Day-Ahead Market Enhancements - Third Revised Straw Proposal

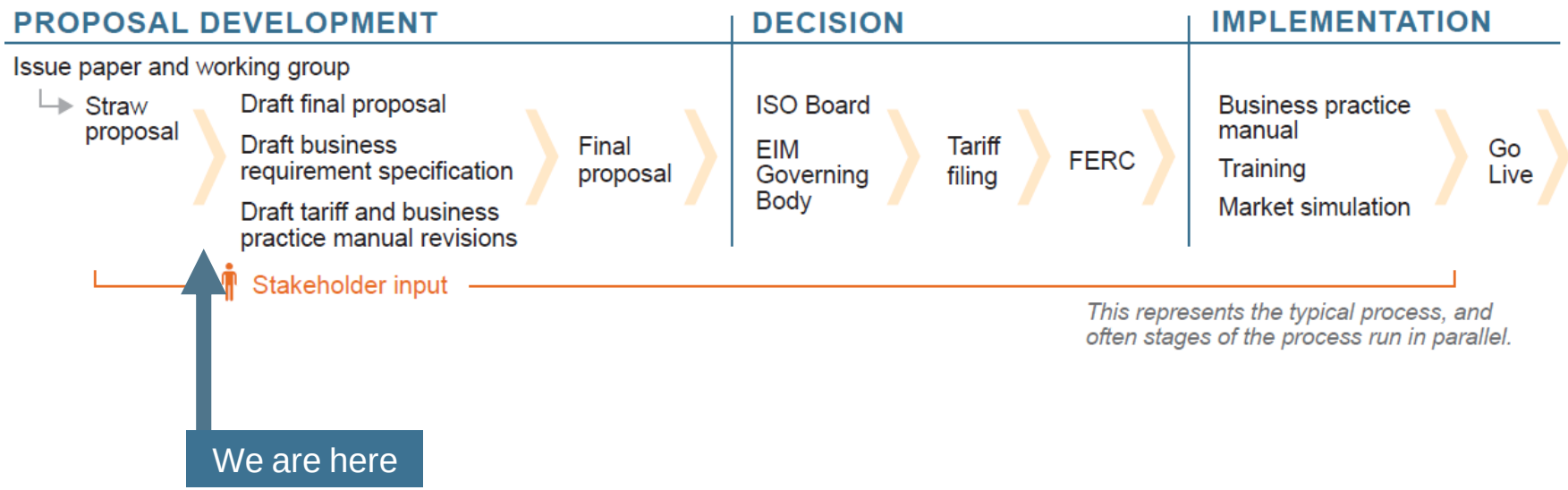
Stakeholder Meeting

April 29, 2022

Agenda

Time	Topic	Presenter
9:00 – 9:10	Welcome and introductions	Kristina Osborne
9:05 – 11:30	-Overview and Objectives -Changes from Revised Straw Proposal and Responses to Stakeholder Feedback -Proposed Day-Ahead Market Enhancements	James Friedrich
11:30 – 1:00	Lunch Break	
1:00 – 2:50	-Additional Design Considerations -Alignment between RA Enhancements, DAME, and EDAM -EIM Governing Body Role	James Friedrich
2:50 – 3:00	Next steps	Kristina Osborne

Stakeholder Process



Housekeeping reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- To ask a question, press #2 on your telephone keypad or send question to meeting host in the chat.
- Calls are structured to stimulate an honest dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Please try and be brief and refrain from repeating what has already been said so that we can manage the time efficiently.

Day-Ahead Market Enhancements

OVERVIEW

Objectives

- Introduce an imbalance reserve product in the integrated forward market (IFM) to procure flexible capacity
  - Covers real-time ramping needs that are not covered by hourly day-ahead market schedules
  - Covers uncertainty in the net load forecast between day-ahead and real-time markets
- Enhance the residual unit commitment (RUC) process
  - Procure downward dispatch capability
  - Incorporate local market power mitigation measures
- Maximize benefits of greater West-wide diversity in the day-ahead optimization for WEIM participants

Day-Ahead Market Enhancements

CHANGES FROM REVISED STRAW PROPOSAL AND RESPONSES TO STAKEHOLDER FEEDBACK

Need for Day-Ahead Market Enhancements

- **Stakeholder feedback:** CAISO has not sufficiently demonstrated the need for DAME and imbalance reserves
- Proposal refreshes the discussion on the need for day-ahead market enhancements
  - Incorporates discussion from recent presentations and reports to provide the CAISO's latest thinking
  - Imbalance reserves would improve market efficiency compared to RUC adjustments
  - Imbalance reserves are an important component of EDAM and increases its benefits

Day-Ahead Bidding Obligations for Imbalance Reserves and Reliability Capacity

- **Stakeholder feedback:** Clarify day-ahead bidding rules and day-ahead must-offer obligations (MOO) for new products
  - Imbalance reserve bids must accompany economic energy bids
  - All RA resources eligible to provide imbalance reserves will have a MOO to bid for IRU/IRD in the day-ahead market
  - All RA resources that currently have a DA MOO for RUC will have a DA MOO for RCU/RCD
  - Proposal clarifies DA and RT bid insertion for imbalance reserves and reliability capacity

Real-Time Bidding Obligations for Imbalance Reserves and Reliability Capacity

- **Stakeholder feedback:** Imbalance reserves would replace the RA RT MOO in a way that would reduce system reliability and undermine procurement decisions made by LSEs. Procuring supply to account for uncertainty through RUC is sufficient and less costly. RA efficiencies may not be achieved in practice.
- Confirms proposal continues to determine real-time availability based on IRU/IRD and RCU/RCD award obligations and allows RA resources to bid for IRU/IRD and RCU/RCD at non-zero prices and be paid the marginal clearing prices
  - Determining real-time availability through capacity awards based on bid costs is a more efficient way to procure reserves and compensate resources, and promotes efficient RA capacity pricing
  - CAISO is working on data analysis to add to discussion
  - CAISO proposes that the LRA can enforce their LSEs to require their RA capacity suppliers adhere to a RT MOO in their supply contracts

Local Market Power Mitigation

- **Stakeholder feedback:** CAISO has not sufficiently demonstrated the need to mitigate imbalance reserve offers. Lack of support for methods to establish a "default availability bid" for mitigation.
- Continues proposal to apply LMPM measures to IRU offers. Example in Appendix C demonstrates mitigation of energy and IRU.
  - It is appropriate to mitigate IRU offers because uncompetitive bids can force a higher cost energy dispatch
- Removes proposal to calculate default availability bids for imbalance reserve and reliability capacity mitigation
  - The competitive LMP for each product will be used as the mitigation price

Local Market Power Mitigation in RUC

- **Stakeholder feedback:** CAISO has not sufficiently demonstrated need to mitigate reliability capacity bids. Previous FERC rulings suggest it is unnecessary. A new market pass may harm market performance.
- Proposal clarifies rationale for mitigating reliability capacity bids
  - Reliability capacity marginal prices include a marginal congestion contribution that could be uncompetitive
  - Prior FERC rulings applied under different market context
- Proposal addresses concerns about market solve time and performance

