



**DATE:** September 16, 2018  
**TO:** PJM  
**FROM:** IMM  
**SUBJECT:** Opportunity Cost Calculations

---

## **Introduction**

On August 7, 2018, PJM issued a notice to Market Sellers indicating that the PJM Opportunity Cost Calculator available in Markets Gateway is the preferred method for calculating an adder to include in a cost-based energy offer.<sup>1</sup> The notice stated that Market Sellers cannot use a higher value than PJM's value "unless PJM has approved the alternative method, and PJM has not approved the methodology used by the Monitoring Analytics calculator." The notice stated that a lower value is acceptable to PJM.

In response to PJM's notice, on August 23, 2018, the MRC voted to approve changes to the PJM OA that would permit market participants to use the IMM opportunity cost calculator. The approved language is:

Notwithstanding any other provision of this Schedule 2, of the Amended and Re-stated PJM Operating Agreement, of the PJM Open Access Transmission Tariff, or any PJM Manual, any Opportunity Cost calculated using the opportunity cost calculator developed and maintained by PJM's Independent Market Monitor shall be deemed approved as in compliance with the PJM market rules by the Office of the Interconnection. Any market participant using an Opportunity Cost adder must designate what Opportunity Cost Calculator it will use and may change that designation no more frequently than annually.<sup>2 3</sup>

On August 29, 2018, PJM issued a response in the form of a public letter to the IMM.

---

<sup>1</sup> A copy of the notice is available in the August 24, 2017 meeting materials for the MIC Special Session - Opportunity Cost Calculators, "Opportunity Cost Calculator Market Seller Notice," Item 2A, <<https://www.pjm.com/-/media/committees-groups/committees/mic/20180824-special-occ/20180824-item-02-opc-calculator-market-seller-notice.ashx>>.

<sup>2</sup> See Meeting Materials for the Markets & Reliability Committee Meeting, "Opportunity Cost Calculator," Item 10, August 23, 2018, <<https://www.pjm.com/-/media/committees-groups/committees/mrc/20180823/20180823-item-10-opportunity-cost-calculator.ashx>>.

<sup>3</sup> The last sentence of the approved language was added as a friendly amendment during the MRC meeting.

This memo is in response to PJM's letter.

## **Objective**

The IMM's objective for opportunity cost calculations is simple. The purpose of the opportunity cost calculations is to ensure that units make competitive cost-based offers when they face specific types of run hour constraints. The only purpose of cost-based offers is to ensure that market power is not exercised and that markets result in competitive outcomes. The objective should be to have the best possible opportunity cost calculations for any unit that requests evaluation of its opportunity costs and that participants understand the basis for those calculations. The goal is to have a pragmatic and workable approach to calculating opportunity costs that makes sense to participants. The goal is not to make opportunity costs high or low, but to make them as accurate as possible based on all the detailed and corroborated facts of each unit and accurate details about the PJM market. That is the best way to ensure competitive market outcomes.

The IMM believes that the standard model of the review process for cost-based offers should apply in the case of opportunity costs. Under the standard model:

1. A market participant requests the application of opportunity costs in a cost-based energy offer.
2. The IMM evaluates the opportunity costs and all the associated inputs in detail, discusses the details with the participant and provides the results of its analysis to the participant.
3. The IMM and the participant discuss in detail and reach agreement after discussion.
4. The IMM informs the participant in writing that the opportunity cost is consistent with a competitive cost-based energy market offer.
5. PJM reviews the results and decides whether to accept or reject the agreed upon opportunity cost.<sup>4</sup>
6. If the IMM and the market participant do not reach agreement, the market participant has the option to request PJM's opinion or to go directly to FERC.
7. If PJM permits the participant to use an opportunity cost that the IMM believes is consistent with the exercise of market power, the IMM can raise the issue with FERC.
8. If PJM requires the participant to use an opportunity cost that the IMM believes is lower than the actual opportunity cost, the market participant or the IMM can raise the issue with FERC.

---

<sup>4</sup> PJM has generally accepted such agreements on opportunity costs, whether implicitly or explicitly.

