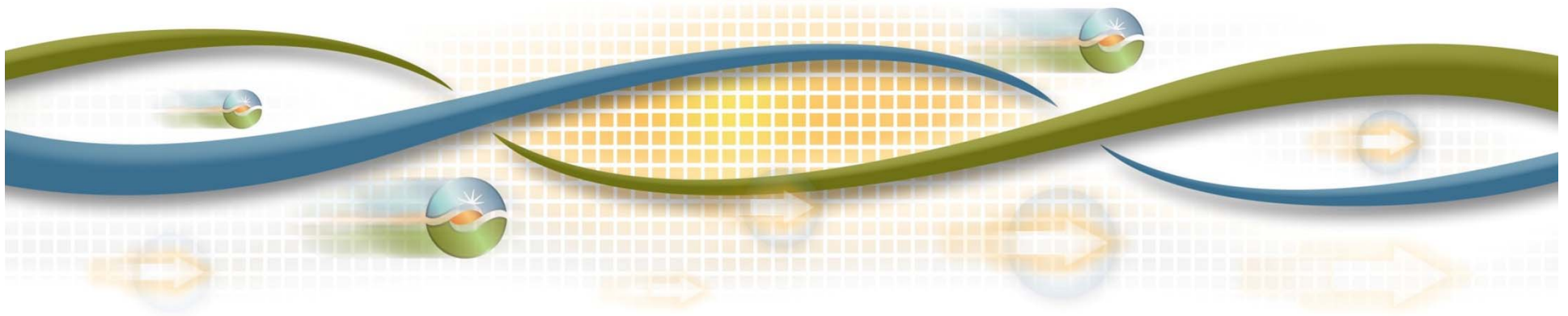# Flexible Ramping Products

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Characteristics of flexible ramping products

- Fast ramping
  - Based on 5-minute ramping capability
  - Ancillary services are based on 10-minute ramping capability
- Dispatched in RTD on a regular basis
  - Ancillary services are not dispatched in RTD on a regular basis
    - Regulation services are dispatched by AGC in real-time
    - Operating reserves are dispatched in RTCD after major system disturbance
    - Day-ahead non-contingent spinning reserve may be dispatched in RTD, but only when it is over procured
- Capacity preserved now to be used in the future
  - IFM flexible ramping is capacity preserved in IFM to be used in RTD
  - RTD flexible ramping is capacity preserved in the current RTD interval to be used in the next RTD interval
  - Ancillary services are capacity set aside for a trade interval, and to be used for the same trade interval if certain condition is triggered

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Flexible ramping capacity bidding rules

- Bid floor and cap
  - Cap = min{$250/MWh, spinning reserve bid if applicable}
  - Floor = $0/MWh
- Why the spinning reserve price sets price cap for flexible ramping?
  - Stakeholders commented that considering the expected energy revenue, flexible ramping should have a lower bid
  - Stakeholders wanted bid replacement, i.e. if spinning reserve bid is lower, then spinning reserve bid should replace flexible ramping bid
  - Counter argument: they are different products, and the bids should not be linked
- SC self provision
  - Only allowed in IFM*   *IFM award is modeled as self provision in RTUC
  - Real-time energy offer obligation
    - Upward flexible ramping award =>real-time energy offer not higher than min{2*DEB, $300/MWh}
    - Downward flexible ramping award =>real-time energy offer not lower than $0/MWh

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Requirement relaxation

- Should requirement be relaxed at a price lower than the bid cap?
  - An instinct answer: "no, because flexible ramping is meeting operational need, and operational need should not be relaxed"
  - The operational need for flexible ramping has a random nature
    - It is not a deterministic requirement, and there is a spectrum of requirements that give us different confidence levels
    - A stochastic optimization will evaluate cost and benefit rather than meet every extreme scenario, cost no object
    - Randomness softens the requirement, and requirement relaxation is mimicking this
- Requirement relaxation penalties
  - requirement relaxation from 0 MW to 100 MW, penalty price $100
  - requirement relaxation from 100 MW to 200 MW, penalty price $150
  - requirement relaxation from 200 MW to 300 MW, penalty price $200
  - requirement relaxation above 300 MW, penalty price $250

Factoring energy cost into flexible ramping cost

- Extreme energy bids will be factored into flexible ramping cost
  - Flexible ramping capacity with extreme energy bids will appear to be more expensive
  - Upward: energy bid above $300 factored in with 2.5% probability
  - downward: energy bid below $0 factored in with 2.5% probability
- Resource bid-in real-time energy cap and floor
  - Resource bid-in real-time energy cap for upward flexible ramping
  - Resource bid-in real-time energy floor for downward flexible ramping
  - Factored into day-ahead flexible ramping cost
  - A resource has incentive to accurately estimate its own real-time energy offer cap and floor
    - Less restrictive cap or floor will reduce the likelihood of being awarded flexible ramping capacity in IFM
    - More restrictive cap or floor will limit the real-time energy bids

Discussion of false opportunity cost payment

Capacity	Procure time	Dispatch time	Possible energy lost opportunity	Price includes energy opportunity cost	False lost opportunity cost payment if it is settled	Capacity Settlement
RUC capacity	Day-ahead after IFM	Current RTD	No	No	No	Yes
DA flex ramp	In IFM	Current RTD	IFM	Yes	No	Yes
RTUC flex ramp	In RTUC	Current RTD	No	Yes	Yes	No
RTD flex ramp	In RTD	Next RTD	Current RTD	Yes	No	Yes

If flexible ramping is paid in RTUC, it will have false opportunity cost payment if the resource is dispatched for energy in RTD.

