



Extended Locational Marginal Pricing (ELMP)

Q: How are market prices currently calculated?

A: Energy and Ancillary Services prices are currently being calculated through the Security Constrained Economic Dispatch (“SCED”) algorithm. SCED is MISO’s primary algorithm for determining the Energy and Reserve product clearing schedules for both its Real Time and Day-Ahead markets. SCED also generates prices for the cleared products that reflect the system marginal costs. A key drawback of the SCED pricing algorithm is that it cannot allow certain Fast Start Resources to set price, even though such Resources often have the highest Offer cost. The SCED prices also may not reflect the Start-Up/Shut-Down Offer costs and the No-Load Offer costs of resources. The SCED prices, thus, do not always cover a Market Participant’s Offer costs. In that event, MISO must make Revenue Sufficiency Guarantee (RSG) payments to compensate the Market Participant for its Offer costs.

Q: What is ELMP?

A: Extended Locational Marginal Pricing (“ELMP”) is a new computational method for calculating the Locational Marginal Prices (“LMPs”) and Market Clearing Prices (“MCPs”) for MISO’s Energy and Ancillary Services Market. The key improvement of ELMP over MISO’s current price calculation method is that ELMP allows Fast Start Resources that are either scheduled at limits or offline to set price. In addition, ELMP allows Emergency Demand Resources (“EDRs”) to set price in the Real Time Energy and Operating Reserve Market. Both Start-Up/Shut-Down Offer costs and No-Load Offer costs will be reflected in the LMPs and MCPs set by Fast Start Resources. The software implementation of ELMP is often referred to as SCED-Pricing, the SCED-Pricing algorithm, or the SCED-Pricing engine. SCED-Pricing is defined in a new Schedule 29A in the Tariff.

Q: What is the difference between Ex Ante LMP/MCP and Ex Post LMP/MCP?

A: Ex Ante LMP/MCP is the price produced from the SCED process. This is the same as current LMP/MCP. Ex Post LMP is the price calculated from SCED-Pricing process. Ex Post LMP and Ex Post MCP are ELMPs.

Q: Why do we still need the general terms LMP and MCP in tariff?

A: The general terms LMP and MCP are used to refer to all prices, including Ex Ante LMP and Ex Post LMP, as well as Ex Ante MCP and Ex Post MCP.



Q: What is a Fast Start Resource?

A: A Generation Resource that can be started, synchronized and inject Energy, or a Demand Response Resource that can reduce its Energy consumption, within 10 minutes of being notified and that will participate in setting prices.

Q: In the future, will MISO consider extending the 10-minute notification time requirement for Fast Start Resource to 30 minutes?

A: Currently, MISO proposes to use 10 minutes in the Fast Start Resource definition, based upon the following:

1. 10 minutes Fast Start Resources will be closer to dispatch, which will cause smaller differences between LMP and ELMP. 10 minutes Fast Start Resource also will provide a better transition for MISO, as a starting point for the ELMP project.
2. In current Real Time dispatch, MISO is only looking 10 minutes ahead. If a resource cannot be operationally available within the 10-minute window, it is not considered an available resource for setting price.

It is possible that MISO will work with its stakeholders to extend the Fast Start Resource definition to 30 minutes after LAC/LAD is in production.

Q: Will there be no need for RSG payment if MISO settles the markets with ELMP prices?

A: There will still be RSG payments with the ELMP prices. However, the overall RSG payments are expected to be reduced under ELMP pricing.

Q: How will RSG be calculated with ELMP prices?

A: The Real Time RSG calculation will remain unchanged. The Day-Ahead RSG will be similar to the current process, the only difference is that price sensitive demand, Must-Run resources, Virtual supply, and demand bid and dispatchable transactions will also be eligible for Day-Ahead RSG payment.

Q: How will MISO calculate Day-Ahead RSG payment for price sensitive demand and virtual demand ELMPs?

A: MISO will calculate Day Ahead revenue based on Day Ahead Ex Post LMP and Day Ahead Ex Post MCP for price sensitive demand. MISO will then calculate the Day-Ahead willing- to-pay based on their bids. MISO will calculate the difference between



the Day Ahead revenue and Day-Ahead willing-to-pay, and if the difference is negative, then the price sensitive demand/virtual demand is eligible for the RSG payment.

Q: How will MISO calculate Day-Ahead RSG payment for Must-Run resource ELMPs?

