

# Context for PJM Market Design Proposals Responding to State Public Policy Initiatives

June 12, 2017



Since the inception of competitive wholesale electricity markets, the industry has evolved significantly and in ways that could not have been fully anticipated. Technological disruptions – in particular hydraulic fracturing to access vast natural gas reserves; environmental regulation; highly efficient lighting, appliances and industrial processes; and increasing penetration of renewable, distributed and demand response resources – have altered the economics of electricity supply, creating new opportunities and challenges.

Demands on electricity markets also are evolving. Increasingly, public policies seek to recognize value associated with generation plants beyond their cost effectiveness and reliability attributes.

This document introduces and links to three working papers that offer straw proposals to spur discussion on the interaction of state actions to promote generation meeting environmental, social and/or political interests beyond simply ensuring resource adequacy at the lowest cost and the operation of the wholesale electricity markets. State actions take the form of subsidies or out-of-market economic support that currently impedes formation of competitive prices in PJM Interconnection's capacity and energy markets.

Two working papers introduce proposals to directly address the state subsidy issue: the first discusses "advancing" state environmental interests in a manner that preserves the operational integrity of PJM markets; the second discusses "accommodating" state programs by recognizing affected resources as capacity, while protecting the formation of a competitive price in PJM's capacity market.

Additionally, a third working paper addresses price formation in PJM's energy market. The price formation proposal does not respond *per se* to state subsidy programs. Instead, it examines whether the aforementioned profound changes to the industry require re-examination of PJM rules that define when and under what circumstances a generator is eligible to set marginal prices. The hypothesis is that the correct energy price in some intervals is understated by operation of rules that disqualify inflexible generation from setting price, even when such generation is needed and economic in that given interval. If this hypothesis is accurate, the pricing problem does not arise because subsidies have distorted prices. Rather, state programs, to some extent, may be a response to organic deficiencies in market design. Getting the market design "right" from the standpoint of price formation – which is justified on its own merits – may have the secondary effect of reducing forces motivating subsidy programs.

All three working papers likely will evolve as PJM works with members, stakeholders, states and the Federal Energy Regulatory Commission to achieve alignment on how best to reach public policy goals while harnessing the benefits of wholesale markets. PJM hopes to start a conversation by offering ideas to modify the competitive wholesale electricity markets to address changing demands placed on the grid and the associated markets PJM administers.



### *Addressing Subsidies*

Wholesale electricity markets have proven to be a nimble, flexible tool to implement a host of state and federal public policies ranging from the development of retail choice to the integration of new renewables and demand response technologies stimulated by state standards and goals. However, the most recent iteration of state policies has involved explicit, legislatively-driven subsidies for specific generating units.

As discussed in the May 2017 FERC Technical Conference<sup>1</sup> on state policies and wholesale markets, these types of subsidies can suppress wholesale electricity market prices and threaten these markets' basic design mission, at least for those independent system operators and regional transmission organizations and their associated states that rely on markets for resource adequacy. PJM believes that market design should evolve to bridge the gap between state policy initiatives and existing market constructs and is evaluating two possible independent paths forward.

#### **Working Paper 1: Advancing Zero Emissions Objectives through PJM's Energy Markets (May 2, 2017)**

The paper discusses advancing state environmental initiatives by establishing a regional or sub-regional carbon price that can be reflected in wholesale market prices.

#### **Working Paper 2: Capacity Market Repricing Proposal (June 12, 2017)**

The paper discusses accommodating state policy initiatives in the capacity market by committing only the amount of capacity the market otherwise would determine to be economic, but administratively adjusting subsidized resource offers to prevent capacity price distortion.

- The Capacity Market Repricing Proposal updates PJM's [Potential Alternative Approach to Expanding the Minimum Offer Price Rule to Existing Resources](#) proposal from the [August 2016 Grid 20/20](#) on public policy and market efficiency.
- The Capacity Market Repricing proposal likely will be evaluated with other potential solutions by the [Capacity Constructs / Public Policy Senior Task Force](#).

<sup>1</sup> <https://www.ferc.gov/EventCalendar/EventDetails.aspx?ID=8663&CalType=%20&CalendarID=116&Date=05/01/2017&View=Listview>

## *Energy Market Price Formation*

Electric industry evolution has exposed the need to examine whether energy market prices accurately reflect true, real-time costs incurred to meet demand.

### **Working Paper 3: Energy Market Price Formation (June 15, 2017)**

A shift in energy market economics has occurred as:

- Sustained low natural gas prices have reduced variable operating costs of natural gas-fired generation.
- Environmental regulations have increased capital and operating costs for steam fossil generation, especially coal-fired generation.
- Penetration of zero-marginal-cost resources, such as wind and solar, has increased and will continue to increase.
- Growth in electricity demand has slowed.

As a result, PJM has observed:

- A supply curve flip in which less-flexible units formerly committed as base and mid-merit supply now are more regularly situated as the marginal resource needed to meet demand. Previously, marginal resources typically were natural gas peaking units that additionally offered operational flexibility to meet load following and other dynamic services needed at the margin.
- Overall flattening of the supply curve, resulting from lower fuel costs in the growing natural gas generation fleet and increasing marginal costs of what previously had been thought to be “base load” resources.
- Diminishing energy market returns to resources resulting in a shift to the capacity market for a greater proportion of units’ recovery of their total costs.

These shifts in economic trends and market dynamics could lead to an unintended bias in the energy markets favoring lower capital cost resources. The concern is that this phenomenon is driven, in part, by current energy pricing mechanisms failing to signal the true, full cost incurred to meet the marginal increment of load. Although this issue is not new, its impact on energy prices is exacerbated by flattening supply curves and low demand, which put financial stress on all units, but particularly large units with high capital costs.

# Advancing Zero Emissions Objectives through PJM's Energy Markets

The role nuclear generation plays in meeting state goals for carbon-free electricity is a concern that has prompted recent state policy initiatives. PJM is working to offer options to state policymakers to pursue carbon policy objectives in a manner compatible with the security constrained economic dispatch operation of the PJM markets. States interested in pursuing this policy choice would address the external cost of carbon by pricing it so that the cost of carbon is internalized by emitting suppliers. This cost will find its way into suppliers' offers in the energy market, and will ultimately be reflected in LMP.

