

UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, L.L.C.

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Docket Nos. EL19-58-003

**COMMENTS OF THE ELECTRIC POWER SUPPLY ASSOCIATION**

In accordance with the August 11, 2020 and August 25, 2020 notices issued by the Federal Energy Regulatory Commission (the “Commission”) in the above-captioned proceedings,<sup>1</sup> the Electric Power Supply Association (“EPSA”)<sup>2</sup> comments on the August 5, 2020 filing<sup>3</sup> by PJM Interconnection, L.L.C. (“PJM”)<sup>4</sup> in compliance with the Commission’s directive to propose a forward-looking energy and ancillary services offset (“EAS Offset”).<sup>5</sup> As discussed below and in the affidavit of Paul M. Sotkiewicz provided

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<sup>1</sup> See *PJM Interconnection, L.L.C.*, Notice of Filing, Docket No. EL19-58-003 (Aug. 3, 2020) (unreported); *PJM Interconnection, L.L.C.*, Notice Extending Comment Period, Docket No. EL19-58-003 (Aug. 25, 2020) (unreported).

<sup>2</sup> EPSA is the national trade association representing competitive power suppliers in the U.S. EPSA members provide reliable and competitively priced electricity from environmentally responsible facilities using a diverse mix of fuels and technologies. EPSA seeks to bring the benefits of competition to all power customers. This pleading represents the position of EPSA as an organization, but not necessarily the views of any particular member with respect to any issue. EPSA is a party to Docket No. EL19-58-000. See *PJM Interconnection, L.L.C.*, 171 FERC ¶ 61,153 at P 17 & Appendix B (2020) (the “May 21 Order”). As such, it is automatically a party to these and other subsequent sub-dockets of Docket No. EL19-58. See *Midwest Indep. Transmission Sys. Operator, Inc.*, 121 FERC ¶ 61,131 at P 5 (2007) (“When an entity is already a party in a particular docket, it need not file a separate motion to intervene in individual sub-dockets to maintain its party status.”).

<sup>3</sup> Reserve Market Enhancements Compliance Filing, Docket No. EL19-58-003 (filed Aug. 5, 2020) (the “Compliance Filing”).

<sup>4</sup> Capitalized terms not otherwise defined herein have the meaning set forth in the Compliance Filing or, if not therein defined, the PJM Open Access Transmission Tariff (the “Tariff”).

<sup>5</sup> See May 21 Order, 171 FERC ¶ 61,153 at PP 308-24.

in Attachment A hereto (the “Sotkiewicz Affidavit”),<sup>6</sup> EPSA believes that the tariff language proposed in the Compliance Filing complies with the Commission’s directives and articulates conceptually sound principles for calculating the EAS Offset on a forward-looking basis. That tariff language should, therefore, be accepted, as filed. EPSA does ask, however, that the Commission condition its acceptance of the Compliance Filing on PJM’s submitting an informational filing after conducting its first Base Residual Auction (“BRA”) with the forward-looking EAS Offset, and, more broadly, that the Commission make clear that future challenges to PJM’s implementation of the principles proposed in the Compliance Filing will not be deemed to be collateral attacks on its order accepting that filing.

EPSA urges the Commission to act expeditiously on the Compliance Filing in order to minimize any further delay in conducting the BRA for the 2022/2023 Delivery Year (the “2022/2023 BRA”). While PJM has previously stated its intent “to commence all pre-auction activities not predicated on the outcome of this compliance proceeding,”<sup>7</sup> there will be only so much it can do without the EAS Offset values, and, as EPSA and others, including PJM and the Independent Market Monitor for PJM, have emphasized, further delay in conducting the 2022/2023 BRA will have significant adverse effects on market participants.<sup>8</sup>

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<sup>6</sup> The Sotkiewicz Affidavit is signed under penalty of perjury, as contemplated by 28 U.S.C. § 1746 (2018), but is not notarized. See *Temporary Action to Facilitate Social Distancing*, 171 FERC ¶ 61,004 (2020) (waiving notarization requirements for documents submitted to the Commission). See also *Temporary Action to Facilitate Social Distancing*, 172 FERC ¶ 61,151 (2020) (extending waiver).

<sup>7</sup> Motion for Extension of Time and Shortened Comment Period of PJM Interconnection, L.L.C. at 4, Docket Nos. ER19-1486-000, *et al.* (filed June 25, 2020).

<sup>8</sup> See *id.* at 4 (recognizing “the negative impacts that further delay in running the next capacity auction can cause to market participants”); Answer of the Independent Market Monitor

As EPSA has previously discussed, the delay is not only negatively impacting market participants; it is also compromising a key element of the Reliability Pricing Model (“RPM”) market design: the three-year forward period.<sup>9</sup> The three-year forward period performs an essential role in facilitating rational planning for exit and entry in the RPM market. At this point, it appears unlikely that PJM will be able to conduct the 2022/2023 BRA before March 2021, which would see the forward period truncated to just 14 months. EPSA urges the Commission to do everything in its power to prevent the forward period from being truncated even further.

## **I. BACKGROUND**

In the May 5 Order, the Commission found provisions of the Amended and Restated Operating Agreement of PJM relating to the operating reserve market to be unjust and unreasonable and largely accepted revisions to those provisions and corresponding provisions of the Tariff proposed by PJM.<sup>10</sup> At the same time, however, the Commission found that those changes “rendered PJM’s methodology for calculating

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for PJM at 1, Docket Nos. ER19-1486-000, *et al.* (filed June 29, 2020) (stating that “[i]t is important that [capacity] auctions be resumed as soon as possible”); Answer of the Electric Power Supply Association and the PJM Power Providers Group to the PJM Interconnection, L.L.C. Extension Motion at 2, Docket Nos. ER19-1486-000, *et al.* (filed June 29, 2020) (urging prompt action on the then-upcoming Compliance Filing “to allow the long-delayed [2022/2023 BRA] to proceed”). See *also* Informational Filing with Indicative Values for Energy and Ancillary Services Offset at 3, Docket No. EL19-58-003 (filed Aug. 19, 2020) (the “Informational Filing”) (urging “the Commission to accept the . . . Compliance Filing, along with the pending revisions to implement changes to the Minimum Offer Price Rule, with expediency so the upcoming Base Residual Auction can be conducted without further delay” (footnote omitted)).

<sup>9</sup> See *generally* Comments of the Electric Power Supply Association, Docket Nos. ER18-1314-003, *et al.* (filed May 15, 2020).

<sup>10</sup> See May 21 Order, 171 FERC ¶ 61,153 at PP 1-2.

the [EAS] Offset used in its capacity market unjust and unreasonable.”<sup>11</sup> The Commission ordered PJM to replace its backward-looking methodology for calculating the EAS Offset, using three years of historical data, with a forward-looking EAS.<sup>12</sup> Recognizing the interaction between this directive and proposed revisions to the Minimum Offer Price Rule pending in another proceeding, the Commission instructed PJM to “present an implementation schedule . . . that appropriately harmonizes the revisions here with ongoing revisions in the other proceeding while minimizing auction delays.”<sup>13</sup>

PJM submitted the Compliance Filing on August 5, 2020, indicating that an informational filing, with illustrative EAS Offset and Net CONE values, would follow “[i]n a couple of weeks . . . .”<sup>14</sup> PJM submitted that informational filing on August 19, 2020.<sup>15</sup>

## II. COMMENTS

### A. The Approach Proposed in the Compliance Filing is Generally Compliant with the Commission’s Directive and Conceptually Sound

EPSA believes that PJM has done a good job complying with the directive to develop a forward-looking EAS Offset on a relatively short timeframe. PJM’s overall approach makes economic sense and represents a reasonable way to forecast future energy and ancillary services revenues. The Commission should, therefore, accept the tariff revisions proposed in the Compliance Filing, as filed.

As Dr. Sotkiewicz discusses, using forward prices has the benefit of capturing

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<sup>11</sup> *Id.* at P 308.

<sup>12</sup> *See id.*

<sup>13</sup> *Id.* at P 2.

<sup>14</sup> Compliance Filing, Transmittal Letter at 8.

<sup>15</sup> *See* Informational Filing.

market expectations without the need to simulate forward prices based on various assumptions.<sup>16</sup> That, in turn, avoids unproductive disputes “over the assumptions going into the model with parties arguing for assumptions that serve their self-interest.”<sup>17</sup> He further explains how PJM’s proposal to shape the forward prices using historical data provides a reasonable means of accounting for volatility given the forward prices.<sup>18</sup>

Dr. Sotkiewicz points out that this approach is really nothing new for PJM in the sense that it is substantially similar to PJM’s approach to calculating energy and environmentally limited opportunity costs for purposes of applying the three-pivotal-supplier (“TPS”) test, an approach that “goes back over a decade” and has its roots in PJM compliance filings relating to the TPS test submitted in 2009 and 2010.<sup>19</sup> In particular, the calculation of energy and environmentally limited opportunity costs, like the calculation of the forward-looking EAS Offset proposed in the Compliance Filing, uses “forward looking energy market and fuel prices, shaped to match the volatility of the previous three years of power and fuel prices on a daily and/or hourly basis,” and then dispatches the applicable generator “against these projected forward prices to project run times and potential net revenues that could be earned by a generator . . . .”<sup>20</sup> While there are certainly differences between the two methodologies, such as the time scale, the

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<sup>16</sup> See Sotkiewicz Affidavit at ¶¶ 8-10.

<sup>17</sup> *Id.* at ¶ 9.

<sup>18</sup> See *id.* at ¶ 7.

<sup>19</sup> *Id.* at ¶ 4. See also Compliance Filing, Docket No. EL08-47-004 (filed July 31, 2009), *order requiring further compliance filing, PJM Interconnection, L.L.C.*, 130 FERC ¶ 61,230 (2010), Compliance Filing, Docket No. EL08-47-005 (filed Apr. 22, 2010), *accepted, PJM Interconnection, L.L.C.*, 133 FERC ¶ 61,081 (2010).

<sup>20</sup> Sotkiewicz Affidavit at ¶ 5.

inclusion of ancillary services in the EAS Offset calculation, and how congestion and cost differentials are determined, Dr. Sotkiewicz explains that, overall, “the methods are very much the same.”<sup>21</sup>

In comparison with the backward-looking EAS Offset values PJM has used to date, the illustrative forward-looking EAS Offset values in the Informational Filing are generally higher for more flexible resources, such as combustion turbine and combined-cycle units, and lower for inflexible resources.<sup>22</sup> Directionally, that is what one would expect, because the dispatch model better accounts for the fact that more flexible resources will offer and clear in more hours than will less flexible resources.<sup>23</sup>

**B. It Will Be Essential to Monitor the Forward-Looking EAS Offset to Ensure That It Is Performing as Intended**

While the tariff language proposed in the Compliance Filing sets forth sound principles for calculating a forward-looking EAS Offset, the fact remains that implementing these relatively broad principles will be a complex exercise. This makes it essential that stakeholders and the Commission have the ability to monitor PJM’s implementation of the forward-looking EAS Offset on an ongoing basis and be in a position to re-assess its implementation periodically to ensure that the principles are properly reflected in practice.