A: A Must-Run Resource will be eligible for Day-Ahead RSG payment only when it is being dispatched above the EconMin or Self Schedule MW amount for Energy. When a Must-Run resource is being dispatch above the EconMin or Self Schedule MW amount for Energy in Day Ahead SCED, MISO will calculate the incremental cost and revenue for the MW above EconMin or Self Schedule MW amount for Energy portion. MISO will then compare the revenue with the incremental cost for the whole commitment period, and if the revenue is less that the incremental cost, then the Must-Run Resource will be eligible for RSG payment.

Q: Would two settlement statements be run during the parallel operation phase?

A: MISO is currently considering this request.

Q: Will ELMP result in Operational changes, such as changing the merit order of dispatching resources?

A: No. MISO's operations and its dispatch of resources will not be affected by the implementation of ELMP because ELMP will only modify the calculation of Energy and Ancillary Service prices.

Q: Will both day-ahead and real-time Markets implement ELMP?

A: Yes, ELMP will modify both markets. Before ELMP, SCED solves both product clearing schedules and prices for market settlement. After ELMP, the SCED product clearing schedule and ELMP prices will be used in settlement. The business process of market clearing will also be changed. Both the Day Ahead and Real Time Markets will be executing SCED-Pricing (*i.e.*, the ELMP software engine) after SCED has occurred. The SCED prices will be called Ex Ante prices, and they will be used for information only. The SCED-Pricing prices will be called Ex Post prices, and they will be used for settlement.

Q: Will the term LMP be replaced by ELMP for the MISO market in the Tariff?

A: No. ELMP refers to MISO's new process for calculating market settlement prices, including both energy LMPs and reserve MCPs. The concepts and definitions of LMP and MCP will remain unchanged after implementing ELMP, however the terms LMPs and MCPs often will be referenced in conjunction with prefixes "Ex Ante" and "Ex Post". These prefixes will help to clarify the process in which the energy LMPs and reserve MCPs are calculated.



Q: How is “Hourly Real-Time Ex Post LMP” different from “Real-Time Ex Post LMP”?

A: The SCED-Pricing algorithm calculates energy LMP for each real time dispatch interval. The resultant LMPs from SCED-Pricing solution are Real-Time Ex Post LMP that are calculated every 5 minutes. Hourly Real-Time Ex Post LMP is the mathematical integration of Real-Time Ex Post LMP over all dispatch intervals during a market hour. The real time market will be settled on Hourly Real-Time Ex Post LMP. However, Market Participants will be notified of the Real-Time Ex Post LMP as they are being calculated. This explanation is also consistent with the other real-time prices that are similarly defined in the Tariff.

Q: Why is hourly Day-Ahead Ex Post LMP not a defined term?

A: This is because all Day-Ahead Ex Ante and Ex Post prices are hourly based, unlike the Real-Time Ex Ante and Ex Post prices. Thus, the modifier “Hourly” is not needed in Day-Ahead price terminologies.

Q: Will the Ex Ante prices and Ex Post price always be different?

A: They may be different when Fast Start Resources are committed. The prices will be the same on occasions when there are no Fast Start Resources committed and the market is not experiencing a transmission constraint violation, or experiencing reserve scarcity.

Q: How are Fast Start Resources handled in Ex Post price calculation by the SCED-Pricing engine?

A: A Fast Start Resource is allowed partial commitment through decision variable $0 \leq On \leq 1$. As a result, for the purposes of calculating ELMP the expected energy MW from the Fast Start Resource can vary continuously between 0 and the maximum limit. And the startup and no-load cost will also be partially counted in the objective function through decision variable “On”. This handling will allow Fast Start Resource to set prices, and the prices will reflect the Start-Up and No-Load Offer costs.

Q: When are offline Fast Start Resources considered for setting price?

A: Offline Fast Start Resources set prices when the real time SCED dispatch experiences reserve deficit, or when transmission constraint violation conditions occur where Fast Start Resources could have been called on to mitigate the conditions. During real time operation, these conditions may or may not result in the actual call-on of the Fast Start Resources depending on the transient nature of the conditions. Persisting reserve deficits or transmission constraint violations would lead to commitment of the Fast Start Resources for mitigation.



Q: Will MISO continue to honor EconMin and EconMax Offers from resources?

A: Yes. Although ELMP will be calculated based upon the assumption that a Fast Start Resource is allowed partial commitment through decision variable $0 \leq On \leq 1$, MISO will continue to operate and dispatch the system by honoring both the Minimum Economic and Maximum Economic Offers submitted by resources. MISO's dispatch algorithm (SCED) will not change.

Q: Can a Fast Start Resource set price during a minimum-generation event?

A: No. For Ex Post pricing during a min-gen event, neither partially committed Fast Start Resources nor offline Fast Resources are allowed in the SCED-Pricing algorithm. As a result, Ex Ante prices and Ex Post prices should be the same.