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Flexible ramping product procurement target

- Flexible ramping procurement target
  - Goal 1: maintain RTD energy balance with high confidence
  - Goal 2: cost effective
- Method
  - Statistical analysis of 5-minute net load variability and uncertainties
  - Tentative: real-time 95% confidence level, and IFM 60% confidence level
  - Subject to tuning based on experience
- Alternative method for day-ahead procurement target
  - Moving day-ahead procurement target driven by cost effectiveness
  - Calculate average RTD flexible ramping price
  - Set day-ahead procurement target the same as real-time target, and allow relaxation at average RTD flexible ramping price
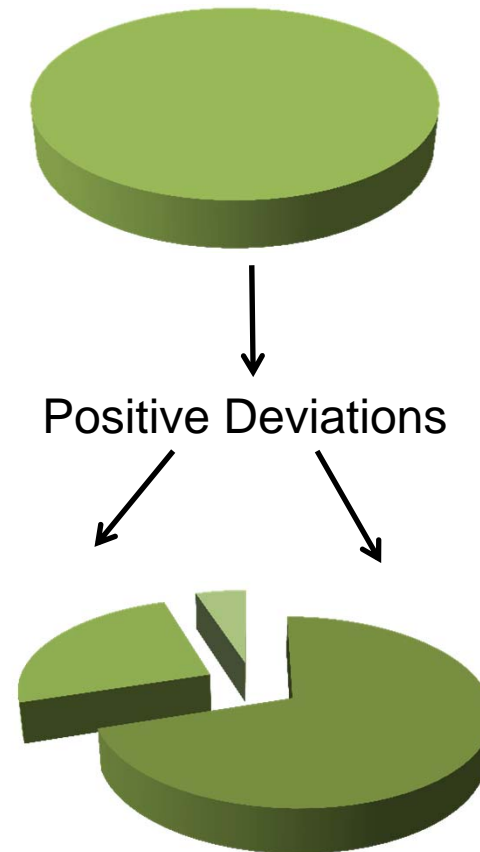
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Allocate flexible ramping product costs consistent with guiding principles

Flexible Ramping Up

Negative Deviations
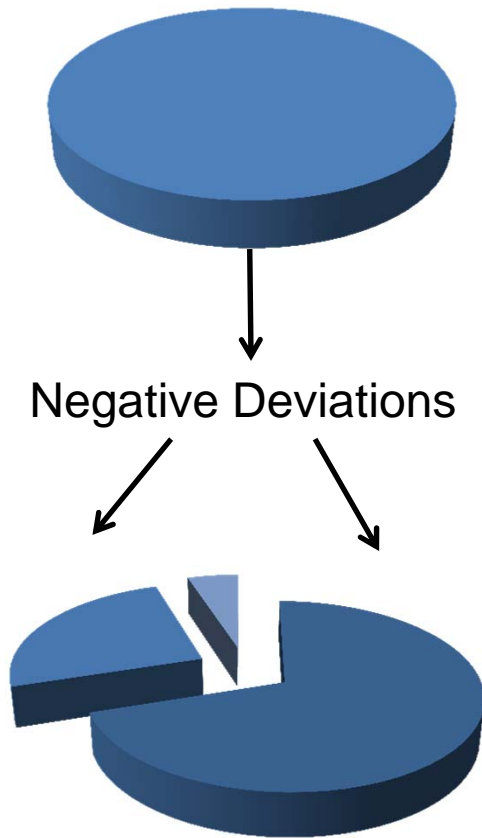
Load   Supply   Intertie Ramp

Flexible Ramping Down

Positive Deviations

Load   Supply   Intertie Ramp

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Cost allocation guiding principles

- Causation
- Comparable Treatment
- Accurate Price Signals
- Incentivize Behavior
- Manageable
- Synchronized
- Rational

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Summary of Cost Allocation

		Hourly Profile	Baseline	Actual	Deviation	Allocation
1	Load	ISO 15 Minute Forecast	Convert Profile to 10 Min	ISO 10 Minute Observed Demand	Baseline - Actual	Load ratio share
2	Renewables (PIRP)	Resource's 15 Minute Forecast	Convert Profile to 10 Min	10 Minute Meter	Baseline - Actual	Gross Deviation
	Internal Generation	N/A	Dispatch	10 Minute Meter	UIE1 + UIE2	Gross UIE
	Interties Operational Adjustments	N/A	N/A	Deemed Delivered	OA1 + OA2	Gross OA
3	Interties Static	Flat	HASP Schedule divided by 4	Deemed Delivered	Baseline - Actual	Gross SC Deviation

- Monthly re-settlement of cost allocation
- Functionality to assign costs at resource level

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