The Commission has, in the past, acknowledged PJM’s longstanding concerns about the “inherent difficulty” of calculating an EAS Offset on a forward-looking basis.<sup>24</sup> PJM’s concerns in that regard have been borne out by its struggles to comply with the

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<sup>21</sup> *Id.* at ¶ 7.

<sup>22</sup> See Informational Filing at 2.

<sup>23</sup> See *id.*

<sup>24</sup> *PJM Interconnection, L.L.C.*, 167 FERC ¶ 61,029 at P 119 (2019).

Commission's directive to implement a forward-looking EAS Offset. Even with a 30-day extension<sup>25</sup> of the original 45-day period for complying with this directive,<sup>26</sup> PJM was still unable to provide illustrative EAS Offset values in the Compliance Filing and had to submit those values two weeks later in the Informational Filing.<sup>27</sup>

The proposed tariff language will give PJM needed discretion in applying those principles to the complex task of calculating the actual EAS Offset values. For example, PJM proposes to specify the products and trading hubs to be used in estimating forward prices in manuals, which are not on file with the Commission, rather than having such data points "embed[ded] in the Tariff . . . ."<sup>28</sup> Particularly given the complexity of the calculation exercise, there are clear advantages to avoiding overly prescriptive tariff language and giving PJM flexibility as to the implementation details, and it is well established that the "rule of reason" does not require that each and every detail of such calculations be hard-wired into the Tariff.<sup>29</sup> At the same time, the fact that PJM will be exercising broad discretion in performing a complex and important task makes it imperative that PJM, stakeholders and the Commission have an opportunity to assess, in a timely fashion, whether the approach is working and to consider whether refinements

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<sup>25</sup> See *PJM Interconnection, L.L.C.*, Notice of Extension of Time, Docket Nos. ER19-58-000, *et al.* (July 1, 2020) (unreported).

<sup>26</sup> May 21 Order, 171 FERC ¶ 61,153 at Ordering Para. (B).

<sup>27</sup> As of August 14, 2020, PJM was still "refining the regulation modeling . . . ." PJM, *EAS Revenue Offset Update* at slide 2 (Aug. 4, 2020), <https://www.pjm.com/-/media/committees-groups/committees/mic/2020/20200814-special/20200814-item-02-eas-offset-update.ashx>.

<sup>28</sup> Compliance Filing, Transmittal Letter at 11. See also *id.* at 19 n.59 (discussing the mapping of prices at illiquid and liquid natural gas hubs and indicating that "PJM intends to memorialize this mapping in Manual 18").

<sup>29</sup> *Constellation Mystic Power, LLC v. ISO New England Inc.*, 172 FERC ¶ 61,144 at PP 29-31 (2020) (discussing the "rule of reason" that the Commission employs in determining whether a given item must be included in a rate schedule or tariff on file with the Commission).

may be in order. Such review would be in keeping with the Commission's longstanding policy that "the design and implementation of a forward market should be continually evaluated and changes made when necessary."<sup>30</sup> It would also be in accord with the Commission's past recognition that, while independent system operators ("ISOs") and regional transmission organizations ("RTOs") are allowed "a great deal of discretion in interpreting their own tariffs, especially with respect to provisions lacking prescriptive detail, that does not relieve the Commission of its responsibility to determine whether [an ISO/RTO]'s interpretation of its tariff is reasonable."<sup>31</sup>

In this regard, EPSA appreciates PJM's stated intent to revisit certain elements of the forward-looking EAS Offset in the next quadrennial review of the shape of the Variable Resource Requirement Curve (the "VRR Curve").<sup>32</sup> EPSA would ask the Commission to make clear that this review should not be limited to just the elements identified in the Compliance Filing and should encompass all aspects of PJM's approach to the forward-looking EAS Offset. Unfortunately, any changes adopted as a result of the quadrennial review would only be implemented after four BRAs have been conducted using the

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<sup>30</sup> *Maryland Pub. Serv. Comm'n v. PJM Interconnection, L.L.C.*, 124 FERC ¶ 61,276 at P 24 (2008) (footnote omitted), *on reh'g*, 127 FERC ¶ 61,274 (2009), *aff'd sub nom. Maryland Pub. Serv. Comm'n v. FERC*, 632 F.3d 1283 (D.C. Cir. 2011).

<sup>31</sup> *Astoria Generating Co., L.P. v. New York Indep. Sys. Operator, Inc.*, 151 FERC ¶ 61,044 at P 30 (2015).

<sup>32</sup> See Compliance Filing, Transmittal Letter at 25 (stating that "the use of historic ancillary services . . . is a reasonable first step in implementing the Commission's requirements subject to re-examination and refinements in future quadrennial review proceedings"); *id.* at 26 (stating that "[t]he forward price determination for ancillary services will, at a minimum, be reevaluated in the next quadrennial review"); *id.* at 50 (stating that "PJM will reevaluate and update, as necessary, the energy efficiency programs [underlying the EAS Offset for such resources] as part of each quadrennial review").

forward-looking EAS Offset.<sup>33</sup> For that reason, EPSA proposes that the Commission provide for an interim “check-up” on the implementation of the forward-looking EAS Offset by requiring PJM to make an informational filing following the 2022/2023 BRA. Such a check-up will provide an opportunity to make any corrections that may prove appropriate before the BRAs for the 2024/2025 and 2025/2026 Delivery Years and possibly even in time for the 2023/2024 BRA.

Dr. Sotkiewicz describes specific information that PJM should provide and analyses it should perform in order to facilitate monitoring of the forward-looking EAS Offset’s performance and provide greater transparency.<sup>34</sup> The analyses Dr. Sotkiewicz describes would serve to test the robustness of its forward-looking EAS Offset methodology after experience is gained through the 2022/2023 BRA. The results of these analyses could be shared with PJM stakeholders (e.g., through posting on PJM’s website) and included in future filings with the Commission concerning the operation of the forward-looking EAS Offset methodology.

In the near term, following the 2022/2023 BRA, Dr. Sotkiewicz suggests that PJM run the EAS Offset model for a combustion turbine unit using actual energy and fuel prices for the 2018/2019 and 2019/2020 Delivery Years and compare the results to the actual run hours and net energy and ancillary services revenues for that unit for the Delivery

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<sup>33</sup> The last quadrennial review proposed changes to the VRR Curve to be applied beginning with the 2022/2023 BRA, and, notwithstanding the delays in running this and subsequent BRAs, the next quadrennial review process will presumably be considering changes that could be implemented for the BRA for the 2026/2027 Delivery Year. See Tariff, § 5.10(a)(iii) (describing the quadrennial review process).

<sup>34</sup> See Sotkiewicz Affidavit at ¶¶ 25-36.

Year.<sup>35</sup> This analysis would effectively control for differences between forward prices and actual realized prices and isolate differences in modeled versus actual outcomes, recognizing that the reference combustion turbine is more efficient than most commercially operating combustion turbines.<sup>36</sup>

As a further near term test, Dr. Sotkiewicz suggests that, again, following the 2022/2023 BRA, PJM run the model for the reference combustion turbine using realized power and fuel prices for the 2018/2019 and 2019/2020 Delivery Years to derive the net energy and ancillary services revenues, as well as the run hours and number of starts.<sup>37</sup> The results could then be compared with those of existing combustion turbines to provide a comparison of the effect of differences in efficiency, size and operating characteristics of the reference unit and existing combustion turbine units.<sup>38</sup>

In the medium term, Dr. Sotkiewicz proposes that PJM calculate hypothetical forward-looking EAS Offset values for the 2021/2022 Delivery Year using historic forward prices at different points in time.<sup>39</sup> PJM could then compare those values with each other and with actual, realized energy and ancillary services revenues following the conclusion of the Delivery Year.<sup>40</sup> Dr. Sotkiewicz explains that this analysis should “provide insights into how well the dispatch algorithm combined with forward prices at different times matches up with actual . . . operations and/or modeled . . . operations at the actual

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<sup>35</sup> See *id.* at ¶¶ 26-28.

<sup>36</sup> See *id.* at ¶ 26.

<sup>37</sup> See *id.* at ¶ 29.

<sup>38</sup> See *id.*

<sup>39</sup> See *id.* at ¶ 32.

<sup>40</sup> See *id.*

prices.”<sup>41</sup>

In the longer term, Dr. Sotkiewicz suggests that PJM provide an examination of historic forward prices corresponding with the timing of past BRAs and past Delivery Years and track the changes in those prices leading up to the Delivery Years.<sup>42</sup> He explains that “[s]uch transparency can help mitigate concerns about the presence of bias in the forward curves and in projected [energy and ancillary services] revenues compared to realized fuel and power prices and [energy and ancillary services] revenues.”<sup>43</sup>

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<sup>41</sup> *Id.* at ¶ 33.

<sup>42</sup> *See id.* at ¶¶ 35-36.

<sup>43</sup> *Id.* at ¶ 35.

### III. CONCLUSION

**WHEREFORE**, for the foregoing reasons, EPSA requests that the Commission take the comments set forth herein into account and approve the Compliance Filing.

Respectfully submitted,

#### **ELECTRIC POWER SUPPLY ASSOCIATION**

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On behalf of the **Electric Power  
Supply Association**

Dated: September 2, 2020

**CERTIFICATE OF SERVICE**

I hereby certify that I have this day served the foregoing document on each person designated on the official service list compiled by the Secretary of the Federal Energy Regulatory Commission in this proceeding.

Dated at Washington, D.C., this 2<sup>nd</sup> day of September, 2020.

/s/ Stephanie S. Lim

Stephanie S. Lim

**Attachment A**  
**The Sotkiewicz Affidavit**

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

**PJM Interconnection, L.L.C.**

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**Docket No. EL19-58-003**

**AFFIDAVIT OF PAUL M. SOTKIEWICZ, PH.D.**

**I. QUALIFICATIONS**

1. My name is Dr. Paul M. Sotkiewicz. I am the President and Founder of E-Cubed Policy Associates, LLC (“E-Cubed”) and formerly served as the Chief Economist in the Market Service Division of PJM Interconnection, L.L.C. (“PJM”). I have been asked by the Electric Power Supply Association (“EPSA”) to submit this affidavit in support of its comments supporting and providing an explanation of the PJM filed forward looking Energy and Ancillary Service Offset (“Projected EAS Offset”) methodology filed by PJM on August 5, 2020 in Docket No. EL19-58-003.<sup>1</sup>
2. Prior to founding E-Cubed, I worked as a contractor and directly for PJM Interconnection, L.L.C. (“PJM”) in Audubon, Pennsylvania from February 2008 until October 2016. In my time at PJM I first served as a Senior Economist until March 2010 and subsequently as the Chief Economist in the Market Service Division until June 2015. From July 2015 until October 2016, I worked as a contractor for PJM under

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<sup>1</sup> *PJM Interconnection, L.L.C.*, Docket No. EL19-58-003; Reserve Market Enhancements Compliance Filing, dated August 5, 2020 (“Compliance Filing”).

the title of Senior Economic Policy Advisor. Prior to joining PJM, I served as the Director of Energy Studies at the Public Utility Research Center (“PURC”), University of Florida from August 2000 until February 2008 and I was an Economist at the Federal Energy Regulatory Commission (“FERC”) from September 1998 until August 2000. I have a B.A. in History and Economics from the University of Florida (1991), and an M.A. (1995) and Ph.D. (2003) in Economics from the University of Minnesota.

