

2025 Real-Time Market Pricing Impacts: Multi-Step ORDCs with Extended Requirements

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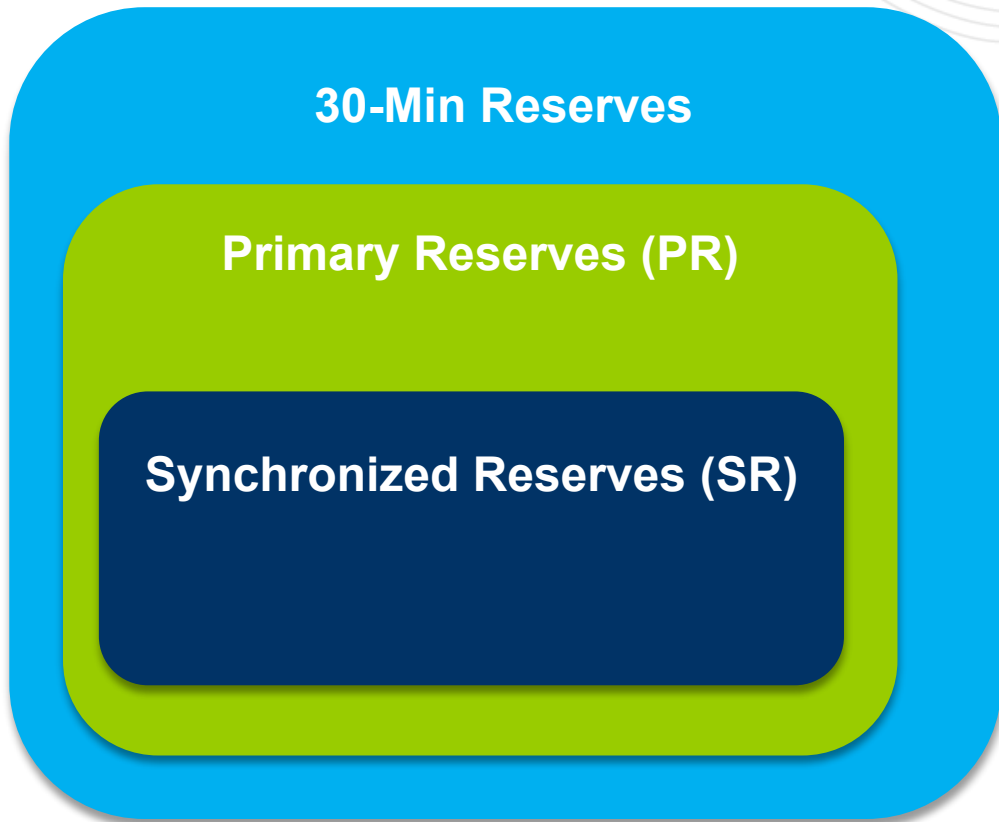
- Analyzed the pricing and commitment impacts in the Real-Time Market (RTM) for the following:
 - Unnesting of 10-Min Synchronized Reserve (SR) from 30-Min Reserve
 - 30-Min Reserve having a nested 30-Min Online Reserve component
 - 10-Min Online Reserve includes 10-Min SR and 10-Min RUR
 - 30-Min Online Reserve includes 30-Min RUR
 - The proposed reserve products are represented using Operating Reserve Demand Curves (ORDCs) that are updated every 15 minutes with multi-step segments.

- Simulations were performed for the full year 2025
 - PROBE Prefect Dispatch (PD) was used to run the simulations for the RTM.
 - Only combustion turbines (CTs) and diesel units were allowed to be committed and decommitted by PROBE PD. The unit commitment for steam units was held fixed to actual real-time operations, but they were allowed to be redispatched by PROBE PD.
 - The MAD reserve sub-zone was not enforced in any of the simulations.
 - 14 days were removed due to the simulations not converging and other data issues.

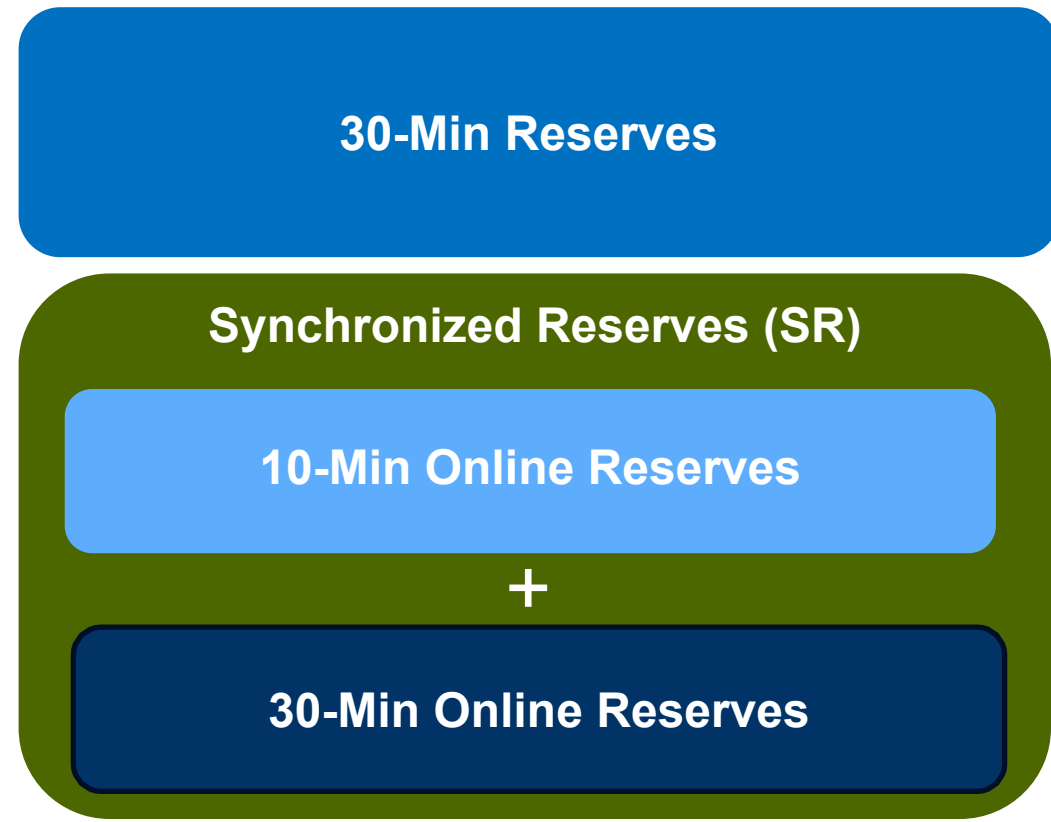
- Two scenarios* were simulated:
 - **Base Case**
 - Status quo with no changes
 - **Full Case**
 - Updated ORDCs for all products with Primary Reserve not cleared to reflect the updated market design.
 - 30-Min Online product requirement is fully added to the SR requirement since PROBE PD lacks a 30-Min Online product
 - (i.e. SR Requirement = 10-Min Online Reserve Requirement + 30-Min Online Reserve Requirement)
 - Note: This case can represent an **upper bound** on the impacts on energy and ancillary service prices due to the proposed reserve market changes.

*Unlike the simulation results presented during the May 21, 2026 RCSTF meeting, we do not provide a sensitivity analysis with 1/3rd and 2/3rd cases.

- Base Case



- Full Case



- Summary of PROBE PD Limitations:
 - PROBE PD runs using 15-minute time intervals.
 - Only combustion turbines (CTs) and diesel units were allowed to be committed and decommitted by PROBE PD. The unit commitment for steam units was held fixed to actual real-time operations, but they were allowed to be redispatched by PROBE PD.
 - PROBE PD does not support a 30-Min Online product. The 30-Min Online requirement is **ADDED** to the 10-Min Online requirement, and the resulting value is used for the SR requirement in PROBE PD*.
 - 14 Days did not solve due to data or other non-convergence issues: 3/2, 3/9, 5/5, 6/24, 6/25, 6/27, 6/29, 8/4, 8/5, 8/11, 11/2, 11/12, 11/16, 11/26
 - Note that 5/5, 6/24, 6/25, 6/27, 6/29, 8/11, 11/12, 11/16, and 11/26 were solved after the June 9, 2026 RCSTF meeting and the results are now posted in the spreadsheet on the RCSTF meeting page.
 - PROBE PD is an offline analysis tool used for indicative analysis and running counterfactual scenarios. The PROBE PD engine is different than what is used in PJM's Real-Time Market (RTM). Results from this simulation study are indicative of the expected price changes but are not intended to exactly replicate the actual RTM clearing.

*This represents an upper bound for pricing, as the 30-Min Online requirement is being satisfied by a 10-Min Online product. In reality, slower or less expensive units would be used to satisfy the 30-Min Online requirement.

- The following table shows a summary of the yearly* simulation results**.

Category	Metric	Product/Type	Base Case	Multi-step ORDC	Multi-step ORDC – Base Case
Energy	Gen-Weighted Avg. LMP (\$/MWh)	N/A	42.78	43.58	0.80
Reserves	Avg. MCP (\$/MWh)	10-Min Online	10.25	13.04	2.79
		Primary	10.19	-	-
		30-Min Online	-	Included in 10-Min Online product	-
		30-Min	0.00	0.00	0.00

- Uplift*** reduced by 3.80% in the Multi-step ORDC Case.

