California ISO

RA Modeling & Program Design:
Modeling Improvements + Straw Proposal Leanings and Options

February 10-11, 2025

Housekeeping Reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.

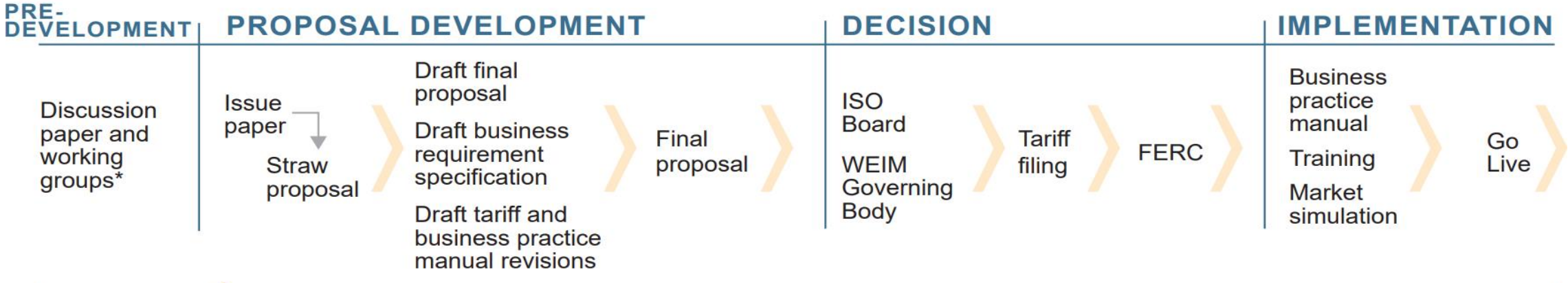
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.

- Please keep comments professional and respectful.

Instructions for raising your hand to ask a question

- If you are connected to audio through your computer, select the raise hand icon located on the bottom of your screen.
- If you dialed in to the meeting, press #2 to raise your hand.
- Please remember to state your name and affiliation before making your comment.
- You may also send your question via chat to all panelists.

Working Group in context



Discussion papers and working groups will be incorporated into the stakeholder process dependent on the nature of the initiative, and may not be necessary for all initiatives.

We are here

This represents the typical process, and often stages run in parallel.

Stakeholder meetings, working groups and workshops may occur throughout the stakeholder process.

Today's Agenda – Track 1

Time	Topic	Speaker
9:00 – 9:15 AM	Welcome	Christina Guimera
9:15 – 9:30 AM	Introduction	Aditya Jayam Prabhakar
9:30 – 10:00 AM	Stakeholder Feedback Review	Ansel Lundberg
10:00 – 10:30 AM	2024 Showings Backcast Analysis Request	Xuping Li
10:30 – 10:45 AM	Break	
10:45 – 11:30 AM	Modeling Improvements	Sai Koppolu
11:30 – 12:30 PM	Default Counting Rules Proposals: Options	Mark Kootstra
12:30 – 1:30 PM	Lunch	
1:30 – 2:00 PM	Accounting for Ambient Derates	Ansel Lundberg
2:00 - 3:00 PM	UCAP	Ansel Lundberg
3:00 - 3:15 PM	Break	
3:15 - 4:00 PM	Stakeholder Presentations	CESA, LSEs

Preview – Tomorrow's agenda: Tracks 2 and 3

Time	Topic	Speaker
9:00 - 9:15 AM	Welcome & Framing	Partha Malvadkar
9:15 - 10:00 AM	Track 3: Visibility	Hilary Staver
10:00 - 10:20 AM	MRP Visibility	Nuo Tang
10:20 - 10:35 AM	Break	
10:35 - 11:30 AM	Track 2: Outage and Substitution	Anja Gilbert
11:30 - 12:00 PM	Stakeholder Presentations	LSEs & DMM
12:00 - 1:00 PM	Lunch	
1:00 - 3:00 PM	Track 2: Availability and Incentive Mechanisms	Anja Gilbert
2:45 - 3:00 PM	Next Steps	Partha Malvadkar

RA package options and leanings

Topic	Summary
Modeling and Defaults	Updated defaults provided as a tool to LRAs to adopt our default rules based on state-of-the-art, transparent probabilistic modeling
UCAP	• Addition to CAISO NQC process to reduce QC values based on resources' forced outage rates • "Supply cushion UCAP" - looks at each RA resource's forced outage rate during a portion of the "tightest" hours of each season (876 hours in each summer and non-summer season) over the past few years to develop a UCAP factor • Applies a derate to resources that do not receive a QC value from an LRA derived from a probabilistic or performance-based methodology (exceedance, ELCC…)
Ambient Derate	Outage data-driven approach to capture ambient derates during historic peak conditions in NQC
RAAIM	New mechanism, Measuring Unavailable RA (MURA), which would assess unavailability during stressed grid conditions and allocate the penalty costs collected from under performing-RA to load
Outage and Substitution	• New processes for conditional approval of outages (without substitution) and a pool design (when substitution is needed) • New definition added for "urgent" outage which functionally is akin to a forced outage
Visibility	Monthly reporting requirements for RA-eligible capacity not shown as RA

Proposed schedule

		Q1	Q2	Q3	Q4
Resource Adequacy Modeling and Program Design					
	Track 1: Modeling, Defaults, and Accreditation	**Policy development**		**Decision (Default Counting Rules/PRM)**	**Implementation (Default Counting Rules/PRM)**
	Track 2: Outage & substitution and availability and incentive mechanisms	**Policy development**		**Decision**	
	Track 3a: Backstop reform and long-term EDAM RSE solutions	**Policy development**			
	Track 3b: RA status visibility	**Policy development**		**Decision**	**Implementation**

What are you going to see this morning?

- Summary of stakeholder feedback and CAISO responses
- 2024 RA Showings' backcast analysis request
- PLEXOS model inputs and methodology improvements:
  - PLEXOS 11 upgrade
  - Resource portfolio update
  - Stochastic hydro modeling
  - Battery modeling
  - Updated maintenance and forced outage rates
- Review Qualifying Capacity counting rule proposals
- Next steps and questions for feedback

STAKEHOLDER FEEDBACK & CAISO RESPONSES

Overall comments from stakeholders

Theme (Parties)	CAISO Response
Supportive of 1-in-10 loss of load expectation modeling to update CAISO tariff default rules, particularly in light of new state legislation AB 2368 (many parties).	CAISO appreciates stakeholders' engagement and input as we develop the model and default rules.
Work with CPUC to align or clarify differences between LOLE modeling efforts (ACP-CA, AReM) Shared dataset with CPUC, CEC (AReM).	The CAISO continues to work with state agencies to better understand differences in models, and align as appropriate.
Suggesting LOLE analysis of previously shown RA portfolios - i.e., "backcast" (MRP, SCE, CESA, Peninsula Clean Energy, Six Cities).	Some high-level observations for discussion today.

