

the PJM Market Rules be modified to include additional safeguards to ensure that offers are competitive. PJM has not identified the problem for which fast start pricing is the solution.

The underlying problem that fast start pricing and even PJM's broader modified convex hull pricing approach are attempting to address is actually scarcity pricing including the impact of operator actions on the definition of scarcity. More specifically, the problem is that prices do not reflect market conditions when the market is tight. A key cause of the problem is that conservative operators take actions that mean that PJM needs additional reserves even these extra reserves are not included in reserve targets when defining scarcity.⁴ Conservative operator actions are not directly priced and suppress prices at times when prices should be higher. Rather than undercutting the basic LMP logic that is core to market efficiency, it would make more sense to directly address scarcity pricing, operator actions and the design of reserve markets. Specifically, PJM should ensure that all real-time resource commitments beyond stated reserve requirements create an expansion of the reserve requirement so that prices reflect the commitment. Scarcity pricing, done correctly and comprehensively, would be fully consistent with efficient market outcomes and fully consistent with appropriate incentives for generators and for load.

I. ARGUMENT

A. Fast Start Pricing Does Not Reflect the Marginal Cost of Serving Load.

The Commission recognizes the value of accurate short run marginal cost price signals that support efficient dispatch.⁵ Accurate short run price signals, equal to the short

⁴ The operators' actions are those required to maintain the reliability of the system. Those actions are accepted as necessary and reasonable.

⁵ See, e.g., *Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 825, 155 FERC ¶ 61,276 (2016) ("Order No. 825"). See Order No. 825 at PP 5, 7, 10, 58, 163; *Offer Caps in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 157 FERC ¶ 61,115 (2016) ("Order No. 831") passim.

run marginal cost of generating power, provide market incentives for cost minimizing production to all economically dispatched resources and provide market incentives to load based on the marginal cost of additional consumption. The objective of efficient short run price signals is to minimize system production costs, not to minimize uplift. Repricing the market to reflect commitment costs would create a tradeoff between minimizing production costs and reduction of uplift. The tradeoff would exist because when commitment costs are included in prices, the price signal no longer equals the short run marginal cost and therefore no longer provides the correct signal for efficient behavior for market participants making decisions on the margin, whether resources, load, interchange transactions, or virtual traders. This tradeoff would be created in more limited form by PJM's fast start pricing proposal and in extensive form by PJM's modified convex hull pricing proposal.

The December 21st Order states (at P 1) that PJM "practices regarding the pricing of fast start resources may be unjust and unreasonable because the practices do not allow prices to reflect the marginal cost of serving load." The statement is incorrect. Locational Marginal Price ("LMP") is the additional cost incurred to meet an additional MWh of load at any pricing location. LMP is, by definition, the marginal cost of serving load. The objective of the operator is to find the least cost solution that satisfies load and reserve requirements subject to physical limitations of the grid. The costs include incremental cost of generation, startup cost and no load costs. However, efficient pricing depends only on the short run marginal costs. The cost of meeting a marginal increase in load is strictly equal to short run marginal costs.

PJM maintains sufficient online capacity at all times to meet an additional MWh of load without committing an additional resource. If PJM cannot meet an additional MWh of load without using capacity reserved to meet reliability requirements, the LMP is calculated using shortage pricing. The costs associated with committing additional resources to meet future system requirements are not marginal costs. The marginal cost is the cost to dispatch a MWh of generation to meet an additional MWh of load in the current market solution.

Reduction of the economic minimum operating limit to zero would allow resources that cannot supply an additional MWh of generation to set the market price, as if they were marginal. The price signal would no longer coincide with the optimal market behavior of the true marginal resource, so the price would not be consistent with an efficient allocation of resources. Due to nonconvex cost curves for most generating resources, marginal cost prices in electricity markets are not high enough to clear the market without uplift payments. Fast start pricing does not change this fact, and the reduction of uplift is not a criterion for market efficiency.

Instead of relying on transparent market prices as signals, efficient production on the margin would rely on nonpublic, resource specific, after the fact lost opportunity cost uplift payments. This new form of uplift would undermine the transparent functioning of the market by creating a split between the dispatch signal based on short run marginal cost and the price including commitment costs. This new form of uplift is unlike current uplift payments in that it replaces the LMP as the market signal on the margin. Even resources that require uplift to support economic commitment, under current LMP, receive a price signal consistent with efficient production given the commitment decision. It does not improve the efficiency of the market to create a split between the efficient dispatch signal and the price signal in the name of reducing uplift.

