

c. The structure of the model invites gaming by more sophisticated participants;

d. And many participants possess substantial market power.[34]

Because of these deficiencies, out-of-market subsidies have not had the effect that economic theory would predict. If these deficiencies are not corrected, it is likely that the imposition of a minimum offer price will have no effect on capacity market prices (up or down) that are already substantially in excess of a competitive level.[35]

The Commission should insist that it understand the algorithm that PJM uses to select among capacity bids before ordering any changes to PJM's capacity construct or requires a minimum bid. First, the Commission would discover that the PJM algorithms are dated 2007; that important parts of the PJM algorithm are undocumented; and that PJM and other stakeholders have different views of how the auction operates.[36] A key anomaly is that the PJM's model appears to treat "consumer rent" or surplus and "producer rent" or surplus differently from most economic models, resulting in a bias toward higher prices ranging from 12.9% to 26%.[37] Further, the effect is to enable bidders to use flexible and inflexible bids as well as PJM's "make whole" payments to drive up prices.[38] The adoption of a minimum price, even if it is correctly determined and applied to all resources, will not address these underlying errors that drive up capacity prices irrespective of out-of-market payments.

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[34] *Id*. at P 5.

[35] *Id*. at P 34; Assuming a competitive level is net ACR, as both the IMM and PJM have asserted, the minimum offer is closer to $0 than to the 2021/2022 high clearing prices. See *id.* at P 3 showing most recent clearing prices ranging from $140.00 to $204.29. See also Monitoring Analytics, Analysis of the 2021/2022 RPM Base Residual Auction: Revised at 2 (August 24, 2018) http://www.monitoringanalytics.com/reports/Reports/2018/IMM_Analysis_of_the_20212022_RPM_BRA_Revised_20180824.pdf

[36] Responsive Affidavit of Robert McCullough at PP 12, 17-19.

[37] *Id*. at PP 21-25, 29-32.

[38] *Id*. at PP 28, 29.

The deficiencies in the operation of the RPM are amplified when market power is present. The problem of market power in the RPM is well established, and recent reports have recognized that efforts to restrain it are not effective.[39] In the ComEd zone, the People demonstrated that in the last auction, one generator owns about 38% of the offered megawatts.[40] If that generator and its load were removed (for example pursuant to an FRR-Alternative or PJM's RCO), three remaining generators would together control 70% of the remaining capacity.[41] With only three bidders controlling so much capacity, it is predictable that they may act jointly or individually to maximize their total capacity market revenues without regard to the costs of individual units, or, adjust their bids to displace imports from the Rest of RTO Zone that may drive down the zonal price.[42] The persisting market power in the ComEd zone, with or without ZEC subsidized units, can be expected to drive prices above a competitive level irrespective of a minimum price.

Illinois is the only PJM state that currently has significant out-of-market revenues for capacity resources in place, with ZEC payments equaling more than $100 million for a single plant (Quad Cities).[43] Yet, capacity prices have increased, not decreased, calling into question the premise that out-of-market revenues are depressing capacity prices. If the Commission chooses to adopt an expanded minimum price rule or order PJM to create a new FRR construct for subsidized resources, it must address the anomalies in the PJM capacity market that are

[39] Monitoring Analytics, Analysis of the 2021/2022 RPM Base Residual Auction: Revised at 2 (August 24, 2018) http://www.monitoringanalytics.com/reports/Reports/2018/IMM_Analysis_of_the_20212022_RPM_BRA_Revised_20180824.pdf

[40] Initial Brief of the People of the State of Illinois at 7.

[41] Responsive Affidavit of Robert McCullough at P 41, 46.

[42] *Id.*

[43] Illinois Power Agency, Zero Emission Standard, Final Payment Calculation Notice of the Illinois Power Agency, Delivery Year: June 1, 2017 through May 31, 2018 (February 8, 2018), available at https://www2.illinois.gov/sites/ipa/Documents/2017ProcurementPlan/Comments/IPA-Payment-Calculation-Notice-Delivery-Year-2017-2018.PDF

inexplicably and unreasonably inflating capacity prices and costing Illinois consumers alone hundreds of millions of dollars per year.[44]

Unlike the Midcontinent Independent System Operator (MISO), PJM does not make masked bidding from its capacity construct public. As a result, it is difficult for the public and for stakeholders to identify the kinds of problems described above, and the lack of transparency enables both the exercise of market power and unjust and unreasonable outcomes. The People request that the Commission direct PJM to release masked bidding data as part of its Order addressing the anomalies identified above.

## III. If The Commission Adopts An FRR-Alternative Option, It Should Require State Approval For A Resource To Opt Into It.

While the People support the proposal of the IMM and urge the Commission to reject a FRR-Alternative and the PJM Resource Carve-Out and RCO, the Commission indicated that a subsidized resource that would be subject to the MOPR under its Order should have the option to exit the capacity market with a commensurate amount of load and potentially receive out-of-market support from the state.[45] The Order implied that resources subject to the MOPR could be expected to fail to clear the capacity market, assuming that the minimum price would exceed the market price. However, as indicated by both PJM and the IMM and discussed above, a correctly defined minimum offer is net ACR, and should not be expected to inevitably increase the bids of subsidized (or other) resources above market levels.[46]

[44] For example, in the ComEd zone, for 2021/2022 the capacity payments equal about $1.6 billion ($195.5 clearing price*365 days*22,358 megawatts). If those payments are overstated due to misspecifications in the operation of the capacity market by an average of 13%, consumers are paying $200 million more solely due to anomalies in the application of the RPM.

[45] Order at P 160-161.

[46] IMM Summary Of The Sustainable Market Rule Proposal Of The Independent Market Monitor For PJM at 4; Initial Submission of PJM Interconnection, L.L.C. at 46 (indicating that the ACR for dual unit nuclear generation is $593, which would be netted against expected energy and ancillary services revenues, resulting in a bid below

Assuming that the Commission adopts net ACR as the minimum offer, the Commission should revisit the question of whether an FRR-Alternative is necessary to accommodate state resources. Regardless of the minimum offer definition the Commission adopts, the option to go to the FRR-Alternative and be treated as a capacity resource priced outside the BRA, should be subject to state approval. The subsidized resource should not control whether the state is expected to provide revenues to substitute for capacity revenues.

Some parties have asserted that if subsidized resources do not clear the capacity market, consumers in those states will become obligated to pay for redundant capacity because the subsidized resources would be obligated to provide service even if they are not designated as a capacity resource.[47] However, some state subsidies are limited to energy services, and do not include a capacity commitment.[48] As indicated by the number of megawatts that do not clear the capacity market, a resource can provide energy without the obligations associated with capacity. If a state concludes that a state subsidy is appropriate for capacity purposes, only the state – not the resource – should be authorized to make that election.

## IV. The FRR-Alternative Will Not Be Effective Or Even Feasible Without Sufficient Time For States To Respond To The Commission's Final Order.