The IMM requests that PJM clarify its preferred review process for opportunity cost calculations. There appear to be two options. Both options are consistent with Order 719 and with the PJM Operating Agreement Schedule 2.<sup>5</sup>

Under the first option, PJM determines that it is the primary reviewer of the opportunity cost element of cost-based offers for compliance with the Market Rules:

1. The market participant inputs its preferred parameters to the PJM calculator and adds the calculated opportunity cost to its cost-based offer.
2. PJM does not provide a written opinion that the calculated opportunity cost is compliant with the rules.
3. The IMM evaluates the calculated opportunity cost. The IMM informs both the participant and PJM as to the IMM's conclusions about the correct opportunity cost.
4. If the IMM believes that the calculated opportunity cost is consistent with the exercise of market power, the IMM can raise the issue with FERC.
5. If the IMM believes that the calculated opportunity cost is lower than the actual opportunity cost, the market participant or the IMM can raise the issue with FERC.

Under the second option, PJM determines that the standard model for the review of cost-based offers applies to opportunity costs. As specified in the standard model, PJM retains the authority to accept or reject the results of agreements between participants and the IMM. The IMM retains the obligation and authority to raise issues with FERC if PJM overrules the agreement in a manner that permits the exercise of market power or requires the use of an opportunity cost that is too low. The market participants retain the authority to request a determination by FERC at any point.

The IMM recognizes that PJM can impose the first option. The IMM recommends the second option. It is consistent with FERC Order 719 and it reflects a sensible division of labor between the IMM and PJM in determinations of market power and compliance with the

---

<sup>5</sup> See Wholesale Competition in Regions with Organized Electric Markets, Order No. 719, FERC Stats. & Regs. ¶ 31,281 at P 154 (2008), order on 8 CFR § 35.28(g)(3)(ii); see also Wholesale Competition in Regions with Organized Electric Markets, Order No. 719, FERC Stats. & Regs. ¶31,281 (2008) (“Order No. 719”), order on reh’g, Order No. 719-A, FERC Stats. & Regs. ¶31,292 (2009), reh’g denied, Order No. 719-B, 129 FERC ¶ 61,252 (2009) (“We also determine that the IMM may provide the inputs required by the RTO or ISO to conduct prospective mitigation, including determining reference levels, identifying system constraints, cost calculations and the like. This will enable the RTO or ISO to utilize the considerable expertise and software capabilities developed by their IMM’s, and reduce wasteful duplication.”).

rules.<sup>6</sup> In addition, it incorporates a core role in the process for market participants and minimizes regulatory risk for participants.

If PJM were to select the second option, the IMM would continue to work to make clear to PJM the IMM approach to the calculation of opportunity costs and would discuss, at PJM's request, the details of any specific case with PJM to ensure that PJM clearly understands the basis for the calculation of opportunity cost.

As part of establishing a clear process for the review of opportunity costs, Manual 15 should be updated and clarified to reflect the best possible approach to calculating opportunity costs. The proposed approach will permit continuous improvement.

## **Operating Agreement**

PJM misunderstands the Operating Agreement (OA) language about approving an alternate method of calculating opportunity cost and therefore mischaracterizes the IMM approach as an alternate method. The IMM approach is fully consistent with the OA defined method and is therefore not an alternate method. There is no OA language giving PJM authority to approve or not approve the results of IMM calculations of opportunity costs or agreements between the IMM and participants about the level of opportunity costs.

Schedule 2 of the OA states:<sup>7</sup>

For a generating unit that is subject to operational limitations due to energy or environmental limitations imposed on the generating unit by Applicable Laws and Regulations, the Market Participant may include in the calculation of its "other incremental operating costs" an amount reflecting the unit-specific Energy Market Opportunity Costs expected to be incurred. Such unit-specific Energy Market Opportunity Costs are calculated by forecasting Locational Marginal Prices based on future contract prices for electricity using PJM Western Hub forward prices, taking into account historical variability and basis differentials for the bus at which the generating unit is located for the prior three year period immediately preceding the relevant compliance period,

---

<sup>6</sup> Order in EL08-47-005 states: "With regard to the participation of the PJM IMM in providing input into such determinations, Order No. 719 permits the PJM IMM to have a role in providing the inputs for such a process as long as PJM retains the ultimate decision making authority.<sup>6</sup> [fn omitted] As the Commission stated in Order No. 719, this would enable PJM to utilize the expertise and software capabilities that the PJM IMM can provide. 133 FERC ¶ 61,081 at P 22 (2010)."

<sup>7</sup> OA Schedule 2.

and subtract therefrom the forecasted costs to generate energy at the bus at which the generating unit is located, as specified in more detail in PJM Manual 15. If the difference between the forecasted Locational Marginal Prices and forecasted costs to generate energy is negative, the resulting Energy Market Opportunity Cost shall be zero.