Although a regional approach is preferred, PJM recognizes the diverse perspectives of the states comprising the PJM region. Accordingly, we believe a coordinated carbon policy could be advanced through the PJM market by a willing sub-region of states prepared to adopt a common set of business rules that:

1. Enable state policies;
2. Preserve orderly and competitive economic dispatch across the entire footprint; and
3. Largely avoid, through rule design, the impacts of the sub-region's policy choices on non-participating states.

## Elements of a Carbon Pricing Framework

A carbon pricing framework would establish a price per ton of carbon emissions. Whether the framework is regional or sub-regional, the carbon price would:

- 1) Apply to carbon-emitting suppliers on a per-ton basis and be reflected in offers
- 2) Be revealed in wholesale market prices
- 3) Align with economic dispatch
- 4) Improve the relative competitiveness of resources that do not emit carbon, and
- 5) Provide a revenue stream to participating states based on unit-specific carbon emissions, which could be tracked through PJM Environmental Information Services (EIS).

In order to be effective, a carbon pricing framework would require:

<b>State Buy-in</b>	Determine which states agree to put a price on carbon emissions, and which states will not. This will establish the "carbon price sub-region" and "non-carbon price sub-region."
<b>Agreement on the Carbon Price</b>	To avoid significant complexity, a single carbon price would apply across the carbon price sub-region. Otherwise, a price adjustment would be needed between individual states within the carbon price sub-region.
<b>Price Reflected in Wholesale Market</b>	The price naturally would flow through offers of emitting units. As a result, these units will have increased costs and be dispatched less often. Wholesale market prices within the carbon price sub-region would increase.
<b>Internal Border Adjustment</b>	Would be necessary to prevent leakage and to create an even playing field for resources competing in each sub-region within PJM.
<b>Revenue Distribution</b>	PJM can facilitate the collection and disbursement of funds if the states so desire. Each state would decide how revenue collected as a result of the pricing will be utilized. Allocating some or all of these revenues to mitigate electricity price impacts might be attractive to states. Allocating any of this revenue stream to support generation would amount to a subsidy and defeat the purpose of internalizing carbon costs into supplier energy offers.

## Sub-Regional Carbon Price Border Adjustment

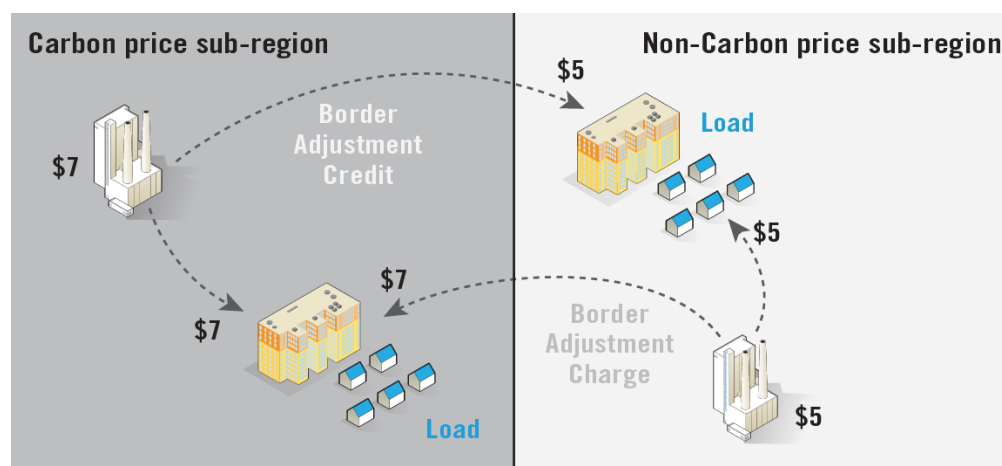
The Regional Greenhouse Gas Initiative (RGGI) is an example of a multi-state initiative to price CO<sub>2</sub> emissions – specifically utilizing an allowance cap and trade. RGGI has not been coordinated with the PJM markets and, because Delaware and Maryland are the only PJM states participating, leakage and the lack of an internal border adjustment have been issues for the RGGI program:

- Price leakage occurs when the increased cost to emitting resources in RGGI states is passed through to consumers in non-RGGI via electricity exports from RGGI states.
- Emissions leakage occurs when fossil fuel based electricity from non-RGGI resources, not subject to the carbon cap, is imported to the RGGI region.

Establishing a carbon price framework that is coordinated with PJM market constructs could more directly address these leakage issues and enhance the policy goals of states that adopt a carbon pricing framework.

A border adjustment would isolate the impact of the carbon price to only those states in the carbon price sub-region in a way that ensures energy exports from the carbon price sub-region could be competitive on equal footing in non-carbon price sub-region. This would preserve PJM's ability to economically dispatch generation over the full PJM region. All resources could competitively participate in the full market, but only consumers in states that have chosen to compensate this policy initiative would pay the incremental costs of a carbon price. Figure 1 illustrates this concept.

Figure 1: Sub-Regional Carbon Price Border Adjustment



In order for the border adjustment to be effective, PJM would need to:

- Measure the transfers of energy into and out of the carbon price sub-region.
- Track CO<sub>2</sub> emissions of each resource in the carbon price sub-region. We would anticipate doing this through PJM EIS.
- Adjust the price charged or credited to transfers by the carbon price.
  - This would involve allocating the tons of CO<sub>2</sub> emitted by a resource to the amount of load in each sub-region served by that resource.
  - In order to minimize the complexity of this adjustment process, it may be necessary to require states in the carbon price sub-region to be contiguous.

- Adjust the zonal definitions for load settlement to match up with the boundaries of the carbon price sub-region. Otherwise, the impacts of the carbon price would affect portions of zones that lie outside the states that have adopted the pricing framework.

## Legal Questions

- PJM's proposal starts with the assumption that states can come together, with PJM's facilitation, to agree to price carbon emissions generated in their states and that such action is not subject to FERC jurisdiction. Although the action would undoubtedly affect wholesale electricity prices, courts have noted that just because a state policy affects a cost input to wholesale electricity prices does not make the policy action FERC jurisdictional.
- Accordingly, PJM would propose a common set of rules pricing carbon and applicable to willing states as a separate framework, outside its FERC approved tariff and operating agreement.
- Implementing border adjustments to preserve a non-discriminatory economic dispatch across the full PJM region and to prevent leakage between internal sub-regions raises more difficult questions of FERC jurisdiction over wholesale electricity rates.



# Capacity Market Repricing Proposal

June 29, 2017

## Introduction

PJM is evaluating *how* policy initiatives and market rules can be designed to harness the benefits of competitive markets while meeting state policy goals in the most efficient manner possible.