While many parties emphasized the importance of the FRR-Alternative to assure that state policies are "accommodated" if the Commission insists that all resources that receive out-of-market payments bid into the PJM capacity market at a high "minimum price," the initial filings make it clear that states, generators, and other stakeholders will need sufficient time to

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current clearing prices, utilizing net revenues reported by the IMM in the 2018 Quarterly State of the Market Report for PJM: January through June, Section 7).

[47] See, *e.g.,* Initial Brief of Exelon Corporation at 9.

[48] The Illinois Zero Emissions Credit (ZEC) law pays the designated nuclear generator for megawatt hours of service and does not include a capacity obligation. 20 ILCS 3855/1-75(d-5)(1).

develop, adopt, and respond to statutes, policies, rules, and regulatory action to implement an FRR-Alternative. While the Commission has indicated that it will "make every effort to issue an order establishing the just and reasonable replacement rate no later than January 4, 2019,"[49] the Commission should make clear that it will refrain from imposing the MOPR or other rule that affects or limits generators' participation in the PJM capacity market, until the states have certified that they have established the processes necessary to offer a viable FRR-Alternative.[50]

Several states emphasized the importance of the FRR-Alternative to states' ability to provide appropriate treatment of subsidized resources. In addition to the Initial Brief of the People of the State of Illinois that stressed that states will require time to develop and implement an FRR-Alternative,[51] the Illinois Commerce Commission correctly asserted that:

> In order to address the legislative gap opened up by the Commission's June 29 Order, Illinois, and likely other states, will require time to consider and enact legislation to enable the FRR-Alternative or other accommodating measures to be meaningful and usable by the owners of resources targeted for MOPR. Such efforts may require revisiting some of the fundamental principles underlying decades-old industry restructuring legislation. … Accomplishing and implementing these legislative and regulatory measures in each of the states impacted by the Commission's June 29 MOPR decision, prior to the PJM's posting deadline for the 2019 auction parameters is daunting, if not impossible.[52]

The Organization of PJM States, Inc. (OPSI), which represents the state commissions in the thirteen states and the District of Columbia served by PJM,[53] filed an argument that recognized that if capacity prices are not set in a competitive PJM process, states and state public utility commissions will have to assume the responsibilities of assuring just and reasonable charges and

[49] *Id*. at ¶172.
[50] Initial Brief of the People of the State of Illinois at 18-19.
[51] *Id*.
[52] Comments of the Illinois Commerce Commission at 6.
[53] https://opsi.us/

of addressing market power in their jurisdictions.[54] States and state commissions will require substantial investigation and analysis to develop processes to replace the competitive effect of the PJM capacity market.

Several parties suggested that removing low bids from the capacity auction may increase prices to unreasonable levels and exacerbate market power concerns by effectively removing megawatts from the bottom of the supply curve. As the New Jersey Board of Public Utilities pointed out, PJM's 2020/2021 market analysis showed that "removing 3,000 MW of generation from the bottom of the supply curve in the MAAC zone, results in a price increase in EMAAC of $103.37/MW-day relative to the actual auction clearing price"[55] equal to a 55.5% increase. The same exercise for the 2021/2022 BRA has prices in EMAAC increasing $34.31 or 20.7%.[56] PJM's sensitivity analyses for 2021/2022 show that in ten or eleven out of fifteen regions, prices increase when 3000 or 6000 megawatts are removed from the bottom of the demand curve, a proxy for the effect of allowing resources to opt out of the RPM or of an unreasonably high minimum bid requirement.[57] Some prices increased by as much as $291.63 or 142.7% in the analysis.[58] [59] By contrast, the IMM reported that if at-risk resources are moved to an FRR and out of the RPM, clearing prices in several zones can be expected to decline by 0.2% to 65.1%.[60] Clearly, states will need time to tease out the anticipated effects of both a minimum offer requirement and a possible FRR-Alternative.

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[54] Argument of the Organization of PJM States, Inc. at 4.
[55] Initial Argument of the New Jersey Board of Public Utilities at 7.
[56] PJM Scenario Analysis for Base Residual Auction, 2021/2022, *compare* Scenarios Base, 2, 4, 6, and 8. https://pjm.com/markets-and-operations/rpm.aspx
[57] *Id.*
[58] *Id.* at PSEG and PS-North
[59] The effect of removing supply in the ComEd zone was negligible, reflecting the effect of a pivotal supplier that owns close to 50% of the local capacity requirement. See Initial Brief of the People of the State of Illinois at 6-9.
[60] Brief of the IMM for PJM, Attachment A, MOPR/FRR Sensitivity Analysis of the 2021/2022 RMP Base Residual Auction, September 26, 2018 at 4-5. The Sensitivity Analysis further shows that the removal of various portions of coal and nuclear capacity to an FRR also reduces capacity prices by substantial percentages. *Id.* at 7-9.

The Comments of Clean Energy and Consumer Advocates identify many of the problems associated with a premature move to a new FRR-Alternative and recommend a certification process so that the MOPR requirement is not imposed until a state process is in place.[61] In addition to the need for all stakeholders to develop and understand a new FRR, the Commission needs to account for the problem associated with the fact that many load-serving entities are in fact part of the same corporate family as the resource. For example, in northern Illinois, Commonwealth Edison Company ("ComEd") is the distribution utility for the vast majority of Illinois consumers in PJM, and it is owned by Exelon Corporation. Exelon Generation, also a subsidiary of Exelon Corporation, owns five nuclear power plants in the ComEd zone, of which one is currently receiving zero emission credits pursuant to state law.[62] In order to avoid self-dealing, states will have to put laws in place to govern capacity contracts between affiliates.

While the terms of the certification by the local public utility commission proposed by the Clean Energy and Consumer Advocates are reasonable, the deferral of the MOPR requirement should not be limited to a single year. The adoption and implementation of state legislation is a complex process and may take more than a single year. State efforts to replace market rates with a state administrative or regulated rate will require critical economic, policy, and procedure decisions to determine which resources will be subsidized, capacity price formulas and levels, which resources and how much capacity are subject to state procurement, which state agency will be responsible for implementing the FRR-Alternative, how much the FRR-Alternative will cost, and of course which consumers will pay the new rate and in what proportions. All of these decisions will have to be made in each state's political climate where

[61] Comments of Clean Energy and Consumer Advocates at 25-31 & App. A at 9.
[62] See 20 ILCS 3855/1-75(d-5)(1); Illinois Power Agency, Zero Emission Standard, Final Payment Calculation Notice of the Illinois Power Agency, Delivery Year: June 1, 2017 through May 31, 2018 (February 8, 2018), available at https://www2.illinois.gov/sites/ipa/Documents/2017ProcurementPlan/Comments/IPA-Payment-Calculation-Notice-Delivery-Year-2017-2018.PDF

competing priorities and local conditions may result in these matters not getting the full attention they require. The Commission should not impose the MOPR requirement until state processes are in place, and not limit state certifications that an FRR-Alternative is in place to a single year.