Imbalance reserves 15-minute dispatch requirement

- **Stakeholder feedback:** The 15-minute nature of imbalance reserves is overly restrictive because materializing uncertainty may be anticipated in advance of FMM
- CAISO recognizes this and proposes to implement imbalance reserve parameters as adjustable

Imbalance Reserve Procurement

- **Stakeholder feedback:** Procuring imbalance reserves under proposed scarcity penalty price could lead to inefficient market results and would be unnecessarily costly
- New proposal procures imbalance reserves based on graduated penalty price parameters rather than a single penalty price parameter
  - Results in more efficient market outcomes and balances the reliability benefit of imbalance reserves without incurring excessive costs

Imbalance Reserve Deliverability

- **Stakeholder feedback:** Procuring imbalance reserves nodally would be inefficient because the market cannot assure deliverability because congestion patterns can change significantly between markets. Consider a zonal approach.
- Continues proposal to maintain imbalance reserves as a nodal product through use of deployment scenarios
  - Nodal procurement offers greater assurance the RTM will be sufficiently prepared to address uncertainty that materializes and provides proper market signals.

Energy Storage

- **Stakeholder feedback:** Include more detail on interactions with energy storage.
- Proposal clarifies how energy storage resources fit into imbalance reserve cost allocation
- Proposal discusses proposed Energy Storage Resource model and its relationship to imbalance reserves and reliability capacity.

DAME and Exports

- **Stakeholder feedback:** Elaborate how imbalance reserves interact with exports. It is inappropriate for resources awarded imbalance reserves to support a high-priority export.
- Proposal discusses imbalance reserve contribution to export protection in the day-ahead market
- Clarifies the relationship between imbalance reserves and high-priority (PT) export rules
  - There is no direct link between the resource's output and the export quantity
- Clarifies interaction between high-priority export rules and RUC transitioning down a multi-stage generator (MSG) resource

EIM and Ramp Deviation Settlement

- **Stakeholder feedback:** Clarify EIM participant connection to ramp deviation settlement
- EIM participants will be subject to a forecasted movement deviation settlement in FMM

Congestion Revenue Rights

- Clarifies that imbalance reserve settlement may result in underfunding for CRRs because the CAISO will not collect congestion revenue on the imbalance reserve flow.
  - CAISO believes in practice the impact to CRRs will be minimal but proposes to monitor the performance of CRRs and be prepared to act if necessary

Accounting for Energy Offer Cost in Upward Capacity Procurement

- **Stakeholder feedback:** General preference for real-time energy bid cap option
- Proposal will implement a real-time energy bid price cap on all resources that receive an imbalance reserve up or reliability capacity up award

Variable Energy Resources Eligibility to Provide New Products

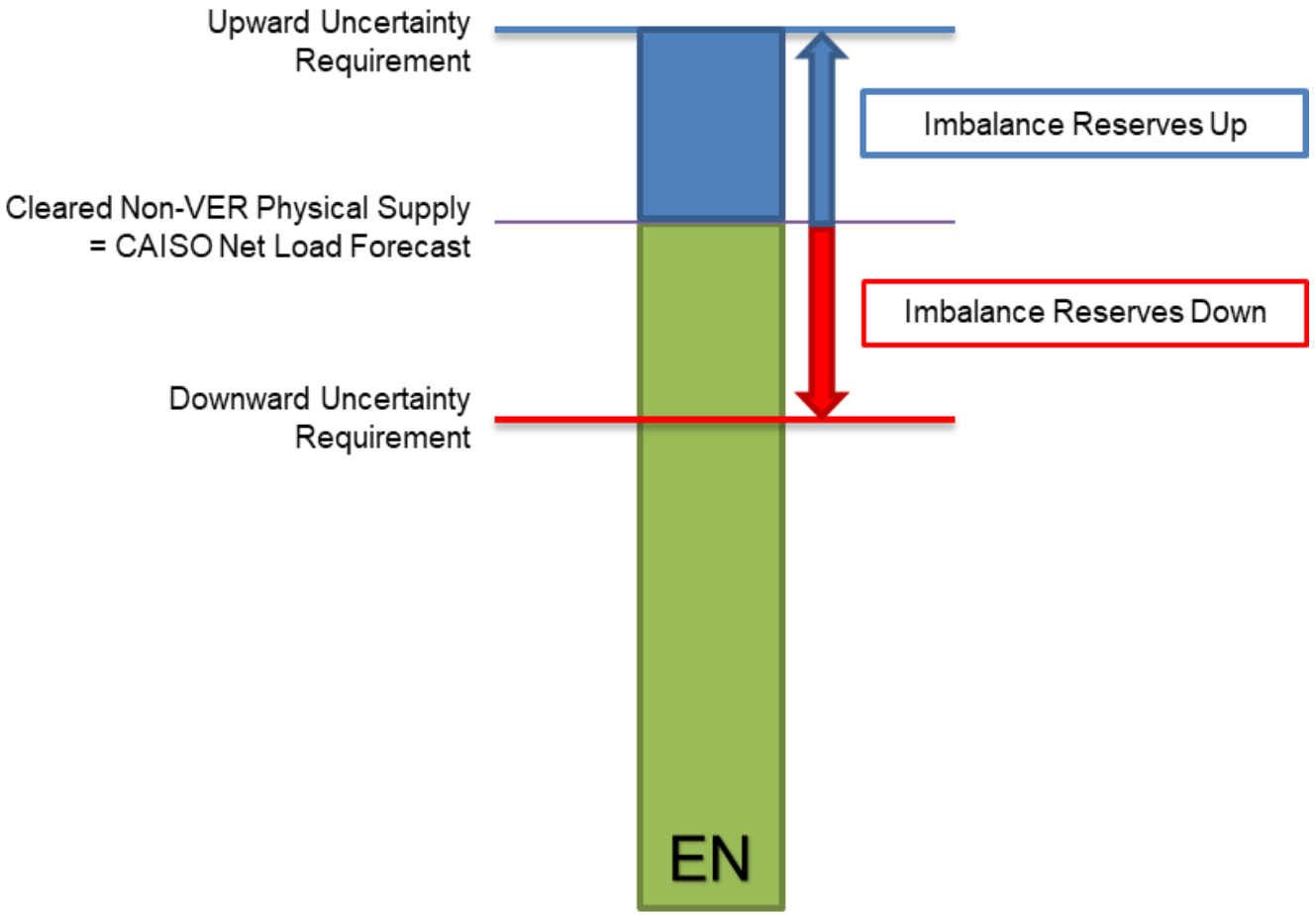
- **Stakeholder feedback:** VERs should not be eligible for IRU/RCU because their output is uncertain
- Confirms the CAISO's position to enable VERs to provide imbalance reserves up and reliability capacity up
  - It is reasonable to allow VERs to participate in capacity services they have the technical ability to provide
  - Propose that VERs provide high-sustainable limit
- Specific mechanics are being re-evaluated

