WPTF WESTERN POWER TRADING FORUM

Day-Ahead Market Enhancements Presentation 1

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About Western Power Trading Forum

- Western Power Trading Forum (WPTF) is a non-profit, trade forum dedicated to competitive markets and transparency at the California ISO and across the West
- The CAISO Committee is paid monthly service for WPTF members that covers CAISO policy and important happenings

- *This presentation does not necessarily represent individual WPTF members' views*

About Gridwell Consulting

Analysis and advocacy consulting firm located in Sacramento, California – www.gridwell.com

- Educate, model, advise, and advocate
- Resource Adequacy Landscape and Price Forecast Report
- Seminars on CAISO market, resource adequacy, and battery storage resources
- Storage optimization and modeling for RFOs, due diligence, and bid strategy
- Interconnection evaluation and contract negotiation services

"All Things CAISO"

Disclaimer

- California ISO (CAISO) and the California Public Utility Commission (CPUC) are constantly updating their rules, processes, and market optimization
- This presentation contains information on the current CAISO and CPUC market rules, as of February 2023

Problem Statement Recap

Background

- IFM clears bid-in virtual and physical internal supply and imports against bid-in virtual and physical internal demand and exports
- RUC removes the virtual supply, adjusts renewables to their forecast and then clears physical supply (including imports) against the CAISO forecast of demand (including exports)
- Despite this, the CAISO is not confident that sufficient economic offers will be submitted in real-time to meet real-time needs
- Historically, it has been considered sufficiently reliable to depend on the spot market for unexpected energy needs, but thin capacity margins and high renewable penetration are decreasing CAISO confidence

Problem Statement

- CAISO would like more assurance in day-ahead that sufficient real-time economic offers will show up in real-time, specifically to account for changes in supply and demand conditions (uncertainty)
- There are varying levels of reliance on spot market for uncertainty across different operators at the CAISO and across the different EDAM entities
- CAISO believes operator action is an insufficient and inefficient way to ensure real-time reliability
  - Operator action in RUC, rather than an IFM market solution, can prevent efficient day-ahead price signals
  - Operator action in RUC is also lumpy and is not well correlated with actual real-time uncertainty needs
  - RUC cannot mandate economic offer, only that a resource bid or self-schedule into real-time

Day-Ahead Possible Changes to Address Real-Time Uncertainty

- How can day-ahead actions impact the real-time market?
  - Commit additional long-start resources with real-time must-offer
  - Schedule more imports/transfers in with real-time must-offer
  - Schedule less export/transfers out
  - Offset uncertainties over a larger footprint through regional diversity
- Short and medium-start resources are already available to the CAISO in real-time via their Participating Generator Agreement, resource adequacy must-offer obligation, or resource sufficiency requirement
  - Once past day-ahead time frame, lost chance to commit long-starts
  - Potentially over- or under-scheduled transfers/imports & exports between regions eroding trust and efficiencies

Imbalance Reserve Product

Imbalance Reserve Product Overview

- CAISO will procure additional capacity from resources in the IFM market and preserve this capacity through RUC process
- Imbalance Reserve Product (IRP) will be co-optimized with energy and ancillary services
  - Awarded capacity will have an economic real-time must offer obligation (no self-schedules)
- RT market uses energy offers from all resources to co-optimize Flexible Ramping Product and energy; Ancillary Services are not re-optimized
- Settlement provisions if IRP capacity does not show up in real-time; must pay higher of FRP and IRP
- Product could be procured under a nodal or zonal framework

Imbalance Reserve Product Framework Options

- WPTF supports evaluation of two IRP frameworks
  - Nodal procurement (a little more like IFM Energy)
  - Zonal procurement (a little more like Ancillary Services)
- Nodal framework uses deployment scenarios and is described in CAISO DAME documentation
- Zonal framework imposes regional constraints based on hourly forecasted congestion and other factors
- Zonal provides benefits relative to a nodal framework from a market design perspective
  - Easier and potentially more accurate to forecast uncertainty
  - Less need for complex market power mitigation construct
  - More transparent price signal so uncertainty needs are distinct from energy needs
  - No additional CRR shortfall concerns
  - Lower implementation risk and lower market timeline risk

Zonal Framework Overview

- Resources still get a specific IRP award the same as in nodal
- Requirements, procurement, and pricing are by region
- Regional requirement set by minimum and/or maximum procurement constraints determined hourly
  - A region is defined as a set of Pnodes
  - Analysis of current and expected Ancillary Service deliverability to determine exact zonal methodology
- Capacity does not compete for use of transmission in optimization except on the interties and transfers where they do compete for transmission
- Regional and sub-region requirements would consider uncertainty patterns, transfer limits, outages, and congestion are considered within minimum and maximum regional procurement constraints

