



Day-Ahead Market Enhancements and Ramp Products

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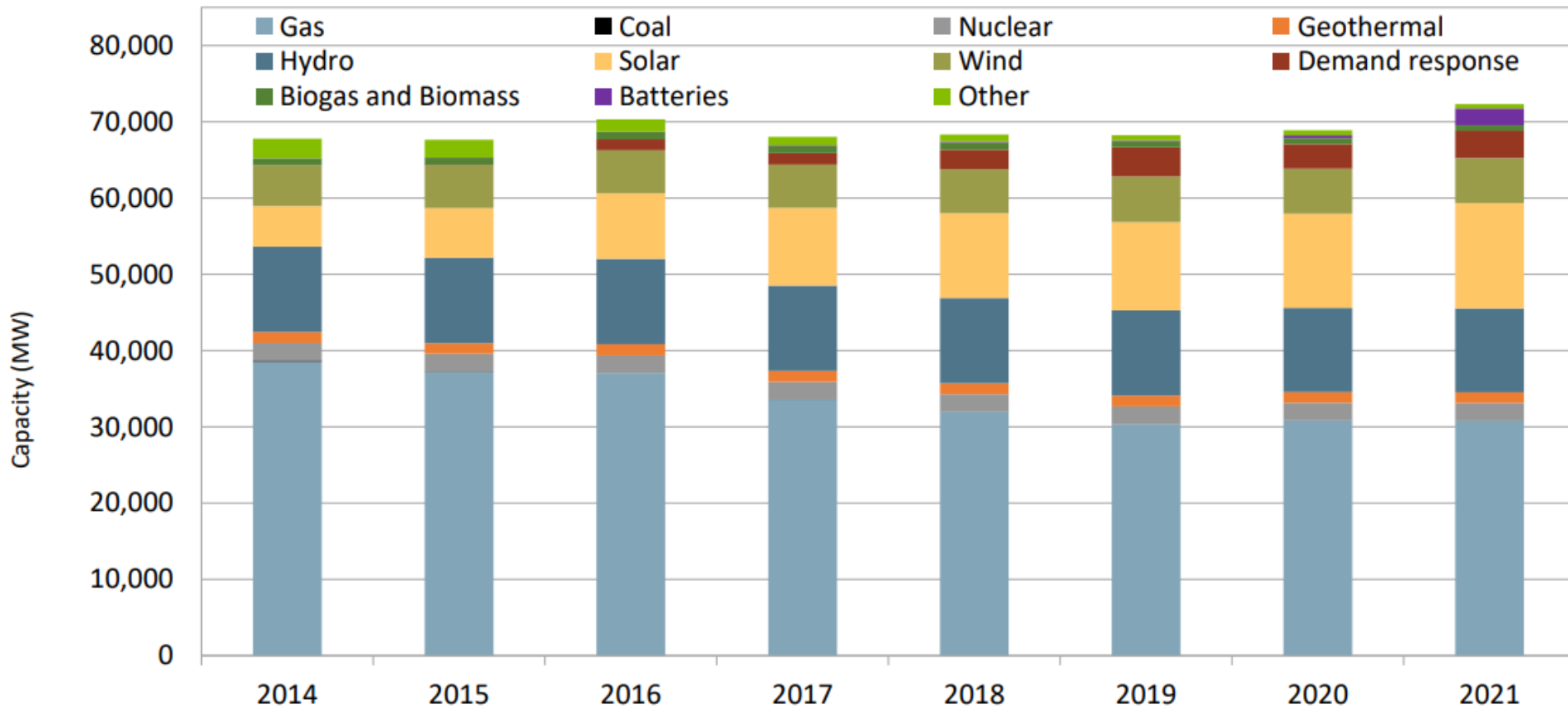
ESIG Session 1: Ancillary Services Markets and Ramping Products
for Renewable Energy