3. I have over 20 years of experience on matters at the intersection of utility regulatory policy, power system economics, and environmental economics. In my current role, I advise private- and public-sector clients on a range of economic issues related to electricity market design and performance, power generation economics, utility regulatory policy, and the economic impacts of state and federal environmental policies. At PJM I provided expert analysis, advice, and support for PJM initiatives related to market design changes in, and performance of, PJM’s energy, ancillary service, and capacity markets.

While the Director of Energy Studies at PURC, I provided executive education and expert advice to regulatory staff and utility professionals from around the world in matters such as electric power regulation, market design, incentive regulation, and cost-of-service rate cases and rate design.

As an economist at FERC, I worked on market design issues and filings related to the newly formed ISO/RTO markets concentrating primarily on the New York ISO and the California ISO markets. The entirety of my experience and work history can be found in my CV attached as Exhibit 1.

**II. THE PROPOSED FORWARD-LOOKING ENERGY AND ANCILLARY SERVICE OFFSET IS CONSISTENT IN CONCEPT WITH PJM**

## **IMPLEMENTATION OF OPPORTUNITY COSTS IN COST-BASED OFFERS**

4. During my tenure at PJM, I led the PJM economic and markets team working through what has become colloquially known as the energy and environmentally limited opportunity cost that generators are allowed to employ as a part of their cost-based offers into the PJM Energy Market.<sup>2</sup> This methodology goes back over a decade to a 2009 compliance filing in a proceeding on the Three Pivotal Supplier Test.<sup>3</sup>
5. One of the main features of the energy and environmentally limited opportunity costs is the use of forward looking energy market and fuel prices, shaped to match the volatility of the previous three years of power and fuel prices on a daily and/or hourly basis. The run limited generator is then dispatched against these projected forward prices to project the run times and potential net revenues that could be earned by a generator in each of three simulated years with the opportunity cost being the energy margin foregone of the next hour (or block of hours) above the run time limitation. This is very much in the same vein as the methodology proposed by PJM in the instant filing.
6. The main differences between the current opportunity cost and the PJM proposed Projected EAS Offset are those of time scale and the inclusion of ancillary service prices and revenues, and how congestion and loss differentials are determined, but otherwise the methodologies are the same in concept. The current energy and environmentally limited opportunity cost only employ forward prices up to one year

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<sup>2</sup> *PJM Operating Agreement*, Schedule 2-Components of Cost, Section 5. Opportunity Costs (“PJM OA Schedule 2”) and PJM Manual 15: Cost Development Guidelines, Revision 35, April 24, 2020, Section 12 at 74-87. (“PJM Manual 15”) Available at <https://pjm.com/-/media/documents/manuals/m15.ashx>.

<sup>3</sup> See Compliance Filing, Docket No. EL08-47-004 (filed July 31, 2009); Compliance Filing, Docket No. EL08-47-005 (filed Apr. 22, 2010).

(12 months) forward based on the restrictions for these run limited units. The PJM proposal uses forward prices over three years forward. The proposed PJM methodology accounts for ancillary services which are not considered under the current opportunity cost method. The current methodology uses historic basis (congestion and loss) differential between the generator bus and the forward pricing hub, PJM Western Hub, whereas the proposed methodology uses Long-term FTRs between the various forward pricing hubs and the PJM zone for which the Net Cost of New Entry (“Net CONE”) is being computed.

7. Otherwise, the methods are conceptually very much the same. Each methodology shapes the forward prices to historic volatility of energy and fuel prices over three previous years. Each method simulates net revenues, subject to operating constraints, given the forward prices.

**III. THE USE OF FORWARD PRICES WITH OPEN INTEREST MORE THAN THREE YEARS FORWARD REFLECTS CURRENT MARKET EXPECTATIONS WITHOUT THE NEED TO MAKE ASSUMPTIONS TO SIMULATE PRICES**

8. From an economic perspective, forward prices reflect a sense of the expectations of those parties with open interest in forward market contracts and any recent trading activity of forward market contracts. It does not matter whether one believes in the Efficient Markets Hypothesis as articulated by Eugene Fama<sup>4</sup> or in so-called “animal

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<sup>4</sup> Eugene F. Fama, “Efficient capital markets: a review of theory and empirical work,” *Journal of Finance* 25, 383-417 (1970).

spirits” as has been articulated by Robert Shiller,<sup>5</sup> who shared the Nobel Prize in Economics,<sup>6</sup> the forward prices reflect some set of expectations.

9. The use of publicly available forward prices avoids the need to simulate future prices based upon assumptions related to fuel prices, energy demand, weather driven volatility, assumed new entry and retirements, technology change, future policy, among other assumptions. Moreover, avoiding the simulation route bypasses the certain arguments that will occur over the assumptions going into the model with parties arguing for assumptions that serve their self-interest.
10. The use of forward prices for energy and fuel already embeds implicitly or explicitly the expectations regarding demand, fuel prices, technology change, generator fleet configuration and policy expectations at the time the forward prices are being viewed.

#### **IV. PJM’S PROPOSED DEVELOPMENT OF FORWARD MARKET PRICES IS CONSISTENT WITH CURRENT PRACTICE IN PJM**

##### **A. Development of Forward Energy Prices**

11. Table 1 below provides the side by side comparisons of the current PJM Opportunity Cost<sup>7</sup> methodology for energy and environmentally limited resources for developing forward energy prices. The methods are similar in concept, but they do have notable differences as they are meant to be used for different purposes.

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<sup>5</sup> See George A. Akerloff and Robert J. Shiller, *Animal Spirits: How Human Psychology Drives the Economy, and Why It Matters for Global Capitalism* (2009).

<sup>6</sup> The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2013 <https://www.nobelprize.org/prizes/economic-sciences/2013/press-release/>.

<sup>7</sup> PJM OA Schedule 2 and PJM Manual 15 at 74-87.

**Table 1: Run Limited Opportunity Cost Relative to PJM Projected EAS: Similarities and Differences in Methods for Forward Energy Prices**

	<b>Opportunity Cost</b>	<b>PJM Projected EAS</b>
<b>Hubs</b>	Western	Western, Northern Illinois, AEP-Dayton. Mapped to zones with high price correlation <sup>8</sup>
<b>Months/Years Ahead</b>	From days ahead up to 12 months ahead depending on run limits	Approximately 4 years ahead. 3.5 years ahead for the start of the Delivery Year and 4.5 years ahead for the end of the Delivery Year <sup>9</sup>
<b>Forward Data Date</b>	Single date immediately prior to the restriction	Most recent 30 days of trading 180 prior to the Base Residual Auction <sup>10</sup>
<b>Updates</b>	Continuous: daily or weekly that require new forward curves as run hours are used	None. This is used one time for an RPM Auction
<b>Congestion Treatment</b>	Three years of historic congestion between Western Hub and generator bus for congestion and losses	Long-term FTRs for peak and off-peak periods that must be adjusted into monthly figures from Hub to zone <sup>11</sup>
<b>Marginal Loss Treatment</b>	Three years of historic congestion between Western Hub and generator bus for congestion and losses	Three year historical based on monthly marginal loss differentials peak and off-peak between the hub and zone and scaled to the forward LMP hub prices <sup>12</sup>
<b>Hourly Volatility Scaling</b>	Scaling for each hour of three historic years for peak and off-peak prices based on ratio of forward monthly average to historic monthly average	Scaling for each hour of three historic years for peak and off-peak prices based on ratio of forward monthly average to historic monthly average <sup>13</sup>

<sup>8</sup> Compliance Filing, Affidavit of Samuel A. Newell, James A. Read Jr., and Sang H. Gang on Behalf of PJM Interconnection, L.L.C. (“Brattle Affidavit”) PP 14-15.

<sup>9</sup> *Id.* P 8.

<sup>10</sup> *Id.* P 16 and Compliance Filing, Transmittal Letter at 14, fn 40 and Redline Tariff Attachment DD 5.10 a) v-1) C) 2).

<sup>11</sup> Brattle Affidavit PP 17, 54-55 and Transmittal Letter at 16.

<sup>12</sup> Brattle Affidavit P 18 and Transmittal Letter at 16 and Redline Tariff Attachment DD 5.10 a) v-1) C) 4).

<sup>13</sup> Brattle Affidavit P 19 and Redline Tariff Attachment DD 5.10 a) v-1) C) 4).

12. The greatest similarities are the use of trading hubs with sufficient trading activity and open interest, as Brattle has noted in its supporting Affidavit,<sup>14</sup> and the use of scaling using the forward prices and applying this to historic hourly price movements.
13. Yet, because these are being used for different purposes, there are some differences. First, the forward prices used in the opportunity cost method are continuously being updated based on changing forward prices and changes in the number of remaining hours of operation. In contrast, the PJM Projected EAS method pulls thirty trading days of data, but the intent is to only use this for a single auction so there is no need for updating to be used even though the forward prices are looking out much further into the future horizon.
14. Second, the Projected PJM EAS method uses forward projections of congestion based on long-term FTRs rather than historic basis differentials to capture both congestion and losses. The long-term FTRs have an additional benefit in that they do provide expectations regarding future congestion based on expected transmission upgrades and other factors. Historic loss factors are used and scaled based upon forward prices which is appropriate given the fact that marginal losses are a function of the underlying energy prices.<sup>15</sup>

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<sup>14</sup> Brattle Affidavit at 13.

<sup>15</sup> Marginal losses are also a function of the energy transfers across the system. The closer load is to generation, the lower will be losses at the margin and overall. The farther away load is from generation, the greater are overall losses and losses at the margin. However, to estimate or forecast future marginal losses would require simulation modeling and various assumptions about load and generation which are problematic as discussed in Section III above.

15. Overall, the side by side comparison shows PJM's proposal for forward power prices makes sense and is consistent with current practice for the energy and environmentally limited opportunity cost.