## V. The Interest Of States, Generators, And Other Groups In The FRR-Alternative Reinforces The Need For The Commission To Set A Cap On Final Capacity Prices.

The justification and need for a state specific capacity price are greatly diminished in the event that the Commission adopts as net ACR to set the minimum price for capacity resources. The minimum price should not be expected to exclude resources, and is low enough to assure that resources could offer bids that reflect their needs, in competition with other resources. However, even if states are authorized to set capacity prices for subsidized resources, the Commission has "exclusive jurisdiction over the wholesale rates of both subsidized and unsubsidized resources, and a statutory obligation to ensure that they are just and reasonable."[63] As the People asserted in their Initial Brief, the price for capacity set by a state should be limited to net-ACR.[64] A capacity price set by a state must include all revenues available to cover avoidable costs—PJM revenues as well as state out-of-market revenues. This assures that the resulting FRR Alternative capacity price achieves both the goal of retaining state preferred resources and the requirement that FERC-jurisdictional rates are just and reasonable.

To the extent that a resource is not satisfied with a capacity charge based on net ACR including state revenues, the resource would have the option to participate in the PJM capacity construct where it could compete among other resources whose bids are not capped or determined by the state or by an administrative process. This would result in state capacity

[63] Order at 158.
[64] Initial Brief of the People of the State of Illinois at 17.

prices that cover avoidable costs enabling the resource to continue operation, while protecting consumers from the risks of unreasonably high prices that are not constrained by competition or other wholesale market rules. Further discussion of the utilization of price caps to assure just and reasonable replacement capacity prices is in the People's Initial Brief at pages 14-17, and will not be repeated here.

## VI. Conclusion

For the foregoing reasons, the People of the State of Illinois respectfully request that the Commission adopt the recommendations above.

Respectfully submitted,

Dated: November 6, 2018

_____/s/_____

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## CERTIFICATE OF SERVICE

I hereby certify that I have this day served, via first-class mail, electronic transmission, or hand-delivery the foregoing upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Chicago, Illinois this 6th day of November, 2018.

_____/s/_____

Susan L. Satter
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ATTACHMENT A – Responsive Affidavit of Robert McCullough

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

| | | |
|---|---|---|
| Calpine Corporation, Dynegy In., Eastern Generation, LLC, Homer City Generation, L.P., NRG Power Marketing LLC, GenOn Energy Management, LLC, Carroll County Energy LLC, C.P. Crane LLC, Essential Power, LLC, Essential Power OPP, LLC, Essential Power Rock Springs LLC, Lakewood Cogeneration, L.P., GDF SEZ Energy Marketing NA, Inc., Oregon Clean Energy, LC and Panda Power Generation Infrastructure Fund, LLC | ) | Docket Nos. EL 16-49-000 |
| v. | ) | |
| PJM Interconnection, L.L.C. | ) | ER 18-1314-000 |
| PJM Interconnection, L.L.C. | ) | ER 18-1314-001 |
| PJM Interconnection, L.L.C | ) | EL 18-178-000 (Consolidated) |

**AFFDAVIT OF ROBERT McCULLOUGH**

1. My name is Robert McCullough. My business address is 6123 S.E. Reed College Place, Portland, Oregon 97202. I have been active as an expert in the field of energy for the past thirty-nine years. I have testified before the Commission, in U.S. and Canadian courts, at state and provincial regulatory commissions, and before Congress on many occasions. My qualifications are Attachment 1 to this affidavit.

2. Materials submitted in this proceeding have assumed, without reference to the evidence or economic theory, that capacity bids are dependent on out-of-market revenues. It is important to note that only one of PJM's markets has a subsidized pivotal capacity supplier. In that market, the ComEd Zone, capacity prices increased in the most recent auction. This occurred even though the Quad Cities unit received subsidies, transmission access into the ComEd Zone increased, and the new tax plan reduced the costs of the plant's owners.

3. This affidavit focuses primarily on the ComEd Zone since it is the only example of the issues in this proceeding. However, it is worth observing that the costs of both existing and new capacity decreased when the new, lowered corporate tax rate was signed onto law on December 22, 2017. If the underlying belief that pervades this proceeding was remotely correct, capacity bids and the resulting prices in the ComEd zone would have

decreased this year. The opposite is the case in the ComEd zone and throughout PJM. In the 2020/2021 Auction the melded price was $116.63/MW/Day.[1] In the 2021/2022 Auction, the melded price increased by 34.76%.[2]

| | 2020/2021 BRA Resource Clearing Prices ($/MW-day) | | | | |
|---|---|---|---|---|---|
| Capacity Type | Rest of RTO | MAAC | EMAAC | COMED | DEOK |
| Capacity Performance | $76.53 | $86.04 | $187.87 | $188.12 | $130.00 |

*Figure 1. Clearing prices in 2020-2021 Base Residual Auction.*[3]

| | 2021/22 BRA Resource Clearing Prices ($/MW-day) | | | | | |
|---|---|---|---|---|---|---|
| Capacity Type | Rest of RTO | EMAAC | PSEG | BGE | ATSI | COMED |
| Capacity Performance | $140.00 | $165.73 | $204.29 | $200.30 | $171.33 | $195.55 |

*Figure 2. Clearing prices in 2021-2022 Base Residual Auction.*[4]

Although the zonal descriptions vary from auction to auction, the only zone in PJM where prices decreased was the remainder of EMAAC after PSEG was formed into a new zone.

4. In this case, only two other parties – the Independent Market Monitor and the Illinois Commerce Commission – made substantive comments on the capacity market in their initial filings.[5,6] Other parties introduced speculative positions based, at best, on hypothetical evidence, or, at worst, no evidence at all.

5. Before adding another level of complexity to the BRA/RPM's already incredibly complex structure, it is useful to consider why the prices went up in this year's auction, even though costs went down. There are four different reasons why prices in the RPM have a tenuous connection to supply and demand:

    a. There is little basis for the underlying algorithm in economic theory;

    b. The algorithm is basically undocumented and major players in the market disagree on the operation of central elements;

    c. The structure of the model invites gaming by more sophisticated participants;

    d. And many participants possess substantial market power.

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[1] 2020/2021 RPM Base Residual Auction Results (Excel)
[2] 2021/2022 RPM Base Residual Auction Results (Excel)
[3] 2020/2021 RPM Base Residual Auction Results
[4] 2021/2022 RPM Base Residual Auction Results
[5] Brief of the Independent Market Monitor for PJM under EL16-49, et al., filed October 2, 2018
[6] Comments of the Illinois Commerce Commission under EL16-49, et al., filed October 2, 2018

6. Since Adam Smith in 1776 dispensed with "those who affected to trade for the public good" we might consider that market participants – especially for-profit entities – have a fiduciary responsibility to their investors to trade for the private good.[7] Prices in the ComEd zone are determined by the pivotal supplier whose actions are designed to maximize their long-term profits. In the most recent auction, Exelon had only two profit maximizing choices:

   Option A: Construct its bids to provide capacity as the market clearing bidder. This is the role of a price leader who accepts a reduction in market share while maintaining a high market price; or,

   Option B: Lowering its bid below the RTO imports into the ComEd Zone and clearing all of its units.