B. Assuming that Inflexible Units Are Flexible in Price Setting Logic Erodes Incentives for Flexibility.

In addition to reducing uplift, another rationale for fast start pricing is an appeal to let common sense override the logic, economics and mathematics of LMP. PJM uses anecdotes to support its assertions that marginal cost pricing is flawed. The anecdotes generally take the same form. For example, there is a CT which is block loaded at its maximum output of 100 MW, has a no load (NL) cost of \$1,000 per hour and an incremental cost of \$50 per MWh. If the CT has to be turned on when the system only needs 50 additional MW, this requires that the output of a flexible combined cycle unit be reduced in order to maintain power balance. The incremental cost of the flexible unit is \$25 per MWh,

so LMP becomes \$25 per MWh when it appears to PJM to be common sense that LMP should be \$50 per MWh, or incremental plus no load equal to \$60 per MWh.⁶

The anecdotal conclusion is incorrect because the CT is not flexible and even its incremental cost is not marginal as a result. The proposed solution is based in part on the assumption that it is necessary that the unit be inflexible, that it is necessary to block load the CT, and that it is efficient to let the inflexible unit set price. By paying the CT uplift or letting the CT set price, PJM would provide an incentive for the unit owner to keep the inflexible CT in the market. This creates the incentive for a generation owner with a portfolio to maintain some high priced inflexible units to set prices for the portfolio without being subject to current market power mitigation rules. This does not provide a longer term incentive to replace the CT with a flexible unit that could set price based on short run marginal costs. It is the longer term incentives that are critical. The correct longer term incentives are for a flexible market response to replace an inflexible unit that was built under cost of service regulation incentives.

The fast start pricing solution would undercut LMP logic rather than directly addressing the actual underlying issues. The solution is not to accept that the inflexible CT should be paid or set price based on its short run marginal costs plus no load. The question of why units make inflexible offers should be addressed directly. Are units inflexible because they are old and inefficient, because owners have not invested in increased flexibility or because they serve as a mechanism for the exercise of market power. The question of why this unit was built, whether it was built under cost of service regulation and whether it is efficient to retain the unit should be answered directly. The question of how to provide market incentives for investment in flexible units and for investment in increased flexibility of existing units should be addressed directly. The question of whether

⁶ See Price Formation Education Session—Day 1 Economic Dispatch, PJM Presentation (December 4, 2017) at 43–54.

inflexible units should be paid uplift at all should be addressed directly. Marginal cost pricing without paying uplift to inflexible units would create incentives for market participants to provide flexible solutions including replacing inefficient units with flexible, efficient units.

Prices that support rapid, flexible real-time market participation should accurately signal cost minimizing production and consumption. Fast start pricing supports dated inflexible technology rather than supporting a market that makes best use of increasingly flexible new technology. With greater market penetration of flexible generating resources, energy storage resources, and price responsive demand, the potential inefficiencies grow.

1. Other Illogical and Inefficient Results

Basing pricing on anecdotes can and will lead to other illogical and inefficient outcomes. As one example, consider the case in which the price is set at \$100 per MWh by a block loaded CT including incremental cost, no load cost and start cost. The \$100 per MWh fast start price exceeds the actual marginal cost of serving the next increment of load, which would be provided by a flexibly dispatched combined cycle at \$50 per MWh. A market participant in a neighboring market has generation available to sell to PJM at \$60 per MWh. In response to the \$100 price, the market participant schedules the import to PJM in real time. The scheduled import causes PJM to reduce output from the \$50 per MWh combined cycle to accommodate the \$60 per MWh energy, increasing the system cost. The result is inefficient. If the import were to entirely replace the inflexible CT, the LMP would fall to \$50 per MWh and the market participant would cancel the import and the cycle would start over. Fast start pricing would create volatility when market fundamentals do not imply volatility.

C. Fast Start Pricing Does Not Enhance Unit Commitment and Dispatch.

The objective of the system operator is to find the least cost solution that satisfies load and reserve requirements subject to transmission limits. The costs that are minimized include the incremental energy cost of generation, start costs and no load costs.

All ISOs, including PJM, separate the commitment and dispatch problems in both day-ahead and real-time markets. The commitment problem is solved first and then the dispatch problem is solved using the solution from the commitment problem. The start, no load and incremental energy costs of the units are considered in the commitment problem. Only the incremental energy costs of the committed units are considered in the dispatch problem, to obtain the least cost solution. Prices are calculated based on the solution to the dispatch problem.

