Fast Start Pricing and Reserves

RCSTF

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IMM

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Fast Start Pricing: DLMP and PLMP

- **PJM implemented fast start pricing in both the day-ahead and real-time markets on September 1, 2021.**
- **The goal of fast start pricing is to allow inflexible resources to set prices based on the sum of their commitment costs per MWh and their marginal costs.**
- **The pricing run LMP (PLMP) is now the official settlement LMP in PJM, replacing the dispatch run LMP (DLMP).**

Fast Start Pricing: DLMP and PLMP

- **Fast start pricing employs a new LMP calculation called the pricing run.**
- **The pricing run calculates LMP using the same optimal power flow algorithm as the dispatch run while simultaneously reducing ("relaxing" or ignoring) the economic minimum and maximum output MW constraints for all eligible fast start units.**

Fast Start Pricing: DLMP and PLMP

- **The price signal no longer equals the short run marginal cost and therefore no longer provides the correct signal for efficient behavior for market participants making decisions on the margin.**
- **The differences between the actual LMP (DLMP) and the fast start LMP (PLMP) distort the incentive for market participants to behave competitively and to follow PJM's dispatch instructions.**

Dispatch Run and Pricing Run

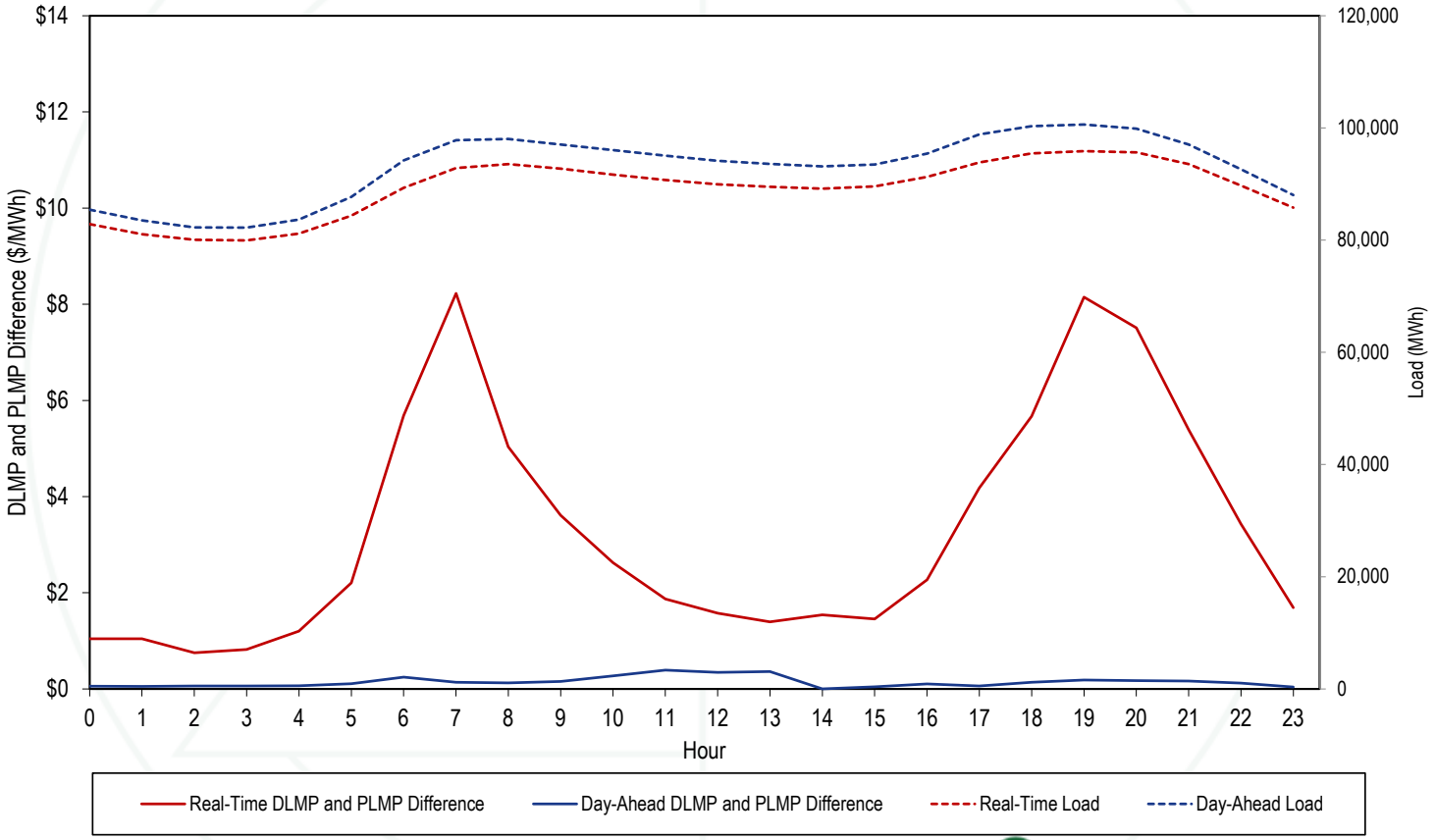
- **DLMP**
  - **Dispatch run LMP.**
  - **This is the price consistent with PJM's pricing calculation prior to fast start pricing.**
  - **The DLMP is the price that is consistent with the market clearing MW.**