Comments on default rules for qualifying capacity

Theme (Parties)	CAISO Response
Goal of unified counting rules across CAISO BAA (ACP-CA, Cal CCA, SDG&E, Sunrise).	LRAs retain control over their own RA programs. The scope of this work is to update the default CAISO QC rules and PRM and would only apply to LRAs that do not have their own QC and PRM methods.
CAISO should clarify its intent when considering marginal ELCC methods (AReM).	The CAISO is looking at marginal ELCCs as one of the options for default qualifying capacity rules.
Supports placing all resources types on a level playing field and accurately reflecting their capabilities (CalCCA).	CAISO agrees.

Comments on default rules for qualifying capacity

Theme (Parties)	CAISO Response
Various parties support different QC methods including: SOD, average ELCC, and UCAP.	The CAISO acknowledges the differing opinions and motivations. Note that non-CPUC LRAs did not suggest adopting SOD for CAISO's default counting rules.
Aligning CAISO RA processes with slice-of-day design has benefits and drawbacks.	CAISO agrees and will continue to analyze its impact on CAISO RA processes and procedures.

Comments on default rules for planning reserve margins

Theme (Parties)	CAISO Response
PRM and accounting methods need to be aligned (CalCCA, SCE).	CAISO agrees.
Update default PRM on same cadence as CPUC (ACP-CA, IEP, SDG&E). Interested in seasonal PRM for gross and net peak needs (Six Cities).	Methodology to determine the default PRM and the schedule for updating default rules will be discussed with stakeholders.

Comments on modeling updates

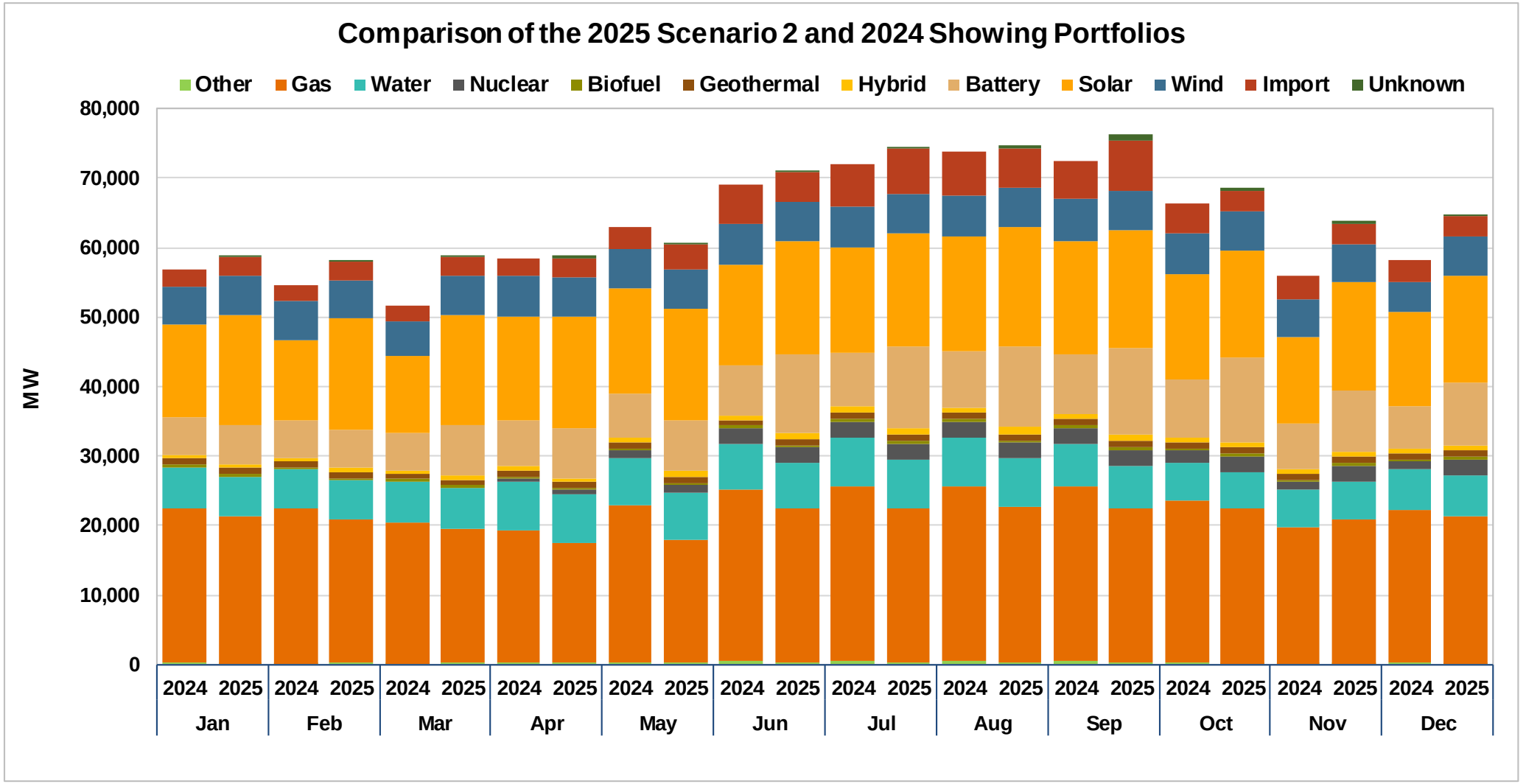
Theme (Parties)	CAISO Response
Requesting formalized, final I&A document (CESA).	An I&A document is in development along with the updated model.
Updated forced outage data inputs with detailed explanation (Cal CCA, MRP, Microsoft, SCE, WPTF) and incorporate 2024 IEPR forecast (Microsoft, WPTF).	The CAISO will share progress on updated forced outage data today. The CAISO will incorporate the 2024 IEPR forecast into its modeling.
Update storage modeling and dispatch (Microsoft, WPTF).	The battery storage modeling is being updated, additional information will be provided today.
Resource profiles: study various hydro scenarios (MRP, Cal CCA, SCE), sensitivity analysis of VER production (SDG&E, Cal CCA) and resource retirements (Sunrise Power Co.).	Thank you for your support and appreciate your input as we continue to make improvements to the model.