Other Changes

- Removes the transition period
- Updates implementation and policy schedule
- Updates Appendix A

PROPOSED DAY-AHEAD MARKET ENHANCEMENTS

Day-ahead market products when net load forecast is equal to non-VER physical supply

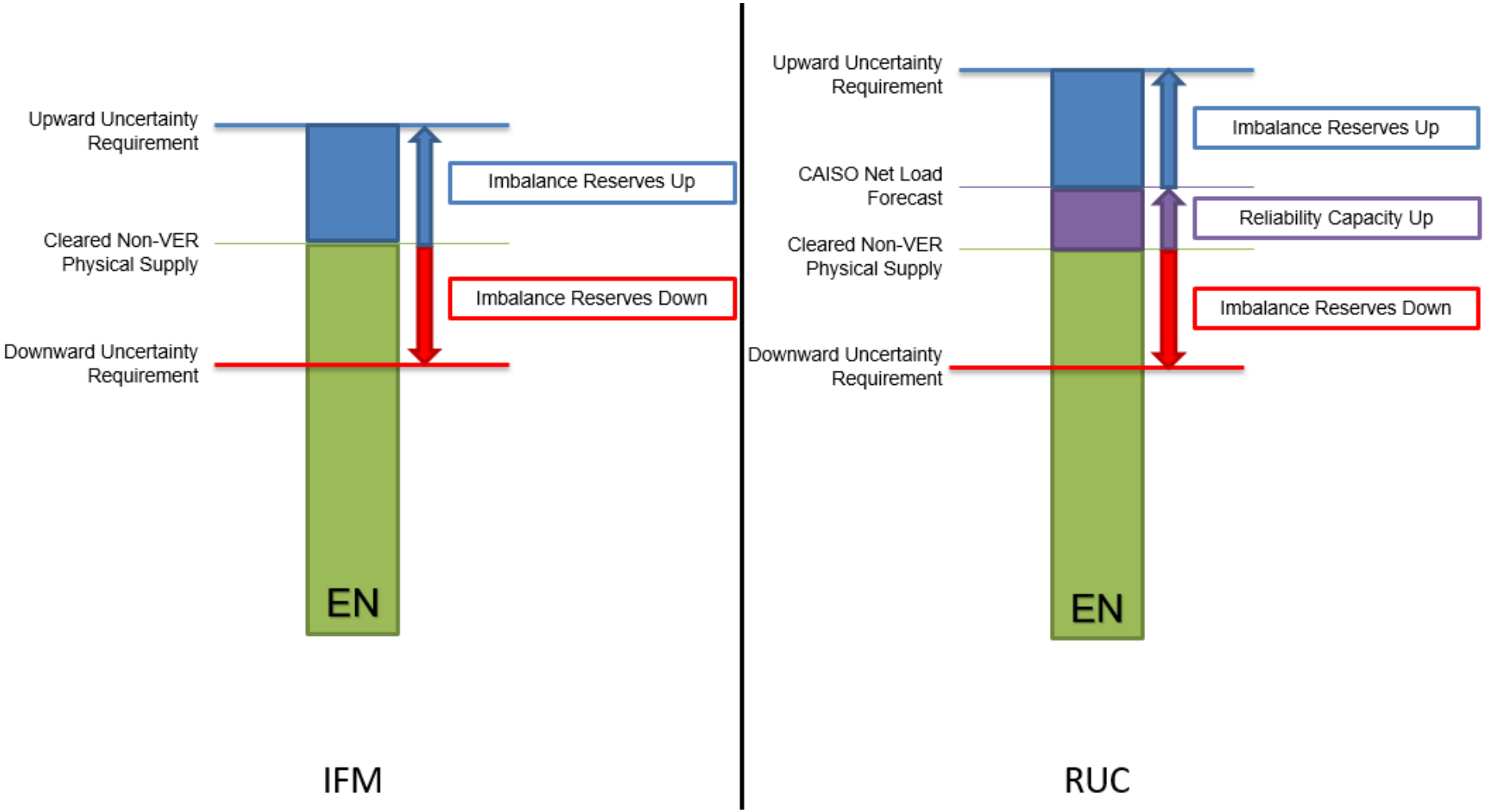


Reliability capacity is needed because physical supply may clear differently when bid-in load, virtual, VER schedules are considered

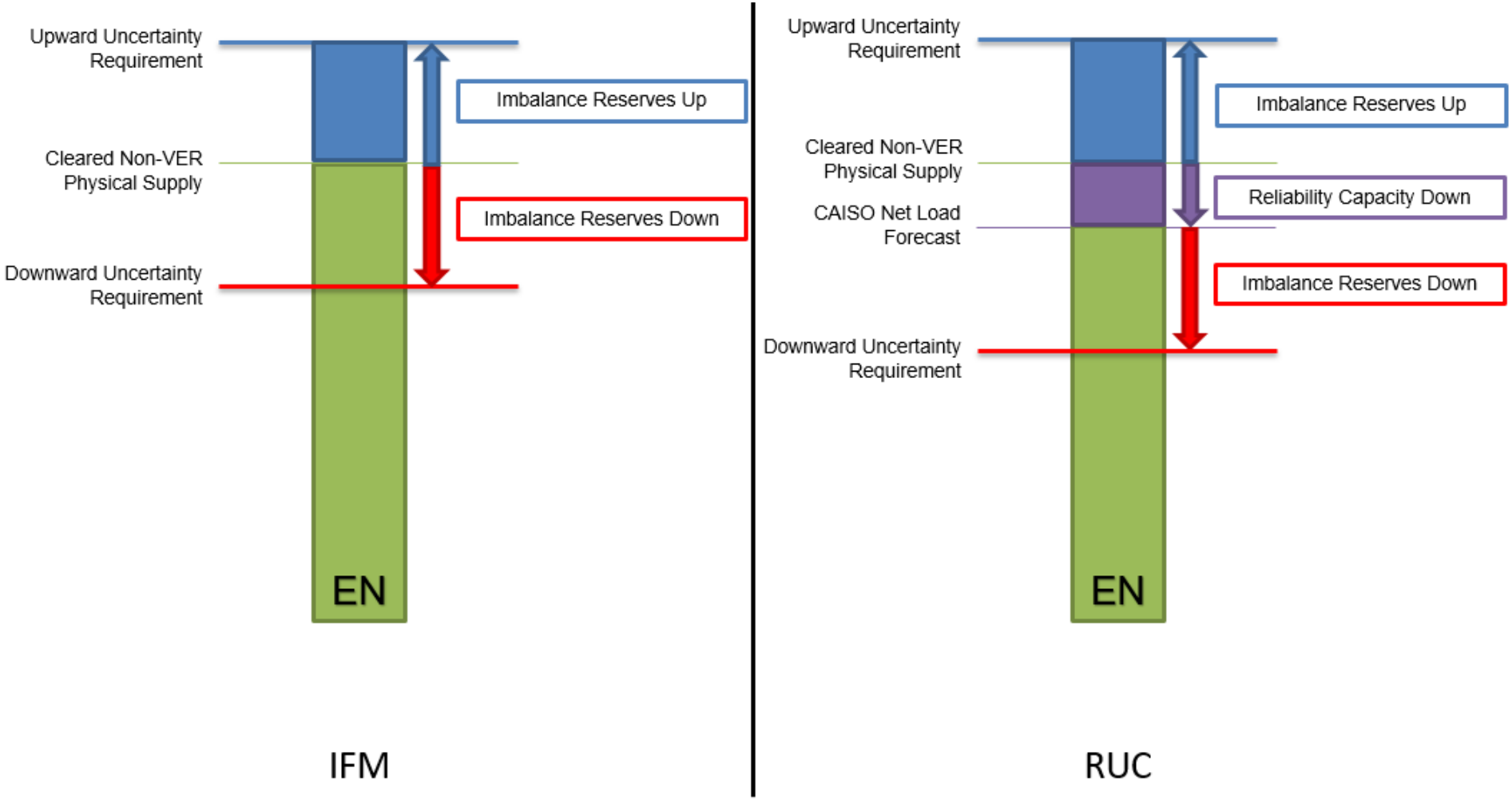
- Drivers of reliability capacity up
  - Bid-in load clears less than CAISO load forecast
  - Net virtual supply clears market
  - Cleared VERs greater than CAISO VER forecast