The IMM opportunity cost method is fully consistent with Schedule 2 of the OA.

The balance of the relevant section of Schedule 2 of the OA states:

Notwithstanding the foregoing, a Market Participant may submit a request to PJM for consideration and approval of an alternative method of calculating its Energy Market Opportunity Cost if the standard methodology described herein does not accurately represent the Market Participant's Energy Market Opportunity Cost.<sup>8</sup>

This alternative method option can clearly be implemented on a case by case basis and does not require the blanket approval of a single method by PJM.

## **Issues**

The IMM does not have the authority to require a market participant to modify any part of its behavior including modifying cost-based offers or the opportunity cost component of its cost-based offer. But the IMM routinely informs market participants that if its use of the PJM calculator results in an opportunity cost greater than that calculated by the IMM that the IMM is required by the tariff to raise the issue with FERC.

The IMM has detailed discussions with market participants about the inputs to the opportunity cost calculations and the results of those calculations. The IMM has discovered that market participants have made mistakes related to input assumptions that significantly affected the outcomes. The IMM has modified its view of specific opportunity cost calculations when additional details have been brought forward by market participants. The IMM has made mistakes. The IMM does not claim that the IMM model is perfect. While it is important to have a complete and accurate model, opportunity cost calculations require case by case analysis and are not a simple matter of just running a model.

Real issues arise that cannot be addressed by PJM's calculator. PJM's opportunity cost calculator demonstrably does not produce accurate results over the entire range of possible scenarios faced by real units. The IMM has identified cases in which the inputs used by the market participant in PJM's model were incorrect. Participants use inputs at their own

---

<sup>8</sup> OA Schedule 2.

discretion and the outputs are deemed to be the correct opportunity costs by PJM. PJM does not review the inputs to its calculator used by participants. PJM does not conclude in writing that the opportunity costs are consistent with the rules. Thus, PJM does not approve the results of its own calculator. Yet PJM states that PJM's calculator is the standard for evaluating opportunity costs.

There are a number of factual inaccuracies in the PJM letter, including:

1. The IMM and PJM results only diverged in the latter part of 2016 and diverged as a result of unknown changes to the IMM calculation method.

In 2011 the IMM implemented an enhanced version of the opportunity cost calculator using an optimization solver. This was necessary to correctly model rolling constraints. From that point forward, any direct comparison would likely have resulted in different outcomes.

2. The details of the IMM calculations have not been shared with PJM.

The IMM has explained the IMM's method for calculating opportunity costs. The IMM has participated in the MIC Special Session on the opportunity cost calculator. The key activities called for a comparison of the IMM and PJM opportunity cost calculators, and the identification of any modifications necessary to make the results of the two calculators comparable.<sup>9</sup> The IMM explained the details of the IMM opportunity cost calculator at the first meeting of the special session.<sup>10</sup> In this education session, the IMM also pointed to several differences in the two calculators, most notably the use of an optimization solver by the IMM calculator versus a block estimation method employed by the PJM calculator, and the precise modeling of the rolling constraints in the IMM calculator versus the inability of the PJM calculator to model rolling constraints.

In addition, the IMM has had recent meetings with PJM at which the IMM's method was described. The first of these meetings was on June 6, 2016. PJM and the IMM had more detailed meetings prior to start of the MIC special session on opportunity costs, and the meetings have continued since the inception of the MIC special session with most MIC special session meetings being preceded by a bilateral meeting or information exchange between PJM and the IMM.

3. The details of the PJM calculations have been shared with the IMM.

---

<sup>9</sup> MIC Special Session, Opportunity Cost Calculator, "Problem Statement and Issue Charge," May 23, 2017, <<https://www.pjm.com/-/media/committees-groups/committees/mic/20170523-special/20170523-item-02-opportunity-cost-calculator-problem-statement-issue-charge.ashx>>.

<sup>10</sup> See "Opportunity Cost Calculator IMM Education Session," Agenda item 4, May 23, 2017, <<https://www.pjm.com/-/media/committees-groups/committees/mic/20170523-special/20170523-item-04-opportunity-cost-calculator-imm-education-session.ashx>>.

The IMM has reproduced the results of the PJM opportunity cost calculator based on the results of cases provided by PJM, and on that basis the IMM questions the accuracy of PJM's estimates.