2024 RA SHOWINGS' BACKCAST ANALYSIS REQUEST

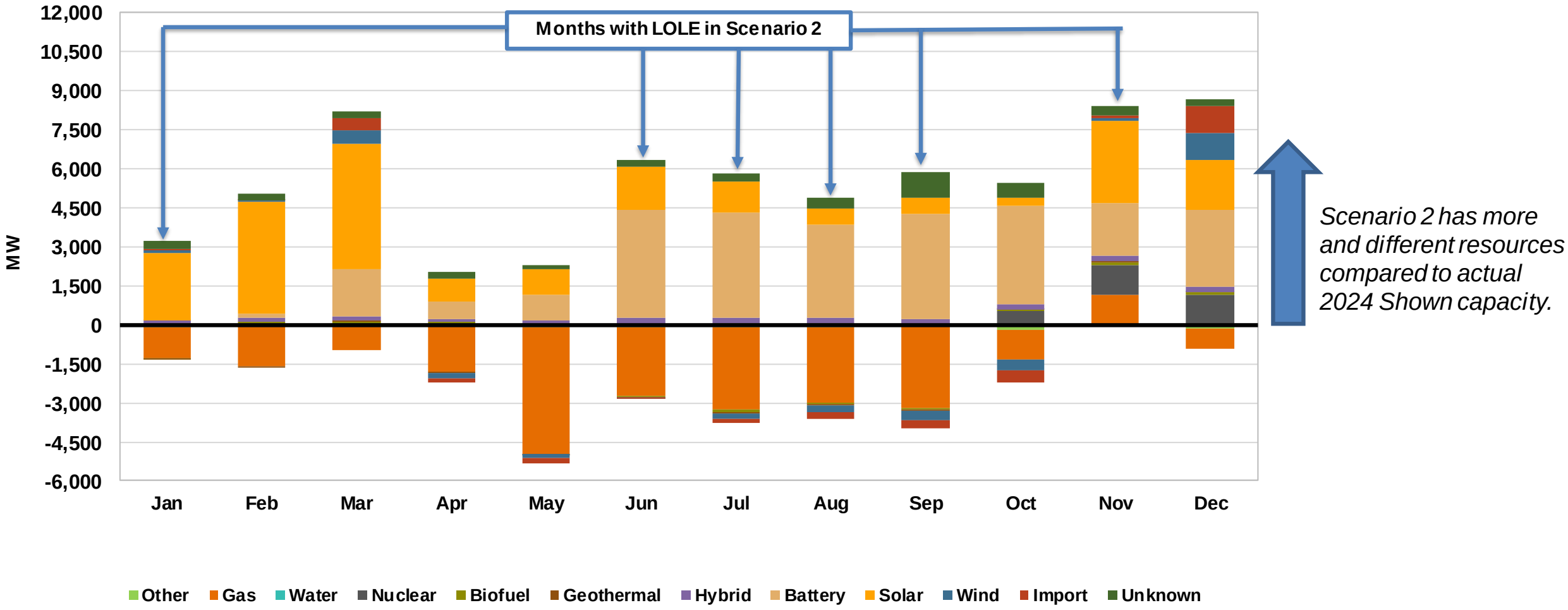
Several stakeholders have requested the ISO to perform LOLE analysis of previously shown RA portfolios

- 2025 Scenario 2 portfolio was developed using the LSE survey and informed by historical RA showings for those LSEs that did not provide a survey response. Scenario 2 modeled RA capacity in excess of monthly obligations consistent with historical pattern of observed excess.
- In lieu of a detailed analysis, CAISO compared the 2024 RA showings to the 2025 Scenario 2 portfolio that was modeled in PLEXOS:
  - Additional differences include updated IEPR load forecast and new resources since 2024
  - Solar, wind, and hydro resources shown are compared using nameplate capacity, and
  - Other resources are compared at Shown capacity.

Monthly portfolios in Scenario 2 exceed 2024 Shown capacity (except in May)



Difference between the 2025 Scenario 2 and 2024 Shown portfolios



Scenario 2 has more and different resources compared to actual 2024 Shown capacity.

2024 Shown RA portfolio is expected to produce a higher LOLE than the 2025 Scenario 2 that resulted in a 0.308 LOLE

2025 Year Ahead Scenarios	LOLE (Days/Year)
1. Showings capped at obligation	0.782
2. RA showings based on historical pattern	**0.308**
3. All RA Eligible, base case	0.024
3a. All RA eligible, (1-in-10 Calibration)	0.1

