



Price Performance in CAISO Energy Markets

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The final price performance analysis report explains findings and conclusions related to the following topics

- i) Pricing in the real-time market in relation to real-time system conditions
- i) Drivers for price divergence
- i) Effectiveness of the flexible ramping product
- i) Price impact of operators' actions in the market

In March 2019 the CAISO committed to start a formal analysis effort to analyze price performance in the CAISO markets

- CAISO posted a proposal on April 3 for the scope and schedule of this analysis
- A conference call was held on April 10 to discuss the proposal
- A conference call was held on June 21 to provide a partial update
- Stakeholder input and comments from the Market Surveillance Committee was considered throughout this process

Analysis utilized two complementary approaches: overall trends and case studies

- Overall trends cover a period from January 2017 to March 2019
- Case studies focus on specific markets/dates to provide a detailed understanding of the pricing outcomes
- Some case studies rely on counter-factual analysis
 - Rerunning original markets to quantify effect of specific drivers

The largest uncertainty in the CAISO market materializes from the day-ahead to the real-time market

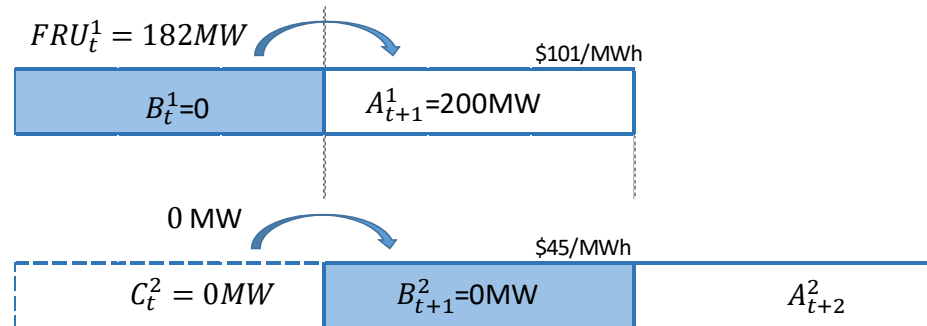
- Currently there is no market mechanism to handle this uncertainty
- Real-time flexible ramping product (FRP) is designed to address uncertainty within the real-time markets
- The lack of a market mechanism lead to necessary but suboptimal actions such as operators' actions
- The CAISO has already an ongoing policy initiative (DAME) to address uncertainty between the day-ahead and real-time market

The CAISO also evaluated the performance of the existing FRP in the real-time market

- Real-time FRP is designed to manage uncertainty that materializes between the fifteen-minute market and the five-minute market, and between each five-minute market run
- FRP requirements are based on historical uncertainty and defined for each EIM area, including the ISO area
- The PPA analysis identified four areas of concern that result in ineffective FRP, as reflected in real-time prices

Findings related to flexible ramp product (1 of 4)

- Lack of requirements for the FMM buffer interval lead to release of the FRP that was previously procured



- This premature release of FRP in the buffer interval can deprive RTD of flexible ramping capacity, or results in losing the FRP capacity
- The ISO is exploring different formulations to ensure the FRP procured in the previous FMM is not fully released in the subsequent FMM

Findings related to flexible ramp product (2 of 4)

- Effective FRP requirements for EIM areas, including the ISO, can be significantly reduced by the transfer capability consideration
- Transfer capability does not consider the actual ramp available in other EIM areas
- The CAISO is exploring other internal mathematical approaches to limit the impact of NIC/NEC on each of the EIM areas

Findings related to flexible ramp product (3 of 4)

- FRP procurement is at the EIM BAA level and there is no locational consideration when procuring FRP
- FRP can become stranded due to congestion from either EIM transfers or internal constraints
- CAISO is evaluating enhancements to address non-deliverability of FRP due congestion
- Given the level of complexity, these enhancements will be addressed in a new policy initiative planned for a 2020 implementation

Findings related to flexible ramp product (4 of 4)

- FRP is awarded to proxy demand resources (PDR) which cannot follow five-minute instructions
- Optimal allocation of FRP on these resources may happen since there is no opportunity costs for energy when bidding close to the bid cap
- In the short term, the ISO is considering not allowing PDR to be scheduled for FRP
- ESDER Phase 3 will implement improvements to model PDR resources that will mitigate the inability to follow five-minute instructions

Divergence between HASP and FMM/RTD markets

- Markets timing may lead to inherent divergence between HASP and FMM/RTD
- As time progresses, conditions may change and each subsequent market may reflect more recent conditions
- At this point the ISO is not considering any changes to the market structure of the HASP and FMM/RTD markets

Divergence between HASP and FMM/RTD markets

- The PDCI losses are only modelled in FMM and RTD
- Treatment of PDCI losses between HASP and FMM/RTD creates a persistent difference
- The CAISO is evaluating if an estimate of these losses can be included in the HASP market

Divergence between HASP and FMM/RTD markets

- HASP considers reservation of existing transmission rights to avoid curtailment of schedules if these rights are exercised in real-time
- If the existing transmission rights are not used in real-time, the associated transmission capacity is then released in FMM/RTD
- This can lead to price divergence when the additional capacity prevents the intertie from binding in FMM

The RUC process commits excess supply when VERs do not bid in the day-ahead market

- The CAISO uses a true-up logic in the residual unit commitment (RUC) to account for under-scheduled VERs
 - RUC considers the VER forecast (as opposed to the VER bid) when committing additional capacity
- If no VER bid is submitted, RUC is unable to account for the VER generation even though it will likely show up in real-time
 - This may result in committing excess generation in RUC
- The CAISO is evaluating whether to expand this true-up logic to VERs with no bids to avoid over commitment in RUC

Prices in the CAISO markets are determined by a variety of inputs and conditions in the system

- Some prices are set by causal and temporal conditions while others are more systemic
- Some pricing outcomes are a reflection of underlying issues
- Operators actions are a reflection of the need to address underlying concerns
- The findings and potential solutions in this report will address some of the underlying drivers impacting pricing performance in the CAISO markets

Next Steps

Milestone	Date
Publish Final Report	September 23, 2019
Stakeholder Web Conference	September 27, 2019
Stakeholder Comments	October 11, 2019

Written stakeholder comments on today's discussion are due by COB **October 11** to InitiativeComments@caiso.com.

All material for this effort is available on the ISO website at:
<http://www.caiso.com/informed/Pages/MeetingsEvents/MiscellaneousStakeholderMeetings/Default.aspx>.