



California ISO
Shaping a Renewed Future

Flexible Ramping Products and Cost Allocation

Market Surveillance Committee meeting

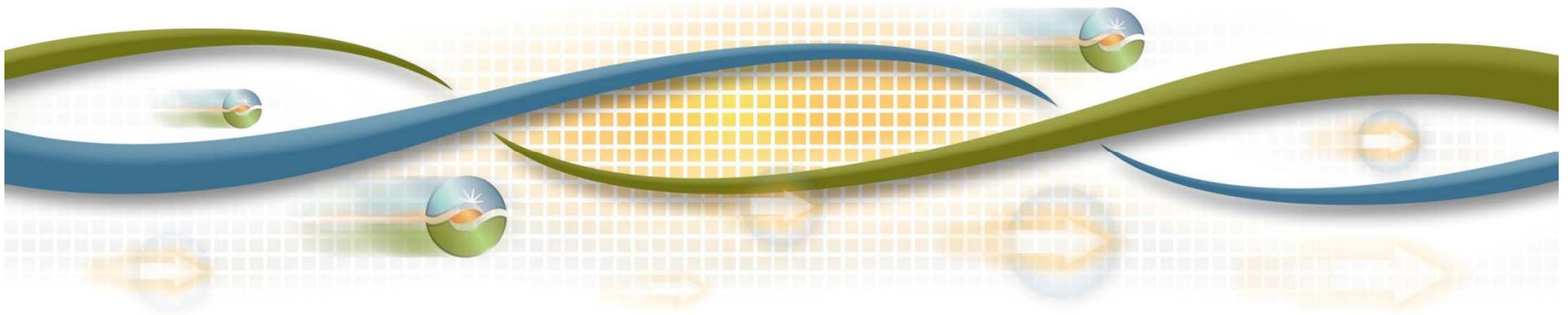
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What is the purpose of the flexible ramping products?

- Upward product and downward product to handle imbalance difference between RTPD and RTD
 - Variability: difference due to modeling granularity difference (15 minute vs. 5 minute)
 - Load forecast profile
 - Variable energy resource profile
 - Unit startup and shutdown profile
 - Inter-tie inter-hour schedule profile
 - Uncertainty: random events happened between RTPD and RTD
 - Load forecast error
 - Variable energy resource forecast error
 - Forced outage
 - Uninstructed deviation
- Procurement target based on RTPD and RTD imbalance difference at proper confidence level, say 60% in day-ahead and 95% in RTPD

Flexible ramping products design

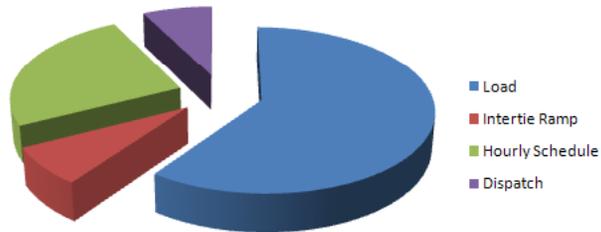
- Awards based on how much a resource can ramp in 5 minutes
 - Aligned with RTD market clearing interval
 - Procurement can be fully deployed in one RTD interval if it is needed
- Allow economic flexible ramping bids (must also submit energy bids)
- Procured in day-ahead and RTPD
 - Co-optimized with energy and ancillary services
- Day-ahead awards conversion in RTPD
 - Day-ahead non-contingent spinning reserve award can partially or fully be converted into upward flexible ramping in RTPD
 - Day-ahead upward flexible ramping award can be partially or fully converted into contingent spinning reserve in RTPD
 - Direction of conversion is from lower value product to higher value product, which are determined in the optimization
- Compensation
 - Procurement payment based on marginal price in day-ahead and RTPD
 - Energy payment in RTD if deployed

RTD deployment method

- Release limitation
 - Reason: variability and uncertainties are realized sequentially in three RTD intervals, so flexible ramping capability needs to be maintained to cover future realizations
 - System wide amount equal to realized imbalance difference (only enforced in RTD1 and RTD2, not in RTD3)
 - One direction: upward for upward and downward for downward
 - Properties of the release limitation
 - Prevent over-using flexible ramping for economic reason
 - Recover previously used flexible ramping capability
 - Do not affect RTD dispatch and energy price when it is not binding
- RTD Dispatch
 - RTD economic dispatch constrained by the release limitation
 - Only consider energy bids, not consider flexible ramping bids
 - If a resource's capacity is not limiting, a resource can be dispatched for energy without deploying its flexible ramping, i.e. its flexible ramping capability kept in the current RTD to be used in the next RTD

Cost allocation and reporting

Flexi-Ramp Up



Flexi-Ramp Down



Bucket	Deviation Metric	
UP – Load	Regulation Up AS Obligation	Cost allocation
UP - Intertie Ramp	Absolute Value Net Hourly Schedule Change (Import - Export, Wheels Exempt)	Reporting only
UP – Hourly Schedule	Negative Uninstructed Imbalance Energy 2 Negative Operational Adjustments	
UP – Dispatch	Negative Uninstructed Imbalance Energy 1	
DOWN – Load	Regulation Down AS Obligation	Cost allocation
DOWN – Intertie Ramp	Absolute Value Net Hourly Schedule Change (Import - Export, Wheels Exempt)	Reporting only
DOWN – Hourly Schedule	Positive Uninstructed Imbalance Energy 2 Positive Operational Adjustments	
DOWN – Dispatch	Positive Uninstructed Imbalance Energy 1	