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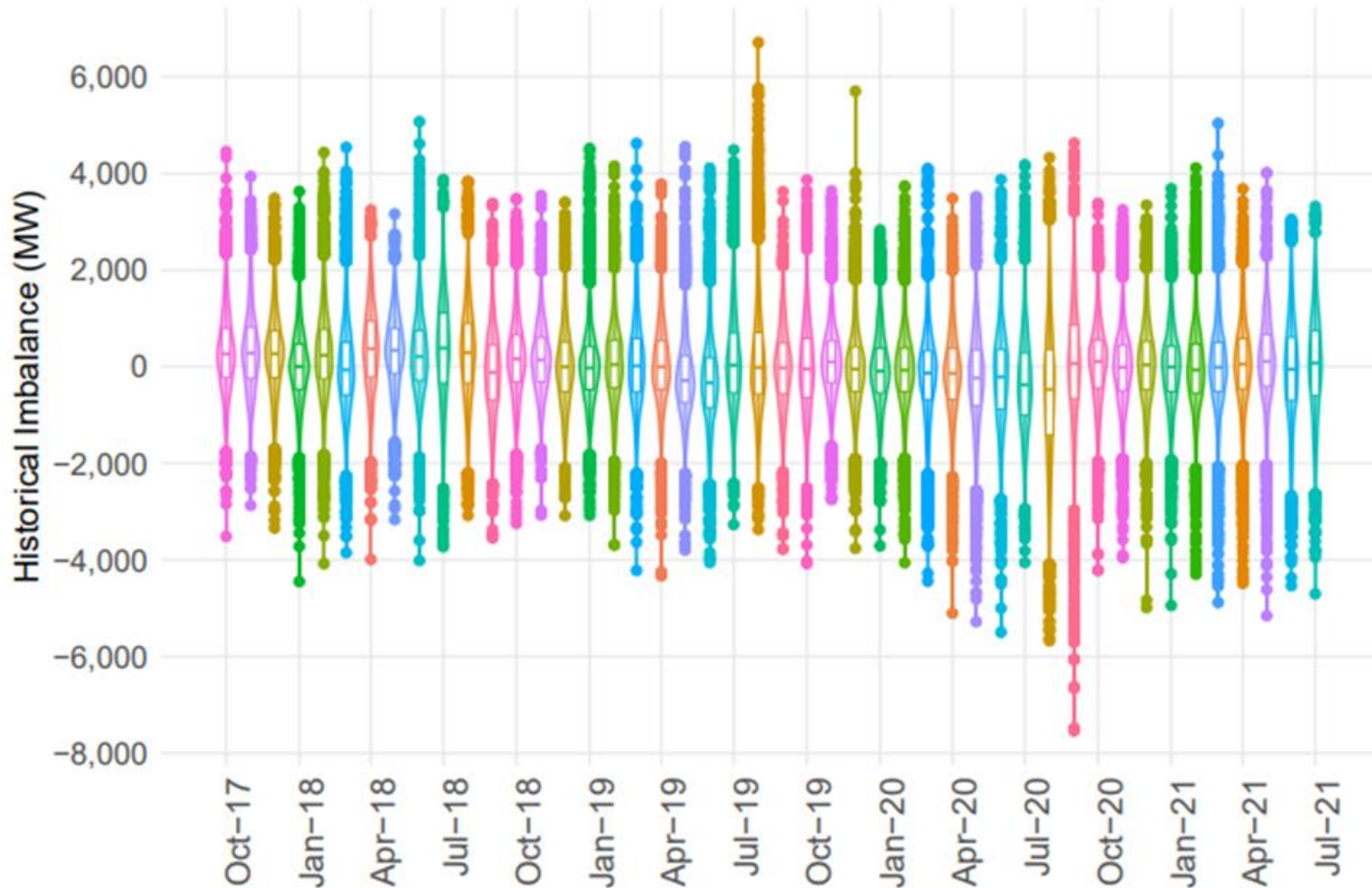
Helpful background information

- CAISO's Day-Ahead Market includes two financially binding market passes, the Integrated Forward Market (IFM) and the Residual Unit Commitment (RUC) process:
 - **IFM:** The IFM clears energy and ancillary service schedules based on bid-in supply and demand
 - **RUC:** The RUC process follows the IFM. The purpose of the RUC process is to ensure that there is enough capacity online to meet the day-ahead demand forecast.