**B. Fuel and Emissions Costs for the Reference CT and Combined Cycle Resources**

16. Table 2 below provides the side by side comparisons of the current PJM Opportunity Cost methodology for energy and environmentally limited resources for developing forward fuel prices. Like with forward energy prices, the methods are similar in concept, but they do have notable differences as they are meant to be used for different purposes. The opportunity cost method is more general and less prescriptive about forward pricing points for fuel than the PJM Projected EAS as the Opportunity Cost method is designed to be used across multiple fuel types.
17. The PJM proposal contains more detail on the targeted gas pricing hubs than does the opportunity cost methodology, but that is a product of the purpose of the Projected EAS method. Scaling for daily volatility is essentially the same as well.
18. The PJM proposal is not as prescriptive as the opportunity cost regarding emissions costs, though both methods do account for emissions costs.
19. Overall, these methods for developing forward fuel costs are markedly similar and there is experience in using these methods that is being proposed by PJM for the Projected EAS Offset.

**Table 2: Run Limited Opportunity Cost Relative to PJM Projected EAS: Similarities and Differences in Methods for Forward Fuel Prices and Other Generator Costs**

	<b>Opportunity Cost</b>	<b>PJM Projected EAS</b>
<b>Hubs</b>	None defined. Basis is delivered cost of fuel	Chicago, Michcon, Dominion South, Transco Z6 (non-NY), TETCO M3, Columbia-Appalachia TCO <sup>16</sup>
<b>Months/Years Ahead</b>	From days ahead up to 12 months ahead depending on run limits	Approximately 4 years ahead. 3.5 years ahead for the start of the Delivery Year and 4.5 years ahead for the end of the Delivery Year <sup>17</sup>
<b>Forward Data Date</b>	Single date immediately prior to the restriction	Most recent 30 days of trading 180 prior to the Base Residual Auction <sup>18</sup>
<b>Updates</b>	Continuous: daily or weekly that require new forward curves	None. This is used one time for an RPM Auction
<b>Basis Differential</b>	Three years of historic delivered fuel cost scaled to forward fuel prices	Use of gas trading hubs in multiple locations mapped to PJM zones <sup>19</sup>
<b>Emissions Costs</b>	Futures prices for SO <sub>2</sub> , NO <sub>x</sub> , and CO <sub>2</sub> allowances as quoted by Evolution Markets. Costs included based on unit emissions rates	Emissions costs are considered a generator cost in the new tariff language describing the Net EAS Revenue Offset <sup>20</sup>
<b>Emissions or Run-time Limits in Air Permit</b>	This method addresses those issues by design	No reference to such limits
<b>Daily Fuel Volatility Scaling</b>	Scaling for each day of three historic years based on ratio of forward monthly average to historic monthly average	Scaling for each day of three historic years based on ratio of forward monthly average to historic monthly average

<sup>16</sup> Brattle Affidavit PP 29-30.

<sup>17</sup> Redline Tariff Attachment DD 5.10 a) v-1) E) 3). Calculating the timing comes to 3.5 to 4.5 years ahead.

<sup>18</sup> Transmittal Letter at 20, fn 61 and Redline Tariff Attachment DD 5.10 a) v-1) E) 3).

<sup>19</sup> Brattle Affidavit P 32 and Table 3.

<sup>20</sup> Redline Tariff Attachment DD 5.10 a) v-1) A).

**V. PJM’S PROPOSED PROJECTED EAS DISPATCH MODEL MAXIMIZES NET REVENUES CONSISTENT WITH ECONOMIC PRINCIPLES**

20. PJM’s Projected EAS Dispatch is designed to maximize the net revenues of both energy and ancillary services subject to generator operating parameters and the costs of the generator.<sup>21</sup> In concept this is no different than the current peak hour dispatch framework used to determine the net revenue of the Reference Resource CT, but the proposed Projected EAS Dispatch allows more “degrees of freedom” in dispatch by allowing the Reference Resource CT to be dispatched in off-peak hours and to be committed and dispatched more flexibly than in four-hour blocks and to be committed or dispatched for regulation or reserves.
21. While PJM characterizes the Projected EAS Dispatch in its transmittal letter and in the proposed tariff language as “co-optimizing energy and reserves,” what it is doing in the Projected EAS Dispatch is not “co-optimizing” in the same sense that, under the approach proposed by PJM and approved by the Commission in Docket Nos. EL19-58-000 and ER19-1486-000, PJM will be co-optimizing energy and reserves. Co-optimizing energy and reserves means that PJM is finding the joint least-cost solution for these products while also accounting for the substitutability of resources to provide energy, regulation, or reserves. What comes out of that co-optimization are prices that are consistent with the commitment and dispatch assignments such that the resources would not wish to change their commitment or dispatch assignments.
22. What PJM is doing in the Projected EAS Dispatch is different. In the Projected EAS Dispatch, PJM is maximizing net revenues for the generator in question given the

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<sup>21</sup> PJM Redline Tariff Definition of “Projected EAS Dispatch.”

energy, regulation, and reserve prices provided. The prices that result from this exercise may not be consistent with “co-optimizing” energy, regulation, and reserves overall. Rather, in maximizing net revenues, the generator will be assigned to the service for which it earns the greatest net revenues. For the purposes of calculating net revenues while including energy and ancillary services, this makes sense and is consistent with price taking behavior assumed in the dispatch model and serves as a reasonable proxy for calculating net energy and ancillary service revenues given the changes approved by the Commission. Moreover, it avoids the need to simulate forward prices and the associated problems that go along with that as I have noted in Section III above. My point here is that this revenue maximizing exercise should not be confused with the sort of co-optimization exercise that PJM will be undertaking in dispatching resources for energy, regulation, and operating reserves in the Day-ahead and Real-time Energy and Ancillary Service Markets.

**A. The Ten Percent Adder is Just and Reasonable for the CT Reference Resource**

23. In the tariff language describing the Projected EAS Dispatch model, PJM states that in the Real-time Market, a unit, if it is committed in the Day-ahead Market, will operate in the hours in which it was committed, but will be dispatched according to the real-time price for energy and ancillary services.<sup>22</sup> My understanding of the tariff language is that a resource, if it faces prices in real-time below its energy offer is not fully decommitted in real-time, but is turned down to its economic minimum since it will still be running

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<sup>22</sup> *Id.* The definition of Projected EAS Dispatch states, “In the Real-Time Energy Market co - optimization, the resource is assumed to be operating in the hours it was scheduled in the Day-Ahead Energy Market but is dispatched according to the real-time price inputs.”

in the hours in which it is committed. If my understanding is correct based on conversations with PJM staff, then this is an important feature for CTs and other gas-fired resources in modeling Net EAS revenues.

24. PJM has proposed that CTs being examined in the Projected EAS Dispatch model can make use of the 10 percent adder in their cost-based offers.<sup>23</sup> This makes good sense as CTs that may be committed Day-ahead, may not be running to their maximums in real-time if prices fall below their offer, yet because of the Day-ahead commitment the CT may have procured gas and pipeline transportation. To turn back gas and not consume the gas in real-time will cause the CT to incur imbalance penalties from the pipeline which need to be covered.<sup>24</sup> These additional costs, which could be incurred when there are changes between the Day-ahead market and Real-time market should be accounted for and are reasonable for CTs to include through the 10 percent adder.

## **VI. FOLLOW UP ANALYSES AND REPORTS SHOULD BE REQUIRED TO ENSURE ROBUSTNESS AND TRANSPARENCY OF IMPLEMENTATION**

25. Unlike the opportunity costs for energy and environmentally limited resources, which can be updated daily or weekly with new information, the Projected EAS Offset cannot be updated once an RPM auction is conducted. Given this inability to update expectations that can be done continuously in the opportunity cost determination and the fact that, notwithstanding PJM's experience in the opportunity cost context, calculating a forward-looking EAS Offset is a complex task, it is important for the

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<sup>23</sup> *Id.*

<sup>24</sup> The 10 percent adder is meant to cover other costs that may be uncertain or hard to quantify in advance. In the case of a gas CT, fuel prices can change between the time of offers and the time gas is procured, or if not all gas that is nominated is used when PJM backs a CT down, selling the gas back is usually done at a discount which results in an additional cost.

Projected EAS Offset to undergo continuing evaluation to make sure that the method is robust.

**A. Short-term Robustness Checks and Information for Market Participants on the Dispatch Model**

26. Within 30 days of the completion of the 2022/2023 BRA, PJM should provide information on the robustness of the dispatch methodology alone based on historic, realized prices for power and fuel. The first part of this back-casting analysis would be to run the Projected EAS Dispatch model for CTs that match those already in commercial operation in PJM in each Transmission Zone to determine the Projected EAS Offset from those prices and compare these to actual CT operations in those zones.<sup>25</sup> Recognizing that these CTs may be a different type/model than the Reference Resource CT (CT used in calculating Net CONE), expected run hours for the commercially operating CTs would be different than the Reference Resource CT. Nonetheless, we can see how well the model predicts for the commercially operating CT to test Dispatch Model fidelity.
27. The comparison should include net revenues for energy and all ancillary services, run hours, number of starts, and accounting of operation in each hour of the delivery year. This comparison should be done for realized power prices for the 2018/2019 DY and the 2019/2020 DY.
28. The reason to examine run hours and number of starts is that the PJM Information filing shows run hours and starts for the Reference Resource CT that are far greater, about

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<sup>25</sup> As a back-cast, this is using the forward prices as they would have been known at the time to come up with what would have been the forward energy and fuel prices against which the CT is being dispatched with the comparison to actual operations.

four times greater, than what is observed for the current fleet of CTs in service which shows only a 6.9 percent capacity factor in 2018 and 6.4 percent in 2019.<sup>26</sup> However, the new Reference Resource CT is much more efficient and larger than existing CTs in operation, and according to the PJM IMM in its net revenue analysis and new entrant simulations for the 2019 State of the Market Report, the new CT would run more than twice as many hours as older frame CTs currently in operation in PJM.<sup>27</sup> Moreover, given these modeled run hours, PJM should also provide in the report an examination of the likelihood that the Reference Resource CT to obtain a Title V Air Permit that would allow the increase in run hours observed in these analyses.

29. The next portion of the short-term analysis would be to run the Reference Resource CT on the realized power and fuel prices in each zone to derive the net EAS revenues broken out by energy and ancillary service along with run hours, number of starts, and operations by each hour of the 2018/2019 and 2019/2020 DYs. These values can be compared to those of existing CTs to provide a comparison regarding the effect of different efficiencies, sizes, and other operating characteristics of the new Reference Resource CT and existing CTs in PJM.
30. Finally, the above simulation runs can be tested under different energy and regulation offer structures that have been observed for CTs in PJM, and under different structures

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<sup>26</sup> PJM Interconnection, L.L.C., Docket Nos. EL19-58-003 Informational Filing with Indicative Values for Energy and Ancillary Services Offset August 19, 2020, Attachment A, Combustion Turbine Table shows an average of 2,408 hours across all zones with an implied capacity factor of approximately 27 percent. See also 2019 State of the Market Report, Table 5-28, at 292. [http://www.monitoringanalytics.com/reports/PJM\\_State\\_of\\_the\\_Market/2019/2019-som-pjm-sec5.pdf](http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2019/2019-som-pjm-sec5.pdf).