PLEXOS MODEL INPUTS & METHODOLOGY IMPROVEMENTS

In this section, we will cover details of improvements currently being made

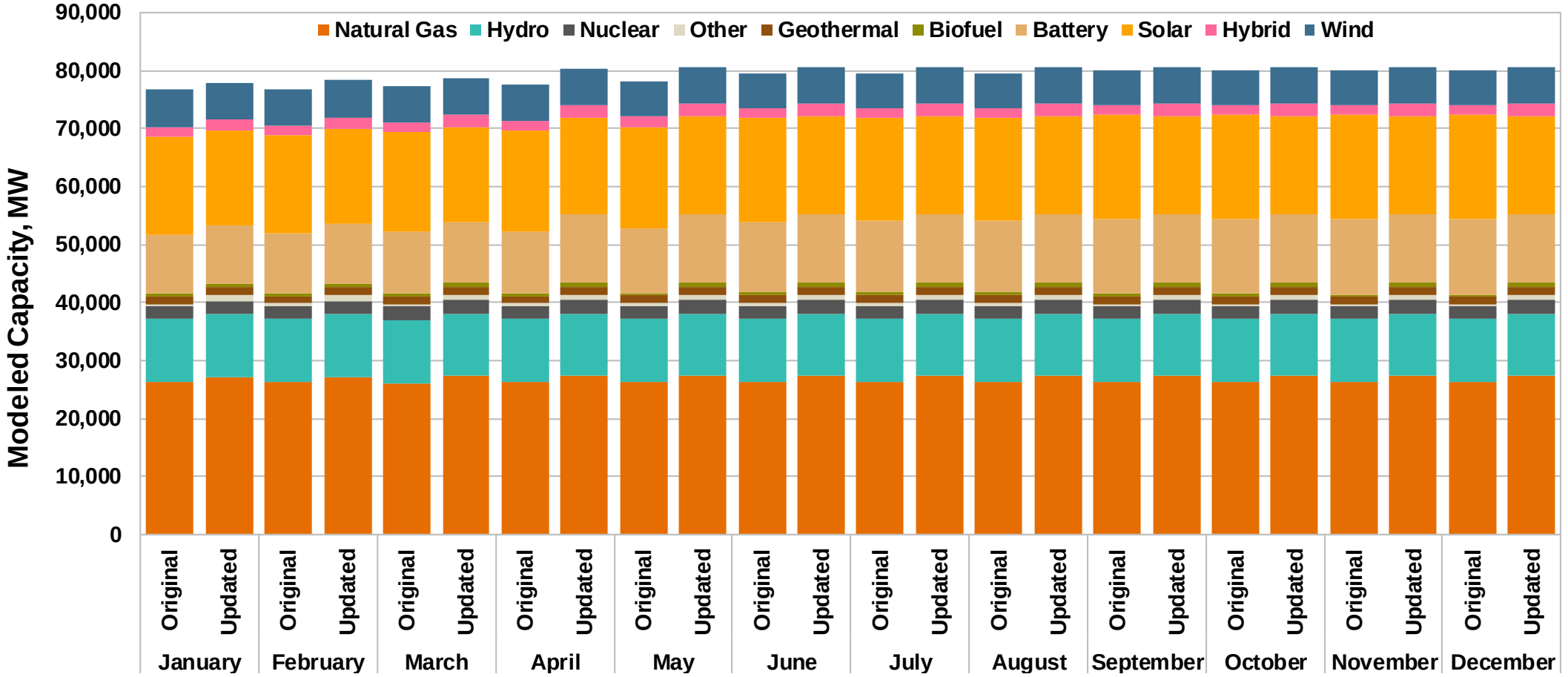
- Upgrade to PLEXOS 11
- 2025 Resource Portfolio update
  - Use latest 2025 NQC list and new resources information from NRI.
- Stochastic Hydro profiles
  - Incorporate 25 years of historical hydro data (2000-2024) expanding the variability of hydro conditions in the model.
- Storage modeling improvements
  - Model storage individually with its own resource level characteristics such as min/max SOC, round-trip efficiency, ramp rates, etc.
- Updated maintenance and forced outage rates
  - Use historical OMS data (2022 – 2024) to reflect resource-specific outage rates and ambient due to temperature derates.

PLEXOS 11 version update

- Improved Model Accuracy: The updates, especially for energy storage, hydro variability will improve model accuracy, leading to better dispatch decisions in the model.

- Operational Optimization: The more detailed parameters for conventional generators will lead to more efficient dispatch decisions, accounting for unique start-up times, ramping constraints, and heat rates.

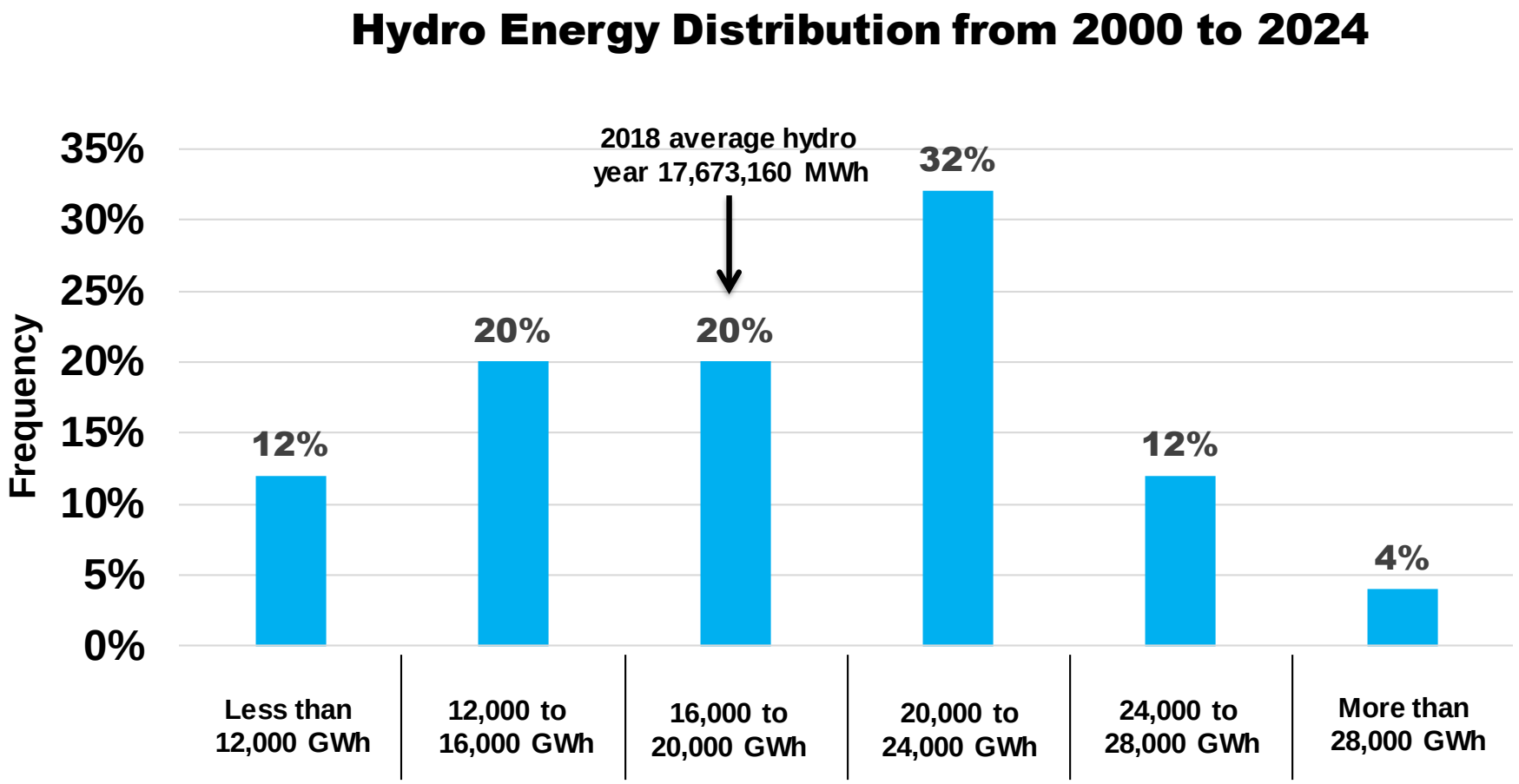
All RA Eligible (scenario 3) resource portfolio was updated based on the January 2025 NQC list and uses CAISO NRI (new resource implementation) data for projected new resources



Stochastic Hydro Model

- Using 500 stochastic samples based on historical hydro years to increase hydro diversity for improved risk management instead of using a single representative hydro year.
- Hydro data sourced from 2000-2024:
  - 2000-2008 energy data from CEC and 2009-2024 hourly data from CAISO.
  - Hydro data was categorized by annual energy to mimic historical hydro energy distribution.
  - 500 hydro year profiles were randomly drawn from each bin based on the frequency distribution.