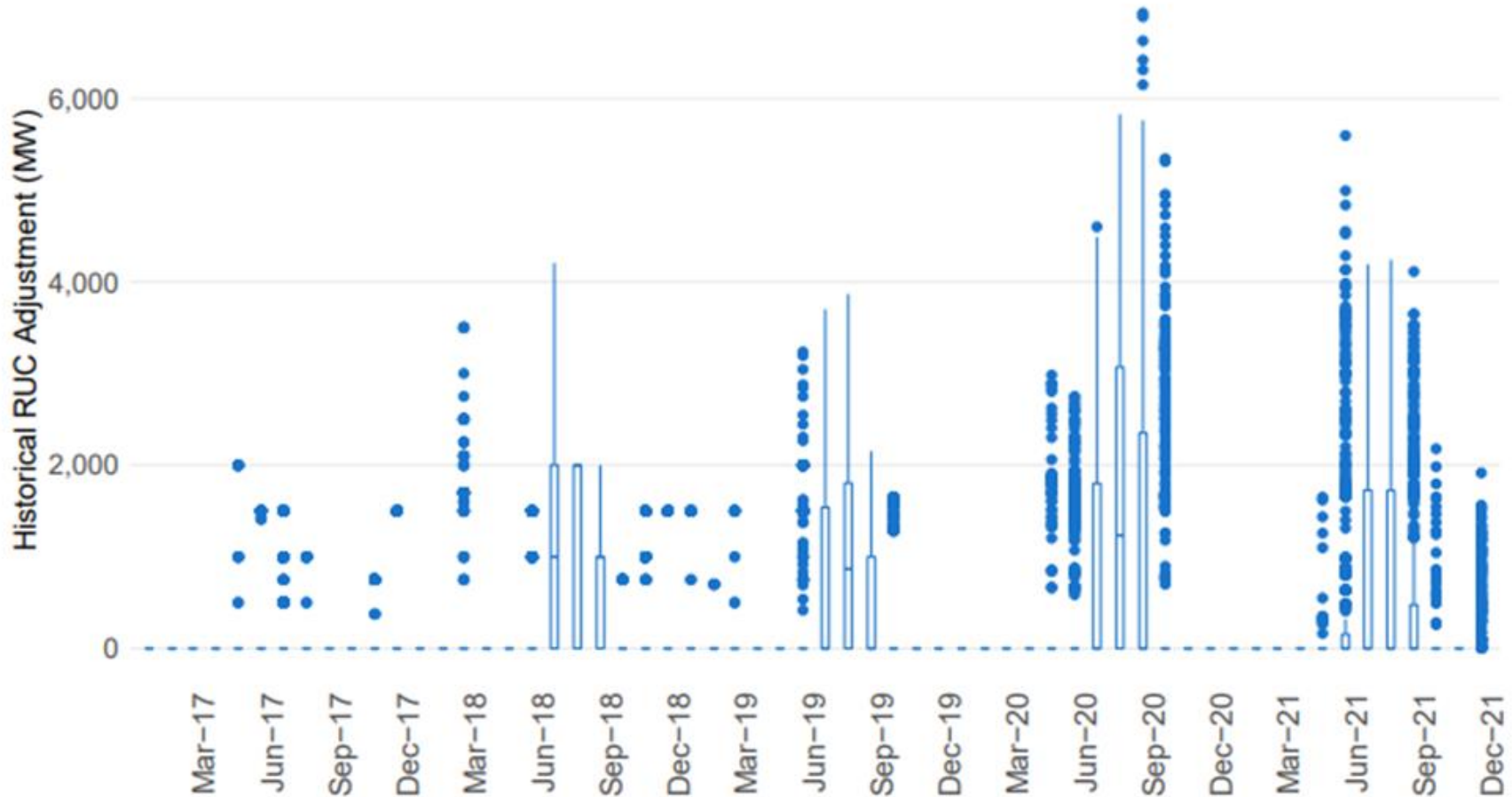
The CAISO resource mix is changing



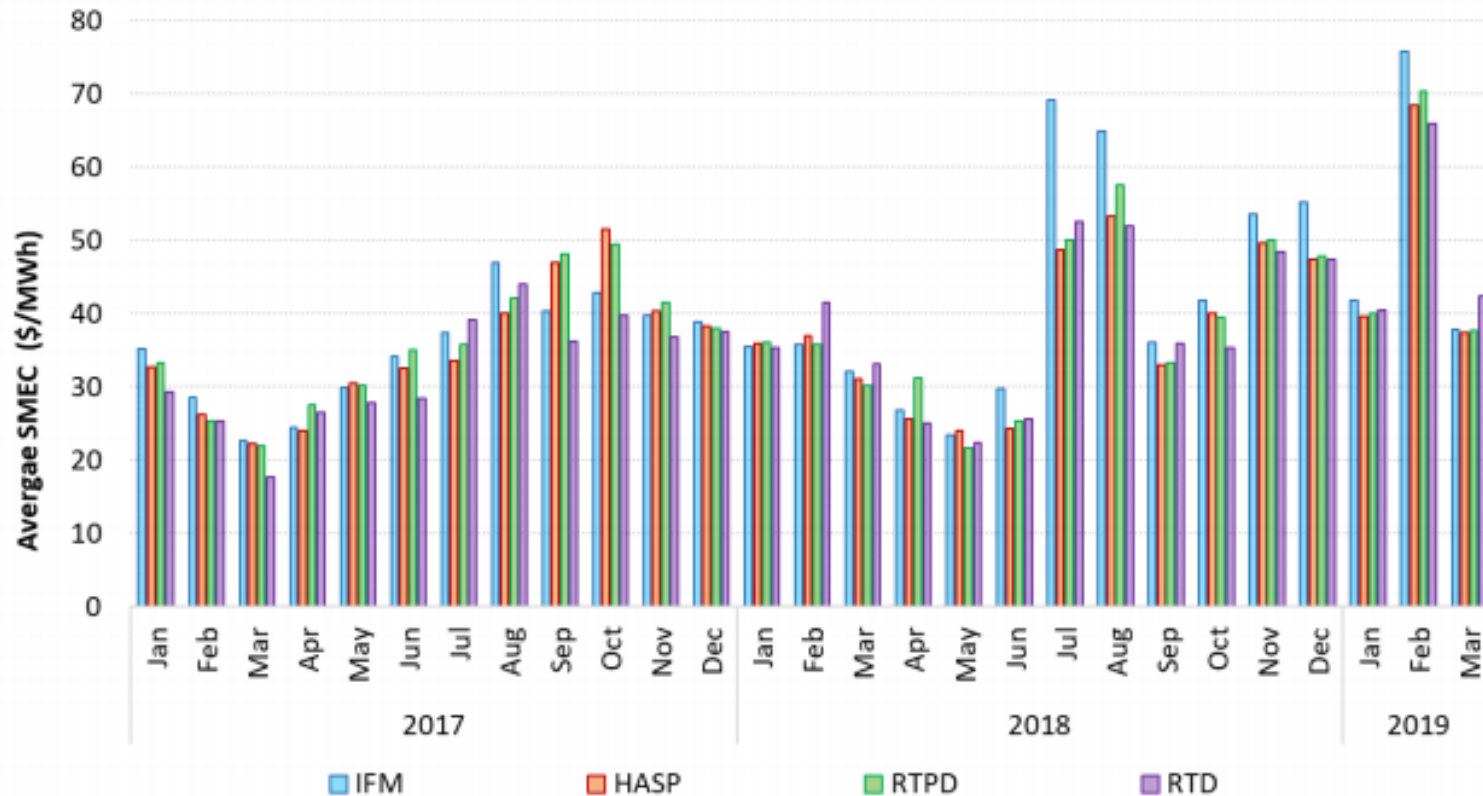
Variable load and renewables increase imbalances between day-ahead and real-time forecasts