<sup>27</sup> 2019 State of the Market Report, Table 7-5 p. 333 and discussion p. 334. [http://www.monitoringanalytics.com/reports/PJM\\_State\\_of\\_the\\_Market/2019/2019-som-pjm-sec7.pdf](http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2019/2019-som-pjm-sec7.pdf). This discussion and Table 7-5 show the new GE 7HA.02 CTs would run over 4,900 hours per year in 2018 and 2019.

allocations of LTSA costs assigned to start-up or to VOM costs as discussed in the Brattle Affidavit.<sup>28</sup>

**B. Medium Term Analysis Combining Forward Price Changes with the Projected EAS Dispatch model**

31. Intuitively, as forward expectations of forward energy and fuel prices are closer to realization, the more accurate they tend to be. Of course, actual hourly and daily price volatility in energy and fuel markets will not exactly repeat themselves, but it is useful to examine how close the forward expectations are to actual power and fuel price realizations and by extension net EAS revenue realizations.
32. One way to start to test the robustness of the methodology in the medium term is to develop forward prices for the 2021/2022 Delivery Year (“DY”) for which the BRA has already been run. PJM can pull the “historic” forward curves for the 2021/2022 DY for the 30 days prior to 180 days before the 2021/2022 BA was conducted to develop the forward power and fuel prices that would have been used had PJM’s proposed method been in place for the 2021/2022 BRA.<sup>29</sup> For each Incremental Auction for the 2021/2022 DY, up through and including the Third IA that has not yet been run, new updated forward power and fuel prices can be developed to show how the forward power and fuel prices evolved over time. Then at the end of the 2021/2022 DY, there will be a comparison of forward power and fuel prices at different snapshots in time that can be measured against realizations of actual power and fuel prices.
33. Next, with the projected Net EAS revenues, unit run hours, and number of starts can be compared to the Net EAS revenues, run hours, and starts at the realized power and fuel

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<sup>28</sup> Brattle Affidavit PP 71-73.

<sup>29</sup> These prices would have been pulled in approximately October to November 2017.

prices for the CT Reference Resource and a more typical CT that has been already been in commercial operation in PJM in each zone. This analysis would provide insights into how well the dispatch algorithm combined with forward prices at different times matches up with actual CT operations and/or modeled CT operations at the actual prices.

34. The report for this can be split into two pieces. The first piece can provide the analysis for forward prices for the time of the 2021/2022 BRA and all three IAs within three months after the completion of the 2022/2023 BRA. The second piece comparing the forward price analysis to realized prices should be released within one month of the completion of the 2021/2022 DY.

**C. Extended Analysis of the Evolution of Forward Price Movements from the BRA through the Delivery Year**

35. Finally, to examine the effects of changing forward power and fuel prices as the DY approaches, PJM should provide an examination of historic quotes of forward market prices for energy and fuel that correspond with the timing of past BRAs for past DYs, and track the changes in forward energy and fuel prices over time leading up to the DY. Such an analysis can be helpful for Capacity Resource owners to see how the forward prices evolve, as well as expected Net EAS revenues and compare them to actual energy and fuel prices and actual realized net EAS revenues. Such transparency can help mitigate concerns about the presence of bias in the forward curves and in projected Net EAS revenues compared to realized fuel and power prices and Net EAS revenues.
36. This report should consist of Delivery Years 2017/2018 through 2019/2020 to go along with the medium-term report discussed above for the 2021/2022 DY. For each delivery year, a comparison of forward prices taken for the BRA and each IA to compare to the

actual power and fuel prices observed for each year. This report can be provided for market participants and FERC as further information one month following the 2023/2024 BRA to inform the next Quadrennial Review.

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37. This concludes my affidavit.

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

**PJM Interconnection, L.L.C.**

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**Docket No. EL19-58-003**

**AFFIDAVIT OF PAUL M. SOTKIEWICZ, PH.D.**

Paul M. Sotkiewicz, Ph.D., states, under penalty of perjury, that the statements contained in the foregoing Affidavit of Paul M. Sotkiewicz, Ph.D. are true and correct to the best of his knowledge and belief.



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Paul M. Sotkiewicz, Ph.D.

September 2, 2020

# Exhibit 1

to the

Affidavit of Paul M. Sotkiewicz

## **PAUL M SOTKIEWICZ, Ph.D.**

President and Founder, E-Cubed Policy Associates, LLC

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### **EDUCATION**

PhD, Economics, University of Minnesota, 2003

M.A., Economics, University of Minnesota, 1995

B.A. (High Honors), History/Economics, University of Florida, 1991

### **PROFESSIONAL AND ACADEMIC EXPERIENCE**

#### **2016- President and Founder, E-Cubed Policy Associates, LLC, Gainesville, FL**

- Founded to provide expert advice, testimony, and policy research to private sector and government clients at the intersection of energy, environmental, and economic policy and regulation
- Supporting litigation defending market participants against accusations of market manipulation in PJM's markets
- Conducting analysis of recent past and future expected profitability of nuclear power plants under consideration for state subsidies to keep these facilities in commercial operation and providing reports and testimony in front of state legislative bodies.
- Provide capacity market design and expertise to the ENMAX Corp. in Calgary, AB with regard to the AESO capacity market proposal filed in late 2018
- Supported rate case litigation for a reactive power rate case for Panda Stonewall explaining the history behind markets and that the filed rate from Panda Stonewall was consistent with precedent and lost market opportunities
- Providing PJM expertise to JPower USA Ltd in its development of new combined cycle gas facilities in PJM and help move the project through the PJM interconnection processes as well as advising on existing facilities in the PJM and NYISO market
- Provided capacity market design expertise to the Alberta Electric System Operator in 2017 as they started their transition from an energy-only market to a combined energy and capacity market
- Supporting the Greek Electricity Market authoring, through ECCO International, a whitepaper on market power mitigation with a special look at buyer side market power mitigation in the energy market with the different indices that could be indicative of buyer market power.
- Authored a Meter Data Study for the NYISO encompassing a survey of metering requirements for demand resources and distributed energy resources in key ISO/RTO markets, the current use of demand response baseline methodologies and possible use of such baselines for distributed energy resources in the context of REV in New York.
- Work with clients in generation and merchant transmission development projects in different parts of PJM related to helping them through the interconnection process, understanding market rules, and regulatory policy and economic advice in the face of changing market rules.
- Supporting clients in docketed proceedings at FERC and at the Florida Public Service Commission providing expert testimony and analysis to be used in regulatory proceedings. These proceedings include need determinations, rate filings, RTO market design changes, and policy related proceedings.
- Supporting US government initiatives in exporting knowledge and experience regarding US electric power market development to the Chinese government as they undertake green energy initiatives and look to improve the overall efficiency of the power system.

**2015-2016 Contractor, YOH Inc. and working under the title of Senior Economic Policy Advisor, PJM Interconnection, L.L.C., Audubon, PA**

**2010-2015 Chief Economist, Market Services Division, PJM Interconnection, L.L.C., Audubon, PA**

**2008-2010 Senior Economist, Market Services Division, PJM Interconnection, L.L.C., Audubon, PA**

- Provide analysis and advice with respect to the PJM market design and market performance including demand response mechanisms, intermittent and renewable resource integration, market power mitigation strategies, capacity markets, ancillary service markets, and the potential effects of environmental policies on the PJM markets.
- Co-authored papers related to effects of the proposed Waxman-Markey climate change bill in 2009, the implementation of the Mercury and Air Toxics Standards (MATS) and Cross State Air Pollution Rule in 2011, and the potential effects of the EPA-proposed Clean Power Plan in 2015.
- Led the Stakeholder Process to implement reserve shortage pricing in PJM in 2009-2010 and provided expert testimony associated with FERC filings in 2010.
- Co-authored paper to explain various market and policy concepts for PJM and its stakeholders including a paper explaining generator costs and compensation in 2010, a paper on possible routes to take on transmission cost allocation in 2010, and a whitepaper on capacity market issues in 2012.
- Advised PJM executives on market power mitigation issues related to the Three Pivotal Supplier test and cost-based offers used for market power mitigation in the PJM Energy Market in 2008-2009
- Advised PJM executives and Board of Managers on demand response compensation prior to the issuance of FERC Order 745.
- Supported and advised the Capacity Market Operations staff and PJM executives on all matters related to the Reliability Pricing Model (RPM) capacity market including implementation of the Minimum Offer Pricing Rule in its various iterations, administered determinations and/or reasonableness of Market Seller Offer Caps during disputes between Capacity Market Sellers and the Independent Market Monitor.
- Provided advice to Capacity Market Operations staff and PJM executives on the RPM Triennial Parameter Review Process in 2011 and in 2014 including supporting legal staff in making filings, providing expert testimony, and providing expert advice during the 2011 and 2012 hearing and settlement process at FERC.  
Supported and provided advice to Capacity Market Operations staff and PJM executives on Capacity Performance through stakeholder presentations, regulatory filings, and working jointly with the IMM in developing many of the ideas and concepts taken from ISO New England's Pay for Performance design for us in PJM.
- Supported the Federal State Government Policy outreach through by providing subject matter expertise during one-on-one meetings with regulatory staff and Commissioners related to any issues of mutual interest and import between PJM and state commission, state environmental regulators, FERC staff, and EPA staff as needed.
- Co-authored and co-led PJM's responses to the Independent Market Monitor's (IMM's) *State of the Market Reports* as well as remaining in communication with the IMM on various matters of concern and interest related to PJM market performance and design.
- Led technical and non-technical external outreach efforts to promote PJM markets or explain PJM positions on policy or market design issues of current interest to industry stakeholders including academic audiences, and invited presentations at industry sponsored events.
- Provided support in gas/electric coordination discussions within PJM and the between the power and gas industries, as well as operations support during critical operating periods in January 2014 through calls and inquiries to PJM generators and pulling environmental permits to better understand generator operating limitations on back-up fuel.
- Provided periodic reports on market performance and the state of PJM's markets to the PJM Board of Managers Competitive Markets Committee including the relationship between PJM's markets and major fuel market, environmental policy, and macroeconomic trends.
- Acted in the role of an internal consultant and advisor to all PJM departments and divisions, as needed, to address any questions or concerns surround market performance, market design, and general economic or environmental policy questions.

- Supported development and issuance of the PJM Renewable Integration Study by outside vendors.