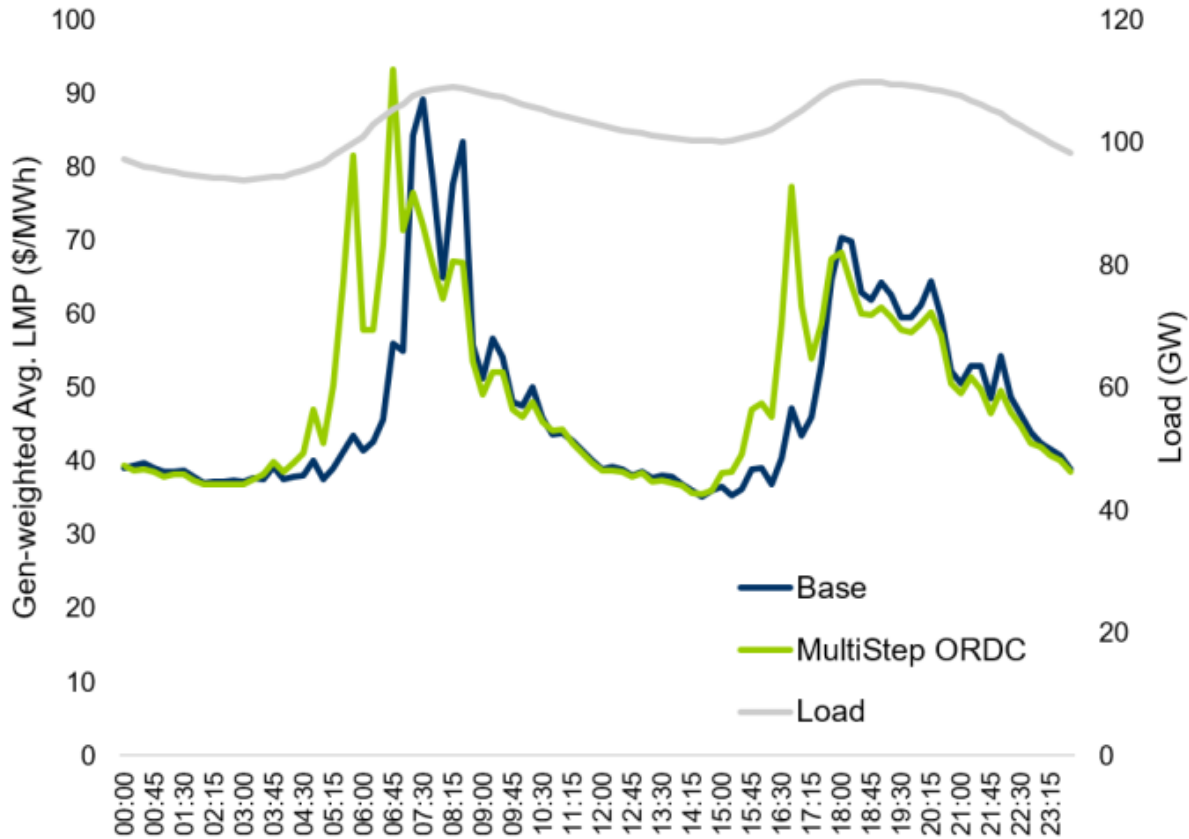
*The following days are excluded from the results due to non-convergence and other data issues: 3/2, 3/9, 5/5, 6/24, 6/25, 6/27, 6/29, 8/4, 8/5, 8/11, 11/2, 11/12, 11/16, 11/26. Note that 5/5, 6/24, 6/25, 6/27, 6/29, 8/11, 11/12, 11/16, and 11/26 were solved after the June 9, 2026 RCSTF meeting and the results are now posted in the spreadsheet on the RCSTF meeting page.

**The results are rounded to two decimal places.

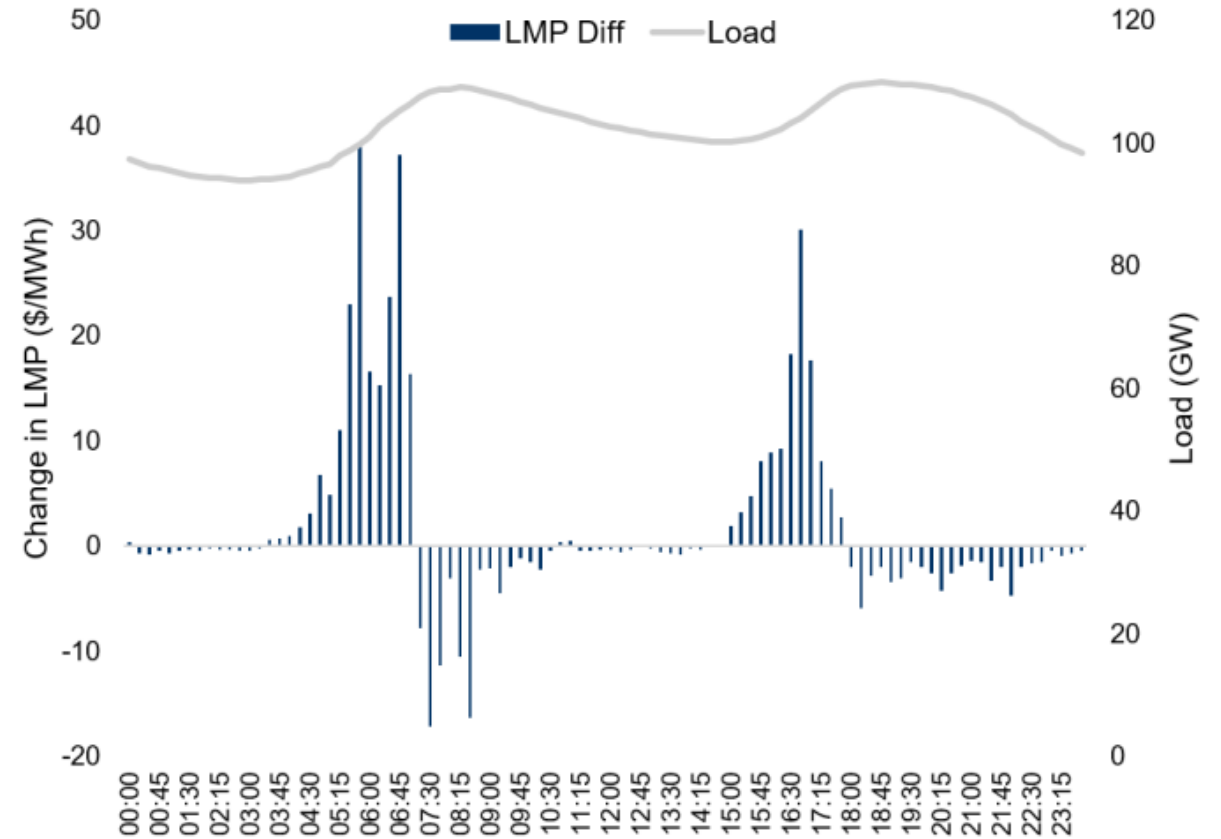
***Uplift is calculated as the difference between a unit's costs and revenues over each day summed for all days and units.

- Winter Generation-Weighted Average LMPs

Winter 2025 Gen-Weighted Avg. LMP

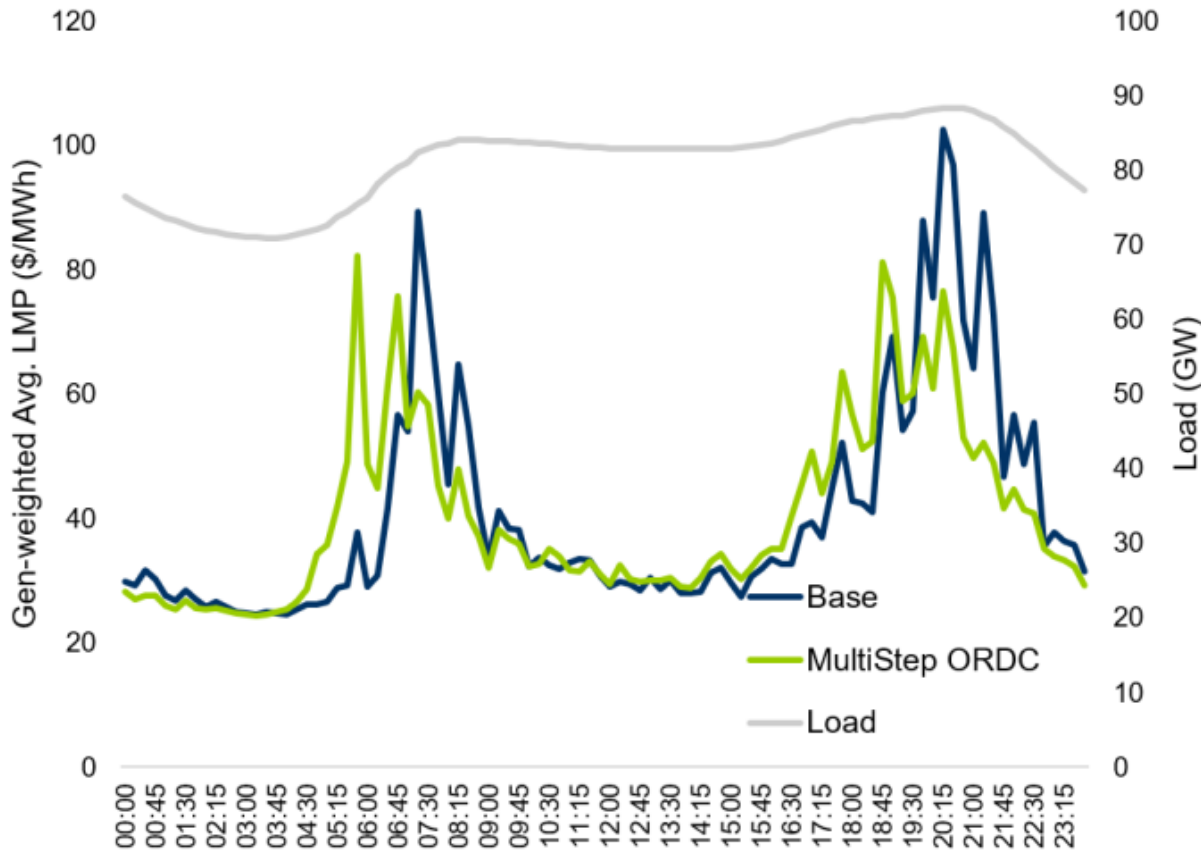


Winter 2025 LMP Difference (ORDC - Base)

