

G-PST/ESIG Webinar Series: An Imbalance Reserve Product to Manage Uncertainty between the Day-ahead and Real-time Markets	
Question	Answer
is this DA reserve product calculated in SCUC? wondering if the need for this suggests SCUC (with transmission constraints, bid curves) may be needed for RA...	No, Imbalance Reserves are only procured in the IFM (Day-ahead market).
how are the “uncertainty reserve” requirements established?	First, we collect historical data to identify load, wind, and solar forecast errors between the day-ahead market and real-time market. Then, we use these errors to calculate the imbalance reserves up and down requirements using a statistical regression technique called quantile regression. The quantile regression estimates the 97.5 and 2.5 percentiles of net load forecast error for every hourly interval, which become the imbalance reserve up and down requirements respectively.
Is the real-time net load forecast made 1 hour ahead of the operating period?	CAISO's real-time net load forecast is updated every 5 minutes. How far ahead the forecast looks depends on the real-time market process (SCUC, HASP, FMM, RTD)
Can you describe how IR differs from other flex products at CAISO?	The CAISO will have two flex products: Imbalance Reserves and Flexible Ramping Product. Imbalance reserves are procured in the day-ahead market to cover forecast uncertainty, ensuring sufficient capacity is available to manage deviations from day-ahead to real-time. FRP, on the other hand, provides additional capacity reserved in the real-time market to manage unexpected changes in supply and demand over short intervals, enhancing the system's ability to respond to intra-hour variability. These products operate in different time frames and address distinct aspects of system flexibility and uncertainty.
why would the RUC adjustment *start* with the P50 forecast? why not start with the P90?	RUC was originally designed before the CAISO system had large quantities of renewables. So the RUC process was designed to use the P50 forecast (median or "most likely" forecast) because it aims to ensure that the day-ahead market accurately schedules sufficient resources to meet the expected load. Starting with the P50 forecast balances reliability with cost, as it reflects the most probable scenario. Using a P90 forecast (higher probability but less likely scenario) from the outset would lead to conservative scheduling, potentially overcommitting resources and increasing costs unnecessarily due to preparing for less likely high-demand scenarios. Now with large amounts of renewable and load uncertainty, system operators are forced to conservatively schedule to maintain reliability. Imbalance Reserves are then the market mechanism that does this all within the market, rather than through manual operator actions.

<p>Can you tell us more about "deployment scenarios"? How does that work? Is it documented anywhere?</p>	<p>Deployment scenarios are a mechanism used to ensure that awarded imbalance reserves are deliverable if deployed in real-time, considering transmission constraints. This approach is similar to the upward and downward deployment scenarios developed for CAISO's Flexible Ramping Product in the real-time market. The deployment scenarios assume that 100% of imbalance reserve awards are converted to energy (in the upward and downward direction) and tested against transmission constraints. The deployment scenarios result in nodal imbalance reserves that ensure scheduled day-ahead physical supply can meet the uncertainty requirements if deployed without violating transmission constraints. For a mathematical explanation see page 20 - https://www.caiso.com/InitiativeDocuments/DraftTechnicalDescription-Day-AheadMarketEnhancements.pdf</p>
<p>Apologies if I missed this, but just want to confirm that "Net" load is observed load (after any BTMPV) minus grid PV and minus grid wind. Anything else?</p>	<p>That's right.</p>
<p>how is imbalance reserve different from flexible ramp product ? are they same ?</p>	<p>See answer to Q7.</p>
<p>Does the IR require NG-fired generators to have non-ratable gas delivery or be able to nominate fuel outside of the NAESB nom cycles in order to participate?</p>	<p>It is not required, but such capabilities could influence a generator's effectiveness and reliability as a provider of imbalance reserves. Because Imbalance Reserves is a biddable product, generators will be able to bid the costs of any actions they must take to achieve the flexibility to provide the product.</p>
<p>How is the amount of IR determined in Day-ahead? Could IR impact the energy bid in real-time market, which also serve the purpose of address imbalance?</p>	<p>See answer to Q5. Yes, the procurement of imbalance reserves in the day-ahead market could impact the energy bids in the real-time market. An Imbalance Reserve award requires a supplier to offer energy economically (with an associated price) so that the real-time market can re-dispatch the resource within its flexible range if needed to manage imbalances.</p>
<p>What are the penalties for unavailability? In ERCOT they have faced ramp non-performance from batteries due to state-of-charge limitations.</p>	<p>There are penalties for the non-performance of resources that are awarded imbalance reserves but fail to be available. Depending on the specifics, the resource could have their awards rescinded or settle against the real-time Flexible Ramping Product price. The general principle is that capacity that is not available in real-time reduces the available supply of flexible reserves and drives up its price. Therefore, resources that do not provide the Imbalance Reserves they are obligated to should settle those deviations at prices reflecting real-time conditions.</p>
<p>Are you procuring imbalance reserve in RTM/FMM as well, reflecting next-24 hr fcst error rather than just DA fcst error and avoiding crashing energy prices?</p>	<p>See answer to Q7. Imbalance Reserve are only procured in the IFM (Day-ahead market). The CAISO has a similar product called Flexible Ramping Product that is procured in the real-time market.</p>