**2000–2008 Director of Energy Studies, Public Utility Research Center and Lecturer,  
Department of Economics, University of Florida, Gainesville, FL**

- Designed and delivered executive education and outreach programs in electric utility and regulatory policy and strategy for professionals in government, regulatory agencies, and industry primarily for developing countries.
- Responsible for electricity regulatory policy curriculum for the *PURC/World Bank International Training Program on Utility Regulation and Strategy* offered twice per year for 65 to 95 industry and regulatory professionals in each course.
- Acted as the electricity expert and liaison to the Florida electric utilities who were contributing members of PURC.
- Developed electricity related topics and obtained speakers for the PURC Annual Conferences held each February on matters related to environmental policy, wholesale market restructuring, so-called “hurricane hardening” of power systems after the 2004-2005 hurricane seasons, and other policy related matters of interest to the state of Florida.
- Served the PURC liaison to the consultants retained by PURC to evaluate the hardening of electricity infrastructure in the wake of the 2004 and 2005 hurricane seasons.
- Conducted original academic research related to electricity regulation and policy and published in peer reviewed academic and policy journals
- Developed customized regulatory training courses or sessions jointly prepared with other organizations for on-site delivery in Panama, Trinidad & Tobago, Brazil, Mexico, Peru, Bolivia, Argentina, Grenada, South Africa, Zambia, Namibia, and Cambodia
- Served as an advisor and subject matter expert on wholesale restructuring and market issue to Florida Governor Jeb Bush’s *Energy 2020 Study Commission* 2000-2001.
- Taught classes as needed in the Economics Department on environmental economics, regulatory economics, and a large lecture class of managerial economics

**1999–2000 Economist, Office of Markets, Tariffs, and Rates, United States Federal Energy  
Regulatory Commission, Washington, DC**

**1998–1999 Economist, Office of Economic Policy, United States Federal Energy  
Regulatory Commission**

- Provided analysis and research related to filings made by ISO/RTO markets as they commenced operations as centralized wholesale power markets.
- Led the economic analysis and evaluation of the NYISO wholesale power market in its initial filings of its market design and subsequent filings after operations commenced.
- Led economic analysis and evaluation of multiple filings by the California ISO related to requested market design changes filed after starting operations in 1998.
- Supported analysis and evaluation of other ISO/RTO markets as needed.
- Supported and provided analysis on merger applications as needed.
- Conducted original research while on the staff of the Chief Economic Advisor in the Office of Markets, Tariffs, and Rates related to unit commitment models used in day-ahead electricity markets and pricing in the presence of lumpy decisions and operational characteristics (technically known as non-convexities).

**1992–1998 Instructor, Department of Economics, Augsburg College, Minneapolis, MN**

- Taught small classes of introductory microeconomics, labor economics, money and banking, and environmental economics

**1992–1998 Instructor, Department of Economics, University of Minnesota, Minneapolis, MN**

- Taught large lecture classes of primarily introductory microeconomics to classes of up to 600 students 3 times per year, managing a staff of teaching assistants and graders and developing curriculum and exams.
- Taught smaller classes of introductory microeconomics as well as environmental economics

## PUBLICATIONS AND BOOK CHAPTERS

Covino, Susan, Andrew Levitt, and Paul Sotkiewicz, "The Fully Integrated Grid: Wholesale and Retail, Transmission and Distribution", in *Future of Utilities- Utilities of the Future: How Technological Innovations in Distributed Energy Resources Will Reshape the Electric Power Sector*, Fereidoon P. Sioshansi, editor, Chapter 22, pp.417-434, 2016.

M. Ahlstrom; E. Ela; J. Riesz; J. O'Sullivan; B. F. Hobbs; M. O'Malley; M. Milligan; P. Sotkiewicz; J. Caldwell, "The Evolution of the Market: Designing a Market for High Levels of Variable Generation", *IEEE Power and Energy Magazine*, Volume: 13, Issue: 6, 2015, Pages: 60 – 66.

Bresler, Stuart, Paul Centollela, Susan Covino, and Paul Sotkiewicz, "Smarter Demand Response in RTO Markets: The Evolution Towards Price Responsive Demand in PJM", in *Energy Efficiency: Towards the End of Demand Growth*, Fereidoon P. Sioshansi, editor, Chapter 16, pp.419-442, 2013.

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Vignolo, Jesus Mario and Sotkiewicz, Paul M., "Towards Efficient Tariffs for Distribution Networks with Distributed Generation", Cogeneration and On-site Power Production, November-December 2006, pp. 67-75.

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Sotkiewicz, Paul M. and Vignolo, Jesus Mario "Nodal Pricing for Distribution Networks: Efficient Pricing for Efficiency Enhancing DG." IEEE Transaction on Power Systems, Vol. 21, No. 2, May 2006, pp. 639-652.

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Sotkiewicz, Paul M., "The Impact of State-Level Public Utility Commission Regulation on the Market for Sulfur Dioxide Allowances, Compliance Costs, and the Distribution of Emissions" Ph.D. Dissertation, Department of Economics, University of Minnesota, January 2003.

O'Neill, Richard P., Helman, Udi, Sotkiewicz, Paul M., Rothkopf, Michael H., and Stewart, William R. Jr., "Regulatory Evolution, Market Design, and the Unit Commitment Problem" The Next Generation of Unit Commitment Models, B. Hobbs, M. Rothkopf, R. O'Neill, and H.P. Chao editors. 2001.

Sotkiewicz, Paul M. "Opening the Lines", Forum for Applied Research and Public Policy, Special Issue on the Role of Public Power in Utility Restructuring, Summer 2000, pp. 61-64.

## **SELECTED WORKING PAPERS AND UNPUBLISHED MANUSCRIPTS**

Holt, Lynne, and Paul M. Sotkiewicz. "Understanding Fuel Diversity Trade-Offs and Risks: Making Decisions for the Future (pdf)" University of Florida, Department of Economics, PURC Working Paper, 2007.

O'Neill, Richard P., Sotkiewicz, Paul and Rothkopf, Michael. "Equilibrium Prices in Exchanges with Non-convex Bids." PURC Working Paper, January 2006, updated September 2007.

Sotkiewicz, Paul M. "Cross-Subsidies That Minimize Electricity Consumption Distortions" University of Florida, Department of Economics, PURC Working Paper, 2003.

**CONSULTING AND ADVISING EXPERIENCE PRIOR TO JOINING PJM IN 2008**

- 2007      Advisor to the Government of Vietnam regarding the design and experience of wholesale electricity markets as Government looked at the creation of US style ISOs to attract investment in generation assets for IPPs
- 2007      Independent Expert in the Matter of the Public Utilities Commission of Belize Initial Decision in the 2007 Annual Review Proceeding for Belize Electricity Limited
- 2006      Advisor to the Division of Air Resource Management, Florida Department of Environmental Protection (FDEP) Regarding Implementation the Clean Air Interstate Rule (CAIR)

## HONORS AND AWARDS

- 2007 Fulbright Senior Specialist Grant in Economics with a specific request for expertise in electricity markets, electricity regulation, and distribution tariff design, Universidad de la República, Montevideo, Uruguay.
- 2007 Principal Investigator, PPIAF/World Bank Grant to conduct two on-site training courses on the regulation of the electric power sector and on independent power producers and power purchase agreements for the Electricity Authority of Cambodia. Grant award \$59,900.
- 2006 “Efficient Market Clearing Prices in Markets with Non-Convexities” published in *European Journal of Operational Research* received New Jersey Policy Research Organization Bright Idea Research Award in Decision Sciences.
- 2003 Transportation and Public Utilities Group, Ph.D. Utilities Dissertation Award for “The Impact of State-Level Public Utility Commission Regulation on the Market for Sulfur Dioxide Allowances, Compliance Costs, and the Distribution of Emissions”
- 1992-97 Distinguished Instructor, Department of Economics, University of Minnesota
- 1995-96  
1994-95 Walter Heller Award for Outstanding Teaching of Economic Principles, Department of Economics,  
1993-94 University of Minnesota  
1992-93
- 1991-92 Distinguished Teaching Assistant, Department of Economics, University of Minnesota
- 1991 Phi Beta Kappa, University of Florida

## Referee and Review Experience

*IEEE Transactions on Power Systems*

*Ecological Economics*

*Environmental Science and Technology*

*Determining the Economic Value of Coastal Preservation and Restoration on Critical Energy Infrastructure*, prepared for The Economic and Market Impacts of Coastal Restoration: America’s Wetland Economic Forum II, September 28, 2006 Washington, DC

*National Research Council of the National Academy of Sciences* report entitled “Changes in New Source Review Programs for Stationary Sources of Air Pollutants”, February 2006

*California Energy Commission (CEC) Energy Innovations Small Grant (EISG) Program*

*Energy Journal*

*Journal of Environmental Economics and Management*

*IEEE PES Letters*

*IASTED International Journal of Power and Energy Systems*

*The Next Generation of Unit Commitment Models* B. Hobbs, M. Rothkopf, R. O’Neill, and H.P. Chao editors  
2001.

## **Professional Affiliations**

American Economic Association  
International Association for Energy Economics  
Association of Environmental and Resource Economists  
IEEE Power and Energy Society

## **EXPERT TESTIMONY**

### ***PJM Interconnection, L.L.C.* FERC Docket No. ER09-1063-004, Affidavit in Support of PJM's Compliance Filing with Order No. 719 and Order on Compliance Filing *PJM Interconnection, L.L.C.*, 129 FERC ¶ 61,250 (2009). June 18, 2010**

In support of its compliance filing to establish a mechanism that ensures appropriate pricing during periods of operating reserve shortages, as required by the Commission's Order No. 719, I provided the following: 1) A high-level overview of PJM's markets, planning, and operations, including a description of what is meant by an operating reserve shortage, and how such shortages arise; 2) An overview of PJM reserve requirements, current reserve market structure, and data on PJM's prices and operations at times when the grid it manages has experienced operating reserve shortages; 3) A showing why PJM's then current scarcity pricing not satisfy the Commission's Order No. 719 criteria for operating reserve shortage pricing mechanisms; 4) Description of the main elements of PJM's proposal to comply with Order No. 719's shortage pricing policy, and how PJM's proposal satisfies the six criteria for reserve shortage pricing set by Order No. 719.

***PJM Interconnection, L.L.C.* FERC Docket No. ER09-1063-004, Affidavit in Support of Answer to Comments and Motion for Leave to Answer to Protests, August 23, 2010.** The purpose of this affidavit is to provide the following regarding PJM's proposed shortage pricing mechanism: 1) The complementary relationship between capacity adequacy in the Reliability Pricing Model ("RPM") and shortage pricing; 2) Additional evidence showing why PJM's shortage pricing proposal leads to energy prices that reflect the cost and/or value of energy, allocates energy to those who value it most, enhance operational reliability, and leads to efficient market outcomes while the alternate proposal from the Independent Market Monitor (IMM) fails to achieve any of these goals; 3) An explanation of how the proposed mechanism is consistent with shortage pricing mechanisms in the New York Independent System Operator ("NYISO") and ISO New England ("ISO-NE") that the Commission has already approved as Order 719 compliant.