Why Evaluate Zonal Framework

- Benefits articulated on slide 11
- Downsides with moving to a nodal design
  - Justification provided thus far on why nodal is needed is weak
  - Deployment scenarios are complex and have unrealistic uncertainty assumptions
  - Interact with Ancillary Services in a way that may degrade reliability and lead to additional operator intervention in RUC
  - Impacts day-ahead price formation in a way that may be inefficient
  - Requires other complex market design elements
  - Implementation and market timeline risk

CAISO explanation of need for nodal

- The explanation that nodal procurement was needed due to the CAISO's experience with Flexible Ramping Product (FRP) seems weak
  - Day-ahead deliverability isn't a thing in a financial market
  - FRP was originally a system-wide product and not procured zonally
  - FRP is a real-time product procured dynamically under actual conditions
  - Opportunity cost methodology means that wind and solar have a $0 opportunity cost and if behind a constraint, their opportunity cost would be $0 and thus likely to be awarded
- Additionally, we observed significant issues with the FRP implementation and have not yet received an update on how well the new nodal design is working
- Finally, we noted that Ancillary Services (AS) are procured zonally so if there was an issue, shouldn't we have concerns about AS procurement?

Forecasting uncertainty challenges

- A nodal design is heavily dependent on deployment scenarios because they must make assumptions about the exact location that uncertainty materializes
  - Seems challenging and CAISO current proposal allocates uncertainty roughly based on size, thus it materializes proportionally to expected load or renewable output
  - Intuitively this seems unlikely, we'd assume solar in Bakersfield has different uncertainty than solar on the coast
  - Is it easier to predict areas that uncertainty may materialize rather than individual nodes?
- Our understanding that the deployment scenarios assume all upward materializes and then all downward
- But even if we don't go to zonal, shouldn't the nodal deployment scenarios have a better forecasting methodology and deployment assumptions?

AS and Imbalance Reserves

- Ancillary Services are regulatory mandated capacity products to account for real-time uncertainty and contingency events
- It is vitally important that operating reserves are deliverable, or they will be useless in a contingency event, and this could cause a grid failure
  - It does not matter how often they are deployed, when they are needed, they are critical to grid reliability
- It is our understanding that AS is not re-optimized in the real-time market because operators want confidence that the resources awarded AS in day-ahead will maintain those awards in real-time
- AS is procured under a zonal framework and operators can block a particular resource if it is behind a constraint

Product importance

- There is a hierarchy of importance of CAISO functions that are enforced through penalty prices:

1. Ensure sufficient capacity is available to bid into real-time to meet forecasted demand
2. Ensure Ancillary Service are available in case of real-time contingencies and as regulation
3. Additional capacity is committed as a hedge against real-time uncertainty

WPTF believes it is important that any IRP design ensure Ancillary Services are at least as likely to be deliverable in real-time as the imbalance reserve product

Significant concern

- If IRP is procured at the nodal level, and AS at a zonal level – all else being equal - will the CAISO be prioritizing IRP deliverability over AS deliverability?
- And if there are already "problems" with AS deliverability (as CAISO has asserted anecdotally without data), won't this just make things worse?
- The CAISO must provide evidence whether there are AS deliverability issues
  - If there are issues with AS deliverability then the zones should be adjusted (as discussed in CAISO Business Practice Manuals) and the CAISO should evaluate whether this would work for IRP, OR
  - If there are issues with AS deliverability then the CAISO should add nodal AS to the scope of this initiative

LMP Price implications

- A nodal design will generate false price signals for energy and IRP because of the deployment scenario assumptions
  - Prices reflect congestion that assumes 100% of procured IRP will materialize, which we know is not true
  - Price signals will always be inaccurate due to deployment assuming 100% upward and then 100% downward
- Under a zonal approach the price signals are not dependent on unrealistic assumptions
  - Congestion patterns will not impact IRP prices, which is more appropriate
  - Instead, congestion patterns will be used to define procurement zones

LMP Price Implications Nodal

- A nodal design may generate energy and IRP prices that do not provide a clear market signal for each product (energy, IRU, and IRD) at each location because of the interaction of bids
  - Seems counter to the concept of nodal pricing if one cannot clearly interpret the meaning of each price and its underlying components
  - Energy price for resources behind a transmission constraint may be higher relative to resources on the other side of the constraint (as demonstrated by CAISO solver)
  - When congestion occurs due to deployment scenarios, IRP prices are based on energy offers from resources at other locations (as demonstrated by CAISO solver)

LMP Price Implications Zonal

- Under a zonal approach the price signals are more transparent for both products
  - Energy price formation remains unchanged other than the natural interaction of co-optimizing all products
  - Prices for the IRP can reflect value of upward/downward capacity in a general area more transparently