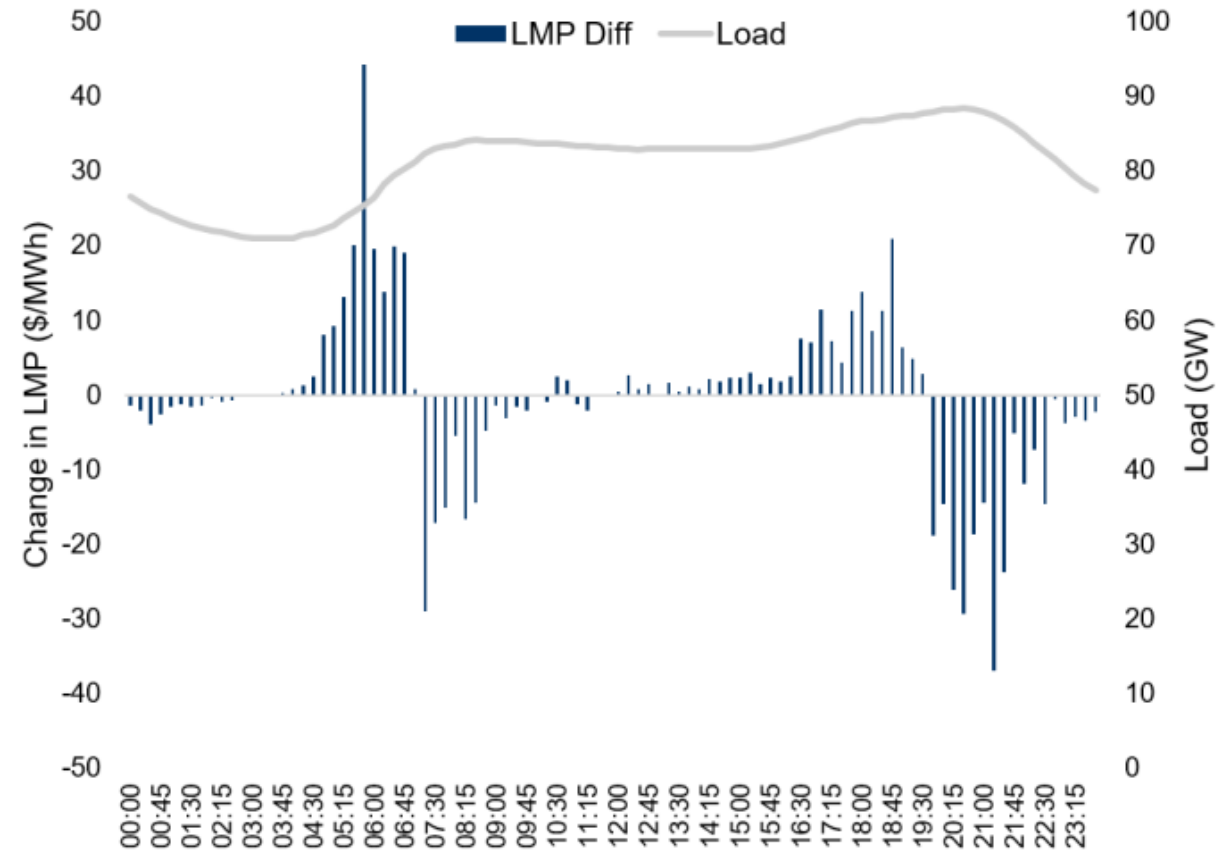


- Spring Generation-Weighted Average LMPs

Spring 2025 Gen-Weighted Avg. LMP

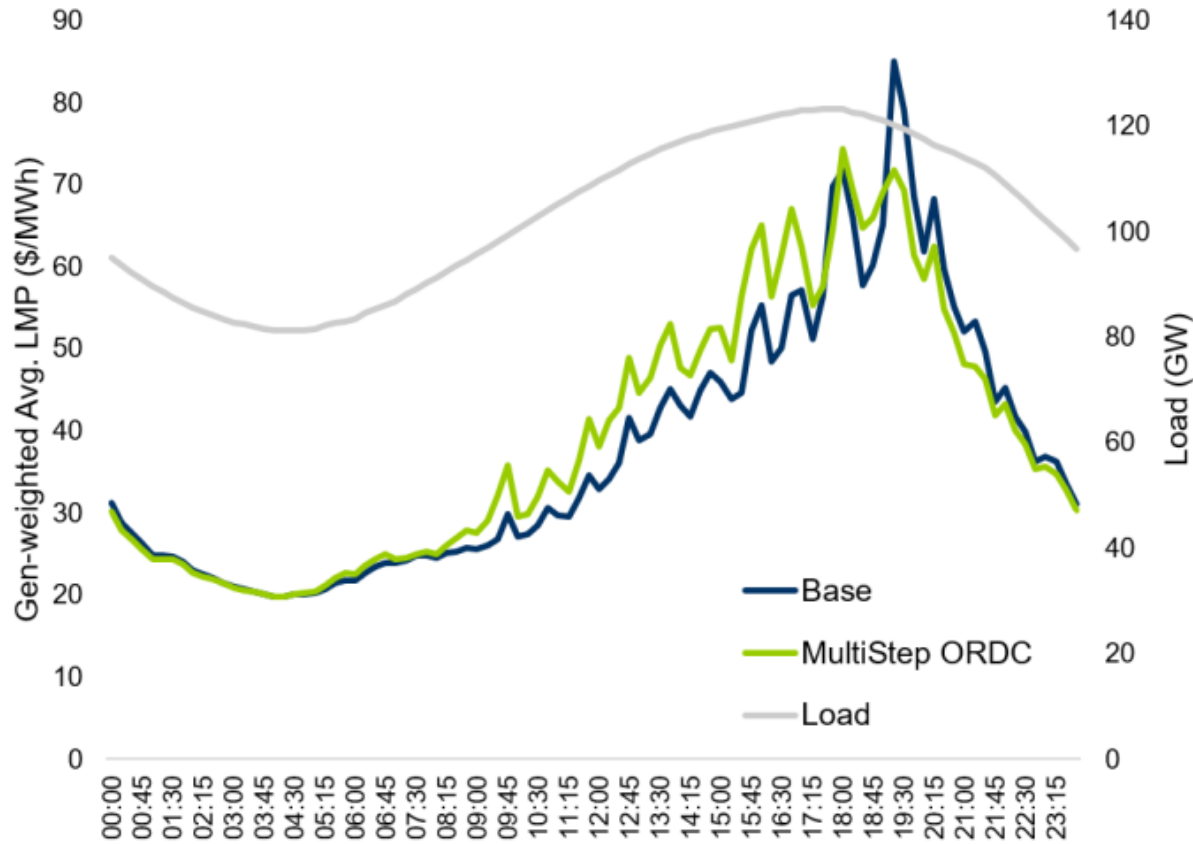


Spring 2025 LMP Difference (ORDC - Base)

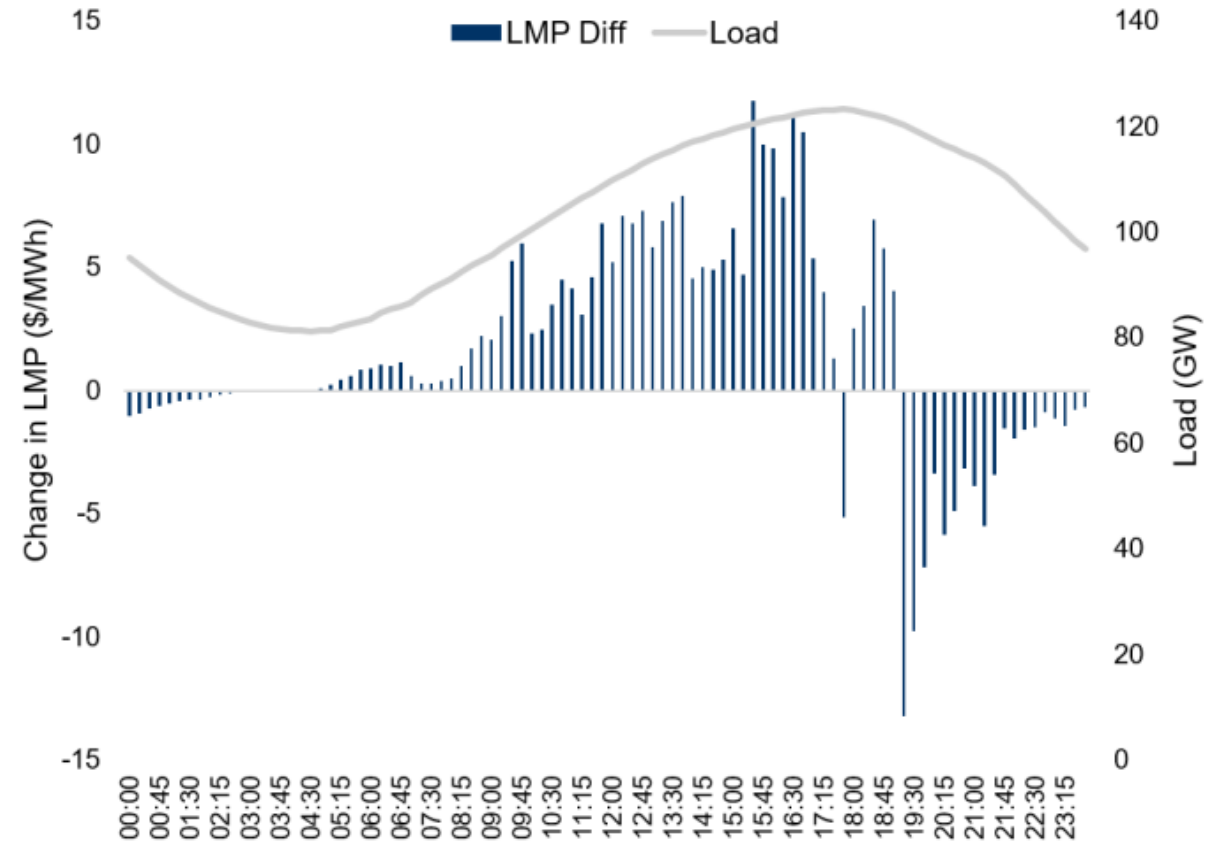


- Summer Generation-Weighted Average LMPs

Summer 2025 Gen-Weighted Avg. LMP

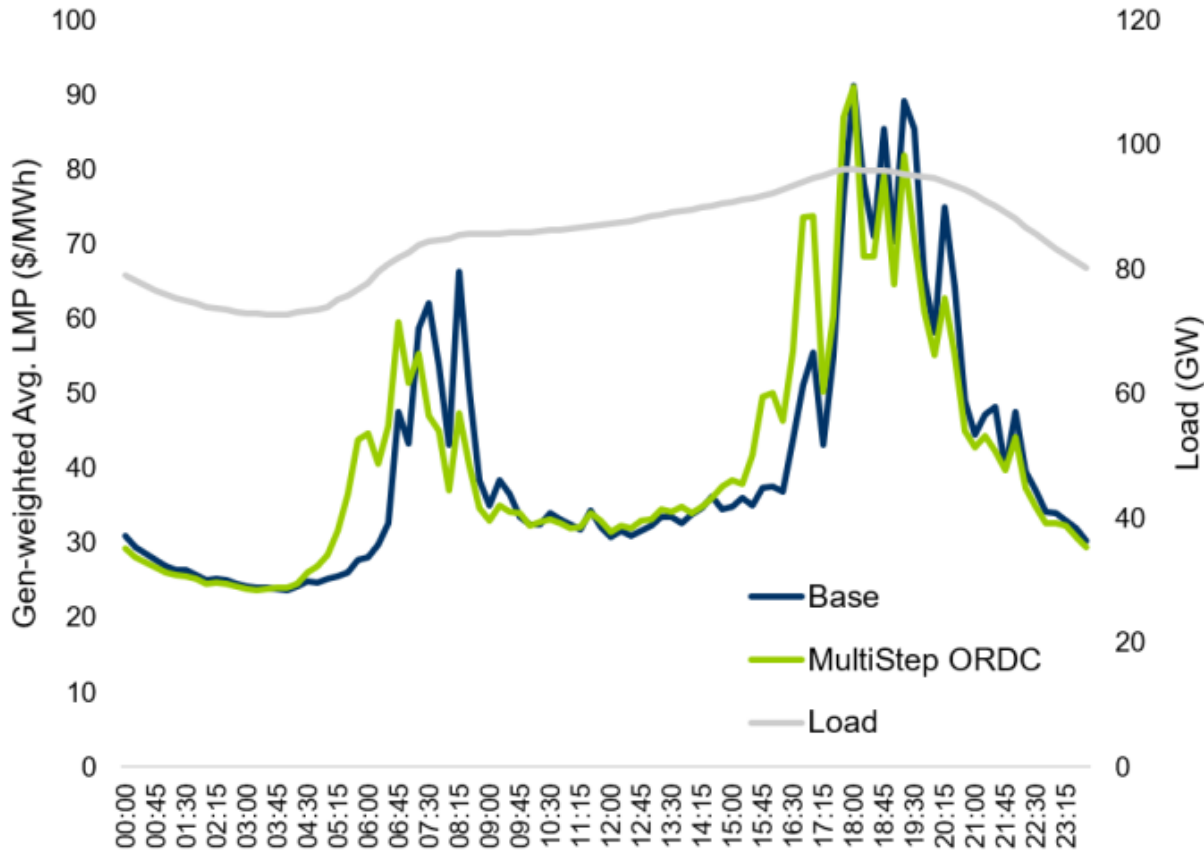


Summer 2025 LMP Difference (ORDC - Base)