- **PLMP**
  - **Pricing run LMP.**
  - **This is the price that results from applying the fast start logic, also called integer relaxation.**
  - **The PLMP results from the fast start (integer relaxation) clearing. It is not based on the physical capabilities of the operating resources.**
  - **The PLMP is not consistent with incentives to follow the market clearing dispatch instructions.**

Monthly Average Load-Weighted DLMP and PLMP

		Day-Ahead Load-Weighted Average				Real-Time Load-Weighted Average			
Year	Month	DLMP	PLMP	Difference	Percent Difference	DLMP	PLMP	Difference	Percent Difference
2024	Jan	$48.45	$48.65	$0.20	0.4%	$40.82	$42.78	$1.95	4.8%
2024	Feb	$23.67	$23.70	$0.03	0.1%	$23.20	$24.86	$1.66	7.2%
2024	Mar	$21.89	$21.93	$0.04	0.2%	$20.30	$23.15	$2.85	14.0%
2024	Apr	$26.73	$26.75	$0.02	0.1%	$23.29	$27.17	$3.87	16.6%
2024	May	$32.92	$32.90	($0.02)	(0.1%)	$31.70	$36.16	$4.46	14.1%
2024	Jun	$32.59	$32.62	$0.03	0.1%	$31.95	$33.35	$1.40	4.4%
2024	Jul	$44.51	$44.69	$0.18	0.4%	$44.12	$47.17	$3.04	6.9%
2024	Aug	$36.34	$36.31	($0.03)	(0.1%)	$34.37	$36.29	$1.92	5.6%
2024	Sep	$30.63	$30.77	$0.14	0.4%	$29.32	$31.81	$2.48	8.5%
2024	Oct	$33.18	$33.26	$0.08	0.2%	$29.85	$31.87	$2.02	6.8%
2024	Nov	$29.78	$29.82	$0.04	0.1%	$25.70	$28.26	$2.55	9.9%
2024	Dec	$36.98	$37.05	$0.06	0.2%	$33.62	$34.98	$1.36	4.0%
2024	Jan-May	$36.95	$37.08	$0.12	0.3%	$32.71	$34.53	$1.82	5.6%
2024		$33.72	$33.79	$0.07	0.2%	$31.31	$33.74	$2.43	7.7%
2025	Jan	$67.53	$67.74	$0.21	0.3%	$59.93	$62.87	$2.94	4.9%
2025	Feb	$48.85	$49.02	$0.16	0.3%	$46.27	$48.90	$2.62	5.7%
2025	Mar	$40.76	$40.74	($0.03)	(0.1%)	$37.82	$42.11	$4.30	11.4%
2025	Apr	$44.36	$44.35	($0.01)	(0.0%)	$40.07	$45.42	$5.35	13.4%
2025	May	$37.56	$37.40	($0.16)	(0.4%)	$33.98	$36.34	$2.36	6.9%
2025	Jan-May	$59.01	$59.20	$0.19	0.3%	$53.71	$56.51	$2.80	5.2%