This working paper details the “accommodate” path, which would address subsidies in the capacity market by administratively adjusting subsidized resource offers to prevent capacity price distortion. This market reform would ensure that out-of-market subsidies do not impact the overall competitiveness of the capacity market, and the efficient entry and exit of resources.

This proposal is being evaluated with other potential solutions as part of the [Capacity Constructs / Public Policy Senior Task Force \(CCPPSTF\)](#). PJM has released this proposal as a point of discussion due to the urgency of the subsidies issue. PJM expects this proposal will receive consideration in the CCPPSTF in due course. This action is not taken to supplant the stakeholder process. Rather, the CCPPSTF will identify both the characteristics of a well-functioning capacity construct as well as potential public policy initiatives states could take regarding resource adequacy, fuel diversity, public and environmental policies. The group will then compare state actions to the current capacity construct to identify areas for change and develop solutions.

## Two-Stage Capacity Auction

A two-stage approach to determine cleared commitments and clearing prices in a single capacity auction would address subsidies in a way that:

- Maintains the correct price signal to incent entry and sustain competitive resources necessary to achieve long-term resource adequacy
- Commits only the quantity of capacity necessary in any given delivery year

This proposal is an update to PJM’s [Potential Alternative Approach to Expanding the Minimum Offer Price Rule to Existing Resources](#) proposal from the [August 2016 Grid 20/20](#) on public policy and market efficiency. The primary difference in this updated proposal is that the settlement for subsidized resources would be administered by PJM instead of by the state(s) with subsidized resources.

In this design, resources would submit one set of offers into a single capacity auction, as they do today. However, the cleared capacity commitments and the clearing prices would be determined in separate stages.

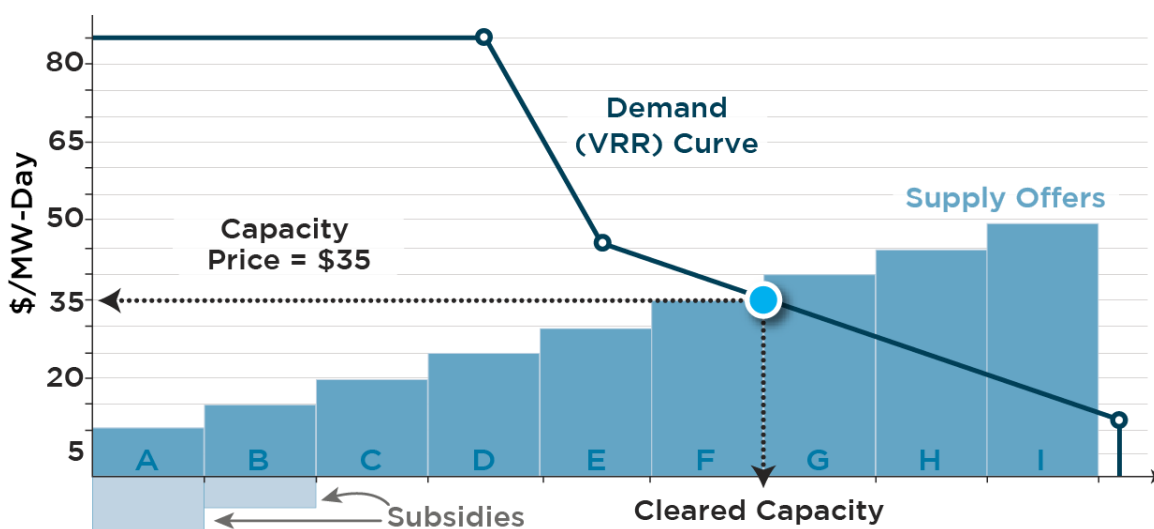
Subsidies that are determined to be actionable by PJM and stakeholders will trigger repricing. More detail on distinguishing between actionable and non-actionable subsidies is included in following sections.

Resources with actionable subsidies that clear the first stage of the auction would be relied on as capacity resources as they are today and subject to the same reliability obligations. Capacity market offers of subsidized resources will be administratively adjusted in the second, price-setting stage of the auction to prevent distortion of the capacity price.

### Stage 1: Determination of Cleared Capacity

- Subsidized units that trigger repricing could offer into the auction as they do today, subject to PJM rules.
- Clearing this auction would determine those resources that ultimately would receive a capacity commitment, and establish a “suppressed capacity price.”

Figure 1. First Stage of Auction, Cleared Capacity Determined



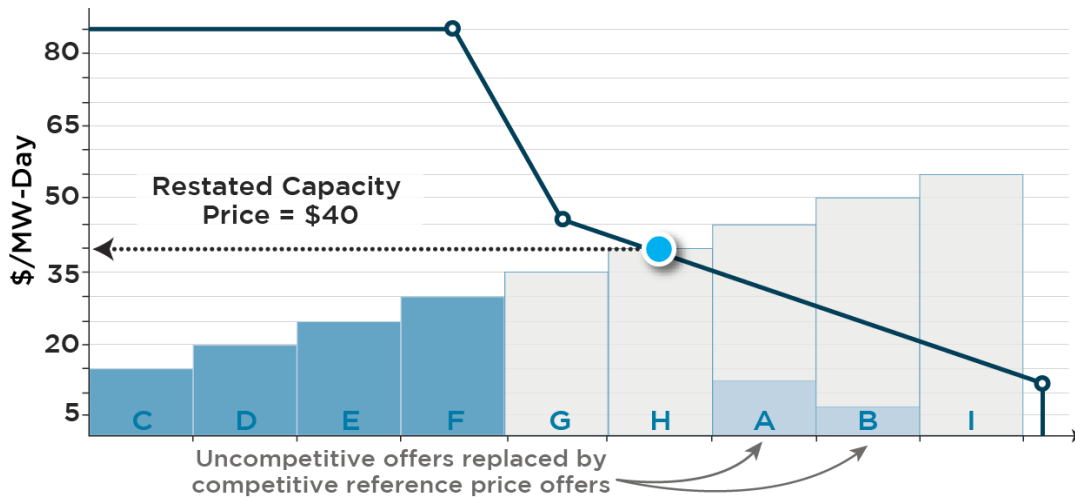
### Stage 2: Determination of Clearing Price

- PJM would recalculate prices in the auction by:
  - Removing offers submitted by subsidized units from the price formation and settlement process, and
  - Replacing those offers with reference price offers<sup>1</sup> reflecting what would be a competitive offer from a unit of that type and vintage
- Although units with offers below the restated capacity price but above the suppressed capacity price would appear infra-marginal, they would not receive a capacity commitment because they did not clear in the first stage.