Stochastic Hydro Model



- Frequency distribution of 25 hydro years used to generate stochastic sampling.
- For example, 20% of the 500 hydro samples are pulled from Bin 3, which includes previously used average hydro year from 2018.

Battery Energy Storage model improvements

Upgrade PLEXOS

- Verify required functionality.
- Migrate dataset and confirm data consistency.

Battery Class

- Make use of the expanded modeling options in the battery class in PLEXOS 11.

Individual Units

- Model unit specific operating characteristics and SOC limits

Battery Energy Storage model improvements cont..

- **From Pump Storage Class to Battery Class:**
  Using battery class to replace pump storage class will facilitate accurate modeling of fast and short-duration energy storage behavior.

- **From Aggregated to Individual Resource:**
  Modeling individual resources instead of aggregated units can help capture more granular behavior and allow for better modeling of specific battery characteristics.

- **From 4-Hour Duration to Energy Limit:**
  The shift from a fixed duration to energy availability will improve modeling accuracy in capturing the operational profile of batteries.

- **Some parameters are average values due to confidentiality concerns:**
  - Battery parameters are sourced from the CAISO master file.
  - Max ramp rate property uses average group data.
  - Energy limits are determined based on group averages.

Forced Outage Natures of Work

Situational Derates

- Ambient Due to Temp

Plant Characteristics

- Annual use limit reached
- Monthly use limit reached
- Other Use Limit reached
- Short term use limit reached

Include in Forced Outages

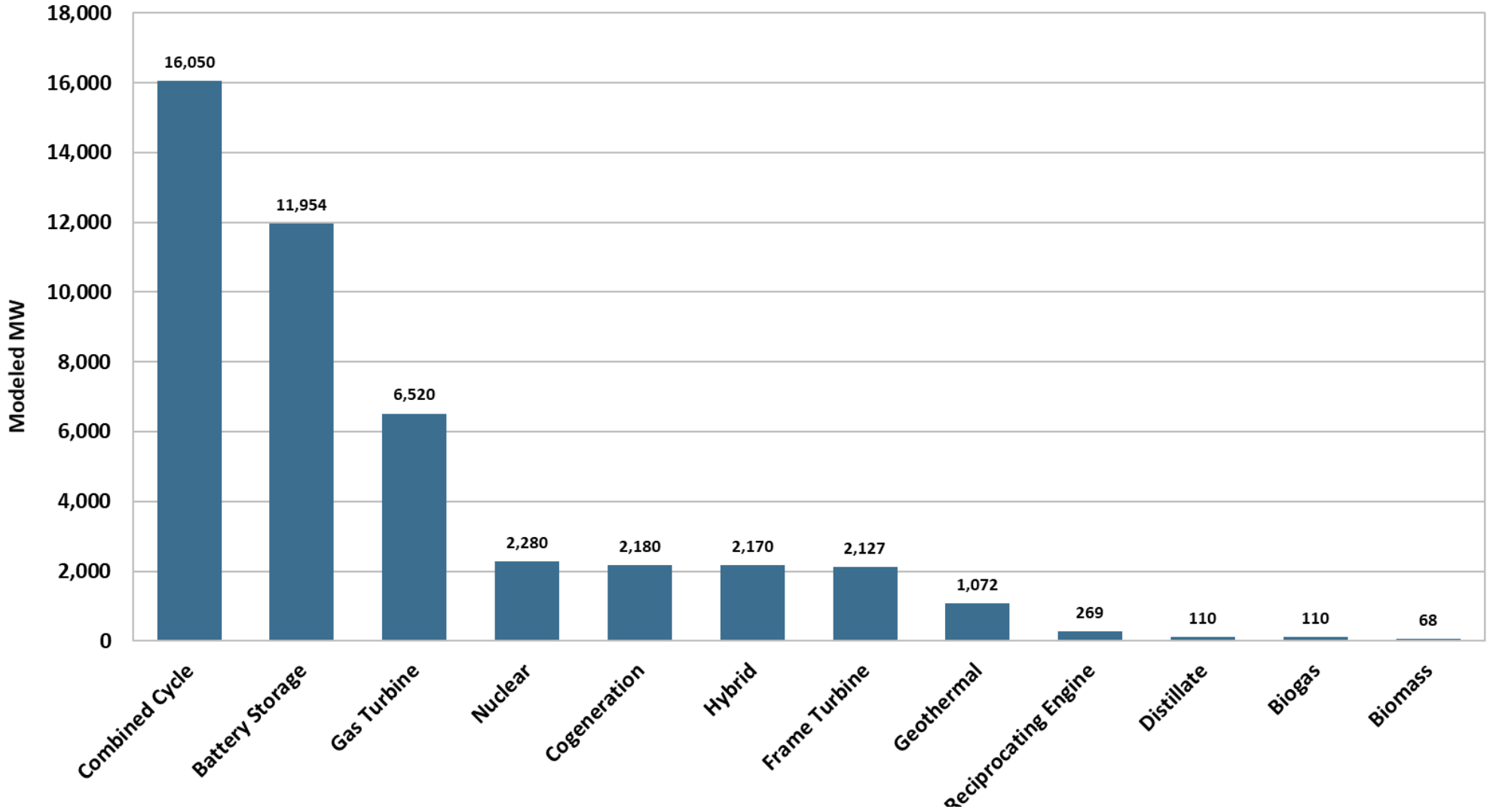
- Plant Maintenance
- Plant Trouble
- Power System Stabilizer
- Metering/ Telemetry
- RTU/RIG
- ICCP
- AVR/Exciter
- Technical Limitations not in Market Model
- Transitional Limitation
- Environmental Restrictions