- Drivers of reliability capacity down
  - Bid-in load clears greater than CAISO load forecast
  - Net virtual demand clears market
  - Cleared VERs less than CAISO VER forecast

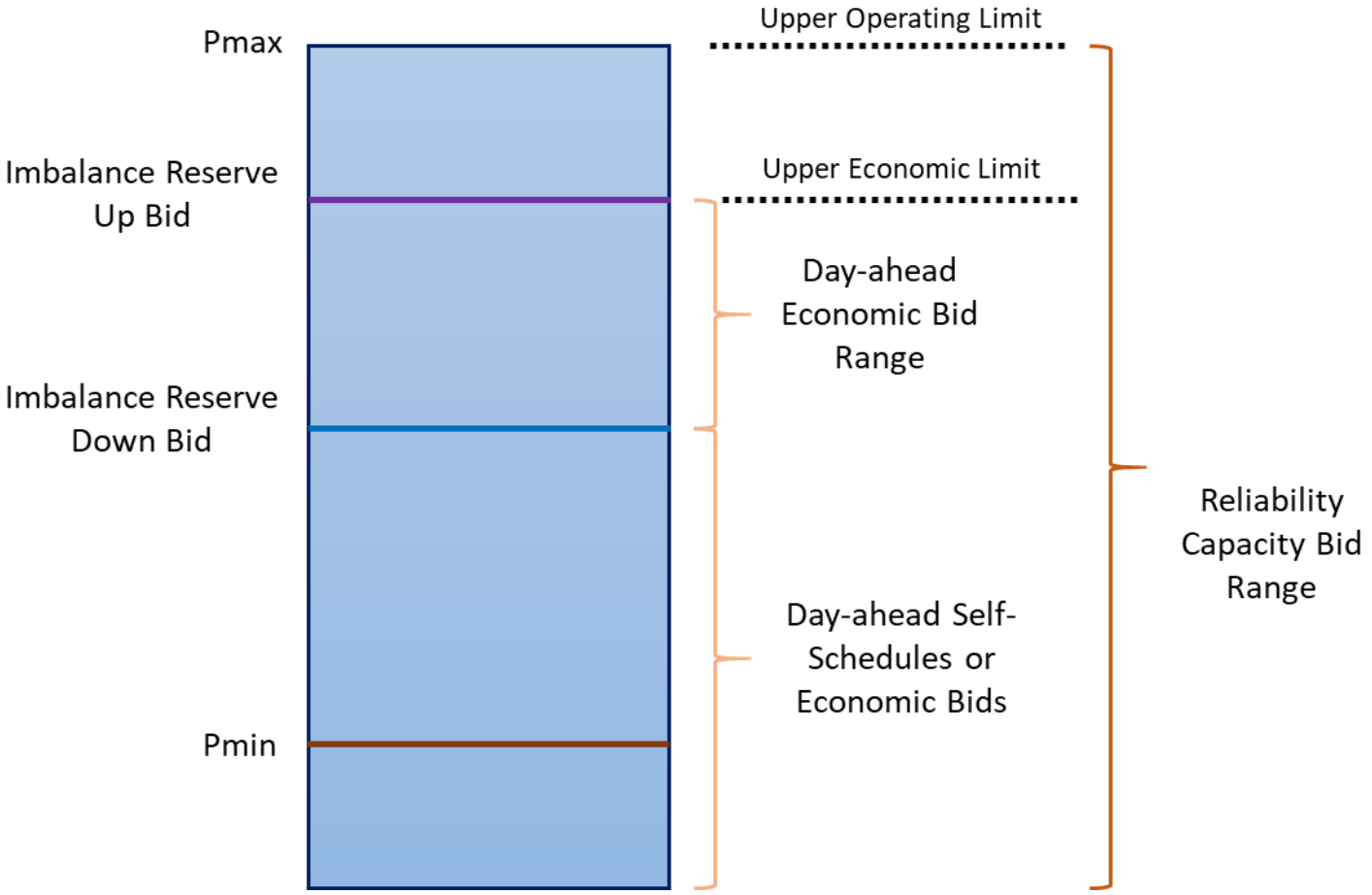
Day-ahead market products when net load forecast is greater than non-VER physical supply



