

Energy Price Formation — Frequently Asked Questions

Version: January 22, 2018

Q 1. What is the goal of PJM's energy price formation proposal?

A The goal of PJM's energy price formation proposal is to enhance the calculation of prices so that they more accurately reflect the actual cost of serving load, improve performance incentives, improve incentives to offer and operate flexibly and improve transparency and efficiency in meeting growing flexibility needs. The proposal includes both enhancements to the manner in which Locational Marginal Prices are calculated and enhancements to the mechanism by which energy and reserve prices are formed under reserve shortage conditions.

Q 2. Why is PJM proposing these changes now?

A PJM's research into price formation was originally motivated by FERC's "Price Formation Docket" (AD14-14), issued in June 2014. Within that docket, the Fast-Start NOPR (issued in December 2015) increased PJM's focus on enhancing price formation. During analysis, PJM investigated different methods for calculating prices that better reflect the costs of all resources required to maintain system reliability.

PJM has offered our price formation proposal because we believe it represents a better method to calculate energy prices and that stakeholder and industry feedback is necessary. The method we are proposing did not exist at the time PJM's markets were implemented.

Q 3. Wasn't Capacity Performance supposed to address the issue the energy price formation proposal addresses?

A Capacity Performance (CP) and PJM's energy price formation proposal serve two different needs. The CP reforms were implemented in PJM's Reliability Pricing Model to ensure that resources selling capacity to PJM loads had strong incentives to perform during emergency operating conditions. PJM's energy price formation proposal is directly targeted at enhancing energy price formation to improve incentives and reduce uplift in all hours.

Q 4. Why is the intent of the proposal to reduce rather than eliminate uplift?

A PJM is not aware of any price calculation method that preserves appropriate incentives in the energy market and eliminates all uplift. If PJM discovers a price calculation method that could achieve this, we would investigate it further.

The non-convexities in the supply curve caused by, for example, start-up/shutdown costs and economic minimum limits on resources create circumstances in which some resources needed to serve load may not be able to fully recover their costs and result in the need for uplift payments. Under non-convex conditions, there is no single set of prices that could fully support the efficient commitment and dispatch solution without additional

payments. Therefore, uplift must be paid to resources to ensure resources recover their costs and are incented to follow PJM's dispatch instructions.

Because PJM's proposal cannot change the underlying non-convex nature of the energy market, uplift can never be completely eliminated. Therefore, pricing alternatives, such as PJM's proposal, lead to reductions in uplift rather than its elimination. Convex Hull Pricing is another approach that has been developed and results in prices that minimize uplift. However, the implementation of Convex Hull Pricing is not computationally feasible at this time.

Q 5. Considering that uplift has decreased substantially, is the proposal increasing LMP unnecessarily without reducing already-low uplift?

A While PJM has made operational enhancements that have resulted in a reduction in uplift, a key driver of the recent trend of low uplift is low natural gas prices. There are several scenarios in which uplift could increase. For instance, if natural gas prices increase, it is likely that uplift will increase commensurately. PJM observed this exact condition during the first week of 2018. In addition, as fuel costs rise, the cost of the resources requiring a make-whole payment would also rise, in part because the current method used to calculate energy prices does not include all costs associated with running a resource.

PJM's proposal seeks to capture more comprehensively all of the resource costs required to maintain system reliability so that the performance incentive will improve, and as a result, the amount of uplift in the market resulting from the method used to calculate prices will be reduced to its practical minimum.

Q 6. The proposal reduces uplift but increases lost opportunity cost payments. Isn't that another term for uplift?

A Uplift includes make-whole payments and lost opportunity cost (LOC) payments. Though LOC payments would increase under PJM's proposal, in net, total uplift would decrease compared to payments in today's market construct, as energy prices would better reflect the costs of resources that are operating.

Q 7. How is uplift allocated for different units? Is it different for wind and coal units?

A Make-whole payments for wind and coal resources are generally determined the same way except for a minor difference in the calculation of LOC. PJM determines the profit-maximizing output for a coal unit by calculating the megawatt amount from where the LMP falls on the offer curve, limited by the unit's economic maximum. The same process is followed for wind resources, but the megawatt amount is limited by the wind forecast data that is available or the economic maximum of the unit, whichever is lower.