<sup>1</sup> The reference price for resources with actionable subsidies would be a technology-based, locational approximation for each resource's going forward costs, similar to the default Avoidable Cost Rates currently in the PJM Tariff.



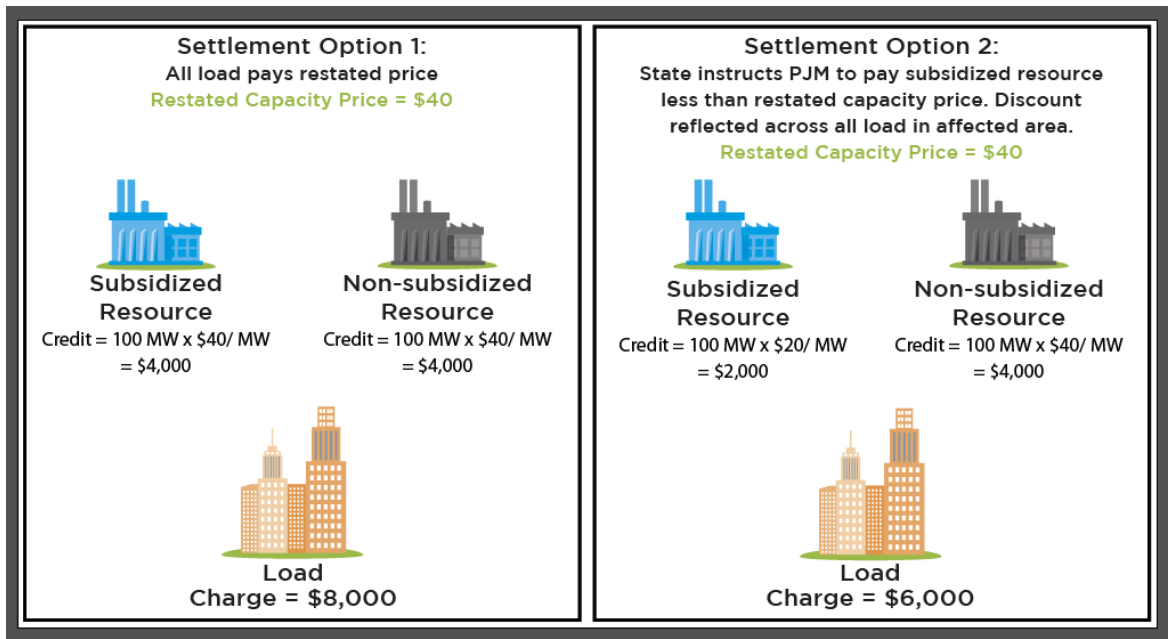
Figure 2. Second Stage of Auction, Capacity Price Determined



### Settlement

PJM would credit all cleared capacity resources and charge all demand the restated capacity price unless the state(s) with subsidized resources direct PJM to pay those resources less than the restated capacity price. The discount from reducing a subsidized unit's capacity credit at the state's request would be applied to load as indicated by that state. This gives states the option to determine how much customers are paying for subsidized resources through the capacity market since the resources are already receiving an out-of-market payment. Figure 3 provides an example of this concept.

Figure 3. Settlement Example





## Subsidies

The question of how to best preserve price integrity in the PJM capacity market in the face of selective, out-of-market subsidies presents, in theory, three broad options:

1. Take action to address all subsidies, recognizing that all subsidies interfere with a theoretically perfect operation of the market
2. Take no action against any subsidy, recognizing the ubiquity of subsidies and the difficulty in justifying distinction between “actionable” and “non-actionable” subsidies
3. Develop criteria or principles that identify subsidies that warrant action based on design or impact, and leave all other subsidies unaddressed

PJM recommends the third approach. The Capacity Market Repricing Proposal distinguishes actionable from non-actionable subsidies. Before examining the approach and rationale used to distinguish actionable from non-actionable subsidies, important preliminary observations should be noted.

First, any action to mitigate subsidies (*i.e.*, PJM's Minimum Offer Price Rule) or to accommodate subsidies (*e.g.*, the repricing proposal discussed here) requires identifying a class of actionable subsidies. The existing MOPR already adopts the third approach by distinguishing between subsidies subject to mitigation (a minimum offer) and those that are ignored. However:

- PJM believes that distinguishing between subsidies would be less controversial and impactful to the market sellers under the repricing proposal because the consequence of that distinction does not fall directly on the subsidized resource. Under the proposed repricing rule, the subsidized resource can freely decide on its capacity market offer. This is not the case under MOPR.
- The repricing rule imposes no added risk on the resource failing to clear the auction or failing to receive a capacity commitment. Thus, the affected locational deliverability area (LDA) does not face the potential of “double procuring” capacity under the repricing rule as it does under MOPR.
- Because the consequence of identifying a resource for repricing under the proposal is limited to forming the clearing price in the RPM auction that is paid to all unsubsidized resources, PJM believes the subsidized resources can be repriced according to a reference price<sup>2</sup> as opposed to a unit-specific cost analysis.

Second, application of the Capacity Market Repricing Proposal is limited only to those jurisdictions that have elected to rely on the PJM markets to manage resource adequacy (states that have by law or regulation unbundled public utility operations). Similarly, the repricing rule is not intended to apply within a Fixed Resource Requirement service area. Finally, existing tariff exemptions in the minimum offer pricing framework (such as the self-supply rules) would be adopted so as to limit applicability of the repricing rule.

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<sup>2</sup> The reference price for resources with actionable subsidies would be a technology-based, locational approximation for each resource's going forward costs, similar to the default Avoidable Cost Rates currently in the PJM Tariff.