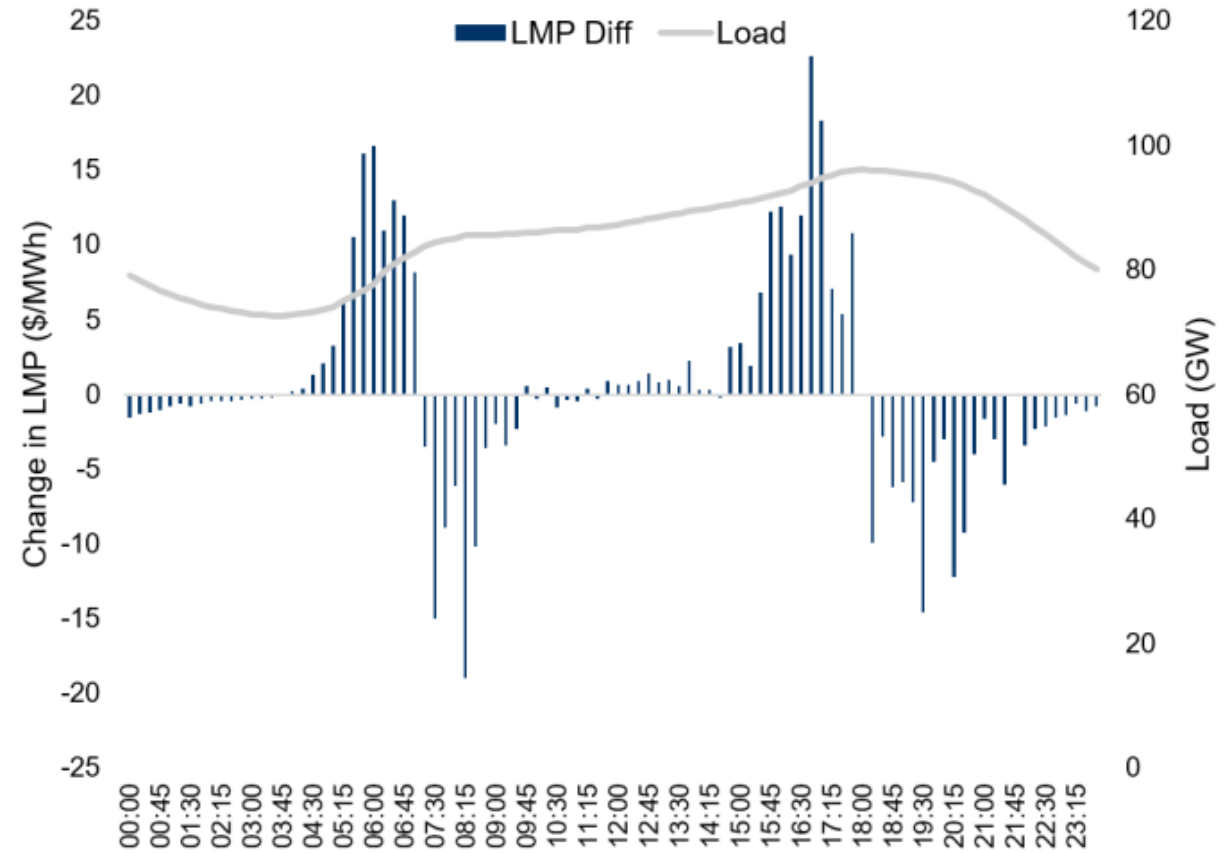


- Fall Generation-Weighted Average LMPs

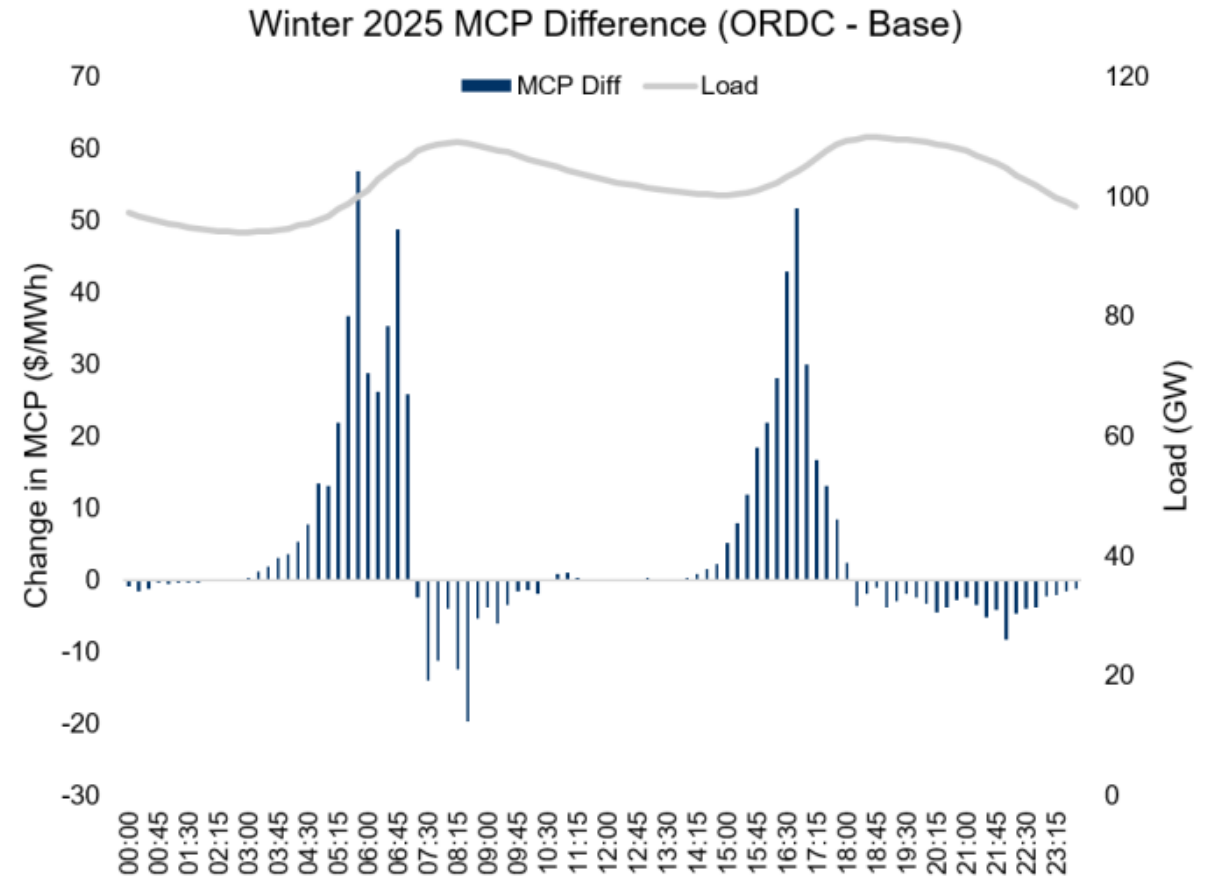
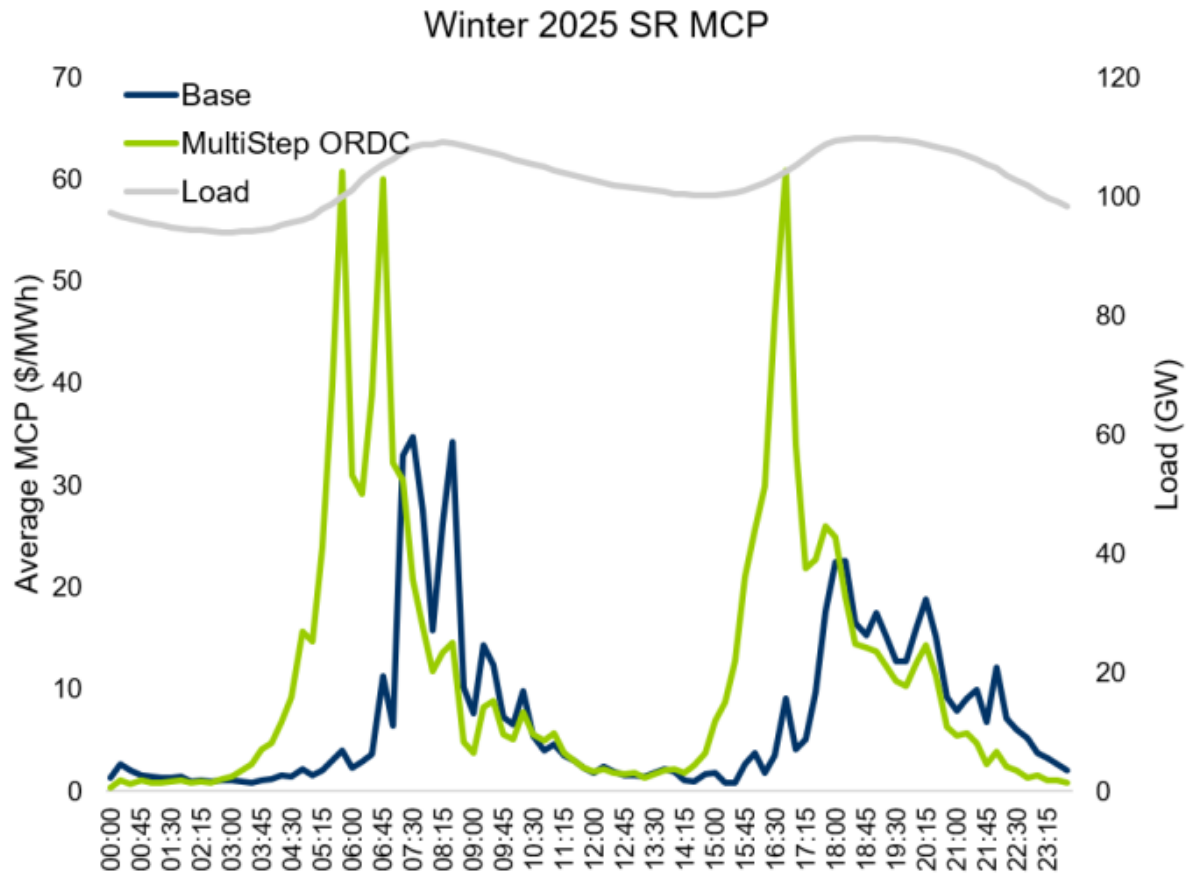
Fall 2025 Gen-Weighted Avg. LMP



