Regulation Redesign Phase 1 Clarification to the IMM Report

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Summary

1.	A clarification to the IMM MC report is necessary.
2.	The ASO clearing of some steam units in alternating 30-minutes periods was not the only contributing factor for the high Regulation prices in early October 2025.
3.	There was no error introduced on October 1, 2025, in the Regulation clearing engine that resulted in incorrect clearing prices as it pertains to PJM's governing document language.
4.	Some enhancements to the Regulation clearing logic have caused the decline in the clearing price spikes.

Enhancements to the Regulation Clearing Logic

The post-go-live release on October 23, 2025, included the following:

Enhanced logic to the value-added pre-ramping of eligible unit into the Regulation basepoint

- Mitigates resource's performance score penalty from being late to service
- Improves quality of Regulation service

Enhanced logic to the value-added 30-minute clearing and commitment, where some units were clearing in alternating 30-minutes

- Mitigates wear and tear on the resource
- Mitigates shoulder interval LOC in Settlement – this has no impact on Regulation MCP

Enhanced Regulation clearing optimization

- Mitigates suboptimal solution that can spike Regulation MCP in real-time (more info in the appendix)

Additional Drivers for High Prices

Several intervals with overall low ramping capability on the system

October 3 events were affected with reserve shortage intervals

Congestion patterns during outage season resulting in additional LOC impacts

Fractional (less than one) megawatt clearing of large units

- Observed improvement since communicated at October MIC
- Markets Gateway optional parameter exists to limit fractional megawatt clearing

PJM is constantly monitoring the optimization engine results with our software vendor for potential improvements

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Regulation Redesign Phase 1 – Clarification to the IMM Report

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Acronyms

Acronym	Term & Definition
ASO	**Ancillary Service Optimizer** performs the joint optimization function of Energy, Reserves and Regulation in the dispatch run. The main functions of ASO are the clearing and commitment of all Regulation resources for a half-hour time period and inflexible Reserve resources for a one-hour time period..
MCP	**Market Clearing Price** - The price that is paid by all load and paid to all suppliers for the service received or provided
LOC	**Lost Opportunity Cost** - In general, the foregone revenues resulting from following PJM's dispatch instructions to provide some type of ancillary service. Lost opportunity costs are calculated for generating units participating in many PJM markets.
MW	**Megawatt** - A unit of power equaling one million watts (1 MW = 1,000,000 watts) or one thousand kilowatts (1 MW = 1,000 kW). To put it in perspective, under non-severe weather conditions, one MW could power roughly 800 to 1,000 average-sized American homes.

PJM Glossary

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BE ALERT TO MALICIOUS PHISHING EMAILS

Report suspicious email activity to PJM.

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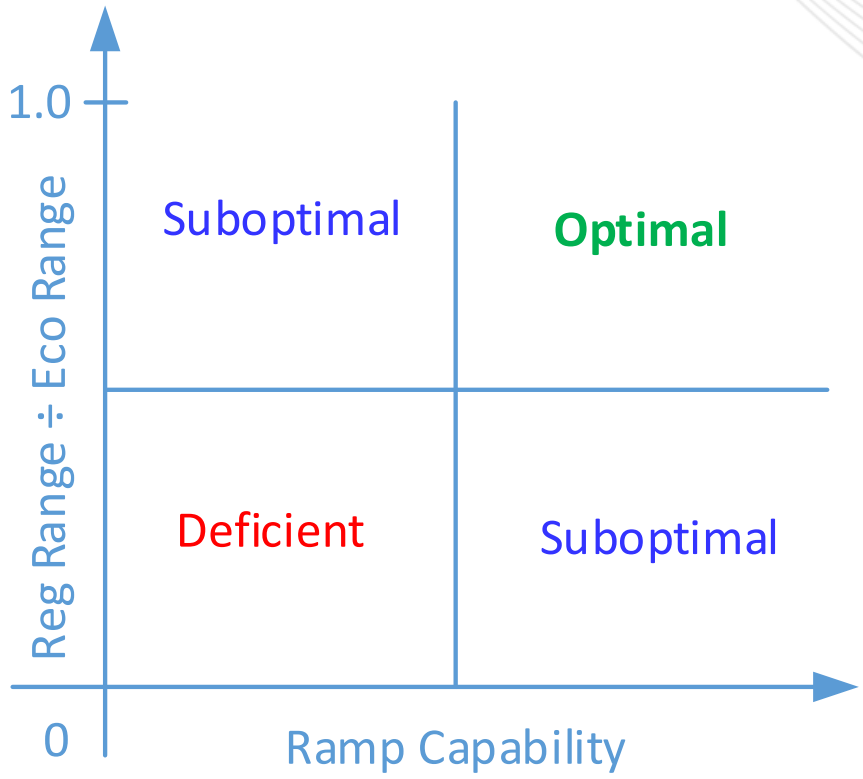
Appendix

Phase 1 Summary of Changes

#	Design Components	Summary Description
1	**Signals and Products**	Change from ***two*** signals (RegA and RegD) bidirectional to ***one*** signal bidirectional that all resources that are assigned Regulation in a given market interval will follow.
2	**Requirement MW**	Changes to better reflect operational needs with consideration both to historic and future system conditions
3	**Performance Scoring**	Change from accuracy, delay and precision to precision only.
4	**Offer and Clearing Timing**	Eliminate “cost increase in VOM” except for Reg-only resources; change from hour clearing and commitment to 30-minute clearing and commitment.
5	**Opportunity Cost Calculation Reform**	1. Use the schedule the resource is running for energy or else the cheaper of available schedule for offline. 2. Use tracking desired megawatt at LMP ramp-rate limited. 3. Use the area between LMP and the energy schedule the resource is running on.
6	**Settlement**	For the eligible resources, settlement will calculate the shoulder interval opportunity cost for two five-minute ramp-in intervals before the resource Regulation operation and two five-minute ramp-out intervals following the resource Regulation operation (currently, three intervals ramp-in and three intervals ramp-out). Also, settlement will update the calculation for the regulation mileage credit (currently performance credit) such that the mileage ratio is equal to real-time regulation mileage/historic regulation mileage.