7. Given Exelon's contemporaneous announcement that only some of its units cleared the auction, it is clear that it chose Option A.[8] Option B could have provided a comparable level of revenue, but would have exposed Exelon to the risk that the RTO Zone price might have fallen below the $140/MW/Day level. Setting a minimum offer for the Exelon portions of the Quad Cities units would not have affected the outcome of the 2021/2022 auction in any fashion, since the clearing price was determined by the bids of marginal resources (Byron) and not that of Quad Cities.

## I. There is little basis for PJM's underlying algorithm in economic theory.

8. The most basic chart used in the teaching of economics is the supply and demand chart drawn on the board by multitudes of professors over the past two hundred years. Below is the chart from Alfred Marshall's *Principles of Economics* published in 1890:

[7] Wealth of Nations, Adam Smith, 1776, Book 4, Chapter 2, para. 9

[8] Exelon Announces Outcome of 2021-2022 PJM Capacity Auction, Exelon, May 24, 2018.

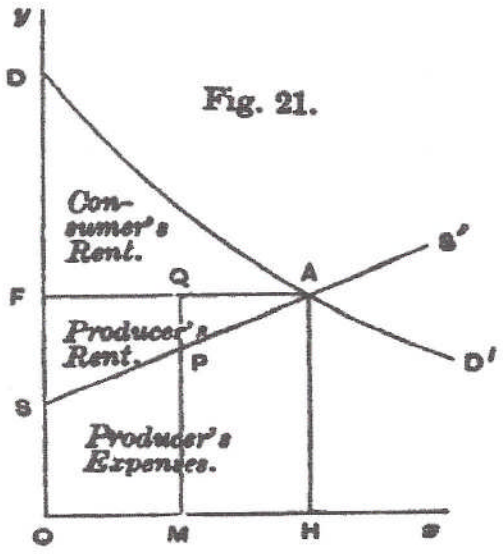


*Figure 3. Marshall's supply and demand curves in a competitive market.*[9,10]

9. Economic theory holds that the optimal market outcome is at point **A** in Alfred Marshall's graph above, where the amount supplied equals the amount demanded. PJM has largely dismissed this with an alternative theory – held, to the best of my research – only at PJM. In their formulation, **A** is dispensed with and the most efficient outcome is found by maximizing the area between the demand curve and the supply curve. In the language of more modern texts, they are maximizing the producer and consumer suplus.[11] In the simple example above, the outcome is the same – maximizing rents gives the same answer as adopting the standard rule that markets should settle where demand equals supply.

10. Unfortunately, PJM did not stop there. PJM has allowed its algorithm to juggle components of the supply curve in order to find the largest producer and consumer surplus area. There is no easy proof that this is an efficient outcome. In fact, the juggling activity necessarily produces prices higher than **A** and quantities that may or may not be surplus or deficient to consumer needs.

11. As discussed below, important parts of the algorithm are undocumented. Two aspects of the algorithm can have a major impact on outcomes. First, if the algorithm determines that reaching point **A** is inappropriate, it will simply choose to stop at a point to the left of **A** which I have marked in red as **A′**.

---

[9] Principles of Economics, Alfred Marshall, 1890, page 429.
[10] Please note that "Fig. 21" reflects the caption from Professor Marshall's original textbook.
[11] Professor Marshall used the term "consumer's rent" and "producer's rent" with same meaning as our current terminology.

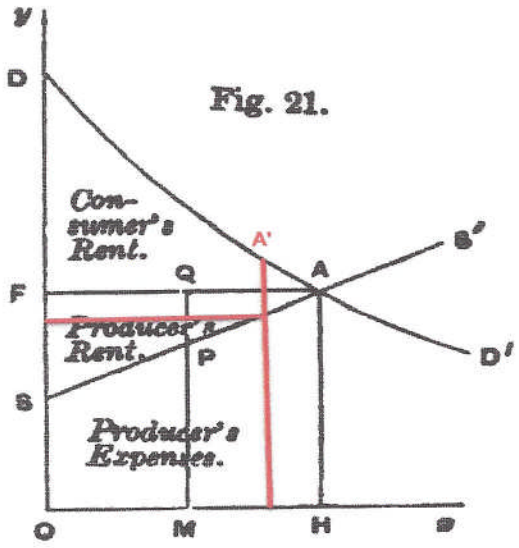


*Figure 4. The "vertical line" solution, adapted from Marshall, PJM.*

In this case the algorithm has determined that stopping short of the standard economic solution is appropriate, leading to a smaller quantity supplied than consumers would prefer at a significantly higher price – **A′**. This is referred to as a "vertical line" solution since the price is determined by a vertical line drawn upwards from the last allowed bid.

12. Alternatively, the algorithm can choose to purchase more capacity than required by the demand curve. In this case the algorithm determines that the best solution is to purchase more capacity than is required which I have marked in red as **A″**:

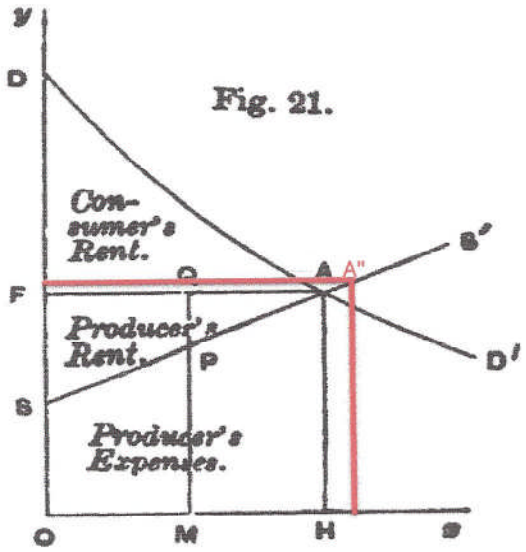


*Figure 5. The "make whole" solution, adapted from Marshall, PJM.*

13. This adjustment is called "make whole". The price impact of "make whole" is the cost of the unneeded supply allocated over all of the consumers in the zone.

14. Neither of these adjustments can be found in any textbook, nor are they consistent with any prevailing economic theories. The most recent PJM Capacity Market manual states:

> In the PJM Region, the basis for the Capacity Market design is the Reliability Pricing Model (RPM). The goal of RPM is to align capacity pricing with system reliability requirements and to provide transparent information to all market participants far enough in advance for actionable response to the information.[12]

15. Economists would put this more simply. Price signals are used to guide future investment and consumption decisions. The current algorithm reflects a degree of the demand and supply information market participants need to guide future investment and operation decisions. Unfortunately, the RPM then veers from that goal by introducing extraneous factors in the attempt to solve bidding issues that are not germane to the basic goal, and that arise as artifacts introduced by RPM's designers.[13]

## II. The Algorithm Is Basically Undocumented and Major Players in The Market Disagree on The Operation of Central Elements.