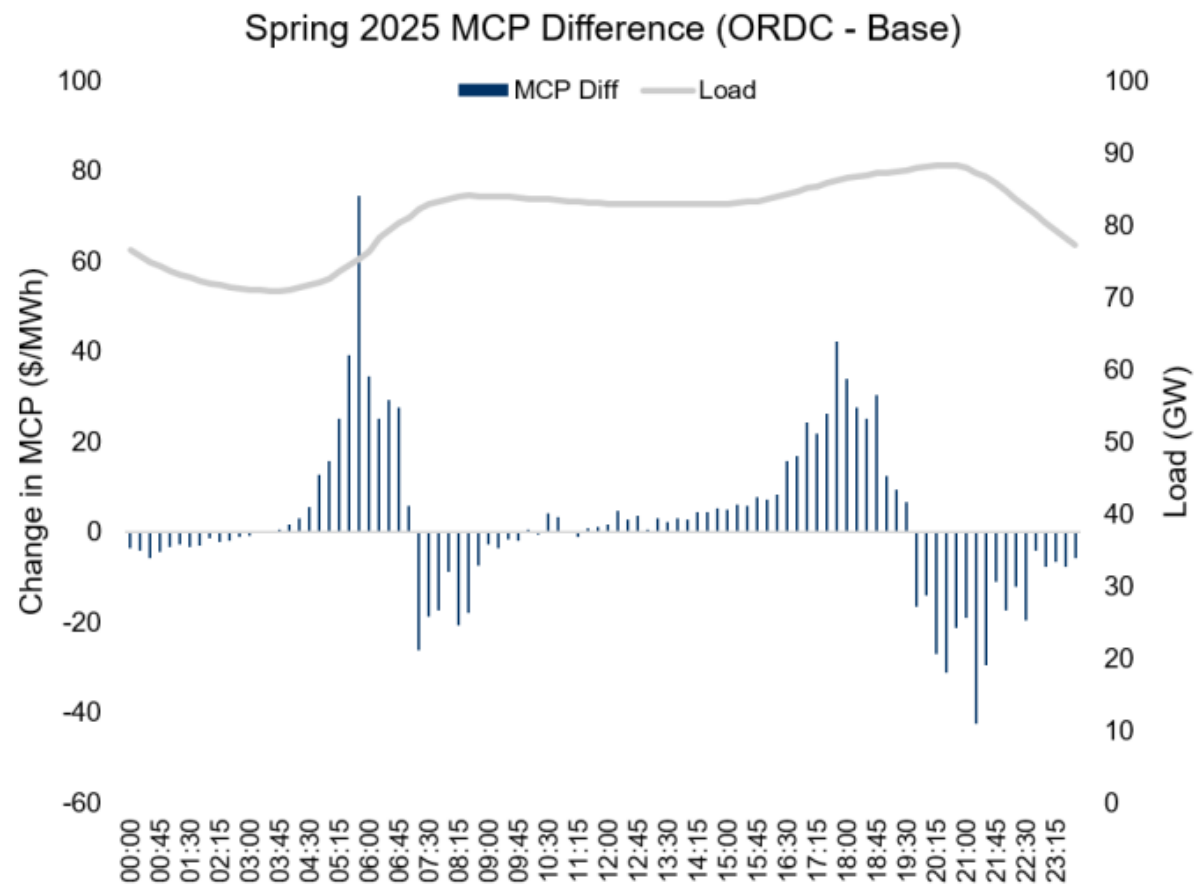
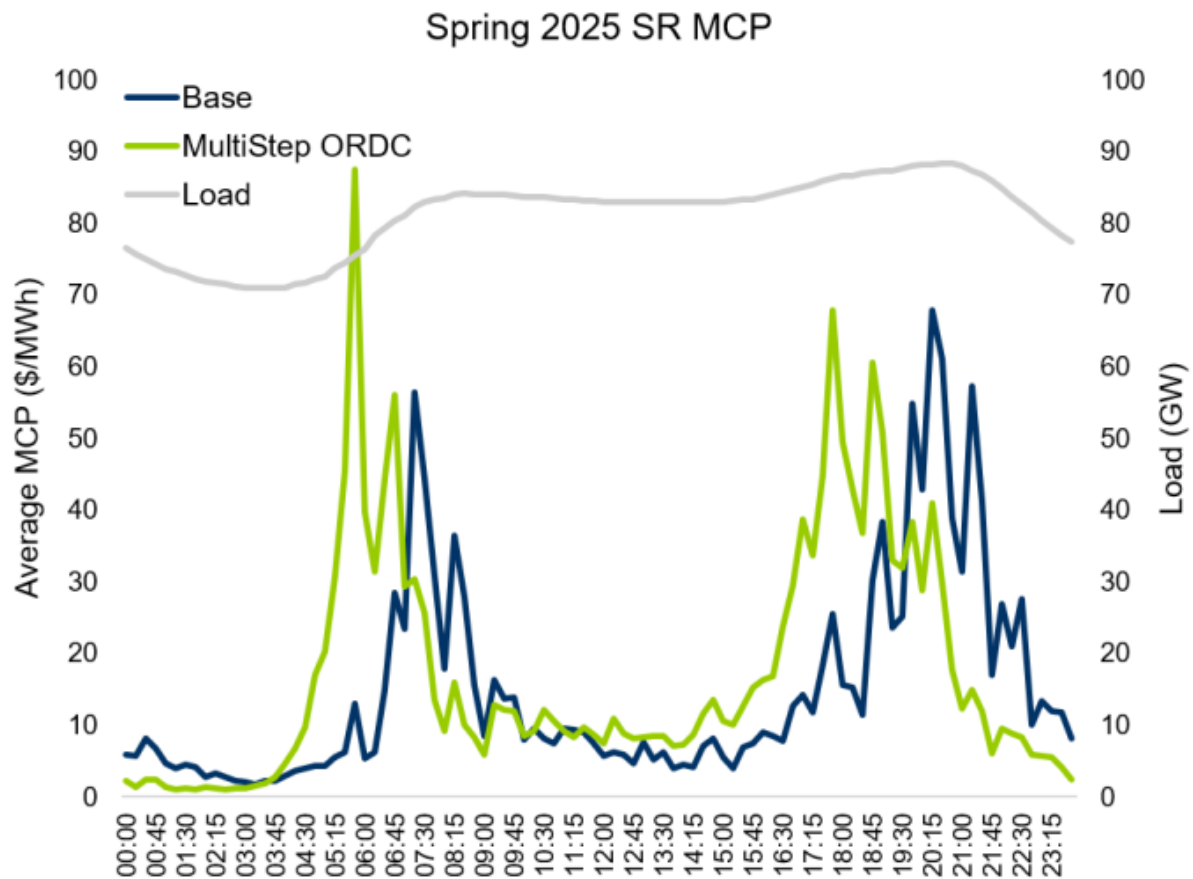
Fall 2025 LMP Difference (ORDC - Base)



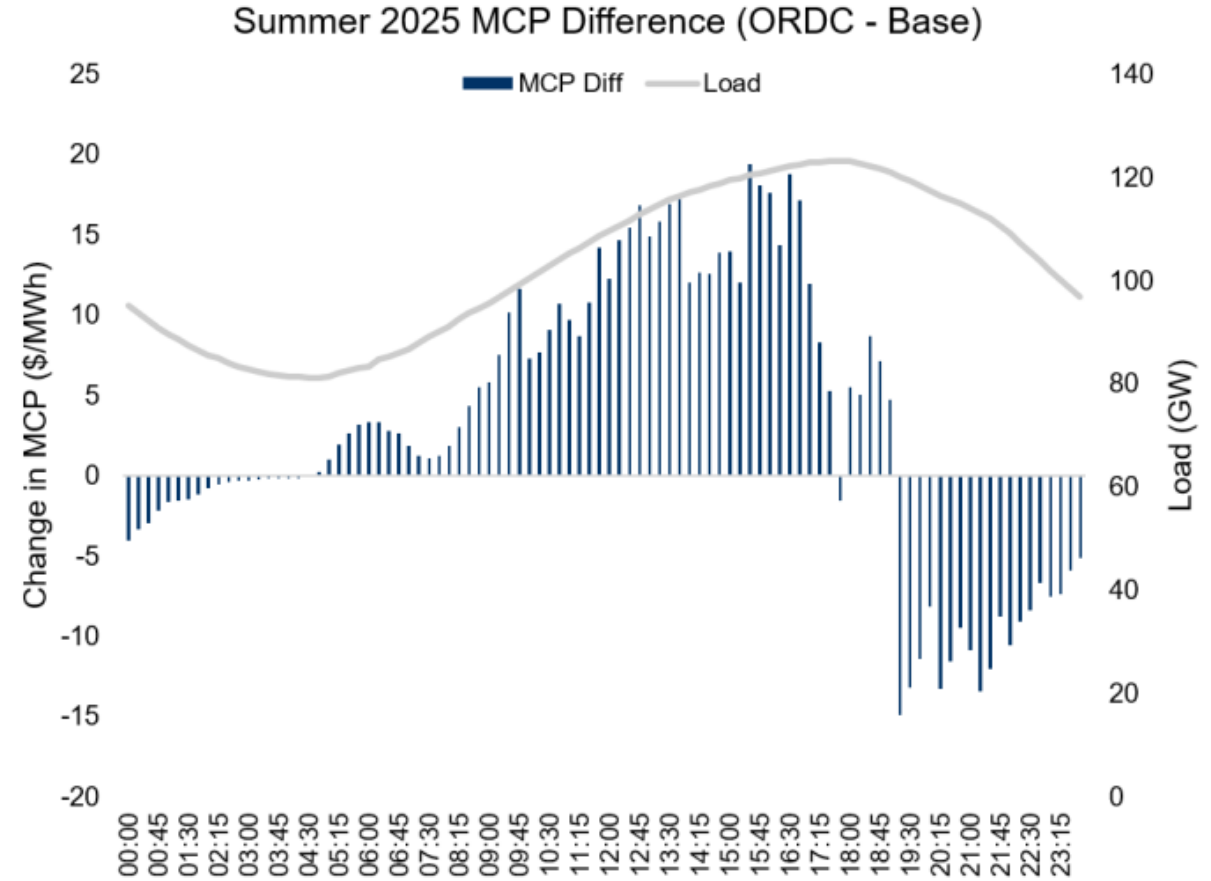
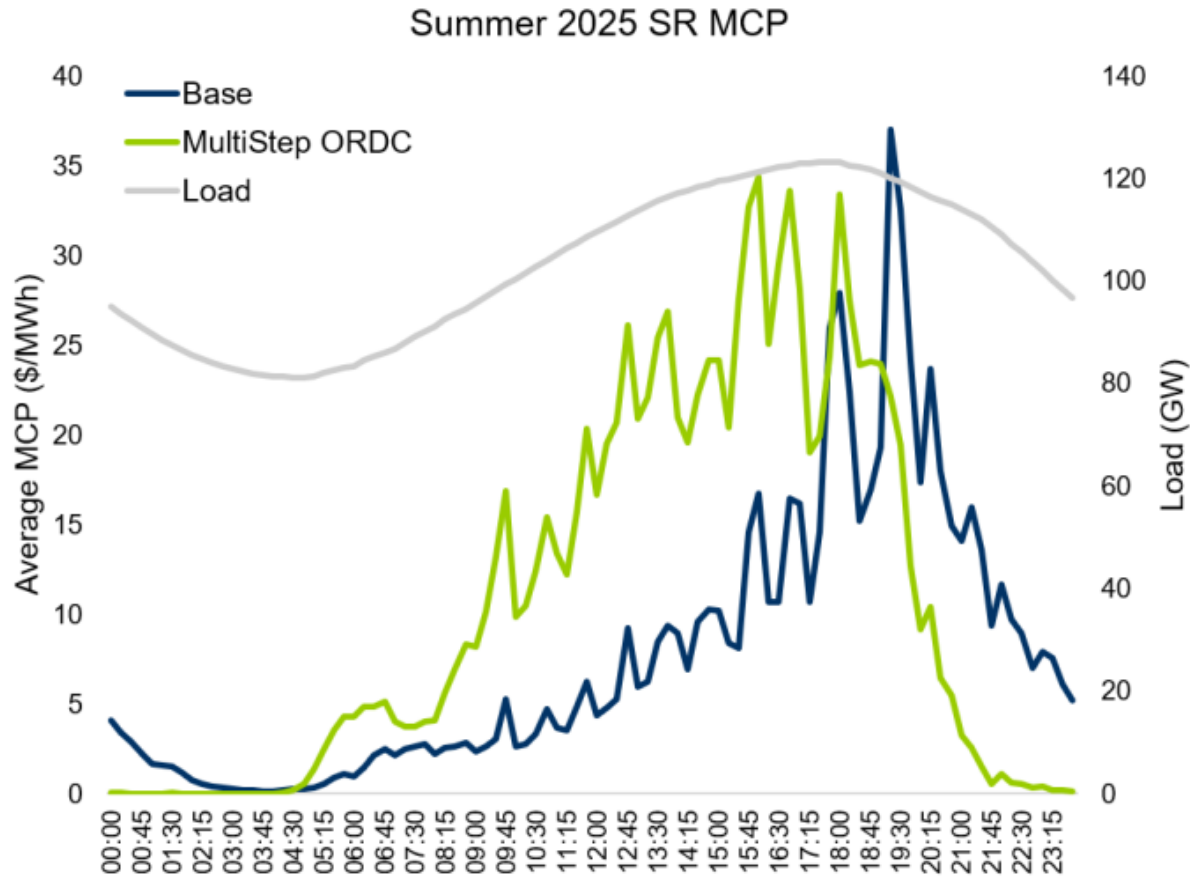
- Winter Average SR MCPs