Not Included

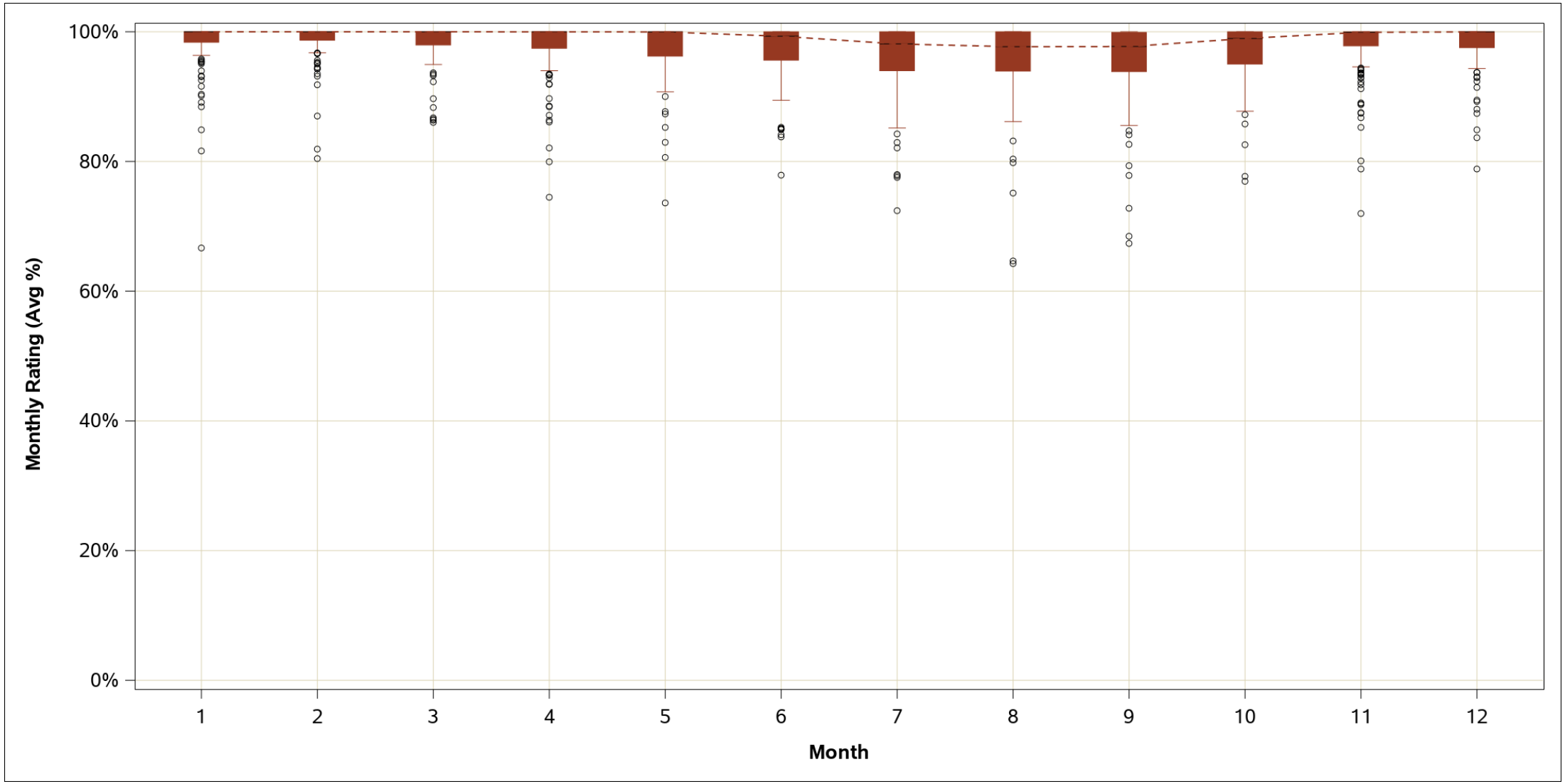
- Transmission Induced
- Unit Supporting Startup
- Ambient Not Due to Temp
- Ambient due to Fuel insufficiency
- New Generator Test Energy
- Unit Testing
- RIMS Outage
- RIMS Testing
- Ramp Rate
- Contingency Reserves Management
- MSS_Reservable

Definitions can be found in the Business Practice Manual for Outage Management, version 30:
BPM CM - BPM Details (caiso.com)

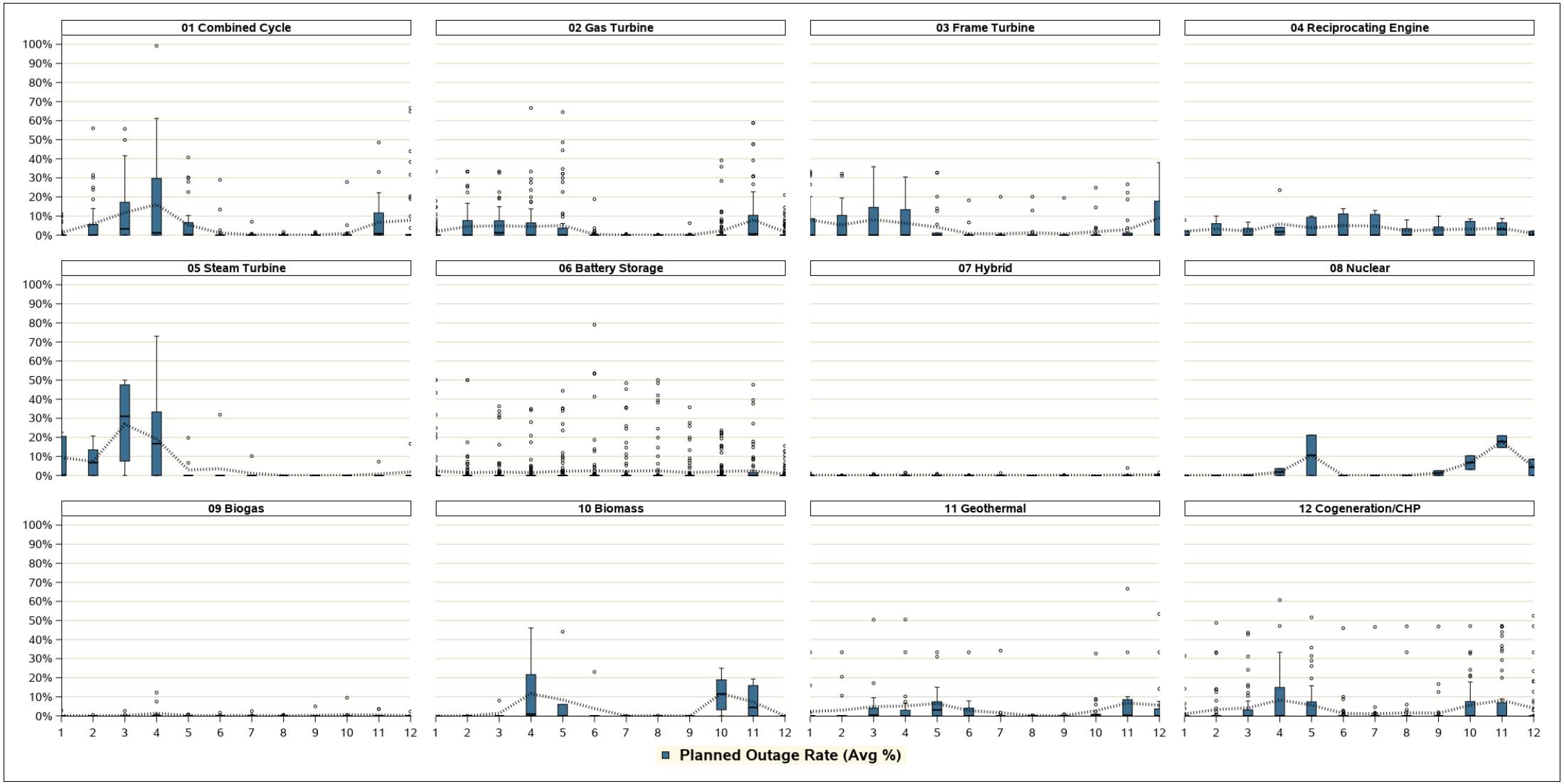
Modeled capacity by technology/fuel type