## Criteria to Identify Actionable Subsidies: When Would Repricing Be Triggered?

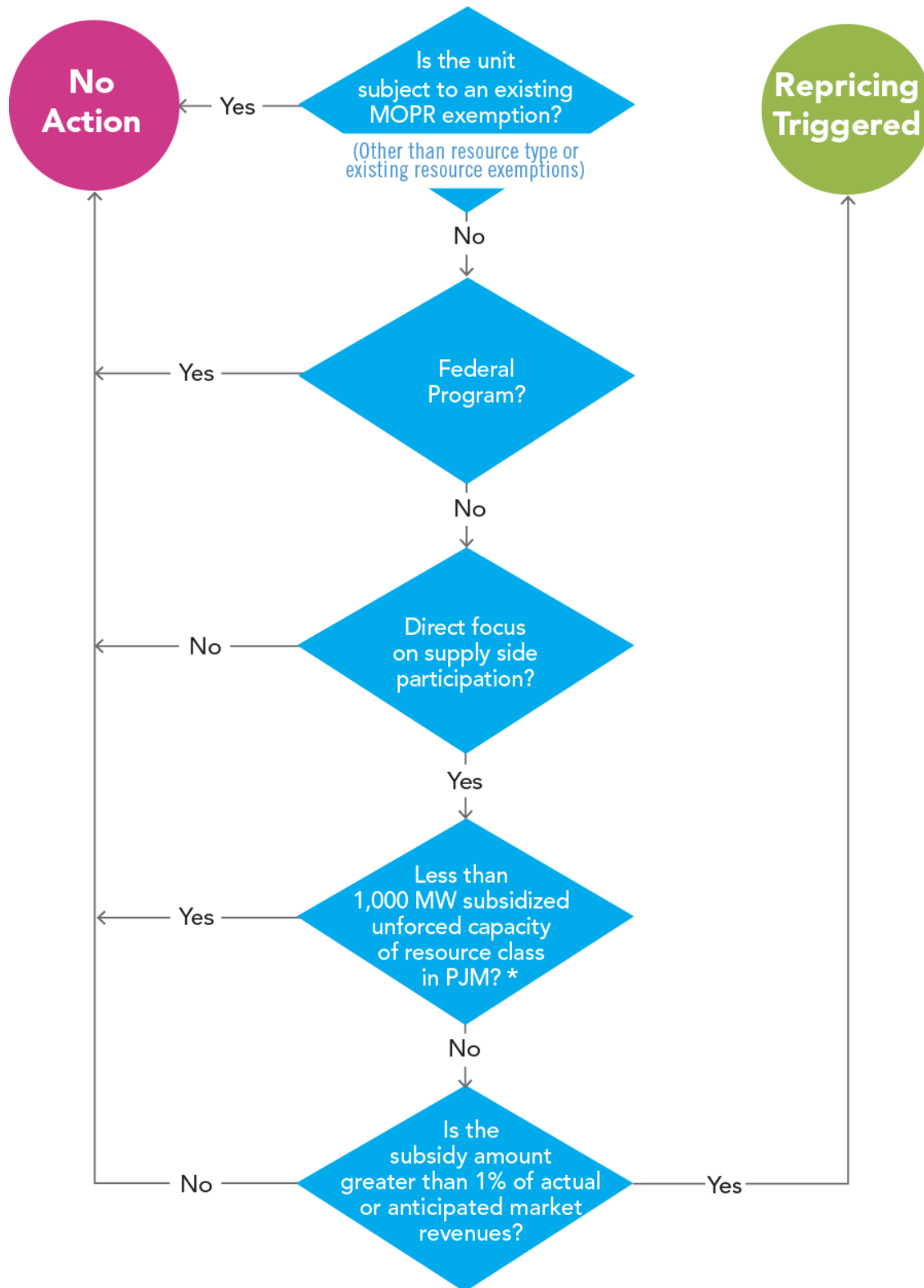
The decision tree in Figure 4 describes the criteria PJM would apply to identify subsidies that would trigger repricing under this proposal. If a subsidy is identified as “actionable,” the associated resource’s competitive offer will be administratively adjusted in the second, price-setting stage of the auction to prevent distortion of the capacity price. All resources that are subject to repricing will still receive capacity commitments and are still subject to the same stringent reliability obligations.

The exercise of distinguishing actionable subsidies from non-actionable subsidies is one of judgment – guided more by practicality and less by pure principle. Although identifying a subsidy as actionable under the proposal is not, as described, as consequential and problematic for the market seller as under MOPR, PJM would prefer to maximize the number of actual competitive offers on the supply curve and minimize repricing subsidized units with administratively set reference price offers.

Accordingly, the repricing triggers set forth in this proposal reflect a judgment on materiality and recognition that the capacity market can tolerate, and has tolerated for a decade, some modest level of distortion from programs that selectively advance certain resources, whether by design or consequence. PJM’s Capacity Market Repricing Proposal is intended to operate by ignoring subsidies that have only a minor or theoretical impact on capacity price outcomes.

The PJM proposal adopts repricing triggers informed by the analysis and reasoning of the federal courts, including the Supreme Court in the *Hughes* case. The Capacity Market Repricing Proposal is designed to ignore “generic” subsidies, such as incentives and tax breaks that support economic development generally. Programs that selectively target the advancement of a particular resource while excluding other similarly situated resources would be subject to repricing under the proposal.

Figure 4. Subsidy Decision Tree for Triggering Repricing



\* Application and implementation issues associated with this proposal as applied to renewable portfolio standards is a matter which should be the subject of further discussion in the stakeholder process.



The first decision criterion distinguishes resources that are subject to an existing MOPR exemption,<sup>3</sup> which could include wholesale resources that are regulated by a state, self-supply resources, etc. Subsidies to any resources that are subject to an existing MOPR exemption (other than current exceptions for existing resources and fuel type) would not be considered actionable.

The second decision criterion distinguishes federal from state programs and excludes federal programs from triggering repricing. Admittedly, this distinction does not rest on any economic difference – a federal production tax credit that supports the uneconomic entry of 500 megawatts is just as distorting as a state purchase power contract for a 500 megawatt preferred resource. The basis for this distinction is a pragmatic recognition that neither PJM nor the FERC have much latitude to address federal programs authorized by Congress. Federal programs apply nationally and arguably form an accepted and understood element of the investment landscape and do not differentiate simply by location of the asset in a particular state. These subsidies are ones we must accept. They are widespread (IRS, DOE, Department of Agriculture, etc.), and examples can be found that support all generation resources and fuel types.

The third decision criterion is designed to exclude from repricing subsidy programs that:

- Are generic across broad areas of the economy, such as tax credits for any commercial investment and local economic development incentives
- Are directed at the electricity sector but predominantly focused on encouraging reduced consumption and conservation, such as rebates and incentives for behind-the-meter resources or programs that incent insulation, energy efficient buildings, etc.
- Do not directly target wholesale supply side resources, either individually or by class of resource.
  - Note: Demand response and energy efficiency that elect to participate as wholesale supply side resources in the PJM capacity market would be subject to repricing based on the other established criteria.