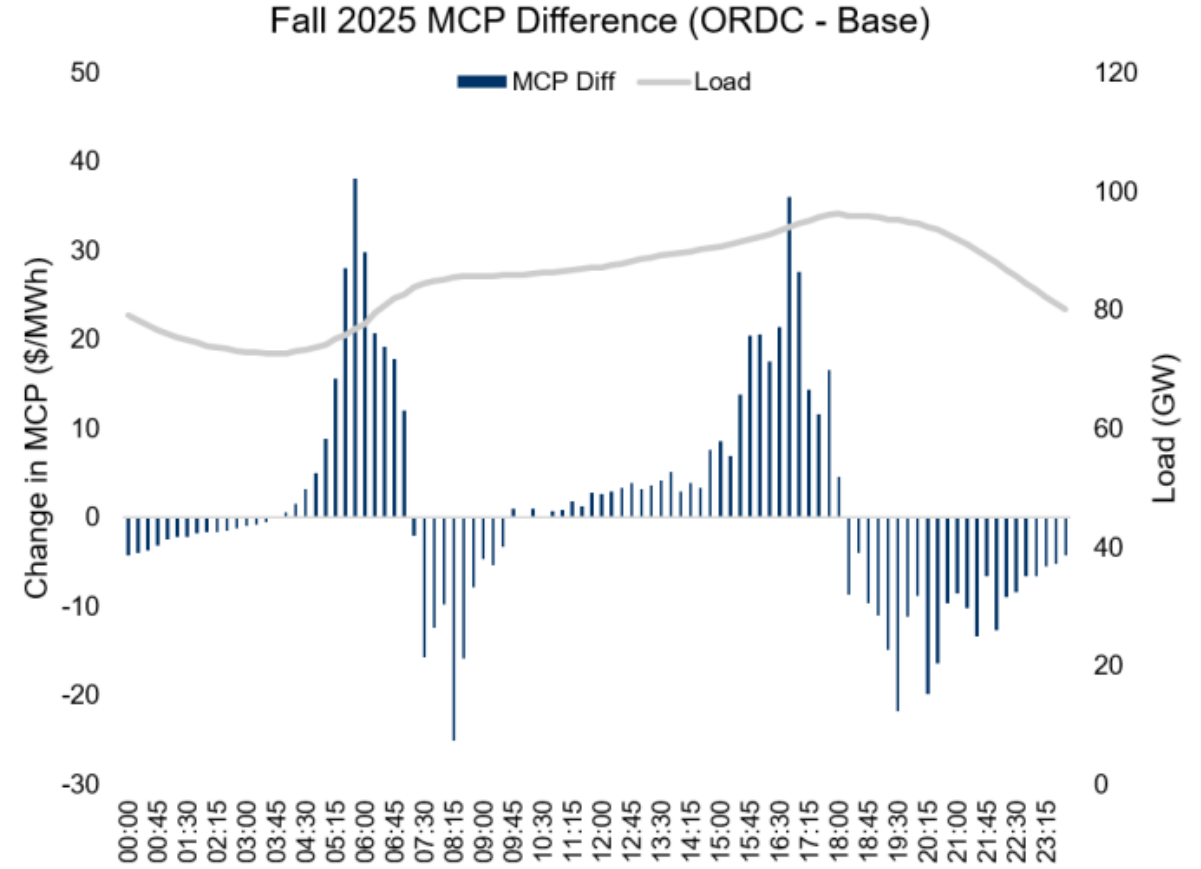
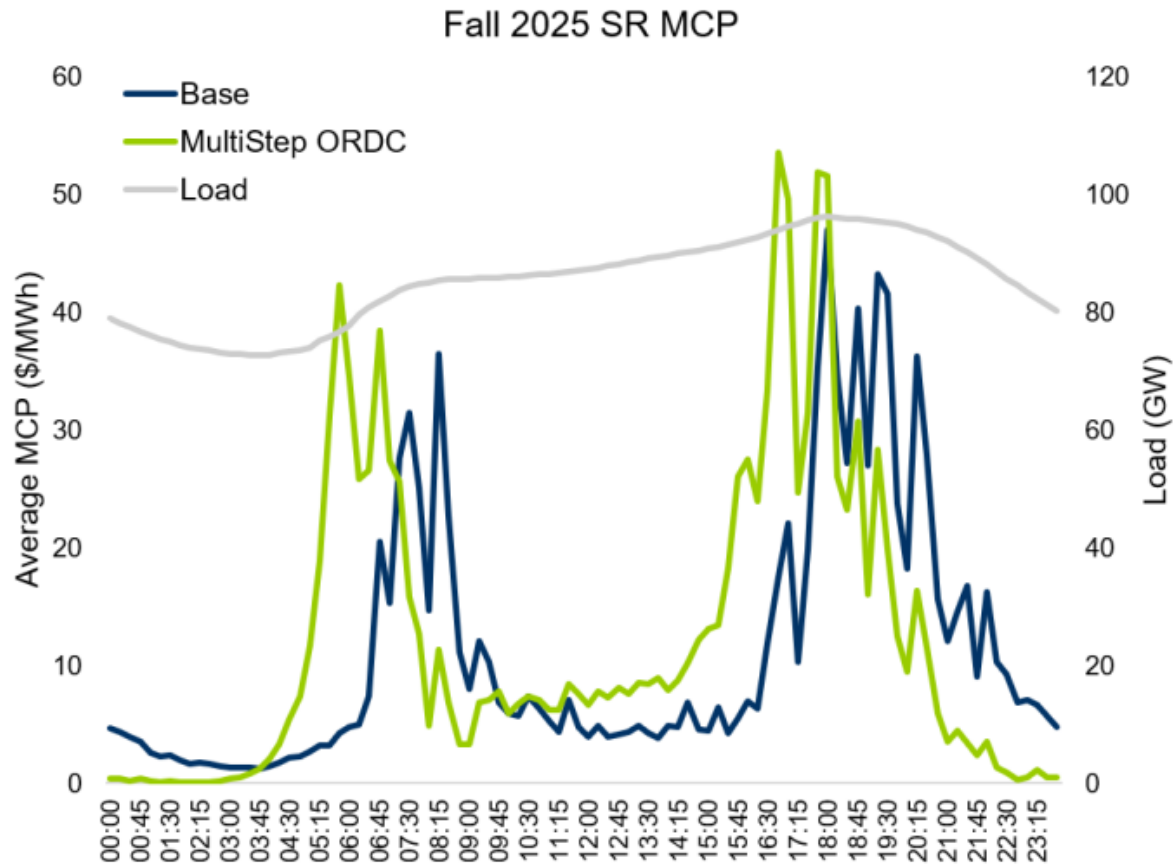
- Spring Average SR MCPs