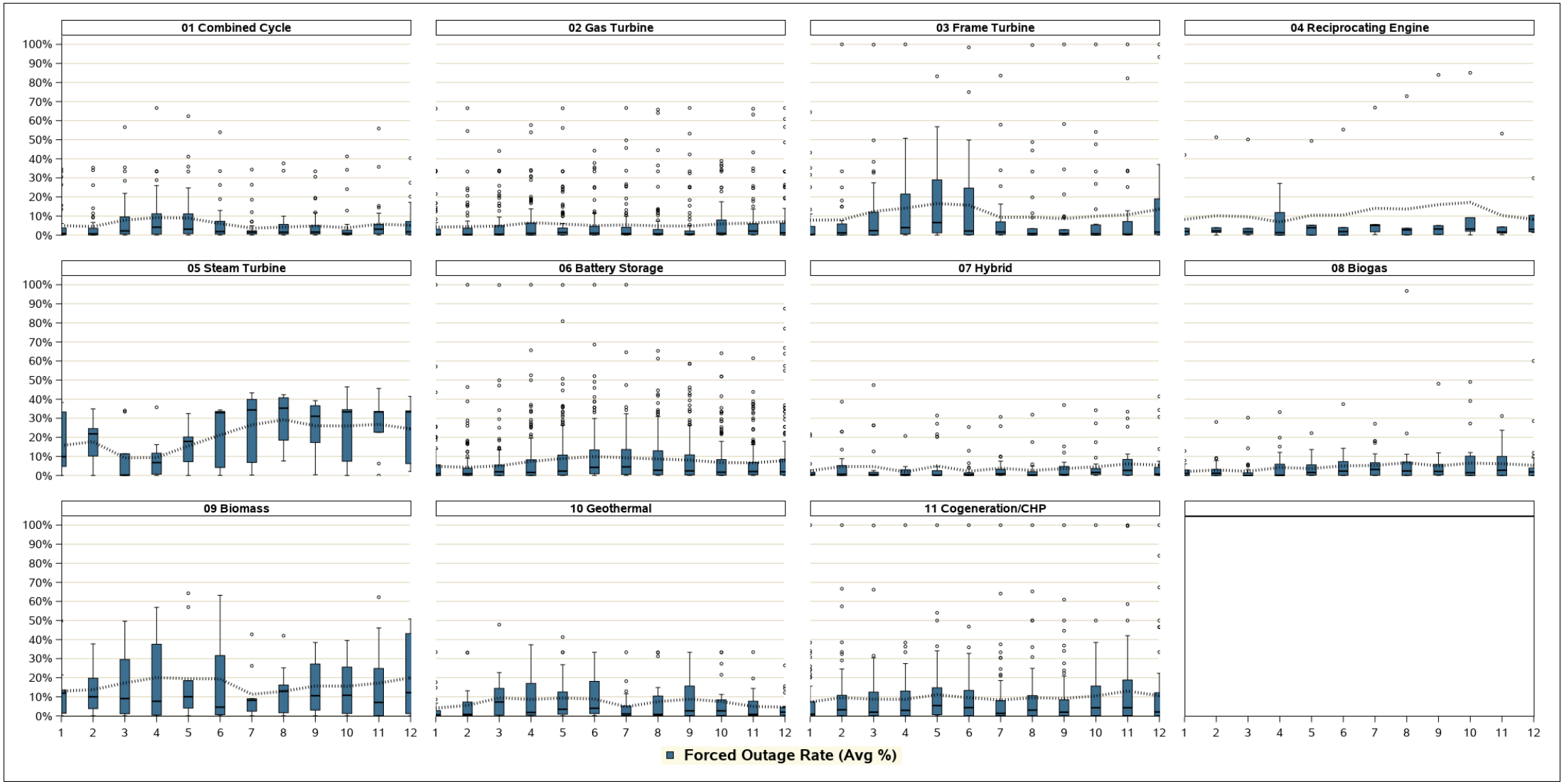
Resource-specific monthly derate to be applied to P_{max} (Based on Ambient Due to Temp derates, historical data from 2022 – 2024)