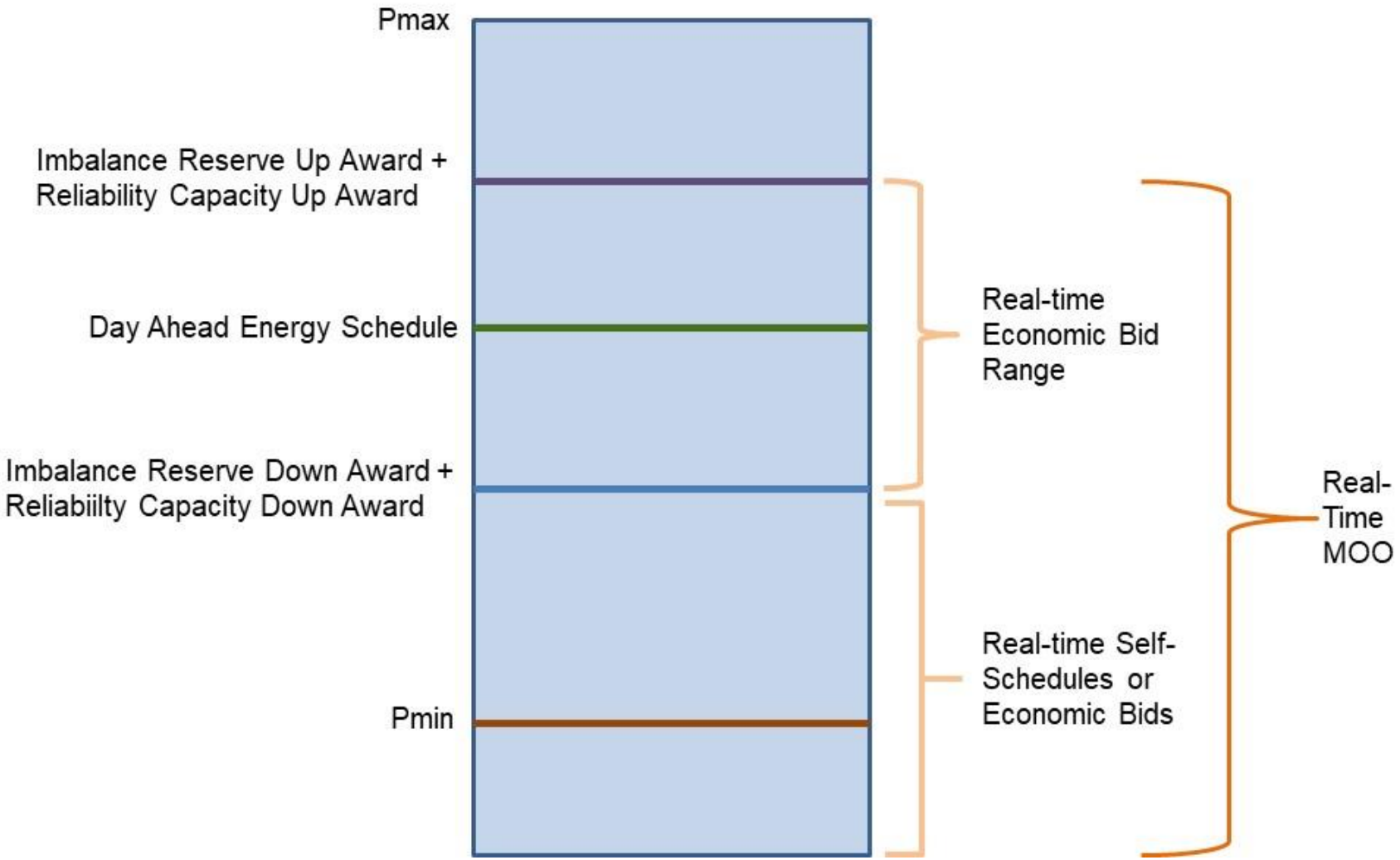
Day-ahead market products when net load forecast is less than non-VER physical supply



Day-ahead bidding obligations



Real-time bidding obligations

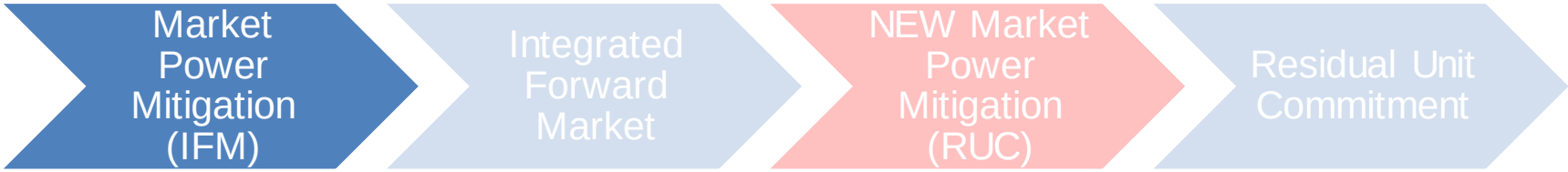


Day-Ahead Market Enhancements

DAY-AHEAD MARKET PROCESSES

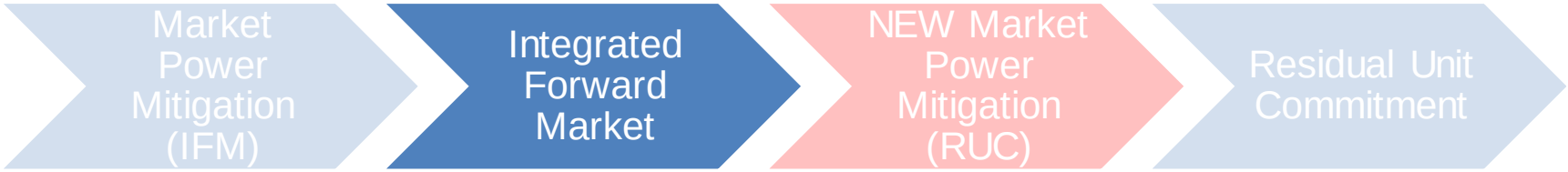
IFM market power mitigation

- IFM MPM uses unmitigated bids to clear bid-in load, bid-in supply, imports, exports, ancillary services and imbalance reserve requirements using unmitigated bids
- Resources that can provide counter-flow to an uncompetitive constraint in any scenario will have their energy bids mitigated
  - No proposed changes to DCPA or 3-pivotal supplier test to evaluate competitiveness
- Resources that can provide counter-flow to an uncompetitive constraint in the upward deployment scenario will also have their IRU bid mitigated
- Market mitigates energy offers to the greater of default energy bid or the competitive locational marginal energy price
- Market will mitigate IRU offers only to the competitive locational marginal IRU price



Integrated forward market

- IFM will clear bid-in load, bid-in supply, imports, exports, ancillary services and imbalance reserve requirements using mitigated bids
  - IFM will co-optimize and procure imbalance reserves based on bids to meet an hourly imbalance reserve procurement requirement
  - Deployment scenarios consider transmission constraints to ensure imbalance reserves are deliverable
  - Awards are capped to resource's 15-min ramp capability and eligible resources must be dispatchable in the 15-minute market



Imbalance reserve procurement requirement

- Upward and downward uncertainty requirement is calculated each hour based on historical forecast errors between DAM and FMM, and the day-ahead demand, solar, and wind forecast.
- Uses a quantile regression set to 2.5/97.5 percentiles similar to FRP requirement
  - Regression percentiles will be configurable
- The imbalance reserve requirement comprises the upward and downward uncertainty portion of the EDAM RSE.

Imbalance reserve graduated penalty prices

- Proposal introduces a graduated penalty price structure that gradually relaxes the imbalance reserve procurement requirement at higher costs
- CAISO would also establish a minimum threshold of imbalance reserves procured over high-priced economic demand bids and low-priority export self-schedules.
- CAISO would retain discretion to set penalty prices and relaxation values in a flexible manner as more entities join the EDAM

Scheduling run IRU relaxation (%)	Scheduling run penalty price ($)	Upward uncertainty percentile	Pricing run penalty price ($)
0.000	247	97.5	247
0.026	300	95	300
0.051	400	92.5	400
0.077	500	90	500
0.103	600	87.5	600
0.128	700	85	700
0.154	800	82.5	800
0.179	900	80	900
0.205	1000	77.5	1000
0.231	1200	75	1000

Imbalance reserve deliverability

- IRU/IRD deployment scenarios are included in the IFM where the IRU/IRD awards are deployed to meet the IRU/IRD requirements at each location while enforcing all network constraints.
- CAISO will use allocation factors derived by historical data to distribute the IRU/IRD requirements among load and VER nodes.
- Awarded resources are paid imbalance reserve up/down locational marginal price

Imbalance reserve bids

- Imbalance reserve bids can have different hourly price/quantity pairs but only a single price/quantity pair in each hour.
- CAISO will insert imbalance reserve bids at $0 for the portion of the resource's capacity that is subject to a DA MOO.
- Resources that do not submit the required real-time bids based on their imbalance reserve award will have economic bids inserted for them at their Default Energy Bid.