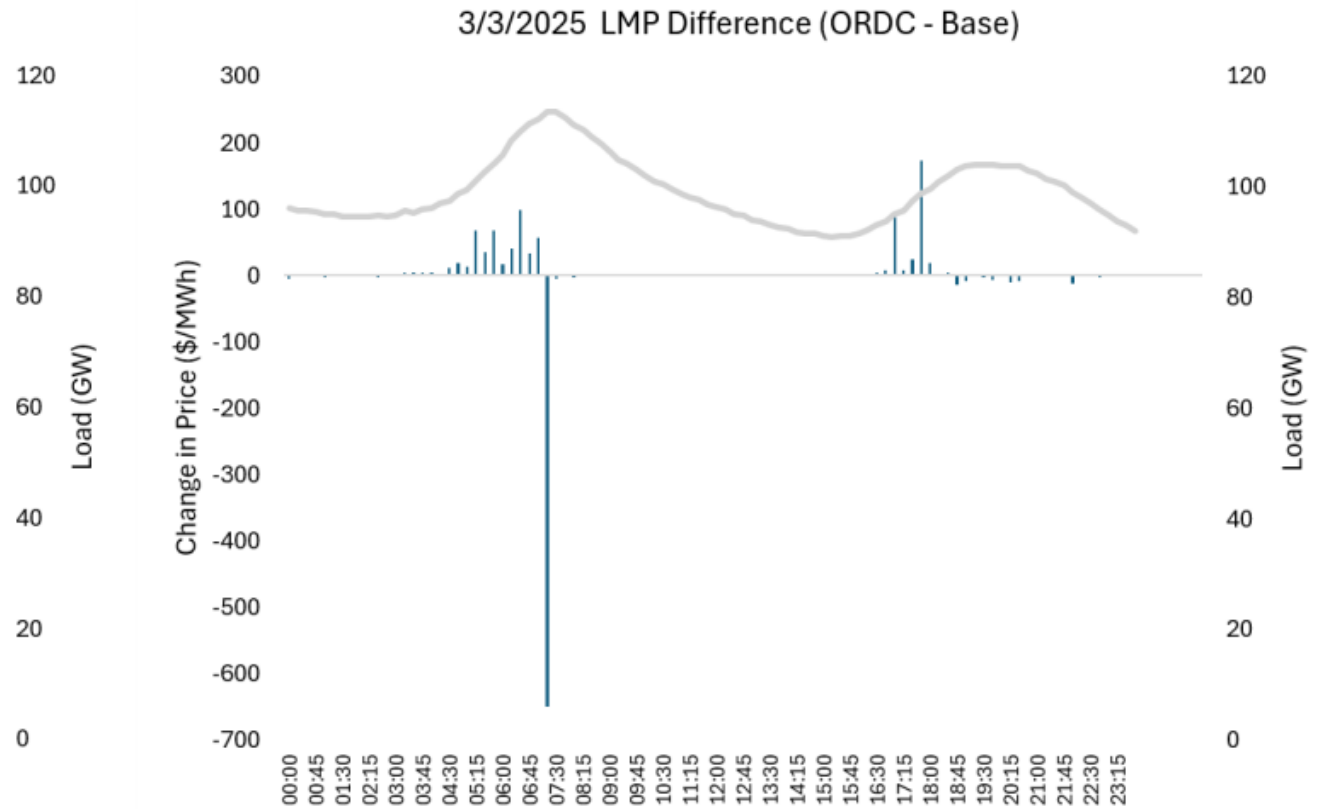
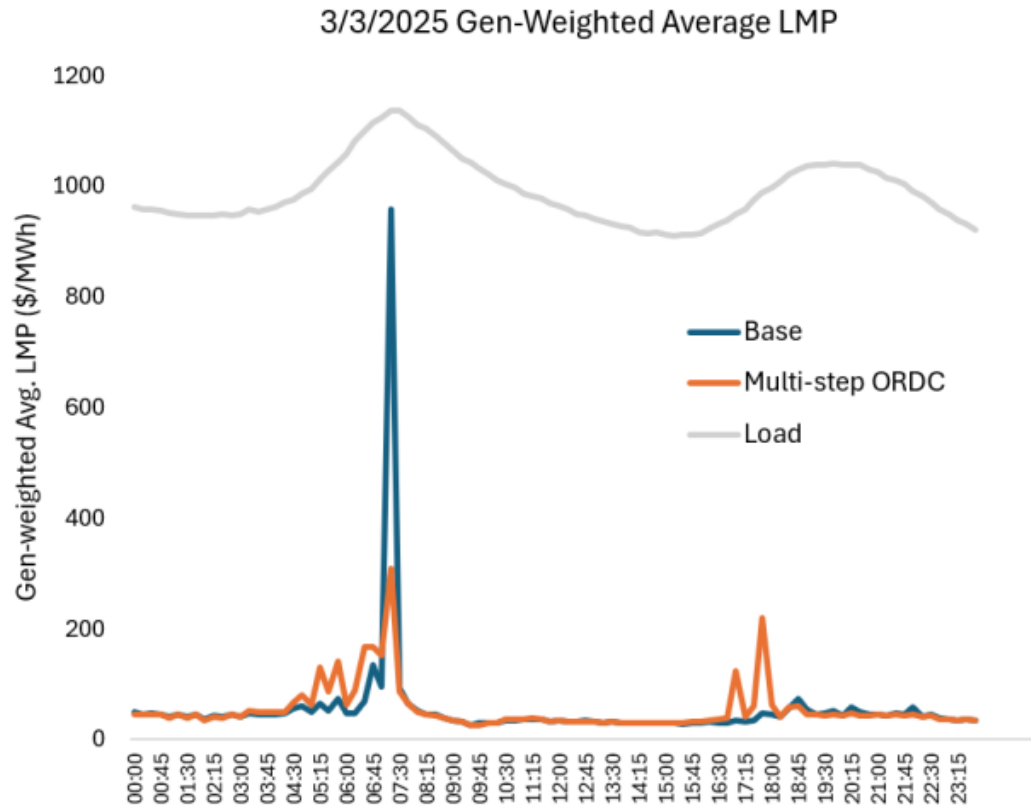
- Summer Average SR MCPs