16. The PJM web site contains an eleven-year-old description of the algorithm lacking significant structural components and lacking updates for the past eleven years of regulatory changes approved by the FERC.[14] The document admits its deficiencies at the outset:

> Some of the logic employed in the optimization such as Flexible Self-Scheduling, Tie-Breaking, and Make-Whole, is not discussed in this document as the intent is to explain the core formulation.[15]

17. After several discussions with PJM, it is apparent that the PJM staff do not have a copy of the full specification of the algorithm. Moreover, there is some evidence that their understanding of the algorithm may be inconsistent with a detailed review of the scenarios released by PJM and the Independent Market Monitor.[16,17]

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[12] PJM Manual 18: PJM Capacity Market Revision: 40, PJM Capacity Market Operations, February 22, 2018, page 15.
[13] We have been unable to find source documents supporting these artifacts as the next section discusses in detail.
[14] Fax Cover, Adam Keech, December 12, 2007.
[15] Ibid., page 1.
[16] Scenario Analysis for 2021/2022 Base Residual Auction, PJM, September 4, 2018.
[17] MOPR/FRR Sensitivity Analyses of the 2021/2022 RPM Base Residual Auction, Independent Market Monitor for PJM, September 26, 2018.

18. Although the 2007 summary is missing a number of critical details, the single most important missing component is the section that would explain how and when the algorithm "skips over" components of the supply curve. Why hide how supplier bids are handled?

19. In submitting a bid, each resource can be entered as one to ten independent parts of the resource. Each part can be entered as "flexible" or "inflexible". This bidding process involves a decision by a bidder today to break a single indivisible power plant into random components and label some parts as normal bids (flexible) and label other parts as "take it or leave it" (inflexible).

20. The determination that a specific bid's quantity is inflexible is not a true market signal. This determination provides no guidance for investors trying to determine the location of a new factory or a new power plant. In three years, when the auction prices take effect, investment decisions can be sized efficiently in the real world to meet a variety of requirements – fuel, location, transmission and others, if accurate market signals are given.

21. How does the algorithm determine which bids should clear and which should not? This important issue is not specified in PJM's documents or FERC filings. Normally, we would return to standard economic theory and make a determination based on the concepts of producer and consumer surplus:

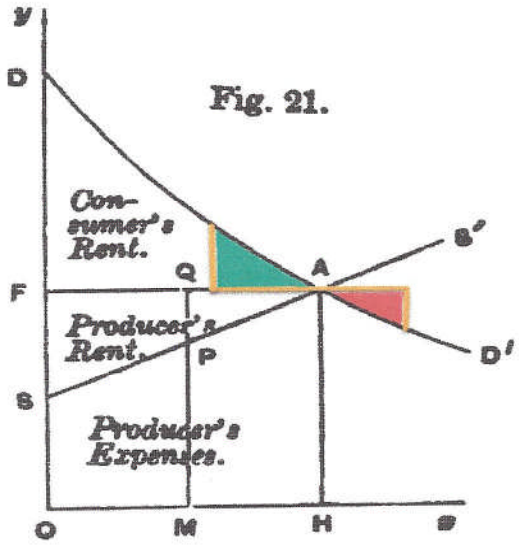


*Figure 6. The decision rule used when the marginal resource is an "inflexible" sell offer.*

22. In the chart above, a bid is considered by the algorithm that has the correct price for inclusion in the solution, but it has been marked as "inflexible". The algorithm would normally consider the gains to the producer – the green triangle – versus the costs to consumers – the red triangle. If the costs to the consumer are greater than the gains to the

producer, then the bid is rejected and the supply curve considers alternative bids that the algorithm finds more attractive. If the cost to the consumer is less than the benefit to the producer, the bid is accepted.

23. This approach is the approach that the staff at McCullough Research considered most consistent with economic theory.

24. In deconstructing the various scenarios, we found that this formulation provided the closest match to the reported results.

25. We were surprised to find that in our discussions and emails with PJM that they have an alternative approach:

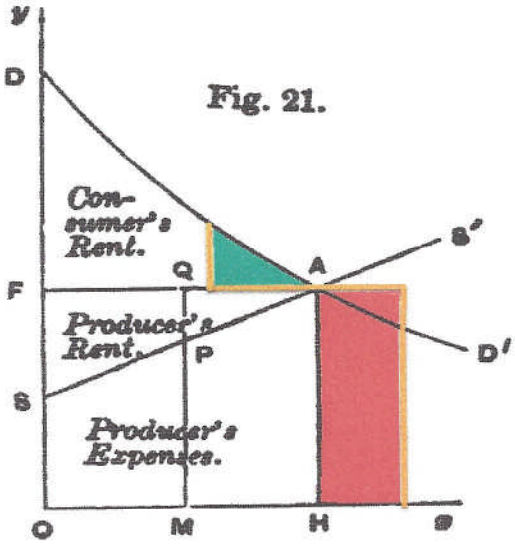


*Figure 7. Alternative decision rule for the case of a marginal inflexible sell offer, as described by PJM.*[18]

26. The PJM alternative turns out to be very important. This has a dramatic impact on clearing prices determined by the algorithm – increasing them by almost 15%. The mainstream economic approach roughly will reject inflexible bids one half of the time and accept inflexible bids the rest of the time. PJM's approach will almost always reject the inflexible bid because the cost to the consumer is overstated. If the bid is rejected, then the prices are determined by "clearing the auction at the higher-priced point on the Variable Resource Requirement Curve that corresponds to the Unforced Capacity provided by all Sell Offers located entirely below the Variable Resource Requirement Curve."[19] The tariff language describes the point where a vertical line drawn from the last

[18] Email from Patrick Bruno dated October 18, 2018.
[19] Conduct of RPM Base Residual Auctions, PJM Open Access Transmission Tariff, Attachment DD.5.12(a).

acceptable bid intersects the demand curve, as shown in the figure accompanying paragraph 11 above.[20]

27. Like many other undocumented features of the PJM algorithm, this would seem to reflect a programmer's decision that has not been presented to or approved by FERC.[21]

28. We have modelled both options using the Monte Carlo method of random experiments. This approach was pioneered at the Manhattan Project during the Second World War in order to model nuclear reactions using the relatively primitive computers of the era. Today, it is easy to build a Monte Carlo model of the capacity market in Northern Illinois.

29. The first step is to estimate the likely bid quantities based on data provide by PJM. There is some uncertainty in this approach which is one of the reasons why a Monte Carlo model is appropriate. Our Monte Carlo model runs 100,000 different simulations (commonly referred to as "games") of the ComEd zone using random bid prices. Once the bid quantities and prices are arranged in a supply curve, the first candidate bid is analyzed to see whether it will be accepted as a "make whole" resource or rejected and the next most optimal resource should be considered. If a "make whole" resource is not selected, then the model calculates the "vertical line" solution.[22, 23]

30. Our Monte Carlo results indicate that application of traditional economic theory, that is comparing the producer and consumer surplus represented by the triangles in Figure 6 above, produces results that are 12% higher than results that would be obtained if the clearing price was simply set to the price where the supply curve intercepts the demand curve. Alternatively, if PJM's assumptions concerning the optimal decision to skip over the marginal resource and revert to the vertical line are used, this results in substantially higher prices – 26% higher than the price where the demand curve crosses the supply curve.