Complex Market Designs Nodal

- A nodal design requires the need for other complex market design elements that also need to be evaluated for adverse market impacts and commensurate benefits
  - Creates the need to implement local market power mitigation (LMPM) approach which is a methodology for energy being imposed on a capacity product
  - There is no standard methodology to determine a competitive capacity offer
  - The "competitive" capacity offer used for mitigation may be based on energy offers when congestion occurs in deployment scenarios
  - CRR holders will be harmed due to the implementation of a capacity product for real-time uncertainty and results in cost shifting

Less Complex Market Design Zonal

- Under a zonal approach there is no need for additional complex market design features which allows for more transactable and transparent market
  - Market power mitigation can be address through a cap
  - No adverse impact to CRR market

Implementation and Timeline Risk

- A nodal design is inherently more complex and has increased implementation risk and higher probability of delayed day-ahead market results
  - Should we risk EDAM implementation delay at all due to complex DAME design or are we comfortable with last minute implementation shortcuts to ensure timely EDAM implementation?
- A nodal design will require additional market processing time and may delay posting of day-ahead market results
  - CAISO has already noted the nodal design is not the "Cadillac" version due to increased computational time needed
  - What other non-CAISO market transactions are dependent on day-ahead results?

Wrap up: Zonal vs Nodal

- CAISO should address these considerations as they will significantly impact the efficiency of the overall market
- Any changes to the day-ahead market must be thoroughly evaluated to ensure commensurate benefits as it represents the largest opportunity for gained efficiencies
- Zonal approach should be meaningfully considered by the CAISO as it provides benefits relative to a nodal approach


Thank you! Questions?

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APPENDIX – ANCILLARY SERVICES

Ancillary Services Overview

- The CAISO has two regions and eight sub-AS Regions for AS, which account for expected congestion on the interconnections and Path 15 and Path 26
- Requirements, procurement, and pricing are by AS region and minimum and/or maximum procurement constraints are determined hourly

Background Reading: Chapter 4 of Market Operations BPM

	AS Region Name	Description of AS Region (set of resources included in AS Region)		AS Region Status
		Internal CAISO Balancing Authority Area	Intertie Resources (current Scheduling Points)	
1	*Expanded System*	All internal Generators	All	Active
2	*System*	All internal Generators	None	Active
3	*South of Path 15*	All Generators residing South of Path 15	None	Active
4	*Expanded South of Path 15*	All Generators residing South of Path 15	NW3, SR3, NV3, NV4, AZ2, AZ3, AZ5, LC1, LC2, LC3, MX, LA1, LA2, LA3, LA4, LA7	Active
5	*South of Path 26*	All Generators residing South of Path 26	None	Active
6	*Expanded South of Path 26*	All Generators residing South of Path 26	NW3, SR3, NV3, NV4, AZ2, AZ3, AZ5, LC1, LC2, LC3, MX, LA1, LA2, LA3, LA4, LA7	Active
7	*North of Path 15*	All Generators residing North of Path 15	None	Active
8	*Expanded North of Path 15*	All Generators residing North of Path 15	NW1, NW2, SR5, SR2, SMUD, TID, Sutter	Active
9	*North of Path 26*	All Generators residing North of Path 26	None	Active
10	*Expanded North of Path 26*	All Generators residing North of Path 26	NW1, NW2, SR5, SR2, SMUD, TID, Sutter	Active

Ancillary Service Regions

- CAISO may establish minimum and/or maximum AS procurement limits for each AS Region, taking into consideration one or more of the following factors:
  - Loads and generation Path Contingency deratings
  - Path Total Transfer Capability (TTC)
  - Largest single Contingency (on-line Generating Unit or in-service transmission)
  - Forecasted path flows
  - Other anticipated local operating conditions for Load and/or Generation pocket AS Regions
- CAISO may also establish a maximum upward capacity constraint
  - Reduces likelihood that significant AS capacity is allocated where there are too many energy supply limitations (transmission or other constraints)

Ancillary Service Sub-regions

- The CAISO considers the following factors when establishing a minimum or maximum limit for each AS sub-Region:
  - The CAISO Forecast of CAISO Demand
  - The location of Demand within the Balancing Authority Area
  - Information regarding network and resource operating constraints that affect the deliverability of AS into or out of a AS sub-Region
  - The locational mix of generating resources
  - Generating resource outages
  - Historical patterns of transmission and generating resource availability
  - Regional transmission limitations and constraints
  - Transmission outages
  - Available Transfer Capacity
  - Day-Ahead Schedules or RTM Intertie Schedules
  - Whether any Ancillary Services provided from System Resources requiring a NERC tag fail to have a NERC tag
  - Other factors affecting system reliability

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Path Forward

WPTF Proposes a Path Forward

1. Separate general DAME design decisions from IRP framework decisions and impact
2. Benchmark framework ability to achieve DAME goals
   - How well does each framework address the problem statement and improve EDAM footprint efficiencies?
3. Compare each framework's market, reliability, and regulatory impacts
   - Price formation rationality
   - Cross-product impacts; LMP price formation, ancillary service deliverability
   - Need for local market power mitigation and CRR shortfall mitigation rules
   - Implementation risk and optimization integrity and timeliness
   - Transparency
   - FERC risk – benchmark against other ISO designs