Hourly Average Load and PLMP – DLMP Delta



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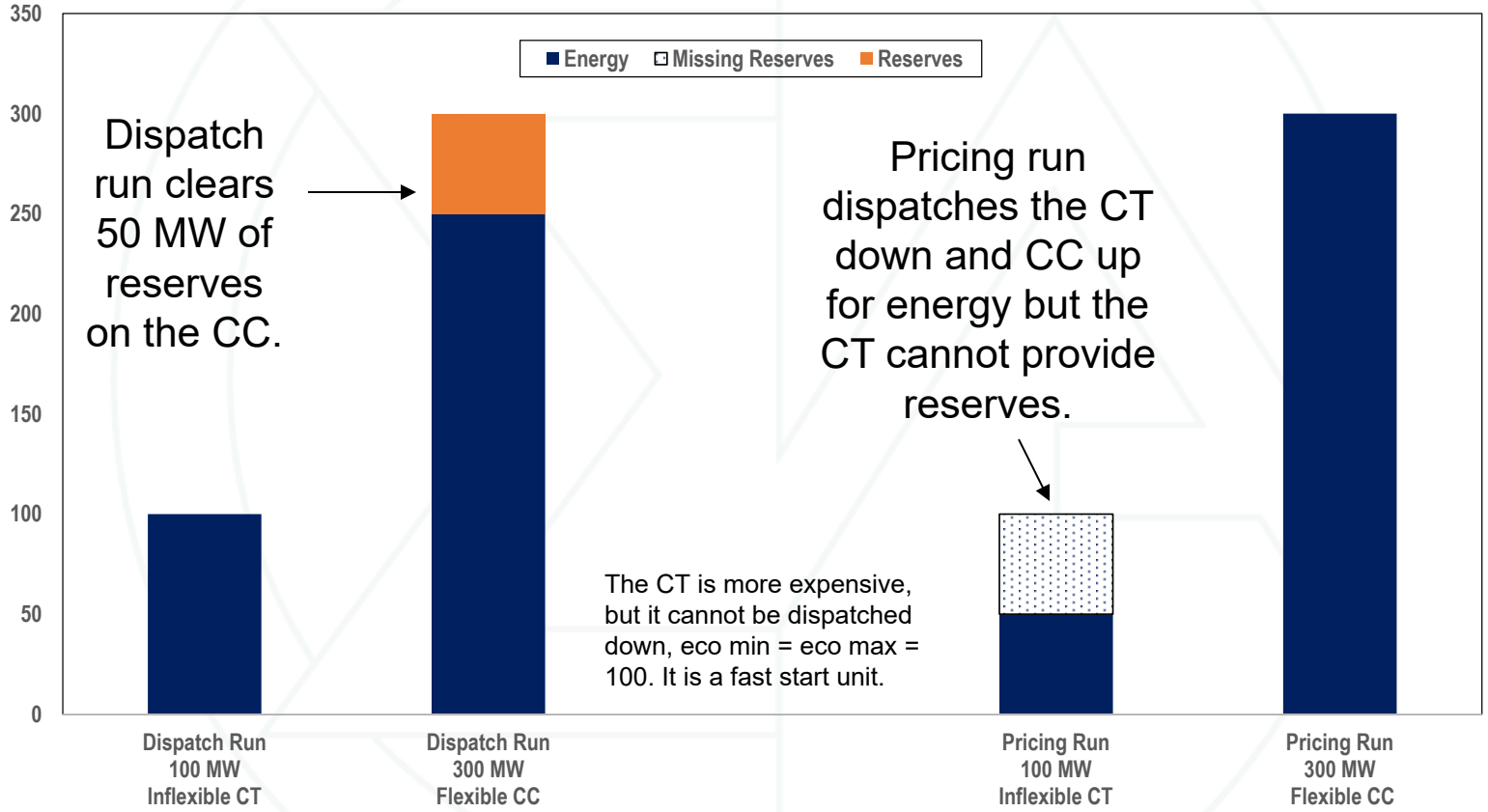
Difference in Components of LMP

Element	Dispatch Contribution to LMP	Dispatch Percent	Pricing Contribution to LMP	Pricing Percent	Change in Percent
Gas	$12.09	38.1%	$13.00	37.9%	(0.2%)
Coal	$4.46	14.1%	$4.17	12.1%	(1.9%)
Positive Markup	$3.41	10.7%	$3.94	11.5%	0.7%
Variable Maintenance	$2.27	7.2%	$3.28	9.6%	2.4%
Transmission Constraint Penalty Factor	$3.16	10.0%	$3.23	9.4%	(0.5%)
Ten Percent Adder	$1.85	5.8%	$1.99	5.8%	(0.0%)
CO_2 Cost	$1.94	6.1%	$1.91	5.6%	(0.6%)
Variable Operations	$1.41	4.5%	$1.46	4.3%	(0.2%)
Ancillary Service Redispatch Cost	$0.84	2.7%	$1.41	4.1%	1.5%
Opportunity Cost Adder	$1.23	3.9%	$1.37	4.0%	0.1%
Oil	$1.08	3.4%	$1.08	3.1%	(0.3%)
Market-to-Market	$0.52	1.7%	$0.30	0.9%	(0.8%)
Increase Generation Differential	$0.17	0.5%	$0.24	0.7%	0.2%
LPA Rounding Difference	$0.32	1.0%	$0.20	0.6%	(0.4%)
Scarcity	$0.23	0.7%	$0.18	0.5%	(0.2%)
NO_x Cost	$0.10	0.3%	$0.11	0.3%	0.0%
NA	$0.12	0.4%	$0.11	0.3%	(0.1%)
Landfill Gas	$0.06	0.2%	$0.05	0.1%	(0.0%)
Other	$0.02	0.1%	$0.02	0.1%	(0.0%)
SO_2 Cost	$0.00	0.0%	$0.00	0.0%	(0.0%)
LPA-SCED Differential	$0.01	0.0%	($0.00)	(0.0%)	(0.0%)
Renewable Energy Credits	($0.07)	(0.2%)	($0.05)	(0.1%)	0.1%
Decrease Generation Differential	($0.02)	(0.1%)	($0.05)	(0.1%)	(0.1%)
Negative Markup	($3.49)	(11.0%)	($3.64)	(10.6%)	0.4%
Total	$31.73	100.0%	$34.31	100.0%	0.0%