31. Using the optimization approach consistent with economic theory shows that PJM's approach results in a margin over competitive prices of 12.9% with a 95% confidence interval between 12.79% and 13.08%:

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[20] The problems do not stop here. The process is intrinsically iterative – one exclusion may well trigger another and so on. Normal optimization techniques handle such problems poorly and frequently fail to find optimal solutions. There is some evidence from the IMM and PJM scenarios that this is the case with the RPM algorithm.

[21] In attempting to understand the algorithm we started with Sections 5.12, Conduct of RPM Auctions, and Section 5.14, Clearing Prices and Charges, of the PJM tariff. We also searched the seventy-nine documents referenced in the web site for these sections. We also reviewed the PJM Capacity Market Manual and the 2007 description of the PJM algorithm.

[22] It should be noted that if the marginal bidder selects inflexible bids – an optimal choice in almost all cases – the clearing prices are always equal to or higher than the prices that would be calculated if bids were "flexible."

[23] A third alternative where the demand curve intersects the supply curve between two steps in the supply curve occurs approximately 5% of the time. In this case, we have followed standard economic theory and set the price equal to the intersection between the demand curve and the vertical line connecting the two bids. It is unknown what the PJM algorithm does in this case.

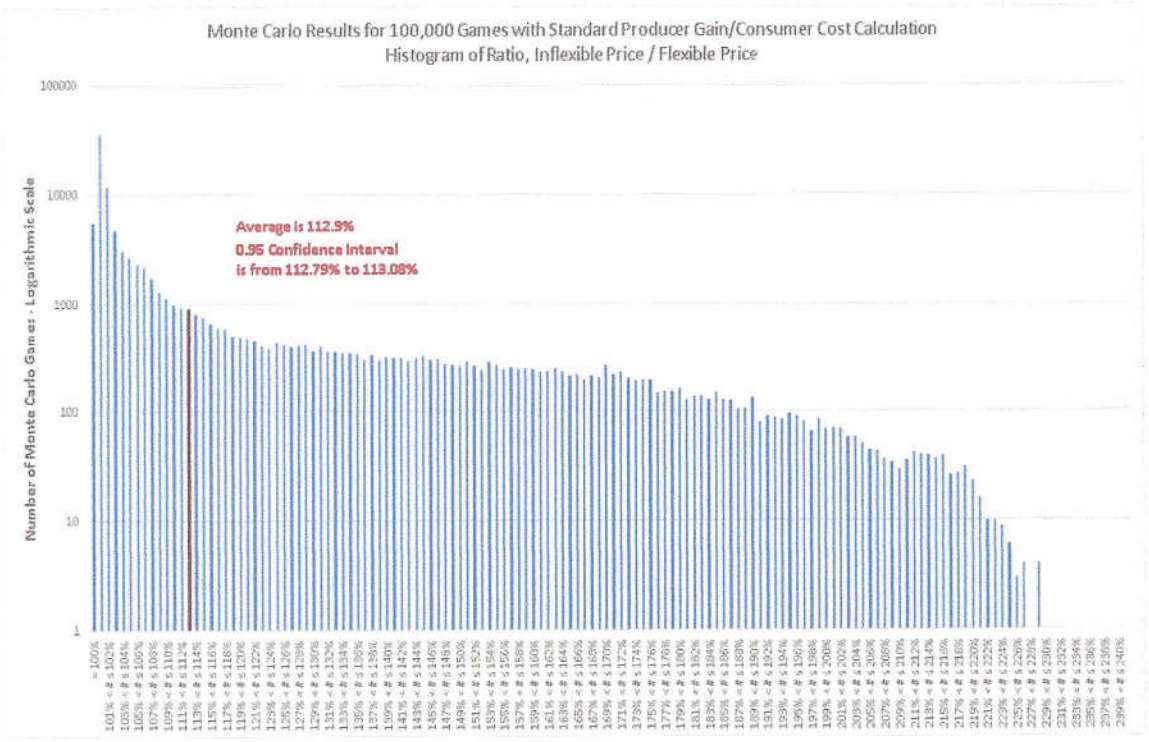


*Figure 8. Monte Carlo results under standard inflexible offer decision rule.*

32. It is easy to run the same 100,000 set of simulations with PJM's alternate theory of how the algorithm decides which bids are "make whole" or "vertical line" clearing-price solutions:

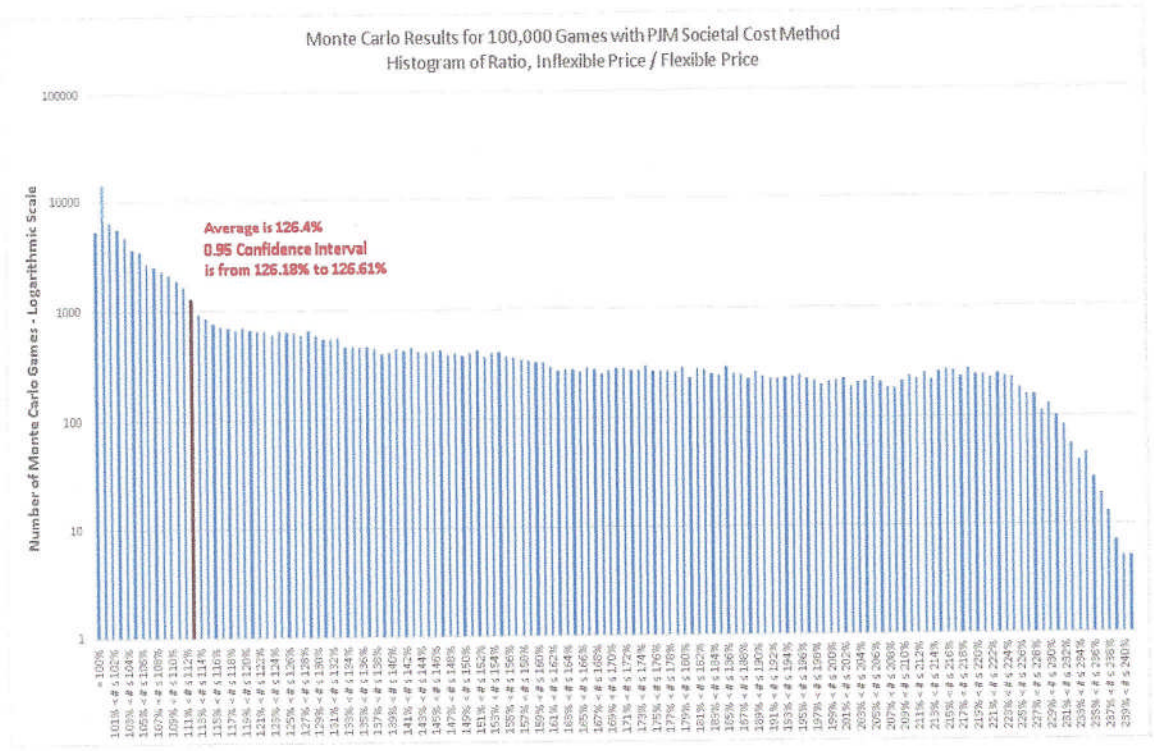


*Figure 9. Monte Carlo results under PJM alternative inflexible offer decision rule.*

33. The results from our model of Northern Illinois indicates that if PJM's description of the model is correct, capacity prices on average are 26% higher than the offer prices of the marginal resource meeting the demand curve, due primarily to the "vertical line" solutions.