***PJM Interconnection, L.L.C.* FERC Docket No. ER12-513, Affidavit in Support of Filing to Update its RPM Auction Parameters (aka Triennial Review) December 1, 2011.** This affidavit was submitted in support of three aspects of PJM's proposed changes related to PJM's capacity market, known as the Reliability Pricing Model ("RPM") including: 1) the continued use of a nominal levelized approach to calculating the estimated Cost of New Entry ("CONE") that is used in RPM's Variable Resource Requirement ("VRR") Curve; 2) retention of a combustion turbine ("CT") as the Reference Resource.

***PJM Interconnection, L.L.C.* FERC Docket No. ER-14-2490, Affidavit in Support of Filing to Update its RPM Auction Parameters (aka Quadrennial Review) September 25, 2014** This affidavit was submitted in support of five aspects of PJM's proposed changes related to PJM's capacity market, known as the Reliability Pricing Model ("RPM"): 1) adoption of The Brattle Group's ("Brattle") recommended VRR Curve shape right shifted by 1% of the Installed Reserve Margin ("IRM"); 2) continued use of a nominal levelized approach to calculating the estimated Cost of New Entry ("CONE") that is used in RPM's Variable Resource Requirement ("VRR") Curve; 3) retention of a combustion turbine ("CT") as the Reference Resource; 4) use of a composite of Bureau of Labor Statistics ("BLS") indices to adjust Gross CONE estimates in between periodic VRR parameter reviews; and 5) adoption of the labor estimates provided by the PJM Independent Market Monitor ("IMM") to determine Gross CONE values.

***Grid Reliability and Resilience Pricing FERC Docket No. RM18-1, Affidavit in Support of the Electric Power Supply Association (EPSA), October 23, 2017.*** This affidavit provides evidence the Department of Energy Notice of Proposed Rulemaking (“NOPR” or “Proposal”) released on September 28, 2017 and appearing in the Federal Register on October 2, 2017 does nothing to enhance reliability or “resiliency” of the bulk power system and will only succeed in distorting wholesale power markets while also raising costs. Consequently, my affidavit supports EPSA’s contention the NOPR should be rejected outright by the Commission.

***ISO New England Inc. and New England Power Pool Participants Committee, FERC Docket No. ER18-620-000, Affidavit in Support of the Protest of the New England Power Generators Association, Inc. January 29, 2018.*** In summary, my affidavit explains that the proposed updated DDBT from \$5.50/kW-month to \$4.30/kW-month: 1) Relies on a flawed and logically inconsistent methodology that differs from the DDBT methodology approved by the Commission three years ago; 2) Sets a dangerous precedent in ISO-NE taking a position on the direction of its Forward Capacity Market (“FCM”) in terms of supply-demand balance and expected market prices that could anchor expectation of market participants. The anchoring of such expectations can change FCA bidding and operational behavior that could harm reliability; 3) The previous methodology approved by the Commission of using Static De-List Bids from oil steam and oil combustion turbine generators remains the appropriate methodology for determining the DDBT; and 4) The cost-based DDBT is likely higher than for FCAs 10-12 given that net going forward costs for oil steam and oil combustion turbine units has likely increased given their age, and other risks and opportunity costs that may be coming into play. My affidavit concludes that the current DDBT should be retained until such time as a new DDBT threshold and be determined using the current Commission-approved methodology following the discovery of the actual costs and risks faced by oil units.

***Petition for Determination of Need for Seminole Combined Cycle Facility in Docket No. 20170266-EC and Joint Petition for Determination of Need for Shady Hills Generating Facility in Docket No. 20170267-EC, January 29, 2018. Testimony and Exhibits on Behalf of Quantum Pasco Power, LP, Michael Tulk, and Patrick Daly.*** My testimony supports the notion that there is no need for either combined cycle facility as Seminole Electric has consistently over-forecast its load growth since the “great recession” and that once correcting for these large errors, there is no need to build two new combined cycle facilities when there where other lower cost merchant generator facilities that offered their capacity to Seminole.

***PJM Interconnection, L.L.C. FERC Docket No. E18-34, Affidavit in Support of EPSA’s Filing and Comments in PJM’s Fast Start Pricing Proposal, March 14, 2018*** My affidavit in this proceeding provides support for PJM’s desire to allow resources with up to two-hour start up times to be considered “fast start” resources and to set price in accordance with the fast start pricing principles the Commission has enumerated in its Fast Start Pricing NOPR. I explain PJM’s use of IT SCED and request to allow two-hour start time resources to set prices as fast start resources is entirely consistent with the ideas the Commission has enumerated with respect to fast start pricing.

***PJM Interconnection, L.L.C. Capacity Repricing or in the Alternative MOPR-Ex Proposal: Tariff Revisions to Address Impacts of State Public Policies on the PJM Capacity Market, FERC Docket No. ER18-1314-000, Affidavit in Support of Comments of American Petroleum Institute, JPower USA Development, Ltd., and Panda Power generation Infrastructure Fund, LLC May 7, 2018.*** My affidavit provides evidence that 1) The PJM Capacity Repricing Proposal is not just and reasonable and is unduly discriminatory and results in an inefficient commitment of resources; 2) The alternative proposal from PJM, MOPR-Ex, is just and reasonable and results in the most efficient and cost-effective use of resource commitments; and 3) The current and previous iterations of the MOPR are not just and reasonable and are unduly discriminatory because they do not apply to existing resources and they only apply to gas-fired resources. Furthermore, my affidavit provides evidence that MOPR has always been viewed as a market power mitigation mechanism that was originally intended to thwart or mitigate the exercise of buyer-side market power. I show in this affidavit that MOPR, and in particular MOPR-Ex, still is a powerful market power mitigation tool that mitigates exercise of supplier market power that are facilitated by the current round of state subsidies to generation. Moreover, I show that Capacity Repricing helps facilitate the exercise of supplier market power through three different means.

***Grid Resilience in Regional Transmission Organizations and Independent System Operators, FERC Docket No. AD18-7-000, Affidavit in Support of Comments of the American Petroleum Institute, May 9, 2018.*** This affidavit focuses on the comments submitted by PJM and: 1) Supports the idea that in the context of bulk power system markets and operation resilience and reliability are indistinguishable and that markets and well-designed incentives are the best avenue to achieve a resilient and reliable bulk power system; 2) Explains why market mechanisms rather than suspension of market and command and control regimes are better at achieving resiliency/reliability even during emergency conditions and that PJM has not made a case for being given the authority to suspend markets; 3) That PJM has not made the case that price formation through integer relaxation is linked to resilience/reliability while other price formations that are crucial to reliability/resilience such as shortage pricing and fast start pricing are being considered concurrently; and 4) So-called “fuel security” is only a minimal contributor to resilience/reliability while transmission and distribution assets are the leading causes for shedding firm load and gas-fired units have been shown to not even be the leading category of generation outages. With respect to generator reliability/resilience, simply providing additional compensation (or minimize penalties) to generators in wholesale markets, without any ties to generator performance, does nothing to enhance reliability/resilience of generators to withstand or minimize the impact of adverse events on the bulk power system. Experience in PJM prior to, and following the discussion and implementation of capacity performance has shown this to be the case as generator performance has improved even in the face of lower energy market prices.

***New England Power Generators Association, Complainant v. ISO New England Inc., Respondent. FERC Docket No. Docket No. EL18-154-000, Affidavit in Support of Complaint and Request for Expedited Consideration of the New England Power Generators Association, Inc. May 24, 2018*** This affidavit in support of NEPGA’s complaint shows the impact of treating Mystic Units 8 and 9 as a price taker on the ISO-NE markets as well as NEPGA’s proposed alternative to accommodating the participation of the Mystic units. Discussions include: 1) treating Mystic and other resources retained for fuel security as price takers will do significant harm to the competitiveness of the FCM market and is inconsistent with the first principles of capacity markets articulated by the Commission; 2) the proposal to insert an above market cost resource into the FCM as a price taker does exactly the same harm as an exercise of buyer-side market power, which the Commission has found to be unjust, unreasonable, and unduly discriminatory; and 3) the proposed remedy offered by NEPGA does not distort the results of the Forward Capacity Auction, results in competitive pricing outcomes in FCA, does not displace otherwise economic resources, and provides better reliability outcomes for ISO-NE load than the current ISO-NE proposal.

***New England Power Generators Association, Complainant v. ISO New England Inc., Respondent. FERC Docket No. Docket No. EL18-154-000, Affidavit in Support of the Motion for Leave and Answer of the New England Power Generators Association, Inc. June 19, 2018.*** This affidavit in support of NEPGA’s answer refutes the answer of ISO-NE and protesters and responds that nothing in ISO-NE’s answer to the Complaint or the protests to the Complaint provides a basis for ignoring that treating the Mystic Units as price takers would suppress prices below competitive levels and inefficiently displace otherwise economic resources in a manner that is observationally equivalent to the harm done by an exercise of buyer-side market power.

***Panda Stonewall, LLC. FERC Docket No. ER17-1821-002, Testimony in Support of Panda Stonewall, LLC Reactive Power Filing, July 2, 2018.*** This testimony supports Panda Stonewall’s reactive power rate case that has gone to hearing and in particular supports the inclusion of firm gas pipeline transportation, the use of proxy cost of capital values from the PJM CONE study, and supports the inclusion of other administrative and overhead costs consistent with fixed, going forward costs incurred by Panda Stonewall to remain in commercial operation. Furthermore, the testimony puts the costs of reactive power into the context of the wider PJM market and other opportunities for compensation and well as providing historical context around the Commission-approved AEP Methodology for reactive power rates.

***ISO New England Inc. FERC Docket No. ER18-2364-000, Affidavit in Support of the Protest of the New England Power Generators Association, Inc. September 21, 2018.*** This testimony supports NEPGA’s protest that the proposed ISO-NE treatment of resources held for winter fuel security as price takers in the FCA makes no sense since winter fuel security is not associated with overall resource adequacy which is based on the summer peak. Moreover, the testimony shows clearly the artificial price suppression that would occur based on ISO-NE proposed treatment of resources held for winter fuel security in the FCA.

***Calpine Corporation v. PJM Interconnection, L.L.C. Docket No, EL16-49; PJM Interconnection L.L.C. Docket No. ER18-1314-000, ER18-1314-001, EL18-178 Affidavit in Support of the Electric Power Supply Association, October 2, 2018.*** This testimony refutes the idea that the Commission proposed remedy a resource specific FRR Alternative equally removes both demand and supply from the market and therefore does no harm. Such a mechanism is the equivalent of an exercise of buyer side market power, artificially reduces price below competitive levels, inefficiently displaces lower cost, economic resources with higher cost resources, shifts cost and benefits between market participants, and reduces overall market efficiency. Additionally, PJM market simulations for scenarios from the 2020/2021 auction show the kind of damage that can be done to the market through the proposed remedy or equivalently buyer side market power by showing prospective price decreases and generation displacement, and the level of subsidy that could be used to facilitate a successful exercise of buyer-side market power.

