



California ISO

Price Formation Enhancements

Stakeholder Workshop

June 9, 2022

Energy storage perspective on price formation

**Addressing inaccurate real-time advisory
pricing and flexible ramp
co-optimization**



REV
RENEWABLES

Inaccurate advisory prices in MIO produce out-of-merit energy storage dispatch that mostly harm storage

- Storage resources are subsidizing a market inefficiency from inaccurate ISO real-time advisory price forecasts in Multi-Interval Optimization (MIO) with no compensation.
- All resources in the real-time energy market are dispatched over a horizon of advisory prices, even though they are only financially settled on prices in the binding interval. Advisory prices are often inaccurate, especially when there is price volatility.
- Storage economics are fundamentally different from other generation types though (faster, fuel is charge energy, etc.), and this practice of dispatching over horizon of advisory prices harms storage more than it helps.
- The combination of dispatching storage on a horizon of estimated prices and the inaccuracy of those prices produces inefficient out-of-merit dispatch, with units often dispatched hundreds of megawatts and hundreds of \$/MWh outside of submitted bid curves.
- This can prevent resources from backing day-ahead energy awards in the real-time market, creating uncertainty and an unhedgeable economic risk for storage owners that fully participate in the Day Ahead market.
- This issue will become more pronounced as more energy storage is deployed in California, and discourages further storage investment by harming returns.

Real example of out-of-merit energy storage dispatch

- The example to the right shows one recent occurrence. The first column is the interval beginning, the second is the real-time energy LMP, the third is the real-time dispatch, the fourth is the energy stored in the plant.
- The resource had bids to charge only at prices under \$8/MWh. In the later half of hour ending 9, CAISO charged the unit outside of its bid curve at prices over \$500/MWh based on inaccurate advisory prices, costing the resource tens of thousands of dollars.
- Subsequently to charging at \$677/MWh and \$537/MWh, the resource locked in that loss by discharging at \$35/MWh. This is typical in our experience.

Real-time prices, dispatch, and state of charge

Interval Begin	Real-time LMP	Real-time MW	Plant MWh
8:00:00	\$897	250	251
8:05:00	\$906	250	231
8:10:00	\$909	250	210
8:15:00	\$976	250	189
8:20:00	\$976	250	168
8:25:00	\$976	250	147
8:30:00	\$976	250	125
8:35:00	\$976	250	104
8:40:00	\$677	-207	87
8:45:00	\$537	-150	97
8:50:00	\$582	-39	110
8:55:00	\$35	105	119
9:00:00	\$80	78	112
9:05:00	\$70	0	106
9:10:00	\$62	0	101
9:15:00	\$60	0	98
9:20:00	\$64	0	95
9:25:00	\$70	0	94
9:30:00	\$36	0	92

The flexible ramp product should be co-optimized with energy to prevent out-of-merit awards

- Flexible ramp up in the fifteen-minute market (FMM) reserves capacity for two intervals, even though energy opportunity costs are only weighed for one interval.
- This produces uncompensated, out-of-merit energy awards in the FMM, which can prevent resources from economically backing day-ahead energy awards.
- REV accepts that the ISO seeks to procure flexible ramping MWs, but fundamentally believes that resources should be paid at least the energy opportunity cost of doing so.
- Resources are often denied energy awards within their bid curve, often priced at hundreds of \$/MWh, and instead forced into a service often priced at \$0/MWh.
- A CIDI ticket to the right shows an example of this dynamic in practice.

See additional details and examples [here](#).

Sample CIDI ticket for an evening FMM interval:

- FMM energy price: \$291/MWh
- FMM flex ramp up price: \$0/MW
- FMM energy dispatch: 0MW (vs 156MW in-merit)
- Cost of out-of-merit FMM dispatch assuming same RTM dispatch: ~\$10,000

Ticket text:

“We would like to understand why Gateway Energy Storage did not receive a DOT to discharge in the FMM market during HE19 period 4. The FMM LMP at Gateway was \$291.19/MWh, by far the highest price of the day, but the award in the period was 0MW. Gateway’s real time bid curve supported discharging with full available power at this price; the battery was fully charged; and there were no awards that would have blocked it day-ahead or real-time regulation up, regulation down, or spinning reserve.”

CAISO’s response:

“Hour ending 19 intervals 4 Gateway Energy Storage received a fifteen-minute market (FMM) energy award of 0 MW and the LMP was \$291.19. The resource did not receive energy awards above 0 MW because it had received a flex ramp award in the hour ending 19 intervals. This flex award from the prior FMM interval is reserved in the FMM buffer interval. As result, the resource energy award could not be higher than 0 MW.”

Next Steps

- All related information for the Price Formation Enhancements initiative is available at: <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements>
- Post Issue Paper: 6/30



- The ISO is pleased to be hosting the Stakeholder Symposium in-person at the Safe Credit Union Convention Center in downtown Sacramento on Nov. 9 – 10, 2022
- Registration will be open in June
 - Public notice will be issued once the site is available
- Additional information is available on the Stakeholder Symposium page on ISO's website at:
<http://www.caiso.com/informed/Pages/MeetingsEvents/StakeholderSymposium/Default.aspx>
- Please direct questions to symposiumreg@caiso.com