Separate - Design Decisions Regardless of Framework that Need Additional Work

1. Downward need for imbalance reserves
   - Seek EDAM entity input and look toward RS flexibility tests for information
   - CAISO area: only 0.25% of renewable generation self-scheduled was cut in 2022, indicating ample downward dispatchability and RUC never seems biased downward
2. Imbalance reserve product total requirement methodology
   - Is procuring based on 97.5% and 2.5% percentiles of uncertainty an appropriate percentage?
3. Demand curve design issues from final draft proposal
   - Resource Sufficiency test implications of using a demand curve
4. Storage provision IRP constraints
   - Is CAISO's ability to add constraint and meet market optimization timeline related to nodal versus zonal framework? Otherwise, why not include?
5. RUC market power mitigation needed or just cap?

Benchmark

Resolve Problems
Increases real-time economic offers
Improve day-ahead price formation
Improve operator confidence and decrease operator intervention

Improve Efficiencies
Offset uncertainties over larger footprint
Increases economic efficiencies of larger footprint hedging risk
Maintain flexibility in real-time through creation and enforcement of RT MOO
Increase confidence in EDAM transfers
Consistent treatment of flexibility in EDAM RSE
Others?

Benchmark Template

	Nodal Framework	Zonal Framework	Considerations
Increases real-time economic offers	☑	☑	Only to extent it requires more economic offers than current bidding practices or other existing requirements in real-time
Improve day-ahead price formation	☑	☑	Both improve if additional Pmin energy within IFM and not RUC; price signal varies based on framework
Improve operator confidence and decrease operator intervention	☑	☑	To extent AS and IRU are both deliverable in real-time

Compare

Market	Reliability	Regulatory
Price formation and transparency	Ancillary Service deliverability	FERC risk
Market power mitigation rules	Real-time deliverability of IRP	Implementation timing
CRR shortfall		
Market timeline risk		

Compare Template Example

Reliability: Ancillary Service Deliverability

	Overview	Analysis Needed	Importance of Issue
Zonal	IRP procured regionally in a similar manner to AS. Will compete on interties for transmission with AS and could cause increase in internal AS to be procured. Operators will continue to have ability to block AS resources and may have to do so more often than today, but less than if nodal framework implemented.	The level of Ancillary Service blocking today would indicate whether nodal would harm reliability if AS blocking had to increase due to nodal procurement. Real-time blocking after nodal FRP implementation may also be indicative of nodal framework concerns in IFM.	Ancillary Services are vital to ensuring the CAISO does not cause a total grid failure and their deliverability and procurement should be prioritized above most items.
Nodal	IRP procured at nodal level in a similar manner to energy. Will compete for transmission internally and on interties. Operators will continue to have ability to block AS resources and may have to do so significantly more often than today.		
Proposal	The CAISO evaluated x,y,z and determined a,b,c.		

WPTF Request to CAISO

1. Acknowledge the importance of day-ahead market and the need to consider implications on price signals and broader market
2. Do up-front analysis and evaluation of trade-offs between possible solutions
3. By the end of the March workshops have a strategy and plan to move DAME forward for stakeholders to comment on


Thank you! Questions?

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Outstanding Questions

- How does Pooled WEIM Flex test work?
  - Final proposal does not provide details
  - Our understanding based on CAISO discussions, its pooled
- What happens if 100% of IR requirement not procured in IFM due to demand curve
  - Increase likelihood of failing WEIM RSE tests?
- Is IRD used in any of the RSE tests?
- What is the impact on RSE flex test if resources awarded IRU are used for that capacity in real-time?
  - Do they not have any upward ramping capability left, so BAA has to get upward flex from other resources?
- Is the IR requirement the same as the uncertainty requirement used in the WEIM RSE flex test?
  - Both use quantile regression approach

Why did the CAISO add software issues as reason for AS blocking?

Version	Change	Date
3.4	Converted from Word SharePoint to Centric	3/09/16
3.5	Minor updates to clean up formatting; no content changes	9/30/16
3.6	Added consideration to add continuing real-time AS blocking into tomorrow's Day-Ahead. Minor format and grammar updates. Replaced A/S with AS.	3/22/18
4.0	Periodic Review: Section 1.4: Updated by adding instances when the "RESOURCE" constraint type drop down should be used. Section 1.3, Steps 2 & 4: Updated second bullet to include "as necessary." Replaced instances of ISO with CAISO.	10/21/21
4.1	Section 1.4: Added consideration for real-time AS blocking ("system condition, unit issue, or software issue").	2/01/23