34. The Monte Carlo model also allows us to evaluate the relevance of a minimum offer on the distribution of prices in the ComEd Zone:

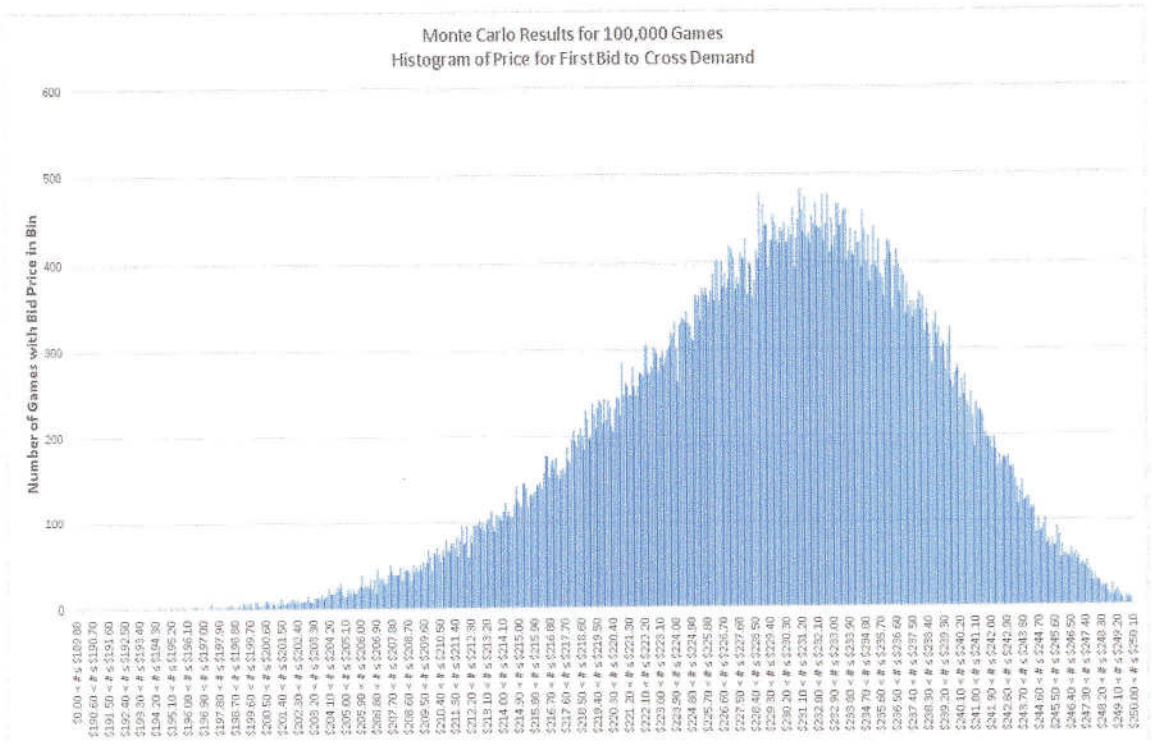


*Figure 10. Monte Carlo distribution of marginal resource offer prices.*

As can be seen in the histogram of results above, the probability that market clearing prices will ever fall low enough to be affected by minimum offer rules is itself minimal.

## III. The Structure of The Algorithm Invites Gaming by More Sophisticated Participants

35. There is an old Enron exploit designed to raise payments to reliability must-run plants. Originally practiced in Texas, it has been rediscovered (or perhaps simply reemployed by traders moving from one employer to another) in other areas. The exploit is relatively simple. The owner of the reliability must-run unit that makes bids or dispatch instructions designed to place the unit offline just before it will be needed in the next period. Bringing the unit from standby to full operation triggers additional payments to the unit when it is actually needed to preserve system stability.

36. The inflexible option can be utilized in a roughly parallel fashion. Even if a specific bidder may not control a large percentage of the total market, any sufficiently large percentage can allow the bidder to set the marginal bid. If the bid is not selected by the algorithm, the bidder will lose the marginal bid but gain the benefit of the vertical line up to the demand curve for other units it owns that did clear the auction. In the previous example from paragraphs 22-26 above, the marginal bid would have been rejected by the PJM calculation of net benefits. Once rejected, the price increases to **A′**:

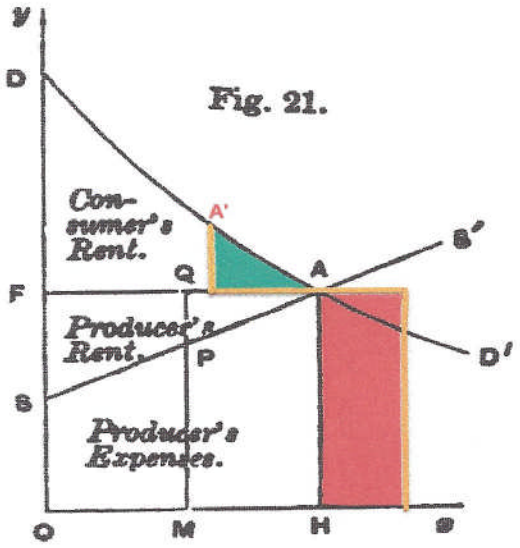


*Figure 11. An inflexible marginal offer gives rise to a "vertical line" solution and resultant price increase.*

37. The bidder will lose the revenues from the marginal bid, but will gain the difference between **A'** and **A** on all of its remaining resources. Since the slope of the demand curve is often quite steep, this is a profit-maximizing strategy in many cases.

38. This strategy is not available to all participants. First, the bidder must have the technical resources to accurately forecast the supply curve. This may be difficult for the large RTO Zone, but it is not terribly difficult for the smaller zones – especially when individual bidders comprise a larger share of the entire supply curve. Second, there is enough uncertainty in the supply curve that the inflexible bid must be large enough to fail the algorithm optimization regardless of possible errors in their forecast. Luckily for the possible bidder, the remote chance that the bid is actually accepted still confers benefits since in that case the bidder will receive "make whole" payments from PJM.