The lack of consideration of commitment costs in pricing is not a limitation. Commitment costs do not change the prices. If PJM were to solve a combined commitment and dispatch problem, the resulting prices would be identical to the prices where PJM solves the commitment and dispatch problems separately. In both the combined optimization problem and the two step optimization problem currently employed by PJM, the efficient pricing depends only on incremental energy costs. The cost of meeting a marginal increase in load strictly depends on the incremental energy cost of additional generation needed. No load and start costs are not marginal costs.

D. PJM’s Current Real-Time Commitment Practice and CT Price Setting Logic are Not Consistent with Minimizing Production Costs.

The Commission suggests that PJM “consider fast start resources within dispatch in a way that is consistent with minimizing production costs, subject to appropriate operational and reliability constraints.”⁷ Regardless of the price setting process, PJM’s real time commitment practices for fast start resources are discretionary and not necessarily cost minimizing.

PJM optimization software does not commit resources in real time. PJM operators commit resources in real time, informed by knowledge of system conditions and by the Intermediate Term Security Constrained Economic Dispatch (“IT SCED”) recommended

⁷ December 21st Order at P 1.

commitments. Discretionary commitments provide no assurance of cost minimizing commitment decisions, because they may not be based on an overall cost minimizing optimization.

1. PJM Also Uses Discretion in CT Price Setting.

Resources that are not cost minimizing, based on the load requirement and modelled thermal constraints, should not set price. PJM manual interventions can cause uneconomic commitments to set prices.

PJM currently engages in a number of discretionary manual market interventions that affect prices in ways not consistent with marginal cost pricing and actual system conditions and that are neither predictable nor transparent. There are three categories of manual interventions relevant to fast start pricing: PJM selectively applies CT price setting logic, which assumes that units are more flexible than the actual unit offers; PJM changes transmission line limits from actual line limits in order to force units to set price; and PJM creates artificial constraints to force units or demand side resources to set price (closed loop interfaces).

The first category applies when a CT provides relief to a thermal constraint and/or to the power balance constraint under normal conditions. In this case, the economic minimum of the block loaded CT is assumed to be lower than the actual offer. The result is that the CT may set price at its incremental energy offer for a MWh output level that it cannot produce, and thus at a price that does not represent actual marginal cost.

Prior to October 4, 2016, the economic minimum of a block loaded CT in the CT price setting logic was reduced to 90 percent of its economic maximum. Starting on October 4, 2016, the reduction was increased to 80 percent of the unit's economic maximum. The reduction appears to be at the discretion of the operators and does not appear to be applied to all CTs. The rules are not clearly stated in the PJM tariff or manuals. Not all CTs with a reduced economic minimum are marginal.

Table 1 shows the frequency with which PJM has used its CT price setting logic. In 2017, there were 138,109 unit intervals or 0.30 percent of total number of unit intervals in 2017, where PJM employed CT price setting logic in the real time market without altering the line limits. A unit interval corresponds to using the CT price setting logic for one CT for one five minute interval. For example, if economic minimum of one CT were reduced for 12 five minute intervals or one hour, the number of unit intervals would be 12. Of the 138,109 unit intervals in 2017 where PJM employed CT price setting logic, in 3,799 unit intervals, the CT was marginal. In 2017, there were 252,557 marginal units in the real time market. Of those marginal units, 3,799 or 1.5 percent were block loaded CTs that set price because of the CT price setting logic.

Table 1 Frequency of PJM employing CT Price setting logic

Year	Number of Unit Intervals	Number of Unit Intervals Marginal
2016	193,463	4,752
2017	138,109	3,799

The second category applies when PJM changes a line limit from the actual limit to an arbitrarily lower limit in order to create a binding constraint and force a CT to set price. The CT is marginal and sets price for all pricing nodes on the constrained side. The constraint limit is continually adjusted based on the output of the CT. This practice is administrative price setting, and it is not consistent with cost minimization.