***Panda Stonewall, LLC. FERC Docket No. ER17-1821-002, Rebuttal Testimony in Support of Panda Stonewall, LLC Reactive Power Filing, October 12, 2018.*** This rebuttal testimony supports Panda Stonewall's reactive power rate case responding to interveners and FERC staff and in particular supports the inclusion of firm gas pipeline transportation, the use of proxy cost of capital values from the PJM CONE study, and supports the inclusion of other administrative and overhead costs consistent with fixed, going forward costs incurred by Panda Stonewall to remain in commercial operation. Furthermore, the testimony puts the costs of reactive power into the context of the wider PJM market and other opportunities for compensation and well as providing historical context around the Commission-approved AEP Methodology for reactive power rates.

***In the Matter of the Implementation of L. 2018, c. 16 Regarding the Establishment of a Zero Emission Certificate Program for Eligible Nuclear Power Plants, New Jersey Board of Public Utilities, BPU Docket No. EO 18080899, Testimony in Support of PJM Power Providers, October 22, 2018.*** This testimony responds to questions posed by the BPU in this docket and provides analysis showing that the nuclear units in New Jersey seeking ZECs are not in need of them to remain in commercial operation. The testimony shows that these resources, given known forward prices for energy and capacity prices are able to cover their going forward costs in the absence of subsidies in the form of ZECs and will remain in commercial operation in spite of warnings these resources will retire in the absence of ZEC payments.

***Calpine Corporation v. PJM Interconnection, L.L.C. Docket No, EL16-49; PJM Interconnection L.L.C. Docket No. ER18-1314-000, ER18-1314-001, EL18-178 Affidavit in Support of the Electric Power Supply Association, November 6, 2018.*** This testimony responds to the Illinois Commerce Commission's protest that suggests the RPM Capacity Market be eliminated and replaced by an energy-only market construct because the capacity market is not a market at all. It also responds to the notion that markets should account directly for environmental policy and because they do not, the Illinois zero emission credit program for nuclear resources is justified. The testimony refutes these ideas by describing in detail that all markets have administrative rules and that markets can account for environmental policies when properly formulated to put a price on emissions rather than subsidizing resources out-of-market. Moreover, this testimony provides evidence of the need for the RPM Capacity Market to maintain resource adequacy as an energy only construct would not result in sufficient resources covering going forward costs in the energy market alone.

***Alberta Utilities Commission, Consideration of ISO Rules to Implement and Operate the Capacity Market, Proceeding No. 23757, Evidence in Support of ENMAX Corporation, February 28, 2019.*** This evidence outlines the elements of the Alberta Electric System Operator (AESO) proposed capacity market framework that require changes to make align the capacity market with fair, efficient, and openly competitive market principles. The evidence addresses the resource adequacy model, capacity value of resources, penalties and bonuses, market power mitigation, Net CONE determination, and interactions with the energy market framework. The evidence also provides a high-level overview of the objectives of a capacity market and how it should interact with the energy and retail markets in Alberta.

***In the Matter of the Implementation of L. 2018, c. 16 Regarding the Establishment of a Zero Emission Certificate Program for Eligible Nuclear Power Plants, New Jersey Board of Public Utilities, BPU Docket No. EO 18080899, Response to Staff Questions on Accounting for Risk in Support of PJM Power Providers, March 8, 2019.*** This is a response to BPU staff questions regarding market risk. This response discusses the mitigation of overall market risk based on changing conditions, optimal energy market offers and mitigation of energy market operational risk, and optimal

offers and risk mitigation in the capacity market that are available to all generation resources including nuclear resources.

***In the Matter of the Implementation of L. 2018, c. 16 Regarding the Establishment of a Zero Emission Certificate Program for Eligible Nuclear Power Plants, New Jersey Board of Public Utilities, BPU Docket No. EO 18080899, Reply Testimony in Support of PJM Power Providers, March 19, 2019.*** This reply testimony responds to PSEG comments regarding the need for ZECs for New Jersey's nuclear units. This reply testimony updates the economic analysis showing New Jersey nuclear units are currently profitable and expected to remain profitable in the future. Furthermore, this reply points out that PSEG did not dispute the costs used in the initial analysis or the idea that new entry of combined cycle gas generation can reduce emissions at zero cost at the margin given these resources will enter the market absent subsidies. The reply argues, contrary to what is stated by PSEG, that the threat to retire is not credible given the statements and evidence provided by PSEG in its Securities and Exchange Commission (SEC) filings. This reply also provides evidence that it would be infeasible for PSEG to buy out of its capacity commitments in Incremental Auctions (IAs) given the supply and demand conditions present in IAs to date.

***Alberta Utilities Commission, Consideration of ISO Rules to Implement and Operate the Capacity Market, Proceeding No. 23757, Reply Evidence in Support of ENMAX Corporation, April 4, 2019.*** This evidence replies to the comments of other interveners regarding various elements of the Alberta Electric System Operator (AESO) proposed capacity market framework. The reply evidence responds to intervener comments on elements of the Net CONE determination, capacity and energy market power mitigation, the capacity value of resources inconsistencies between the resource adequacy model and offered supply, and penalties and bonuses.

***Colorado Public Utilities Commission in the Matter of the Commission's Implementation of §§ 40-2.3-101 and 102, C.R.S. The Colorado Transmission Coordination Act, PROCEEDING NO. 19M-0495E, in Support of the Intermountain Rural Electric Association, November 15, 2019.*** This evidence provides the Colorado Commission with an overview of the benefits of RTO markets for electric cooperatives.

***American Transmission Systems Incorporated, Docket No. ER20-1740 Affidavit in Support of Buckeye Power Inc. Counter the Capacity Market Benefits of ATSI Moving from MISO to PJM and Recovery of Transition Costs, May 29, 2020.*** This affidavit provides empirical evidence and theoretical support that load connected to the ATSI transmission system paid more in capacity costs in PJM than they would have paid had ATSI stayed in MISO to counter ATSI's argument that ATSI connected load would have paid more for capacity had ATSI remained in MISO.

***Alberta Utilities Commission ("AUC") Distribution System Inquiry Proceeding 24116, Response from Kalina to AUC Information Request Round 2, Jointly with Regulatory Law Chambers, Terradigm Energy, Inc, and Nican International Consulting, Ltd on Behalf of Kalina Distributed Power, June 17, 2020.*** This response to information requests provides support for an optimal distribution tariff design that rewards resources that reduce the need for additional upgrades and reduce line losses and send price signals regarding the optimal location on the distribution system. This response also argues against tariff policies that would inefficiently charge such resources for costs they do not cause to either the distribution system or the transmission system and argues that efficient pricing is consistent with the competitive objectives of the Alberta energy market.

***Investigation into Resource Adequacy Alternative, New Jersey Board of Public Utilities, BPU Docket No. EO 20030203, Prepared Comments in Support of PJM Power Providers, June 24, 2020.*** These prepared comments address the benefits of Reliability Pricing Model (RPM) Participation for New Jersey customers and the additional costs of moving to a Fixed Resource Requirement (FRR) Plan as proposed by PSEG and Exelon in earlier comments. These comments note the extra costs could be over \$700 million per year for New Jersey customers and would facilitate the exercise of market power by a small set of generation owners.

***American Transmission Systems Incorporated, Docket No. ER20-1740 Reply Affidavit in Support of Buckeye Power Inc. Counter the Capacity Market Benefits of ATSI Moving from MISO to PJM and Recovery of Transition Costs, June 25, 2020.*** This reply affidavit supports the previously supplied empirical evidence and theoretical support that load connected to the ATSI transmission system paid more in capacity costs in PJM than they would have paid had ATSI

stayed in MISO to counter ATSI's argument that ATSI connected load would have paid more for capacity had ATSI remained in MISO. Additionally, the reply affidavit responds to ATSI critiques of the original affidavit and the ATSI responses to answers.

***Alberta Utilities Commission ("AUC") Distribution System Inquiry Proceeding 24116, Concluding Remarks of Kalina Distributed Power, Jointly with Regulatory Law Chambers, Terradigm Energy, Inc, and Nican International Consulting, Ltd on Behalf of Kalina Distributed Power, July 15, 2020.*** These concluding remarks reiterates support for an optimal distribution tariff design that rewards resources that reduce the need for additional upgrades and reduce line losses and send price signals regarding the optimal location on the distribution system. These concluding remarks provide established economic theory to explain why the current policies that inefficiently charge such resources for costs they do not cause are not in the best interests of Alberta's energy market or Alberta energy customers.

***Investigation into Resource Adequacy Alternative, New Jersey Board of Public Utilities, BPU Docket No. EO 20030203, "Prospective Minimum Offer Price Rule Price Floors and Cost-Effectiveness of the PSEG/Exelon Fixed Resource Requirement Plan for New Jersey" in Support of PJM Power Providers, July 22, 2020.*** This whitepaper responds to the PSEG and Exelon comments submitted on June 24, 2020 and responds to the report of the PSEG/Exelon Consultant assertions about the alleged cost savings of moving to a Fixed Resource Requirement (FRR) Plan as proposed by PSEG and Exelon in earlier comments. This paper also discusses the Minimum Offer Price Floor levels for various clean energy resources to show they would largely not be excluded from the RPM capacity market and would likely clear the market given historic capacity prices.

## **POLICY WHITEPAPERS**

**The Market and Financial Position of Nuclear Resources in Pennsylvania**, April 5, 2019. Available at <https://citizens-against-nuclear-bailouts.prezly.com/new-report-highlights-long-term-profit-projections-for-pennsylvania-nuclear-generators> and <https://cdn.uc.assets.prezly.com/210b1e76-c577-4ffb-9bb9-c60c1f4299b8/-/inline/no/>

This paper shows that nuclear resources in Pennsylvania are profitable historically and going forward and are in no need of any kind of subsidies to keep these resources in service.

**The Market and Financial Position of Nuclear Resources in Ohio**, May 13, 2019. Available at [https://img1.wsimg.com/blobby/go/30b6d3a5-dffd-4a1b-9b4d-](https://img1.wsimg.com/blobby/go/30b6d3a5-dffd-4a1b-9b4d-0bf3451282cd/downloads/OH%20Nuclear%20Analysis%2020190513-final.pdf?ver=1559092681975)

[0bf3451282cd/downloads/OH%20Nuclear%20Analysis%2020190513-final.pdf?ver=1559092681975](https://img1.wsimg.com/blobby/go/30b6d3a5-dffd-4a1b-9b4d-0bf3451282cd/downloads/OH%20Nuclear%20Analysis%2020190513-final.pdf?ver=1559092681975)

This paper shows that nuclear resources in Ohio, Davis-Besse and Perry, are profitable historically and going forward and are in no need of any kind of subsidies to keep these resources in service as had been proposed under House Bill 6.