Imbalance reserve cost allocation

Imbalance Reserves Up

Tier 1

- **Generation**: MAX(0, Day-ahead energy schedule – FMM upper economic limit as affected by de-rates)
- **Load**: Negative uninstructed imbalance energy
- **Imports**: MAX(0, Day-ahead energy schedule – FMM upper economic limit as affected by e-Tag transmission profile)
- **Exports**: MIN(0, FMM self-schedule – Day-ahead energy schedule)

Tier 2

- Metered demand

Imbalance Reserves Down

Tier 1

- **Generation**: MAX(0, FMM lower economic limit as affected by rerates – Day-ahead energy schedule)
- **Load**: Positive uninstructed imbalance energy
- **Imports**: MIN(0, MAX(e-Tag transmission profile, FMM self-schedule) – Day-ahead energy schedule)
- **Exports**: MAX(0, Day-ahead energy schedule – e-Tag transmission profile)

Tier 2

- Metered demand

Imbalance reserve unavailability no pay

- **Imbalance reserves up:** Resources with an upper economic limit that does not support their day-ahead energy + IRU award less the 5-minute uncertainty award in FMM will be charged the higher of the RTPD FRU price, the RTD FRU price, or the IRU price.
- **Imbalance reserves down:** Resources with a lower economic limit that does not support their day-ahead energy - IRD award plus the 5-minute uncertainty award in FMM will be charged the higher of the RTPD FRD price, the RTD FRD price, or the IRD price.

Bid cost recovery and grid management charge

- Revenues and bid costs from imbalance reserve awards will be included in day-ahead BCR.
- Market services charge will be applied for imbalance reserve awards.

Imbalance reserves and export protection

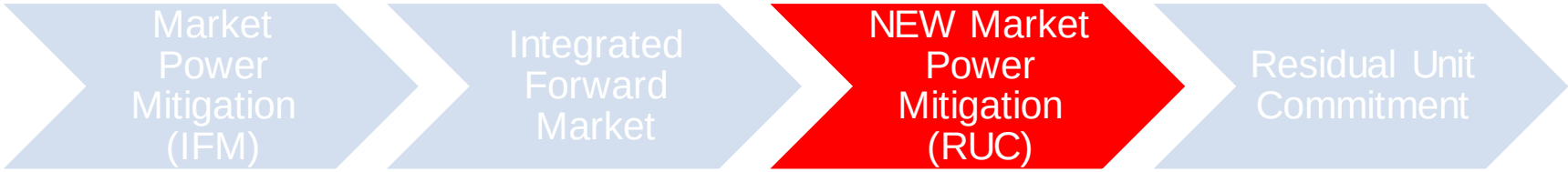
- Imbalance reserves should greatly reduce RUC adjustments that increases risk of export reduction in RUC.
- Graduated imbalance reserve penalty prices could allow more exports to clear IFM but increase curtailment risk in RUC if operators “backfill” the imbalance reserves

Imbalance reserves and PT exports

- A resource with non-RA capacity could both support a PT export and receive an imbalance reserve award.
- There is no direct link between the supporting resource's output and the export quantity.
  - Just requires sufficient bids
- Non-RA capacity supporting a PT export must bid reliability capacity up to the export self-scheduled quantity.

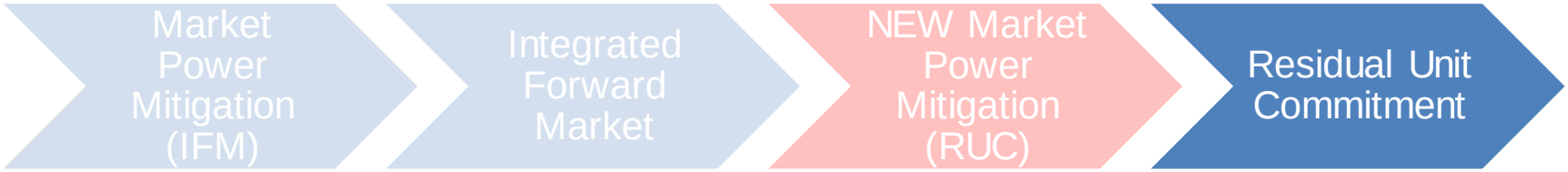
Market power mitigation for RUC

- Hold IFM schedules fixed and use unmitigated reliability capacity bids to procure reliability capacity to meet CAISO net demand forecast
- Resources that can provide counter-flow to an uncompetitive constraint will have their RCU bids mitigated
  - Extend DCPA and 3-pivotal supplier test to evaluate competitiveness
- Market will mitigate RCU offers only to the competitive locational marginal RCU price
- CAISO unconcerned about market performance and solve time



Residual unit commitment

- Holds IFM schedules fixed and procures incremental capacity (reliability capacity up) or decremental capacity (reliability capacity down) based on bids on IFM energy schedules compared to CAISO net load forecast
- Transition MSG resources in the downward direction (but not turn them off completely) and establish their binding configuration



Reliability capacity (RCU/RCD)

- RUC awards reliability capacity as either an incremental dispatch on an already-committed resource or by committing additional resources.
- RUC optimization will consider transmission constraints
- Reliability capacity awards are settled at the reliability capacity locational marginal price
- Reliability capacity awards will be limited to a resource's 60-min ramp capability

Multi-stage generating (MSG) resources

- MSG configurations are currently committed in the IFM
- RUC will transition MSGs in the downward direction but not shut down
- MSGs transitioned down in RUC can still support a PT export

Reliability capacity bids

- Reliability capacity bids can have different hourly price/quantity pairs but only a single price/quantity pair in each hour.
- CAISO will insert reliability capacity bids at $0 for the portion of the resource's capacity that is subject to a DA MOO.
- Resources that do not submit the required real-time bids based on their reliability capacity award will have economic bids inserted for them at their Default Energy Bid.