Q 8. Why is uplift more difficult to hedge than locational marginal pricing?

A Hedging is possible where forward markets exist and current information can be used to predict what might happen in the future. LMPs have a day-ahead signal, and real-time patterns can be understood, which supports

forward markets for these products, and therefore hedging. In contrast, no forward markets exist for uplift because it is only known after the fact and can be volatile.

Q 9. Under PJM's proposal, would total locational marginal prices always be higher than they are currently?

A No. While analysis shows that PJM's proposal will, on average, result in an increase in LMPs, they will not always be higher than they would be under the current methodology. Under PJM's proposal, and absent the impacts of transmission congestion, prices will be higher than under the current method when there are non-convexities in the supply curve that either (1) affect the dispatch of the system (such as a binding economic minimum constraint) or (2) result in costs (start-up and no-load) that are not recovered through the current LMP. When these conditions exist, the current LMP calculation relies on uplift payments to ensure resources have the incentive to operate at PJM's direction.

To the extent that PJM's proposal attempts to handle non-convex conditions in supply curves explicitly and includes more resource commitment costs in the price, it will result in higher prices and less uplift, all else equal. Otherwise, PJM's proposal would produce a price similar to the current method.

Q 10. Why include start-up and no-load costs in the locational marginal price?

A Uplift results in cost shifts that distort incentives. For example, if PJM calls on a generator in real time to serve additional load that was not cleared in the Day-Ahead Market, that additional real-time load should pay the cost of that additional generator. This only occurs when the market-clearing prices fully reflect the cost of that generator. If that generator is not permitted to set LMP because it is inflexible, or its start-up and no-load costs are not included in the LMP, all or part of the cost of running that unit is moved into uplift and socialized. This socialization is imprecise by nature and results in entities that did not cause the unit to be committed paying a portion of its cost while those that did cause it to be committed pay less than its full cost.

PJM believes uplift should be minimized because of the aforementioned distorting effects. Including start-up and no-load costs in the LMP will more appropriately allocate the costs of operating generators by enhancing the prices and reducing uplift.

Q 11. Would changing energy price formation also change prices in the capacity market?

A The purpose of PJM's energy price formation proposal is to produce prices that more accurately reflect the true cost of serving load. Because this will, in general, result in an increase in the average LMP, it is expected that resources will collect more revenues from the Energy Market than they do today, resulting in lower offers into the capacity market. The increase in LMP would also result in an increase in the Energy and Ancillary Service Revenue Offset, which would result in a reduction in the Net Cost of New Entry (CONE). The combination of lower capacity market offers and a lower Net CONE is expected to reduce capacity market costs, all else equal.

Q 12. Why does PJM view more reliance on the capacity market as a negative?

A PJM views more reliance on the capacity market as negative because the capacity market alone does not provide adequate incentives for reliable, efficient, real-time system operation.

The capacity market incents the availability of generation during the Delivery Year and values each megawatt equally (notwithstanding locational differences). As such, it does not provide incentives for valuable attributes such as low marginal operating costs, dispatchability, flexibility, the ability to provide ancillary services, or the short lead times and minimum run times necessary to ensure that the system is operated reliably and efficiently in real time. The incentives for these attributes all exist within the Energy and Reserve Markets. Overreliance on the capacity market can lead to a reduction of the Energy Market incentives needed to promote the development and operation of flexible assets needed to optimize the real-time grid.

It is important to note that there is no “right” distribution of revenues between the Energy and capacity markets. Therefore, PJM is not seeking a specific level of funding in either the Energy or the capacity market.

Q 13. Why does PJM want to reward generators for not following dispatch instead of penalizing them?

A Lost opportunity cost payments are not a reward for following dispatch; they are a method to incent flexible resources to follow dispatch instructions rather than prices. Penalizing units is another option. However, penalties may incent resources to stop offering flexibly or following dispatch altogether and self-schedule to maximize profit instead.

Q 14. Would PJM’s proposal affect the Real-Time Energy Market or the Day-Ahead Energy Market?

A PJM’s price formation proposal would affect both markets.