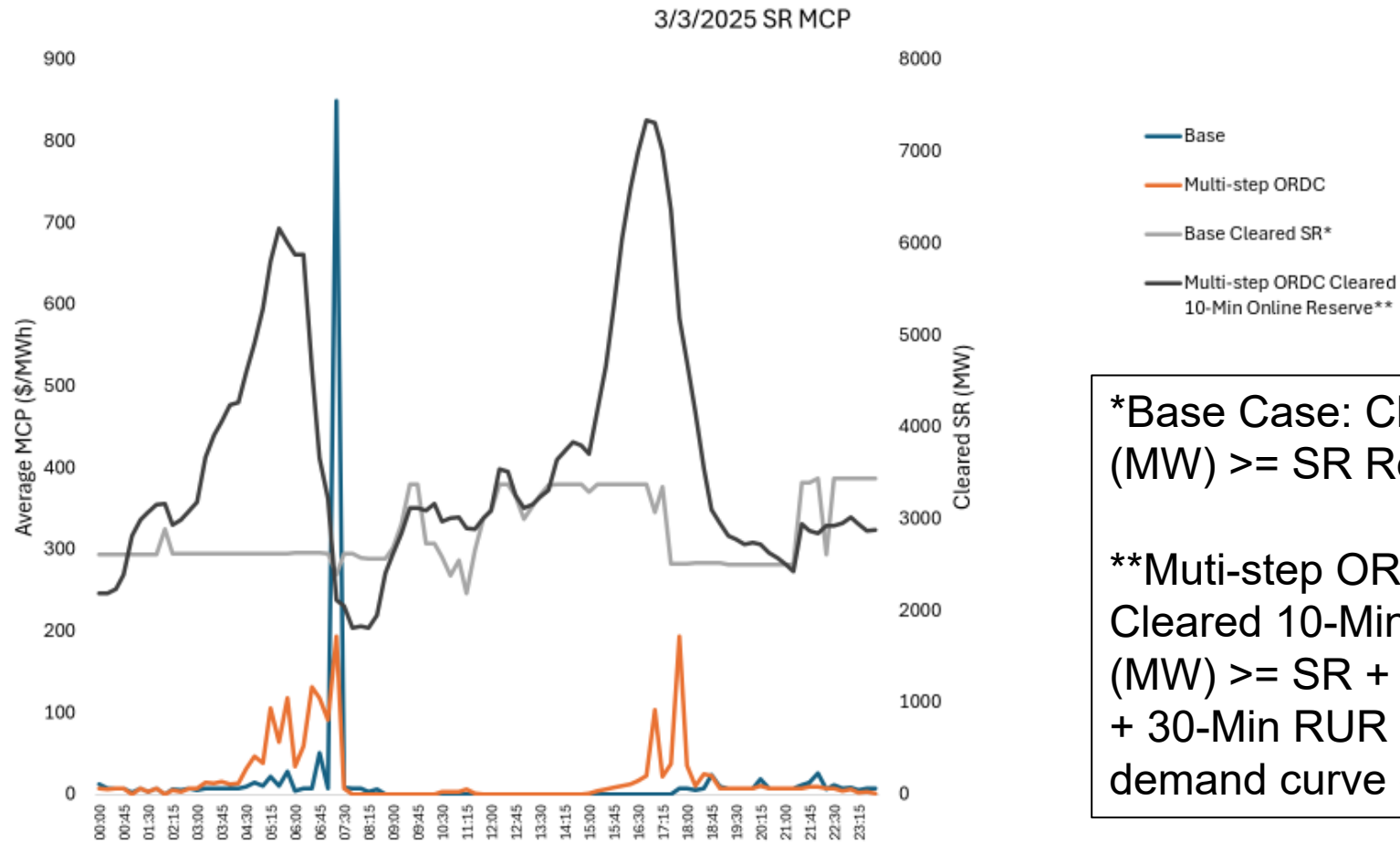
- Fall Average SR MCPs



- LMPs on 3/3/2025



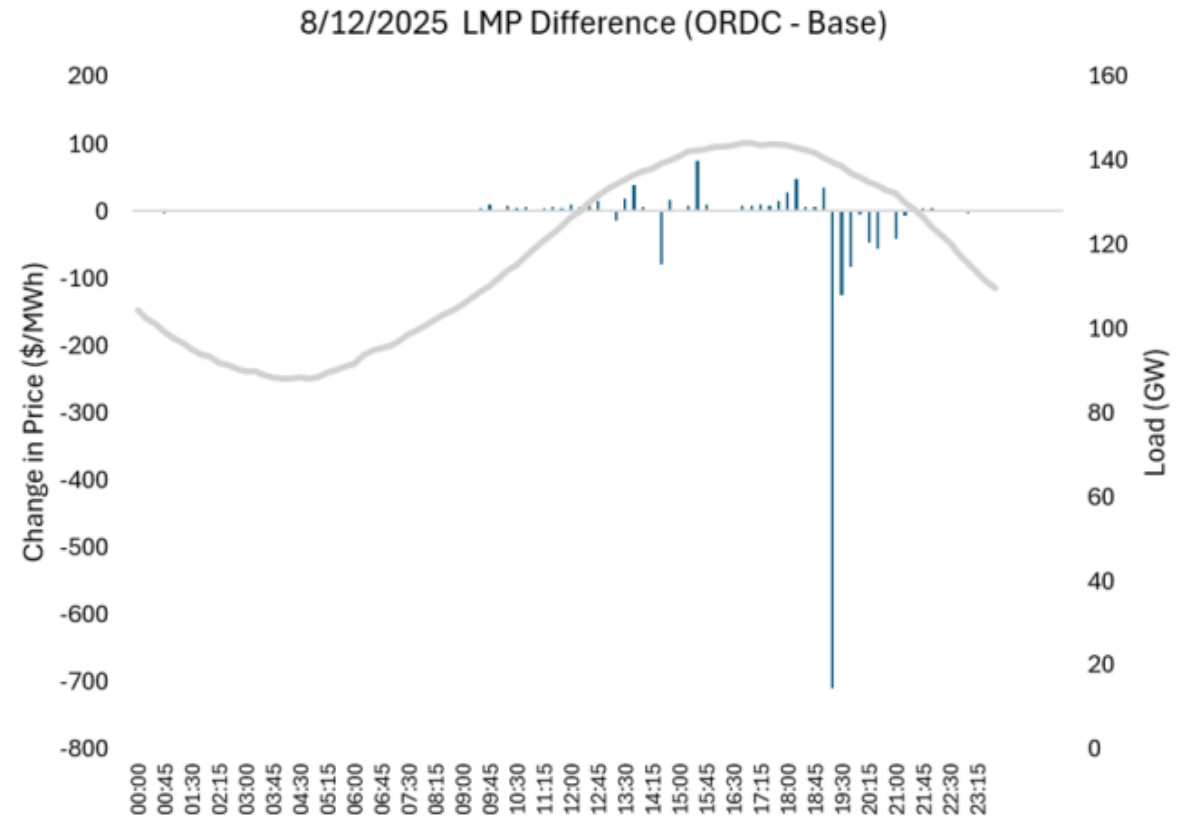
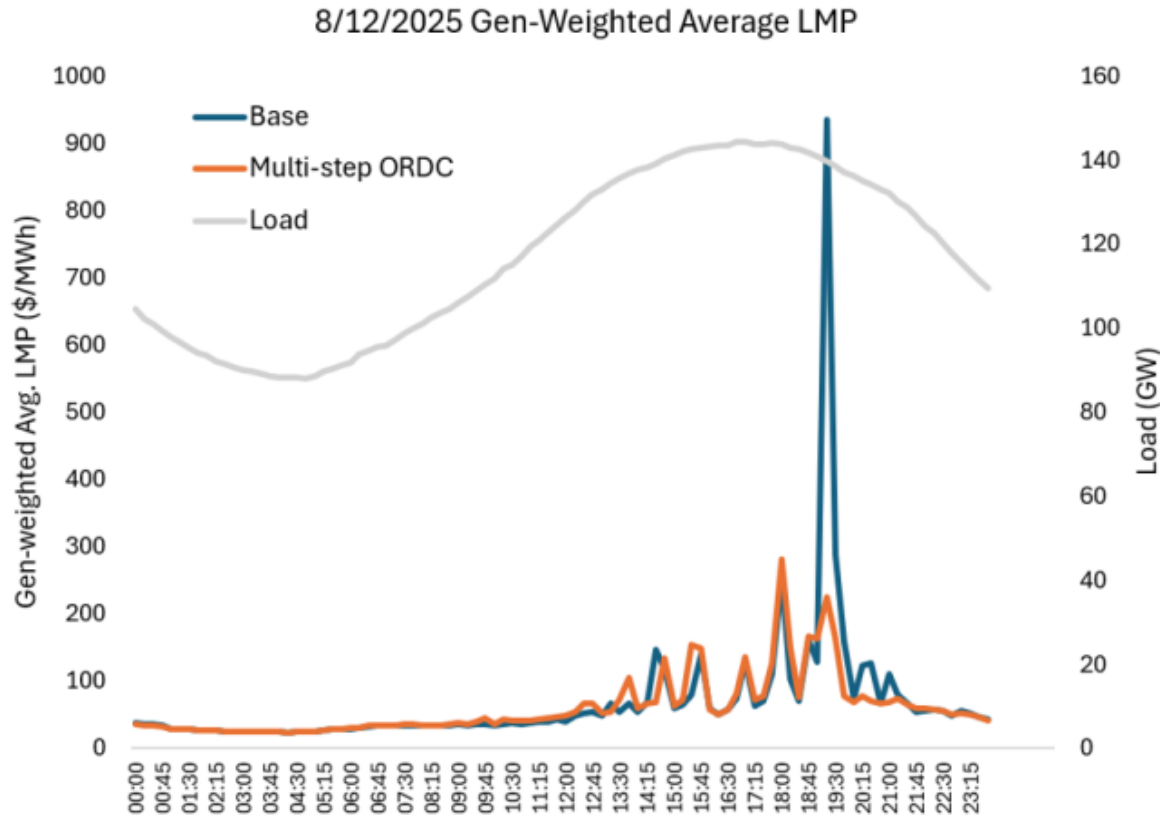
- 10-Min Online Reserve MCPs on 3/3/2025



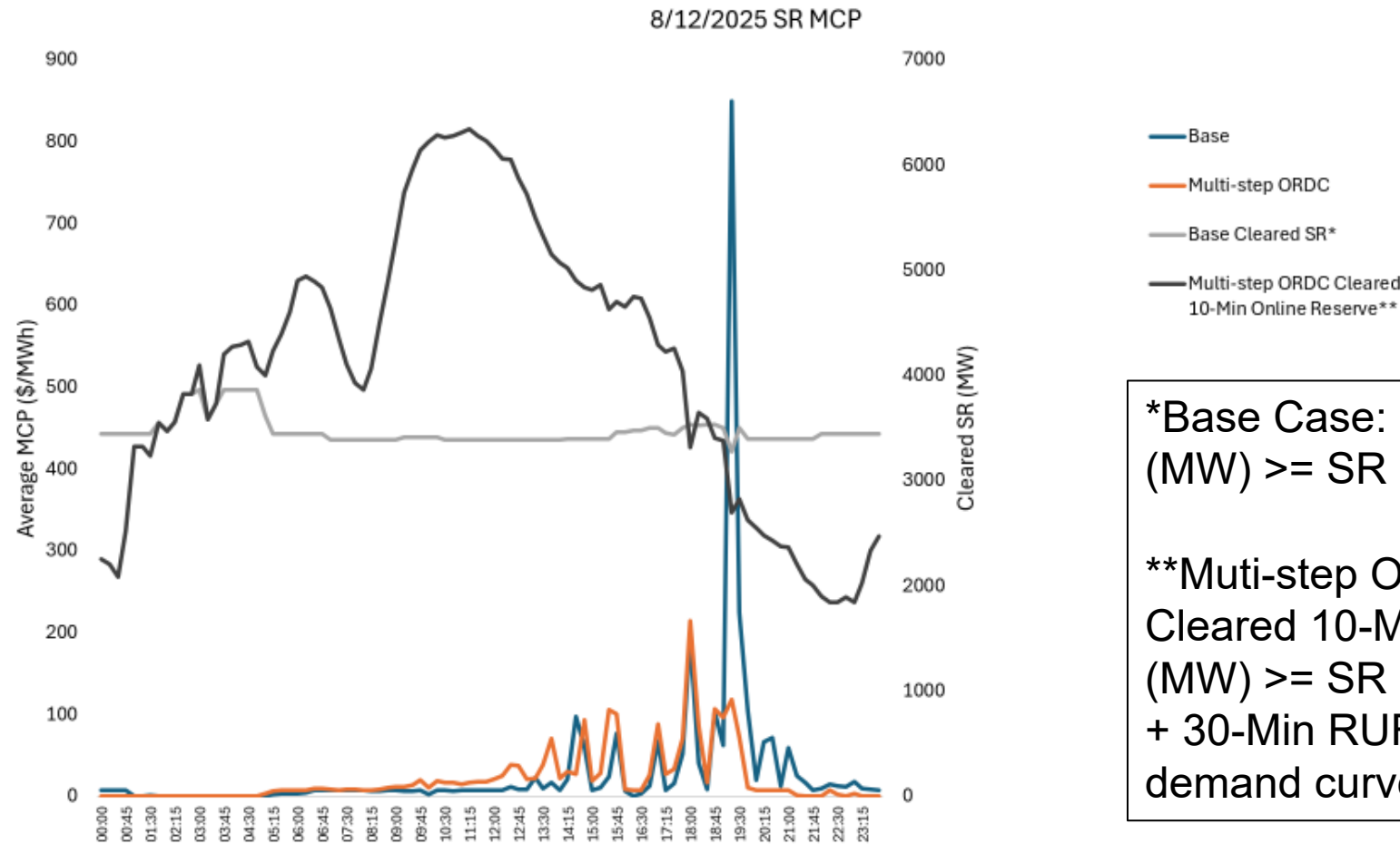
*Base Case: Cleared SR (MW) \geq SR Requirements

**Multi-step ORDC Case: Cleared 10-Min Online (MW) \geq SR + 10-Min RUR + 30-Min RUR (composite demand curve clearing)

- LMPs on 8/12/2025



- 10-Min Online Reserve MCPs on 8/12/2025



*Base Case: Cleared SR (MW) \geq SR Requirements

**Multi-step ORDC Case: Cleared 10-Min Online (MW) \geq SR + 10-Min RUR + 30-Min RUR (composite demand curve clearing)

- The following table shows an approximate yearly real-time load* payment comparison between the cases.
- Note: these costs **cannot** be simply added to those of the Day-Ahead Market simulation results load payments posted with the May 1, 2026 RCSTF meeting materials.

Category	Metric	Product/Type	Base Case	Multi-step ORDC	Multi-step ORDC – Base Case
Energy	Load Payment (\$M)	N/A	37,401	38,182	781
Reserves**	Load Payment (\$M)	10-Min Online	261	477	216
		Primary	39	-	-39
		30-Min Online	-	Included in 10-Min Online product	-
		30-Min	0	0	0

**The reserves \$ impact includes both changes in yearly average MCP and MW provision between the cases.

- The load payment costs presented on the previous slide **cannot** be simply added to those of the Day-Ahead Market simulation results load payments posted with the May 1, 2026 RCSTF meeting materials.
- PJM uses a two-market settlement system where **only** balancing energy and reserves are settled on the Real-Time Market prices.
- The payments on the preceding slide assume **all** load and reserves are settled at the Real-Time Market prices, which is not an accurate reflection of reality, and will be an overestimation of actual load payments, in addition to the overestimation caused by adding the 30-Min Online Reserve requirement to the SR requirement.
- Over all days in 2025, the median amount of total daily RT load cleared in the DAM was 96.7% and the minimum amount was 89.1%. In summary, only a small fraction of load is settled at Real-Time Market prices.
- The calculations are being provided for informational purposes only.

- Seasonal generation-weighted average LMPs remain broadly similar between the Base Case and the Multi-step ORDC Case with increases occurring just before the peak hours and decreases occurring after the peak hours.
- Seasonal hourly-average ancillary MCPs generally show higher prices in the Multi-step ORDC Case across all seasons due to the increased requirements. Specifically, prices increased leading into the peak hours, and decreased after the peak hours.
- The total uplift for 2025 reduced in the Multi-step ORDC Case.
- Days with reserve shortages in the Base Case show the benefits of prepositioning the system with the ramping products in the Multi-step ORDC Case reducing the frequency of scarcity events.

1	2	3
<ul style="list-style-type: none"> • New ORDCs increase the reserve requirements when reserves are needed most and decrease them when they are not needed as much compared to the status quo. 	<ul style="list-style-type: none"> • Prepositioning units with the ramping products reduces the frequency of scarcity events. 	<ul style="list-style-type: none"> • Overall, the average impact of the proposed changes to LMPs are minimal.