Reliability capacity cost allocation

Reliability Capacity Up

Tier 1

- **Net virtual supply:** Max of (a) zero or (b) scheduling coordinator net virtual supply awards
- **Under-scheduled load:** Net negative metered demand
- **Over-scheduled VERs:** Max of (a) zero or (b) sum of VER day-ahead schedule less their CAISO day-ahead VER forecast

Tier 2

- Metered demand

Reliability Capacity Down

Tier 1

- **Net virtual demand:** Max of (a) zero or (b) scheduling coordinator net virtual demand awards
- **Over-scheduled load:** Net positive metered demand
- **Under-scheduled VERs:** Min of (a) zero or (b) sum of VER day-ahead schedules less their day-ahead VER forecast

Tier 2

- Metered demand

Reliability Capacity No Pay

- **Reliability capacity up:** Resources with an upper economic limit that does not support their day-ahead energy + RCU award will be charged the higher of the RTPD FRU price or the RCU price.
- **Reliability capacity down:** Resources with a lower economic limit that does not support their day-ahead energy - RCD award will be charged the higher of the RTPD FRD price or the RCD price.

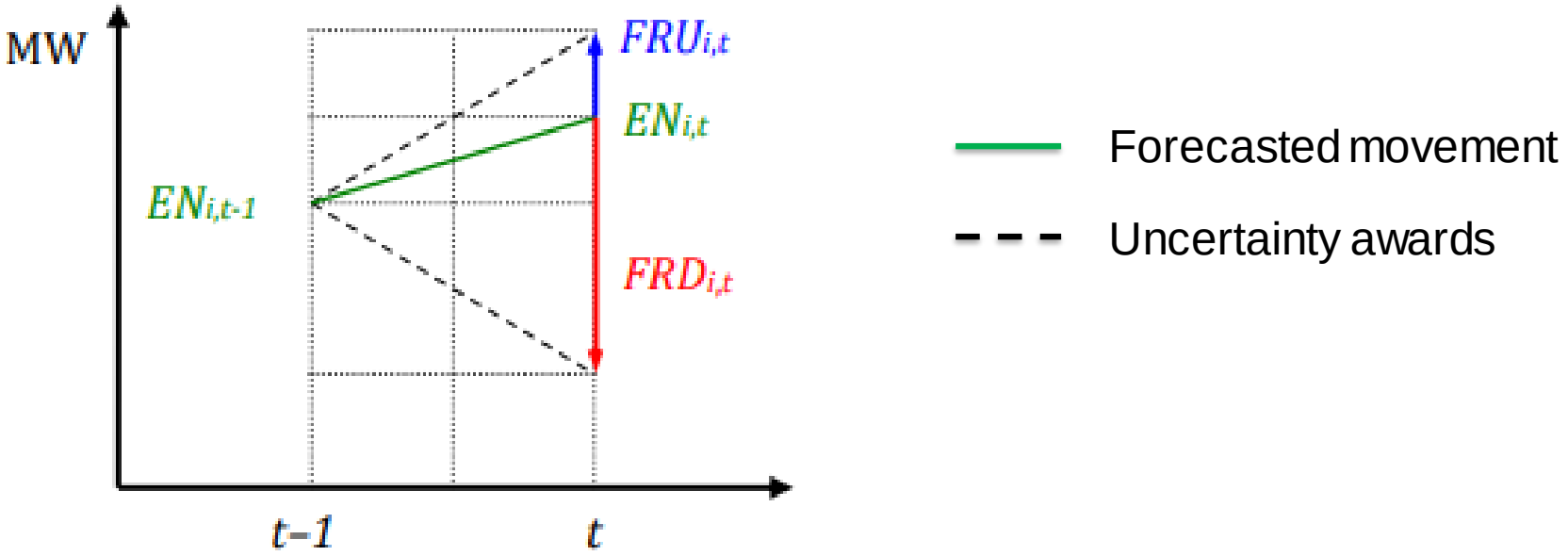
Bid cost recovery and grid management charge

- Reliability capacity revenue and cost will be considered in the RTM bid cost recovery over the day
- RUC BCR costs will be allocated to net virtual supply, under-scheduled load, and over-scheduled VERs in alignment with RCU cost allocation.
- Market services charge will be applied for reliability capacity awards

ADDITIONAL DAY-AHEAD MARKET ENHANCEMENT DESIGN CONSIDERATIONS

4.1 Real-Time Market Ramp Deviation Settlement

- Ramp is composed of …
  1. *Forecasted movement* is the change in energy schedules between intervals in same market run
  2. *Uncertainty awards* are additional ramp capability held back to meet changes in net load between market runs



Differences between imbalance reserves and flexible ramping product

- Differences between imbalance reserves and flexible ramping product make a direct deviation settlement infeasible

Imbalance Reserves	**Flexible Ramping Product**
Single settlement (uncertainty awards)	Dual settlement (uncertainty awards and forecasted movement)
Awards based on resource's 15-min ramp capability	Awards based on resource's 5-min ramp capability
Marginal clearing price based on bids and opportunity cost	Marginal clearing price based only on opportunity cost

Problems that can occur without a ramp deviation settlement

- Double payment of opportunity costs
  - Opportunity cost is part of marginal price of both imbalance reserves and FRP
- Double payment of forecasted movement
  - Forecasted movement is embedded in IFM energy LMP but is a side payment in RTM
- Capacity that is not available in real time reduces the available supply of ramp and drives up its price
  - Resources that do not provide the ramp they are obligated to should settle those deviations at prices reflecting real-time conditions.

Summary of ramp deviation settlement of forecasted movement and uncertainty awards

	Ramp Settlement
IFM Forecasted Movement	No side payment, paid energy price
IFM Imbalance Reserve Award	Pay award
FMM Forecasted Movement	Settle deviation from IFM 15-minute forecasted movement
FMM FRP Uncertainty Award	Settle deviation from embedded 5-minute ramp within IR award
RTD Forecasted Movement	Settle deviation from FMM 5-minute forecasted movement
RTD FRP Uncertainty Award	Settle deviation from FMM
Imbalance Reserve No Pay	Charge if 15-minute ramp above 5-minute deviations is unavailable

Impacts to EIM from ramp settlement

- Forecasted movement is included in EIM base schedule changes similar to CAISO day-ahead schedules
  - Deviation settlement will apply between base schedule and FMM schedule
- No imbalance reserve awards are included in EIM base schedules to meet uncertainty in FMM
  - No deviation settlement for uncertainty, all FRP uncertainty awards are incremental

Impact to convergence bidding from ramp settlement

- Convergence bids are settled at the day-ahead price and liquidated in FMM
- Forecasted movement is settled in the IFM energy price but is a side payment in FMM
- Virtual supply and demand will have a forecasted movement deviation settlement at the FMM FRP prices

Congestion revenue rights

- No changes are proposed to the existing CRR nomination and auction processes to account for imbalance reserves.
- Imbalance reserve costs are settled through allocation instead of direct locational settlement, which may cause CRR shortfalls because congestion revenue will not be collected on the imbalance reserve flows
- CAISO will monitor and be prepared to act

Accounting for energy offer cost in upward capacity procurement (1 of 3)

- Market cannot differentiate between two resources with same capacity bid but different energy bid costs when awarding upward capacity products
- Greater concern for IRU/RCU because there is a higher likelihood of being dispatched for energy in RTM
- Objective is to prevent opportunities for high energy cost resources from routinely being awarded IRU/RCU when the resources will rarely be dispatched for energy in the RTM