The third category is closed loop interfaces. In order to allow real-time committed resources to set prices, PJM defines system constraints that require commitment of a particular resource and cause that resource to set price. Most such constraints are closed loop interfaces. A closed loop interface is an artificial transmission constraint created to limit power flow to and from a defined closed region in the grid. PJM implements closed loop interfaces to allow units committed for reactive support and emergency DR to set price when they would not otherwise set price under LMP logic. The price setting mechanism of a closed loop interface is similar to that of a CT price setting logic with altered line limits. In the case of closed loop interfaces, composite constraints are specifically constructed for the

purpose of allowing a unit or demand response to set price when they would not otherwise set price under the marginal pricing principles. This practice is administrative price setting, and it is not consistent with cost minimization.

Rather than engage in administrative interventions, including fast start pricing, to mask the effect of uneconomic commitments, PJM should address the underlying issues directly.

E. Setting Prices Based on Start and No Load Costs Would Distort LMP and Impose Unjustified Additional Costs on Consumers.

1. Commitment Costs are Not Consistent Between Day-Ahead and Real-Time Markets.

PJM uses different processes to commit resources. PJM commits units for reliability prior to the Day-Ahead Energy Market. The Day-Ahead Energy Market results in unit commitments based on the least cost optimization. PJM may commit additional units after the Day-Ahead Energy Market based on the results of the Reliability Assessment Commitment follows the Day-Ahead Energy Market. PJM commits additional, shorter lead time units during the operating day. PJM evaluates resource commitment costs using different time frames, using different sets of resources, in each commitment process.

If PJM were to add commitments costs to day-ahead market prices for day-ahead commitments, the result would be a significant inconsistency between day-ahead and real-time prices, in addition to the inconsistencies that already exist. Day-ahead prices would include commitment costs but real-time prices would not include commitment costs because the units were committed in the day-ahead market. But, if a resource's commitment costs were added to prices in both markets, the result would be a double recovery of costs.

No action taken by PJM or market participants can eliminate the inconsistency between day-ahead and real-time prices that would result from including commitment costs in prices. Virtual participants cannot solve this problem. Instead, the problem would create an opportunity for false arbitrage under which virtual traders would be guaranteed profits from trading that could never result in convergence.

2. Start Costs are Not Adequately Limited by the PJM Market Rules.

If start costs are to be included in prices, the Commission should require PJM to include a thorough and accurate definition of these costs in the PJM Operating Agreement (“OA”) to ensure that offers are competitive and based on short run marginal costs. Schedule 2 of the OA includes a Start Additional Labor Cost that both PJM and the Market Monitor agree should not be included in start costs.⁸ The Cost Development Guidelines include Maintenance Adder costs that are not short run marginal costs.⁹ Maintenance costs that are not short run marginal costs are a large portion of start costs for several units that would qualify as fast start under PJM’s proposed two hour start time.

Unlike incremental energy costs, the PJM Market Rules impose no cap on start costs or no load costs. The requirement for cost-based offer verification for offers exceeding \$1,000 per MWh does not include validation of start and no load costs.¹⁰ If start and no load costs are to be included in fast start prices and therefore LMP, start and no load costs should be subject to the same cost review.

⁸ See Item 3 – VOM Matrix, PJM materials for the Markets Implementation Committee VOM Special Session (January 16, 2018) at Design Components #20 and #21. <<http://www.pjm.com/committees-and-groups/issue-tracking/issue-tracking-details.aspx?Issue={49DFD7B6-1E99-488F-BC00-D6750114DF15}>>.

⁹ PJM has also suggested that some maintenance costs should be excluded from the Cost Development Guidelines. See Item 3 – VOM Matrix, PJM materials for the Markets Implementation Committee VOM Special Session (January 16, 2018) at Design Component #3. <<http://www.pjm.com/committees-and-groups/issue-tracking/issue-tracking-details.aspx?Issue={49DFD7B6-1E99-488F-BC00-D6750114DF15}>>

¹⁰ See Order No. 831 at P 208.

F. Market Power Issues

1. Fast Start Pricing Would Increase the Need for Aggregate Market Power Mitigation Rules.

At times when fast start resources are committed to meet increases in load, PJM's options for commitment may not include sufficient diversity of resources to ensure a competitive outcome. The average HHI market concentration index for the peaking segment of the PJM supply curve is near 6000, well above the 1800 HHI cutoff defining the market as highly concentrated.¹¹ With fast start pricing, more resources in the peaking segment would become eligible to set price and able to set prices at higher levels, by including start and no load costs. Fast start pricing enhances the ability to exercise market power. The Commission should require PJM to include a process for mitigation of market power for fast start resources.