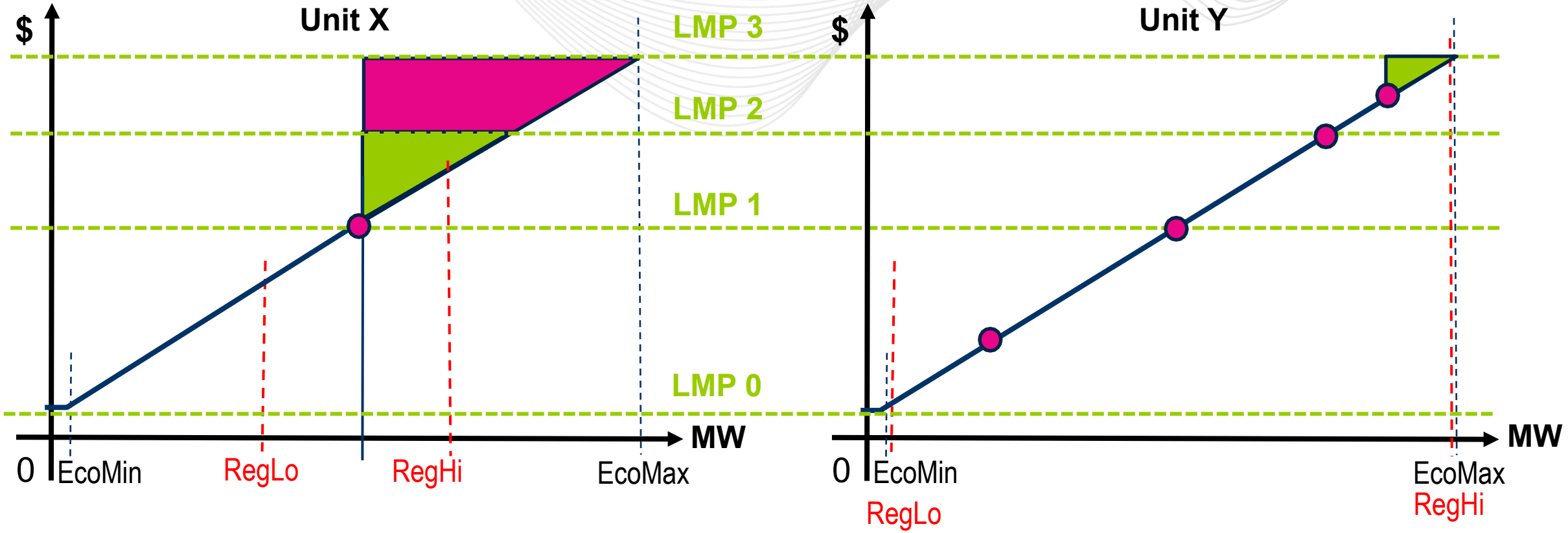
Regulation Lost Opportunity Cost (RegLOC) Drivers



- Regulation range and Economic range define the dispatchable limits of a resource for the respective products.
  - The closer $\frac{Reg\ Range}{Eco\ Range} \rightarrow 1$, the less volatile (spike) RegLOC.
- Ramp capability of a resource is the rate of change of its output in megawatts per minute.
  - The higher the up-ramp and down-ramp, the less volatile (spike) RegLOC.
- RegMin, RegMax, EcoMin, EcoMax and Ramp values are all bid-in parameters of a resource by the Market Participants.

Key Takeaway: The ultimate objective of the Regulation clearing optimization enhancements is to ensure that the best solution is always attained.

RegLOC Drivers – Numerical Example



At LMP 1: Both Units X and Y have the same effective cost determined as LOC = 0.
At LMP 2: Unit X incurs LOC defined by area shaded green. Unit Y has LOC = 0. **Unit Y is optimal**.
At LMP 3: Unit X incurs higher LOC defined by area shaded green and red. Unit Y incurs very minimal LOC as a result of necessity to back down the unit for the Reg set-point. **Unit Y is optimal**.

RegLOC Impact on Regulation Market Clearing Price (MCP)

- Reg MCP = max[Adjusted Offer Prices + Adjusted RegLOC]
  - Adjusted Offer Prices includes the Capability and Mileage Offer prices
  - Adjusted RegLOC = $\frac{\Delta\$ * \Delta MW}{PS * RegMW}$
- Adjusted RegLOC constitutes the majority of the Reg MCP
- Adjusted RegLOC can increase with
  - Wider Δ$
  - Wider ΔMW
  - Lower Performance Score of the marginal resource (0.4 to 0.99)
  - Fractional Reg MW (0.1 to 0.9)