CAISO operators secure capacity for uncertainty & ramping through out-of-market actions

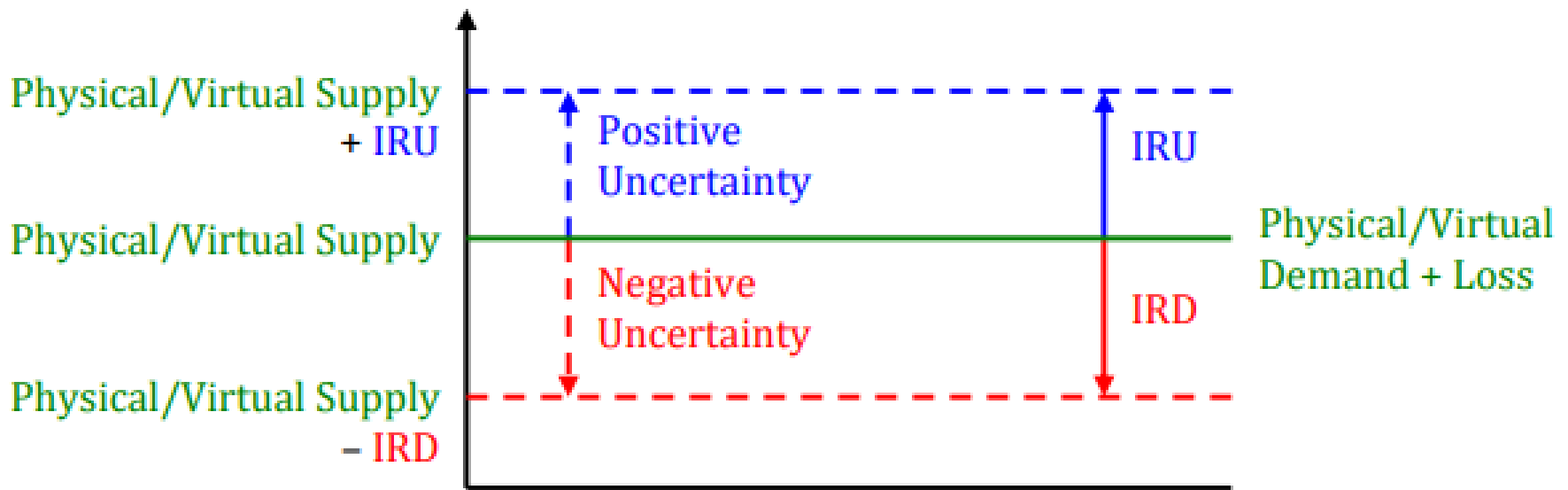


Out-of-market actions contribute to market price divergence and other inefficiencies



CAISO is introducing a new product “imbalance reserves”

- Imbalance reserves will be upward and downward ramp capacity reserved in the day-ahead market to meet uncertainty that may materialize in the net load forecast (load – wind&solar) between day-ahead and real-time



CAISO is introducing a new product “imbalance reserves”

- Biddable product (up and down)
- Procured in the integrated forward market and co-optimized with energy and ancillary services
- Awards are capped to resource’s 30-min ramp capability and eligible resources must be dispatchable in the 15-minute market
- Awards obligate supplier to provide energy bids in the real-time market above/below their day-ahead energy schedule for the quantity of their up/down awards. Unavailability penalties encourage adherence to these obligations.

CAISO is introducing a new product “imbalance reserves”

- The integrated forward market will use a mechanism called “deployment scenarios” to ensure imbalance reserves are deliverable without violating transmission constraints. This results in locational marginal prices for imbalance reserves.
- Imbalance reserve procurement subject to a demand curve