Accounting for energy offer cost in upward capacity procurement (2 of 3)

- Proposes a real-time energy bid price cap consistent with the expected system marginal price if the entire upward uncertainty requirement materialized ("P97.5 price") that applies to all resources awarded IRU/RCU
  - Resources with energy costs above cap must incorporate financial risk into IRU/RCU bid → higher bids for RCU and IRU → less likely to be awarded → meets policy objective

Accounting for energy offer cost in upward capacity procurement (3 of 3)

- Looking to establish general acceptance of the concept before working on the P97.5 price methodology
- P97.5 price would be published in advance of DAM close
- Quantity of real-time energy bids subject to the real-time energy bid price cap limited to the MW quantity of IRU/RCU awards
- Propose to implement functionality to turn off bid cap during pre-defined tight system conditions

Variable energy resource (VER) eligibility to provide new products

- VERs should be eligible to provide imbalance reserves and reliability capacity in both directions but CAISO is re-evaluating the specific mechanics by which VERs would be eligible for and participate in these products
- Proposes to alleviate concern around VERs providing IRU/RCU by requiring their High Sustainable Limit (HSL)

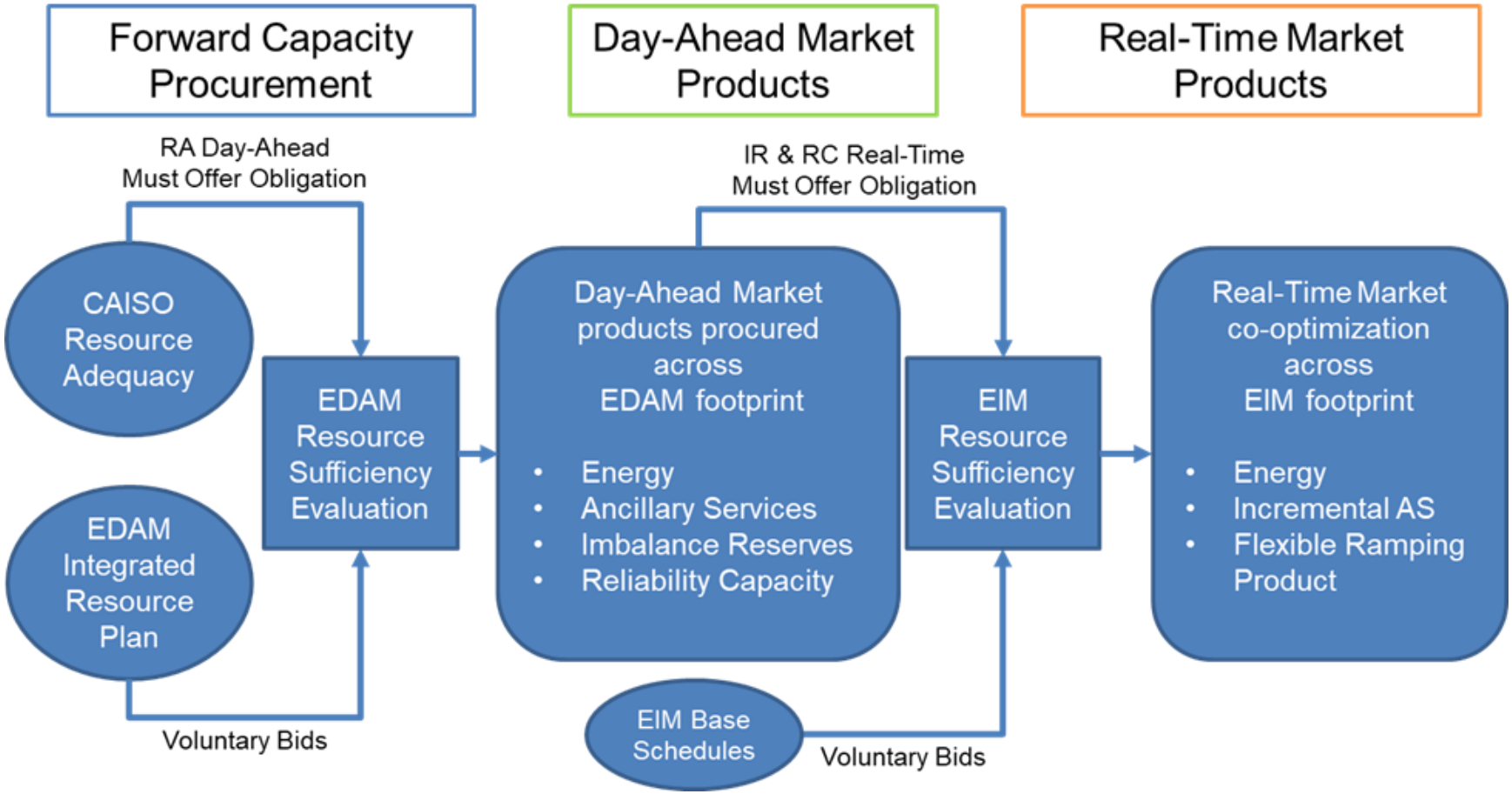
Interaction with energy storage enhancements

- Proposed Energy Storage Resource (ESR) model allows storage resources to submit bids based on incremental or decremental state-of-charge
- DAME formulation includes constraints to limit imbalance reserve and reliability capacity awards based on available SOC and SOC limits
- ESRs will need to ensure their RT energy bids reflect a SOC that is consistent with their obligations based on IRU/IRD or RCU/RCD awards

Day-Ahead Market Enhancements

ALIGNMENT BETWEEN RA ENHANCEMENTS, DAME, AND EDAM

Relationship between DAME, EDAM and RA Enhancements



Day-Ahead Market Enhancements

EIM GOVERNING BODY ROLE

EIM Governing Body Classification

Proposal	WEIM Governing Body Authority
Financial settlement of flexible ramping product, to remove the double payment of forecasted movement (§ 4.1)	Joint authority
Other changes to the financial settlement of flexible ramping product (§4.1)	Advisory role
Real-time offer obligation for resources with California Resource Adequacy obligations (§ 3.1)	Advisory role
Real-time energy bidding rules for resources that received awards in the day-ahead market to provide imbalance reserve up or reliability capacity up (§ 3.3)	Advisory role
Bidding obligations for resources that have day-ahead schedules for imbalance reserve or reliability capacity (§ 3.1)	Advisory role
Remainder of initiative	No role

California ISO

DAME Appendix C: Local Market Power Mitigation Examples

Next Steps

Date	Milestone
April 22, 2022	3rd Revised Straw Proposal
April 29, 2022	Stakeholder Meeting
May 19, 2022	Comments Due
July 19, 2022 (tentative)	Draft Final Proposal
September 1, 2022	ISO Board of Governors and WEIM Governing Body joint meeting
Fall 2023	Implementation

Submit comments using the comment template linked on the initiative webpage https://stakeholdercenter.caiso.com/StakeholderInitiatives/Day-ahead-market-enhancements

Please contact isostakeholderaffairs@caiso.com