Fast Start and Shortage Pricing

- Fast start pricing removes reserves from the market in the pricing run, creating pricing run shortages that do not exist in the actual dispatch.
- Fast start pricing removes MW at the top of a fast start resource's dispatch range, and creates MW at the bottom of their dispatch range.
  - The market clearing engine has to remove as many MW as it creates to maintain power balance.
  - No MW created below the minimum dispatch point can clear as reserves.
  - Therefore, fast start pricing removes reserves from the pricing run solution.
- False shortage pricing is a result.

Example of Fast Start Pricing and Reserves



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Shortage Differences: 2024

	Pricing Run					Dispatch Run				
Interval (EPT)	RTO Extended Primary Reserve Requirement (MW)	Total RTO Primary Reserves (MW)	RTO Primary Reserve Shortage (MW)	Uncapped RTO Primary Reserve Clearing Price ($/MWh)	Capped RTO Primary Reserve Clearing Price ($/MWh)	RTO Extended Primary Reserve Requirement (MW)	Total RTO Primary Reserves (MW)	RTO Primary Reserve Shortage (MW)	Uncapped RTO Primary Reserve Clearing Price ($/MWh)	Capped RTO Primary Reserve Clearing Price ($/MWh)
10-Mar-24 19:50	3,664.9	3,205.6	459.3	$850.00	$850.00	3,664.9	3,213.6	451.3	$850.00	$850.00
10-Mar-24 19:55	3,664.9	3,343.9	321.0	$850.00	$850.00	3,664.9	3,351.9	313.0	$850.00	$850.00
21-May-24 18:10	3,664.9	3,635.7	29.2	$300.00	$300.00	3,664.9	3,664.9	0.0	$236.45	$236.45
16-Oct-24 19:05	2,668.4	2,644.6	23.8	$300.00	$300.00	2,668.4	2,668.5	0.0	$170.75	$170.75
16-Oct-24 19:10	2,668.4	2,644.6	23.8	$300.00	$300.00	2,668.4	2,668.5	0.0	$170.75	$170.75
06-Dec-24 07:25	3,716.8	3,676.9	39.9	$300.00	$300.00	3,716.8	3,716.8	0.0	$294.45	$294.45

- **The pricing run had a deeper shortage than the dispatch run in six of 36 RTO primary reserve shortage pricing intervals in 2024.**
- **Primary reserve had no shortage in four of 36 RTO primary reserve shortage pricing intervals in 2024.**

Fast Start and Reserve Pricing

- **Reserve prices are higher in the pricing run than the dispatch run.**
- **This occurs for two reasons:**
  - **The same reason that false shortages occur with fast start pricing, the pricing run removes reserves**
  - **PLMP is higher than DLMP on average, which increases the marginal cost of dispatching any unit in the market down to provide reserves.**