2. Fast Start Pricing Would Require Modifications to the Implementation of the Three Pivotal Suppliers Test.

The current test for market power mitigation, the Three Pivotal Supplier (TPS) test, defines which suppliers have structural market power based on their ability to provide relief of congestion. Currently, only suppliers that provide relief can impact market prices. Under fast start pricing, the disconnect between system dispatch and prices would mean that the current TPS test would need to be modified in order to address local market power under the new design.

With fast start pricing, a resource's offers could set prices even though the resource has no ability to relieve actual congestion. In the pricing run, different constraints may bind than in the physical dispatch and commitment models. Resources may affect prices based on the pricing model congestion, rather than the physical model congestion. The reduction

¹¹ See *2017 State of the Market Report for PJM: January through September*, Vol. II, Section 3: Energy Market at 101.

of the economic minimum, or integer relaxation, would apply to all eligible resources, also changing the supply curve for constraint relief that determines which suppliers are pivotal.

The three pivotal supplier test would have to be applied under in both of the two market solutions under fast start pricing. The TPS test using the physical dispatch and commitment models would determine which suppliers are able to relieve physical congestion, which determines efficient dispatch and could impact lost opportunity cost payments. The TPS test applied to the fast start pricing solution would determine which additional suppliers have structural market power with reduced economic minimums, or integer relaxation. The results from both market power tests would need to be combined as an input in the final commitment, dispatch, and pricing solutions.

G. PJM Allows Inaccurate and Inefficient Physical Parameters to Determine Resource Commitment.

The PJM Market Rules contain no requirement that resources submit accurate time based physical operating parameters with their market offers. The application of Parameter Limited Schedules is limited to cost based offers and to offers used during emergency events. The fast start resource designation would rely on start and notification times. If the parameters remain discretionary, generators will face incentives to overstate or understate start and notification times. The Market Monitor recommends that physical parameters not be discretionary and that they be based, at minimum, on the parameters of the best available comparable technology.

H. The Commission Should Clarify that its Determination Does Not Permit the Extension of Fast Start Pricing to Other Resources.

PJM's stated goal is to extend pricing based on the inclusion of start and no load costs in offers to the greatest extent possible.¹² Fast start pricing presents an opportunity for PJM to begin that process. The Commission has not established whether resource

¹² See PJM Order No. 825 Compliance Filing, ER17-775-000 (Jan. 11, 2017).

commitment time frames of zero, 10, 30, 60, or 120 minutes distinctly separate fixed commitment costs from marginal commitment costs in short run electricity markets. Allowing commitment costs in prices for any units opens the door to allowing all commitment costs in prices and an erosion of efficient short run price signals.

The December 21st Order states (at P 25):

[C]ommitment and dispatch of resources with a minimum run time in excess of an hour does not appear analogous to a marginal decision, so applying fast-start pricing logic to such units could result in prices failing to reflect the marginal cost of serving load.¹³

The December 21st Order states (at P 28):

[C]ommitment and dispatch of resources with start-up times in excess of an hour do not appear analogous to a marginal decision, so applying fast-start pricing logic to such units could result in prices failing to reflect the marginal cost of serving load.¹⁴

PJM has stated its preference to include commitment costs in prices, not only for resources that start in two hours, but for all resources, regardless of start time and minimum run time.¹⁵ PJM's position directly contradicts the Commission's statements. If the Commission determines to permit some form of fast start pricing in the PJM markets, despite the issues and alternatives raised by the Market Monitor, the Commission should clarify again, specifically for PJM, that extending the eligibility for inclusion of commitment costs in prices to all resources is inconsistent with the Commission's price formation goals.¹⁶

¹³ December 21st Order at P 25.

¹⁴ *Id.* at P 28.

¹⁵ See Proposed Enhancements to Energy Price Formation, PJM Interconnection (November 15, 2017) at 10, which can be accessed at: <<http://www.pjm.com/-/media/library/reports-notices/special-reports/20171115-proposed-enhancements-to-energy-price-formation.ashx>.>

¹⁶ See *Price Formation in Energy and Ancillary Services Markets Operated by Regional Transmission Organizations and Independent System Operators*, 153 FERC ¶ 61,221 at P 1 (2015).

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to the arguments made on brief as the Commission resolves the issues raised in this proceeding.

Respectfully submitted,



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Dated: February 12, 2018

CERTIFICATE OF SERVICE

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

Dated at Eagleville, Pennsylvania,
this 12th day of February, 2018.



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