Regarding the bid requirement IRU/IRD resources, are there rules around what the bid prices are allowed to be?	Imbalance reserve up and down bids can be anywhere between the bid floor (\$0) and the bid cap (\$55).
Considering the benefit of regional markets, how large of a factor are transmission constraints in renewable curtailment now and anticipated for the future?	<p>Significantly. Transmission constraints exacerbate renewable curtailment by limiting the deliverability of renewable resources. These constraints may arise due to bottlenecks or limitations in the transmission infrastructure. As more renewables come online, oversupply conditions are expected to occur more frequently. Regional markets do help to reduce renewable curtailments renewables by facilitating inter-regional exchange of renewable energy to balance supply and demand, but they do not directly resolve transmission constraints. The renewables transition requires investments in transmission infrastructure.</p> <p>For detailed information on wind and solar curtailment, you can refer to the daily wind and solar curtailment reports provided by CAISO. These reports offer insights into the challenges posed by oversupply and the ongoing efforts to manage it effectively.</p> <p>https://www.caiso.com/informed/Pages/ManagingOversupply.aspx</p>
Is RUC only ran in the DA (after IFM) or also during operations day?	RUC is only run in the day-ahead market. CAISO does not have an intra-day RUC.
Does CAISO itself do the Day Ahead wind output forecast for all its members? Or does it aggregate Day Ahead forecasts from individual members?	CAISO conducts its own resource-level wind (and solar) forecasts. Participants have the option to forecast their own resources but almost all agree to use the CAISO's forecast.
How are the IRU/IRD requirements set? Historic data? Incorporating target day's characteristics like weather? What percentage of uncertainty is covered?	See answer to Q5.
is IRP symmetrically procured (same forecast up and down)/do providers have to provide same up/down reserve?	No, there can be different IRU and IRD requirements. Suppliers do not have to provide the same quantity of IRU and IRD.
In the 50 MW ramp capable unit example, does the 50 MW ramp capability apply to the total of IRU/IRD, contingency reserve, and other flex products?	Yes, the 50MW would be shared amongst all of the relevant reserve products to ensure the market does not double count the ramp capability.
is the energy bid in RT required by an IR award compensated like other energy bids? (does it create price exposure?)	Yes, they are compensated for their real-time energy schedule at the real-time market price like any other resource.
Is this product for both DA and RT markets or RT market only?	Imbalance Reserve is only procured in the day-ahead market, but the CAISO does have a real-time market flexibility product called Flexible Ramping Product. See answer to Q5.

<p>Would you characterise this product as addressing a market failure within the existing market, or as providing a new (heretofore) missing market?</p>	<p>Both. It addresses the market failure to adequately account for and manage forecast uncertainty between the day-ahead and real-time markets. But it also creates a new market signal to measure the need for, and incentivize the provision of, flexibility and quick response capabilities required to address forecast errors and variability in renewable generation.</p>
<p>What additional cost has CAISO identified for participants to provide IR on top of opportunity costs? Why is it a biddable product?</p>	<p>In a nutshell, any costs associated with being prepared to meet a higher (or lower) energy schedule without the certainty of being dispatched in the real-time market. These additional costs can include, but are not limited to, increased operational and maintenance costs due to the need for resources to be ready to ramp up or down quickly, costs associated with greater wear and tear on equipment, higher fuel costs if the resource needs to procure fuel to maintain a higher state of readiness, costs to reserve transmission (for imports), option value associated with other intra-day procurement opportunities, etc.</p>
<p>would the RUC be unnecessary if load was required to bid consistently/adequately to cover its DA forecast?</p>	<p>It could theoretically reduce the need for RUC, but I would not say makes it unnecessary. The day-ahead market (IFM) is a financial market that allows market participants to take forward financial positions against the spot market, so markets do not generally require loads to bid their forecasts in the day-ahead market. There are other factors too, such as convergence bidders who compete with physical demand/supply for day-ahead schedules, and forecasting challenges (load-serving entities may have different next-day load expectations than the system operator).</p>
<p>Trying to unpick the 'most valuable' component wrt LMP; is the potential imbalance assigned nodally or is value co-opt of energy and ability to deliver?</p>	<p>I'm not sure I understand the question. CAISO and similar markets perform a co-optimization process in their market operations, where they simultaneously determine the dispatch of generation for energy production and the procurement of ancillary services (such as regulation, spinning reserves, non-spinning reserves, and imbalance reserves). This co-optimization ensures that the market meets the demand for energy and reserves at the least cost.</p>
<p>Can IRU be provided by offline quick start resources ?</p>	<p>Yes, offline resources can receive imbalance reserve awards as long as they can start-up within 15 minutes or less.</p>
<p>How is the cost of IR allocated?</p>	<p>A combination of load, generators, imports, and exports who deviate from their day-ahead schedules. Detailed information can be found in the proposal pages 39-40.</p>