39. Price leadership has both rewards and penalties. Currently, Saudi Arabia has been forced to curtail oil production to offset burgeoning supplies from U.S. and Canadian producers. This is an optimal strategy for Saudi Arabia since keeping high prices on part of its capacity is better than lower prices on all of its oil production capacity. Like Saudi Arabia, Exelon can limit its participation in the market to maintain higher prices on some of its capacity rather than accept lower prices on all of its capacity.

40. The FRR option set out by FERC poses similar risks. Northern Illinois currently has one supplier whose market share is more than sufficient to set the clearing price. If the current dominant bidder retires from the capacity market using the FRR option, it is not at all clear that the remaining market participants will make the same bids and that prices will fall.

## IV. Many Participants Possess Substantial Market Power

41. In the ComEd zone, if the dominant party leaves the stage with its associated load, the next three major bidders have seventy percent of the remaining capacity resources in the market. Any one of the three can elect to set the new clearing price with careful research. Nor is it likely that the other two dominant bidders will see the benefit of competing to set a lower clearing price since the market leaders' sacrifice benefits all parties.

42. Notwithstanding other issues, the reality of the PJM capacity market is that market power is not the exception. While Northern Illinois is a worst-case location for competitive outcomes, a number of major companies possess substantial market power in specific PJM capacity zones. PJM's willingness to continue to "calve off" portions of their region into smaller Locational Delivery Areas, or zones, reduces the technical obstacles to forecasting specific supply curves. It also magnifies the influence of specific companies in ever smaller regions.

43. In the case of the ComEd Zone, elimination of Exelon's market power – either through the FRR option for all of Exelon's nuclear units or through a ceiling on nuclear bids low enough to reduce imports of capacity from the RTO Zone – does not reduce the problem of market power.

44. The IMM has an interesting scenario in its August analysis where all of PJM's nuclear units are bid at $0/MW/Day in the 2021/2022 Auction. In Scenario 20, prices crash in the ComEd Zone, falling from $195.55/MW/Day to $71.48/MW/Day:

Table 46 Nuclear offers set to $0 per MW-day: 2021/2022 RPM Base Residual Auction

Scenario 20

| | | Actual Auction Results | | All Nuclear Offers at $0 per MW-day | |
|---|---|---|---|---|---|
| LDA | Product Type | Clearing Prices ($ per MW-day) | Cleared UCAP (MW) | Clearing Prices ($ per MW-day) | Cleared UCAP (MW) |
| RTO | Annual | $140.00 | 162,911.8 | $71.48 | 165,256.7 |
| | Summer | $140.00 | 715.5 | $71.48 | 587.6 |
| | Winter | $140.00 | 715.5 | $71.48 | 587.6 |
| RTO Total | | | 163,627.3 | | 165,844.3 |
| ATSI | Annual | $171.33 | 8,007.3 | $71.48 | 8,603.4 |
| | Summer | $171.33 | 6.3 | $71.48 | 6.2 |
| | Winter | $171.33 | 0.0 | $71.48 | 0.0 |
| ATSI Total | | | 8,007.3 | | 8,603.4 |
| EMAAC | Annual | $165.73 | 29,287.5 | $125.94 | 29,597.6 |
| | Summer | $165.73 | 88.0 | $125.94 | 86.7 |
| | Winter | $165.73 | 1.0 | $125.94 | 1.0 |
| EMAAC Total | | | 29,288.5 | | 29,598.6 |
| PSEG | Annual | $204.29 | 5,366.6 | $204.29 | 5,366.6 |
| | Summer | $204.29 | 9.3 | $204.29 | 9.2 |
| | Winter | $204.29 | 1.0 | $204.29 | 1.0 |
| PSEG Total | | | 5,367.6 | | 5,367.6 |
| BGE | Annual | $200.30 | 1,937.7 | $200.30 | 1,937.7 |
| | Summer | $200.30 | 85.0 | $200.30 | 83.5 |
| | Winter | $200.30 | 0.0 | $200.30 | 0.0 |
| BGE Total | | | 1,937.7 | | 1,937.7 |
| ComEd | Annual | $195.55 | 22,083.6 | $71.48 | 24,345.0 |
| | Summer | $195.55 | 274.5 | $71.48 | 154.4 |
| | Winter | $195.55 | 274.5 | $71.48 | 268.2 |
| ComEd Total | | | 22,358.1 | | 24,499.4 |
| DEOK | Annual | $140.00 | 2,733.3 | $128.47 | 2,636.3 |
| | Summer | $140.00 | 25.4 | $128.47 | 24.9 |
| | Winter | $140.00 | 0.0 | $128.47 | 0.0 |
| DEOK Total | | | 2,733.3 | | 2,636.3 |

*Figure 12. Reproduced from IMM Analysis of 2021/2022 BRA.*[24]

45. The flaw in this optimistic analysis is the assumption that the elimination of the market leader would leave all other bids unchanged. The removal of the pivotal bidder and the potential crash of capacity prices by $124.07/MW/Day would be a life and death market event for the remaining market participants. It is unlikely – very unlikely – that the loss of the market price leader would not affect the remaining market participants' bidding strategy.

[24] Analysis of the 2021/2022 RPM Base Residual Auction: Revised, Independent Market Monitor for PJM, August 24, 2018, page 117.

46. If Exelon were removed from the market through an FRR or some other mechanism, three firms would control 70% of the remaining capacity in Northern Illinois. They would face exactly the same decision that Exelon faced in the 2021/2022 auction:

    Option A: Act jointly or individually as market leaders; or,

    Option B: Lower their bids to displace imports from the RTO Zone.

47. Their decision will depend on the value of market bid cap adopted by PJM (currently Net CONE x B) and the market participants' sense of the tolerance of FERC, anti-trust authorities, and the Independent Market Monitor to accept "counter intuitive" market outcomes.[25,26] As in the 2021/2022 Auction, it is quite possible that prices would increase if they pursue Option A. The one thing that would not enter their calculations would be the existence of an expanded MOPR.

48. This completes my affidavit.

Signed and sworn under penalties of perjury this 6th day of November, 2018.

**Robert McCullough**

Signed and sworn before me this 6th day of November, 2018.

Notary Public

OFFICIAL STAMP
KAREN AMIN
NOTARY PUBLIC-OREGON
COMMISSION NO. 941984
MY COMMISSION EXPIRES AUGUST 20, 2019

[25] Analysis of the 2021/2022 RPM Base Residual Auction: Revised, Independent Market Monitor for PJM, August 24, 2018, page 11.

[26] The profit maximizing result would be for the market leaders to pursue the highest possible price allowed by the algorithm as described above in Section III of this affidavit. In the California energy crisis in 2000/2001, either through cooperation or a keen individual understanding of the California ISO's market algorithms, the quantities offered during system peaks were often simultaneously reduced by the five market leaders. The subsequent investigations found many market violations, but did not find a conspiracy between the market leaders to coordinate their bidding.

Document Content(s)