The fourth decision criterion is aimed at capturing materiality. Subsidies for a defined class of resource types would not be subject to repricing to the extent each resource class has less than 1,000 MW of subsidized, unforced capacity offered into and clearing the PJM capacity market. (Such resources classes are proposed as coal; nuclear; natural gas; renewable, including hydropower, pumped storage, solar and wind; and demand response and energy efficiency.) However, once that threshold is exceeded all subsidized resources within that resource class would be subject to repricing. PJM acknowledges this approach relies on judgment. The “1,000 MW” level stated here should be considered indicative and, like other elements of this proposal, the appropriate value certainly will be subject to further stakeholder discussion. The intent, however, is to filter subsidies in a way that prevents them from having a material impact on market prices. An amount of subsidies that does not have a material impact on price is less likely to result in the creation of more subsidies. However, an appreciable quantity of subsidies could suppress price to the point of creating a domino effect resulting in additional subsidies.

The fifth decision criterion establishes a cutoff in instances where the subsidy amount is greater than 1 percent of a resource’s actual or anticipated market revenues. This element of the test also is one of materiality, designed to exclude trivial benefits that state or local authorities might offer to generation in their regions.

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<sup>3</sup> PJM Open Access Transmission Tariff (OATT), Attachment DD, Section 5.14(h)



## Version History:

### Version 1 (5/2/2017)

- Original posted as supporting material for the FERC Technical Conference on State Policies and Wholesale Markets

### Version 2 (6/12/2017)

- Addition of sections titled "Subsidies" and "Criteria to Identify Actionable Subsidies: When Would Repricing Be Triggered?"
- Addition to "Introduction" section about the role of this proposal in Capacity Construct / Public Policy Senior Task Force (CCPPSTF)
- Clarifications to "Two-Stage Capacity Auction" section

### Version 3 (6/29/2017)

- Clarifications to "Criteria to Identify Actionable Subsidies: When Would Repricing Be Triggered?" section

# Energy Price Formation and Valuing Flexibility

June 15, 2017

Over the past several years, the Federal Energy Regulatory Commission has focused on energy market price formation in order that prices better reflect system conditions and appropriately value resources needed to meet changing system conditions throughout an operating day. Although the commission's efforts have appropriately tackled some significant and difficult policy issues,<sup>1</sup> a number of the energy price formation regulatory proposals have addressed very specific and, in some cases, very narrow issues.<sup>2</sup>

PJM has supported FERC's efforts but believes a fundamental price formation issue remains to be addressed – one which would have far greater implications for the future profile of the generation fleet. Specifically, PJM wishes to initiate dialogue on the following issues:

- **Pricing Reform:** Refining locational marginal price (LMP) formation to recognize the contribution of all resources, including large, inflexible units (often referred to as “baseload” resources) in serving load in a given interval
- **Impacts of Negative Offers:** Addressing the pernicious effect that negative offers may have in hastening the premature retirement of economic thermal generation, whose continuing operation is needed to meet capacity requirements and provide reliability services to accommodate for the intermittency of renewable generation

## Pricing Reform: Ensuring LMP Reflects Resources Needed to Serve Load

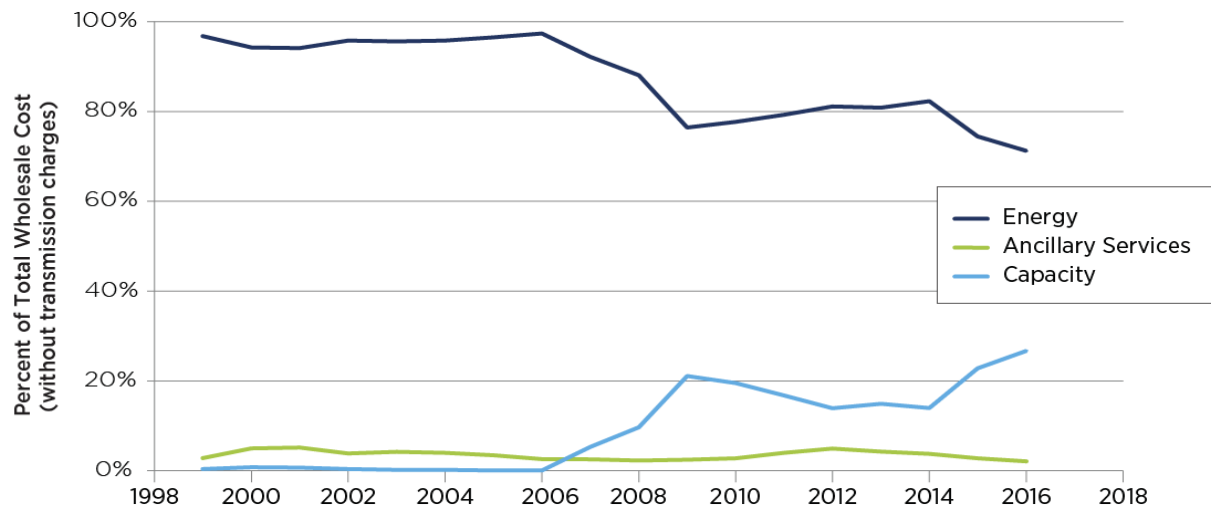
PJM is observing diminishing energy market returns to supply resources, resulting in a shift to the capacity market for a greater proportion of units' recovery of total costs. This shift could lead to an unintended bias in the energy market, favoring lower capital cost resources. Figure 1 shows that this cost shift has been more pronounced since 2014.

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<sup>1</sup> For example, amendments to the \$1,000 nationwide offer cap

<sup>2</sup> For example, the FERC staff has issued separate Notices of Proposed Rulemaking on extremely granular issues such as cost allocation associated with uplift (Docket No. RM 17-2-000) and a second associated with creating specific pricing rules for a limited class of resources deemed “Fast Start” resources (RM 17-3-000).

**Figure 1. Share of Total Wholesale Electricity Costs**



Low energy market prices, in and of themselves, are beneficial for consumers and desirable – provided they result from the fundamentals of supply and demand in the market. A concern arises, however, if prices are driven not solely by strict supply and demand fundamentals but in part by a failure of current energy pricing mechanisms to fully and transparently value all resources. Although the trend is not new, its impact on energy prices is heightened because of flattening supply curves and low demand, which put financial stress on all units – particularly large units with high capital costs.