RTO Synchronized Reserve Pricing Differences

		Day-Ahead				Real-Time			
Year	Month	Dispatch-Run MCP	Pricing-Run MCP	Difference	Percent Difference	Dispatch-Run MCP	Pricing-Run MCP	Difference	Percent Difference
2024	Jan	$1.69	$1.72	$0.03	1.9%	$1.98	$2.53	$0.55	28.0%
2024	Feb	$1.49	$1.50	$0.00	0.3%	$1.29	$1.82	$0.53	40.9%
2024	Mar	$2.72	$2.74	$0.02	0.8%	$2.69	$3.88	$1.19	44.3%
2024	Apr	$4.14	$4.15	$0.01	0.2%	$0.99	$1.54	$0.55	55.1%
2024	May	$4.29	$4.28	($0.01)	(0.2%)	$3.28	$4.99	$1.72	52.4%
2024	Jun	$2.02	$2.13	$0.11	5.5%	$2.29	$2.56	$0.27	11.8%
2024	Jul	$2.63	$2.80	$0.17	6.3%	$3.00	$3.69	$0.69	23.0%
2024	Aug	$2.33	$2.44	$0.11	4.7%	$2.81	$3.44	$0.62	22.2%
2024	Sep	$2.72	$2.82	$0.11	3.9%	$2.77	$3.73	$0.96	34.8%
2024	Oct	$4.01	$4.10	$0.09	2.1%	$3.62	$4.45	$0.82	22.7%
2024	Nov	$2.13	$2.18	$0.05	2.4%	$1.32	$2.22	$0.90	68.1%
2024	Dec	$0.92	$0.95	$0.03	3.0%	$1.16	$1.64	$0.48	40.9%
2024	All	$2.59	$2.65	$0.06	2.3%	$2.29	$3.08	$0.79	34.2%
2025	Jan	$4.43	$4.79	$0.36	8.0%	$2.02	$2.62	$0.61	30.1%
2025	Feb	$2.56	$2.56	($0.00)	(0.1%)	$1.96	$2.88	$0.92	46.9%
2025	Mar	$7.73	$7.23	($0.50)	(6.5%)	$4.89	$7.28	$2.39	48.9%
2025	All	$5.19	$5.13	($0.06)	(1.2%)	$3.10	$4.48	$1.37	44.2%

RTO Nonsynchronized Reserve Pricing Differences

		Day-Ahead				Real-Time			
Year	Month	Dispatch-Run MCP	Pricing-Run MCP	Difference	Percent Difference	Dispatch-Run MCP	Pricing-Run MCP	Difference	Percent Difference
2024	Jan	$0.48	$0.49	$0.01	1.4%	$1.13	$1.38	$0.26	22.6%
2024	Feb	$0.48	$0.48	$0.00	0.3%	$0.58	$0.81	$0.23	40.4%
2024	Mar	$1.57	$1.58	$0.01	0.7%	$1.71	$2.43	$0.72	42.1%
2024	Apr	$2.77	$2.79	$0.02	0.6%	$0.47	$0.73	$0.26	54.1%
2024	May	$2.09	$2.09	($0.00)	(0.2%)	$2.00	$3.12	$1.13	56.5%
2024	Jun	$1.11	$1.19	$0.08	7.1%	$1.11	$1.26	$0.15	13.6%
2024	Jul	$1.56	$1.68	$0.11	7.4%	$1.32	$1.65	$0.32	24.6%
2024	Aug	$1.19	$1.25	$0.06	5.0%	$1.66	$1.99	$0.32	19.4%
2024	Sep	$1.39	$1.44	$0.06	4.1%	$1.31	$1.77	$0.46	35.5%
2024	Oct	$1.75	$1.78	$0.02	1.4%	$1.89	$2.31	$0.42	22.5%
2024	Nov	$0.88	$0.90	$0.02	2.4%	$0.43	$0.80	$0.37	85.8%
2024	Dec	$0.39	$0.40	$0.01	3.3%	$0.36	$0.48	$0.12	33.3%
2024	All	$1.20	$1.24	$0.03	2.7%	$1.11	$1.48	$0.37	33.1%
2025	Jan	$1.23	$1.30	$0.07	6.1%	$0.70	$0.92	$0.22	31.7%
2025	Feb	$0.59	$0.59	($0.00)	(0.7%)	$0.51	$0.79	$0.28	54.2%
2025	Mar	$3.27	$3.00	($0.26)	(8.1%)	$2.20	$3.41	$1.21	55.1%
2025	All	$1.58	$1.54	($0.05)	(2.9%)	$1.09	$1.63	$0.54	49.2%

Conclusions

- **Fast start pricing changes the price signal relative to the dispatch run, which is the actual market clearing.**
- **An important aspect of reserves market design is creating a price signal for when reserves are needed. Fast start pricing undermines that goal.**
- **When reserve constraints bind more frequently, fast start pricing affects prices more frequently. This would be an expected outcome of increasing reserve requirements and products.**
- **Fast start pricing should be removed or restricted to improve pricing for reserves products.**

Monitoring Analytics, LLC
2621 Van Buren Avenue
Suite 160
Eagleville, PA
19403
(610) 271-8050

MA@monitoringanalytics.com
www.MonitoringAnalytics.com