PJM’s price formation initiatives seek to prompt discussion to consider whether the true marginal cost of serving load is recognized and transparently signaled to buyers, sellers, asset investors and financial traders in the LMP-based market clearing process. In turn, reform of this sort should reduce uplift costs and improve price signals to support efficient investment and retention decisions.

***PJM Response to FERC Fast-Start Pricing Notice of Proposed Rule Making***

The FERC recognized the energy market price formation issue in its recent “Fast-Start” Pricing Notice of Proposed Rulemaking (NOPR).<sup>3</sup> PJM supports the price-setting aspects of the NOPR and believes that this initiative promises beneficial and fundamental change. However, because the FERC’s proposed scope price setting reform is limited only to “fast start” resources (principally natural gas-fired combustion turbine units), it does not extend the benefits of the proposed change to larger units (such as coal and nuclear units) to the extent they are needed to serve load in a given hour. Although the fast-start NOPR is helpful in identifying the issue of price-setting eligibility, its proposed remedy may address only a subset of the larger issue. PJM, with input from ISO/RTOs and stakeholders, believes price formation should be addressed on a broader scale and the inquiry should not be limited only to a particular class of flexible resources.

***Expanding Eligibility to Set Price Beyond Flexible and Fast Start Resources***

If the system needs a unit’s output to maintain power balance while managing transmission constraints, that need should be reflected transparently through energy prices. PJM believes the range of resources eligible to set price should be expanded to include *all* units whose output is needed to serve load or control transmission constraints in a given interval.

<sup>3</sup> Docket No. RM 17-3-000 (December 15, 2016)



Presently, only additional megawatts above a unit's economic minimum are considered "needed" for economic dispatch and therefore eligible to set price.

This expansion of price-setting eligibility would include:

- Inflexible units<sup>4</sup> needed to meet demand for five minute increments
- Evaluations of requirements for unit parameters such as ramp rates, economic minimums and emergency minimums

Allowing *all* units to set price would create a function in which price more consistently increases as load increases. It also would remove the current discontinuity in LMP created when a unit's output is reduced to its economic minimum level at which point the entire output of the unit is removed from price-setting eligibility. This price-setting expansion would reduce uplift and lead to better incentives and more predictable, rational price signals. This concept is illustrated with an example in Figure 2, which illustrates two options for setting LMP in a simple system with increasing load to serve and two units available for dispatch – one flexible and the other inflexible.

The flexible unit can be dispatched from 0 megawatts output up to 300 MW output. Its offer price begins at \$30 at 100 MWh of output and increases by \$0.01 for every megawatt-hour of output in excess of 100 MWh. The inflexible unit is either off-line or on-line with an output of 100 MW and has an offer price of \$40/MWh.

As load increases from 100 MW, the flexible unit's output is increased and sets LMP at a consistently increasing value consistent with its increasing output.

At 200 MW of load and \$40/MWh LMP, it is economic to start the 100 MW inflexible unit because dispatching additional megawatts from the flexible unit would cost \$40.01/MWh and higher. However, because the 100 MW unit must come online and produce all of its 100 MW, the flexible unit must be dispatched down by 100 MW to maintain generation and load balance.

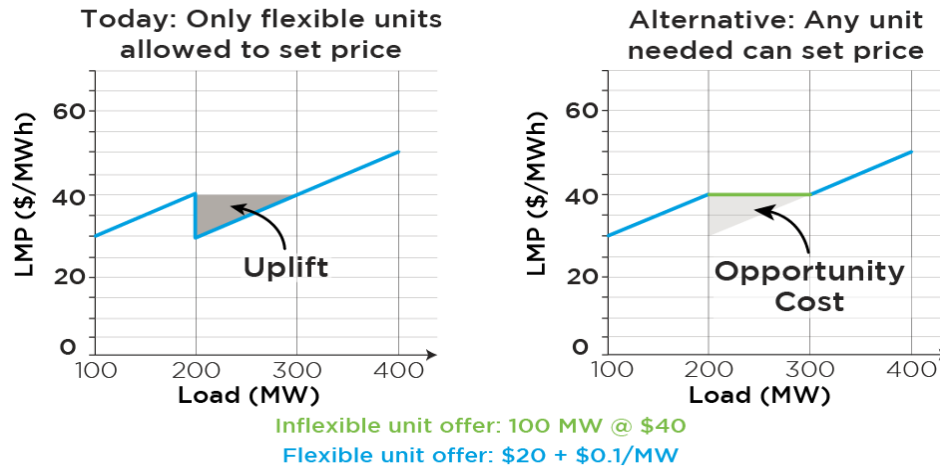
Under today's rules, the inflexible unit would be ineligible to set LMP, and the LMP would therefore drop to \$30/MWh, the offer price of the flexible unit at its reduced dispatch level. As load continues to increase, the flexible unit once again is dispatched up, and LMP increases along with the flexible unit's increasing offer price at its increasing output value. Until the LMP reaches \$40/MWh, the inflexible unit must be made whole to its offer because it is operating with a cost in excess of the LMP.

PJM's proposal would instead allow the inflexible unit to set LMP, thereby transparently indicating the cost of the most expensive unit necessary to economically serve the load. The resultant opportunity cost experienced by the flexible unit could form the basis for a load-following product as described below.

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<sup>4</sup> PJM already allows demand response resources to set LMP when their reductions are necessary to maintain power balance and will continue to do so as discussion of these additional reforms moves forward.

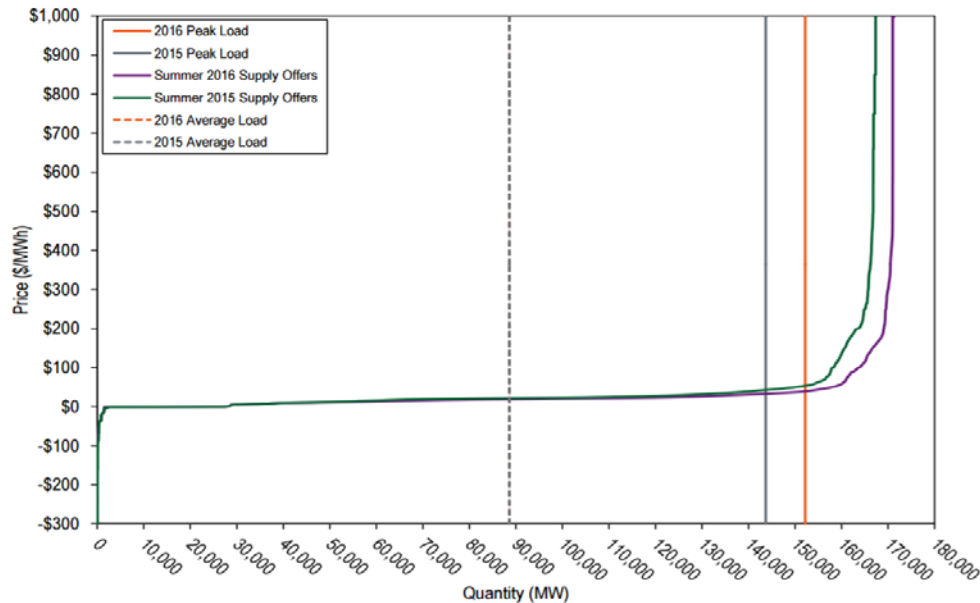
Figure 2. Comparison of Price Setting Methods



## Developing a Complementary Load-following Product to Value Flexibility

Price formation has grown in importance as the supply curve in systems across the nation continues to flatten. Figure 3 displays this supply curve trend in the PJM footprint. Units formerly considered base and mid-merit now are being relied on to operate more flexibly as if they were peaking units. Many times, these same units are ineligible to set LMP based on their operating parameters. Excess supply in light of reduced load levels has also contributed to a flattening of the supply curve. As a result of these supply curve trends, incremental movements in LMP seem less effective in incenting units to reduce output to follow dispatch.

Figure 3. Average PJM Aggregate Real-Time Generation Supply Curves in summer 2015 and 2016<sup>5, 6</sup>



<sup>5</sup> Monitoring Analytics, LLC. *PJM State of the Market Report – 2016*. Section 3 – Energy Market

<sup>6</sup> Real-time average hourly load was 88,601 MW in 2016 and 88,594 MW in 2015.

PJM also has observed that resources using natural gas as their primary fuel tend to acquire gas on an inflexible basis, given the economic advantage in so doing and the limited availability of flexible pipeline transportation products.

The limited LMP variations at the margins coupled with natural gas procurement limitations combine to reduce economic incentives for resources to follow PJM dispatch signals. This phenomenon erodes a critical mechanic in LMP pricing: its ability to create economic incentives for units to follow RTO dispatch instructions in order to ensure efficient dispatch of the system and maintain system reliability.

To maintain generation and load balance when inflexible units are dispatched, the proposed pricing eligibility reform should be accompanied by development of a load-following product, which would compensate flexible resources forced to ramp up or down uneconomically to meet demand when a larger, inflexible resource must operate at a minimum output level.

Flexibility is not explicitly valued in PJM today. Reforming pricing so that inflexibility does not negatively impact LMP would allow PJM to monetize flexibility. The load-following product thus would provide enhanced opportunities for flexible resources, including new technologies, such as energy storage resources, to receive compensation for the value of their flexibility without displacing the need for the dispatch of larger, more inflexible units in the circumstances outlined above.

Valuing flexibility in electricity markets also could potentially drive innovation with respect to flexibility in the gas nomination cycle and promote enhanced gas-electric coordination. These incentives would drive gas-fired units to acquire – and pipelines to offer – more flexible products so that natural gas units could take advantage of the economic benefits associated with offering their flexibility to the market.

## Addressing Impacts of Negative Offers

PJM has observed negative energy market offers from wind generation enabled by the federal wind production tax credit (PTC). The negative offers, encouraged by this production subsidy, negatively impact all resources by distorting price signals and eroding revenue streams. The erosion of value for assets needed to maintain critical resources used to ensure reliability is of particular concern given the intermittency of renewable resources. While respecting the decisions of Congress to maintain, but phase-out the wind PTC, PJM believes a FERC initiative is necessary to address the impacts of negative offers on the wholesale markets that FERC is jurisdictionally bound to protect.

There are several ways to address the issue of negative pricing, such as expanding price-setting eligibility while implementing a flexibility product as described above. The economic challenges facing the industry as well as the operational challenges faced by units that are unwilling to curtail in response to dispatch instructions during low-load periods argue for a broader discussion on ways to ensure grid reliability in the face of negative pricing. PJM intends to raise this issue with stakeholders and regulators in order to assist in the development of national and regional solutions that address reliability needs.

## Moving Forward

PJM believes that expanding price-setting eligibility to better recognize the contributions of all resources in the energy market would be a productive first step toward more efficient price formation. This effort could be coordinated with development of a load-following product or, more broadly, reforming pricing for reserves.

The ideas and initiatives described above do not comprise an exhaustive list of items that PJM would encourage the FERC and stakeholders to consider. PJM and stakeholders are considering other initiatives in parallel:

- A related reserve and resilience pricing effort, which is further detailed in PJM's Resilience Roadmap. Part of enhancing resilience involves instituting operational reforms in which PJM would commit additional reserves or operate the system more conservatively.<sup>7</sup> PJM believes that reserve markets and the method by which PJM co-optimizes reserve products with energy is a significant opportunity to enhance the market price formation while making the system more resilient through efficient commitment and pricing.
- A consolidation of PJM's current three-part bid structure, consisting of startup costs, no-load costs and incremental cost, to a two-part bid using only startup costs and the incremental offer.
- A revision of the demand curve used in shortage pricing.<sup>8</sup> The revision adds a smaller step to the demand curve to better reflect the lower reliability concern of small reserve deficiencies. This change potentially could create more effective price signals before synchronized reserves fall below the largest contingency requirement.

PJM is performing analysis and simulations to evaluate the concepts described above. PJM will encourage proactive action to be taken by the FERC to begin to address needed reforms in each of the above areas. This working document encapsulates PJM's preliminary thoughts, which will continue to be refined in consultation with policymakers and stakeholders.

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<sup>7</sup> In the recent report, "[PJM's Evolving Resource Mix and System Reliability](#)," PJM highlighted the need to focus on grid resilience, which means preparing for significant, credible system events, being able to operate through such events, and building the capability to recover quickly.

<sup>8</sup> This effort is related to FERC Order No. 825 on shortage pricing reforms. PJM submitted a section 205 filing on May 12, 2017, regarding changes to the Operating Reserve Demand Curve (Docket No. ER17-1590-000).