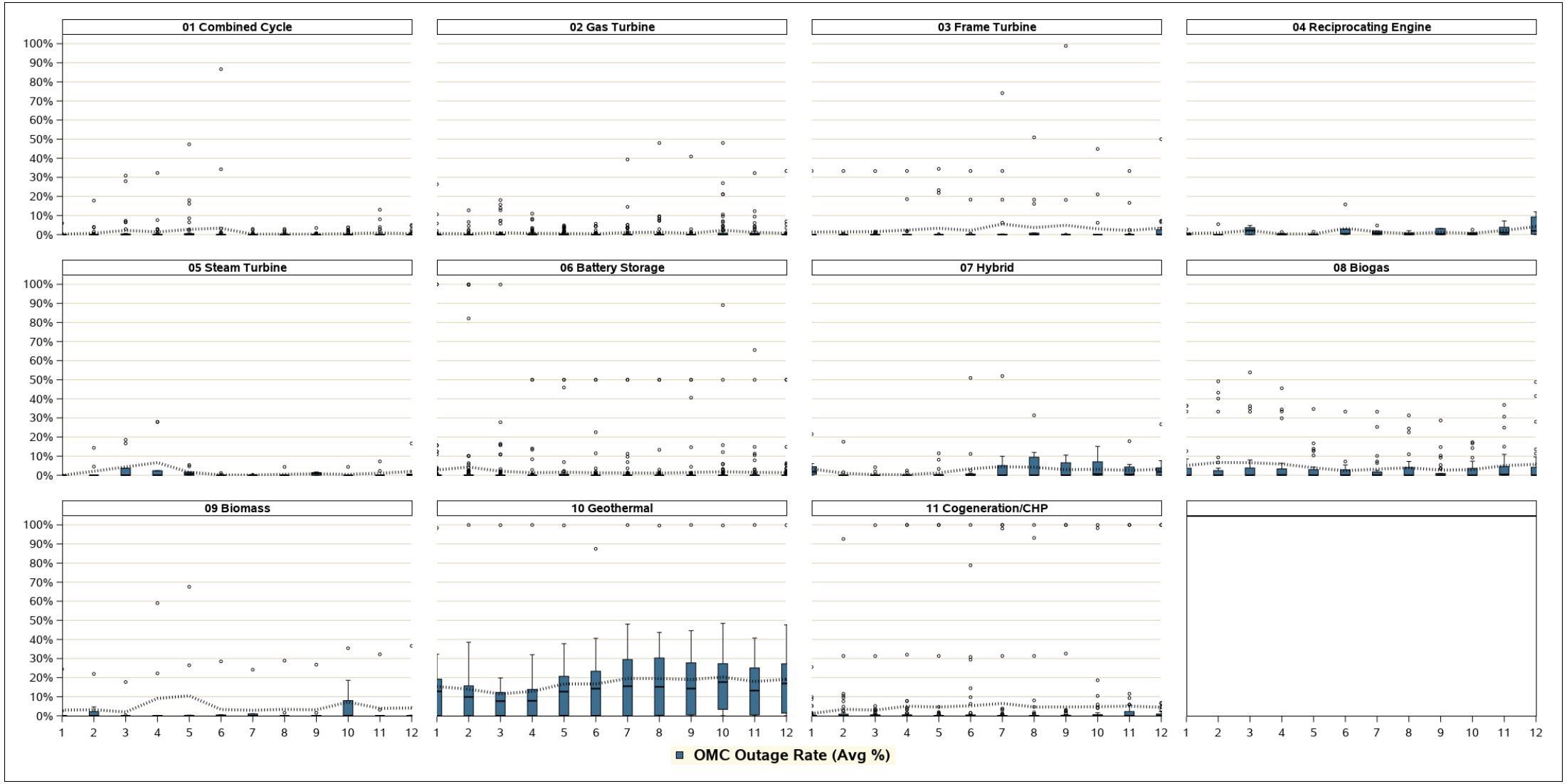
Resource-specific planned outage rates to be modeled (Distribution shows a seasonal pattern, historical average rates, 2022 – 2024)



Resource-specific forced outage rates shows an increase from previously modeled rates (Historical average rates, 2022 – 2024)



Outages outside management control are excluded from modeling (generally low for Natural Gas and Battery Storage resources)



Definitions and key considerations for setting default QC counting rules and PRM.

Identify different approaches being used by other ISOs.

DEFAULT QUALIFYING CAPACITY COUNTING RULES

Key definitions

- **Average ELCC** – the effective load carrying capability of the entire resource type in a portfolio.
- **Marginal ELCC** – the marginal value of the next, or last, MW of a specific resource type applied to all resources of that type.
- **Exceedance** – a representative generation profile that a resource is reasonably expected to produce.
- **Planning Reserve Margin (PRM)** – the qualifying capacity provided by a portfolio that meets a 0.1 LOLE standard divided by the peak load, less 1.

$$PRM = \frac{QC\ of\ a\ portfolio\ acheiving\ 0.1\ LOLE}{Peak\ Load} - 1$$

Critical periods and at risk hours

- **Critical periods** – periods when additional available capacity or a reduction in load would improve reliability by reducing unserved energy at that time or another time. Critical periods are used for marginal ELCC using a critical hours framework.
- **At risk hours** – used for reasonably expected output. We can describe at risk hours in multiple ways, including:
  - Hour that includes loss of load, but only in samples with loss of load.
  - Hours that include loss of load, for all samples.
  - Hours where the supply cushion falls below a specific percentage (for example 5%), or a percentage of hours with the smallest supply cushion (for example the 10% of hours with the smallest supply cushion).

Key considerations for setting default qualifying capacity counting rules and associated PRMs

- The qualifying capacity counting rules should reflect the contribution of resources to reliability.
- The default QC and PRMs should provide valuable insights to LRAs.
- The default QC and PRMs should:
  - Work well with the adoption of UCAP procedures and complement any performance incentive programs implemented by the CAISO.
  - Be reasonable to update so the default QC and PRM remain relevant.
- The CAISO expects to review the default QC values and PRM periodically (for example, every two to three years) and update the defaults, as necessary.

Approach used now is not required to be permanent and there are many ways to accredit resources

ISO	Current Approach	Anticipated Approach
New York ISO Independent System Operator	Marginal	Marginal
pjm	Marginal	Marginal
MISO	Average	DLOL
SPP Southwest Power Pool	Average	Average
ISO new england	Contribution at pre-defined hours	Marginal
ercot Your Power. Our Promise.	Contribution at pre-defined hours	Performance Credit Mechanism?

Source: Adapted from Kevin Carden, Astrapé, November 19, 2024 presentation

The CAISO is seeking feedback on several proposals for the default qualifying capacity rules and planning reserve margin

<table>
<tr><th></th><th>Proposal 1*</th><th>Proposal 2*</th><th>Proposal 3</th><th>Proposal 4</th></tr>
<tr><td>Description</td><td>Reasonably expected output</td><td>Average ELCC for all resources</td><td>Marginal ELCC based on critical hours</td><td>24-hour monthly peak-day stack</td></tr>
<tr><td>Thermal</td><td rowspan="3">Availability of resources in at risk hours</td><td rowspan="5">Average ELCC</td><td rowspan="5">Marginal ELCC</td><td>Ambient de-rates plus UCAP</td></tr>
<tr><td>Renewable Thermal</td></tr>
<tr><td>Storage (includes hybrid and collocated)</td><td>Predefined dispatch hours with charging sufficiency</td></tr>
<tr><td>Hydro</td><td>(High/Mid/Low) ELCC based on expected hydro</td><td rowspan="3">Exceedance Values</td></tr>
<tr><td>Wind</td><td rowspan="2">Average ELCC</td></tr>
<tr><td>Solar</td></tr>
<tr><td>PRM</td><td colspan="3">Measured against the managed peak</td><td>Peak day</td></tr>
</table>

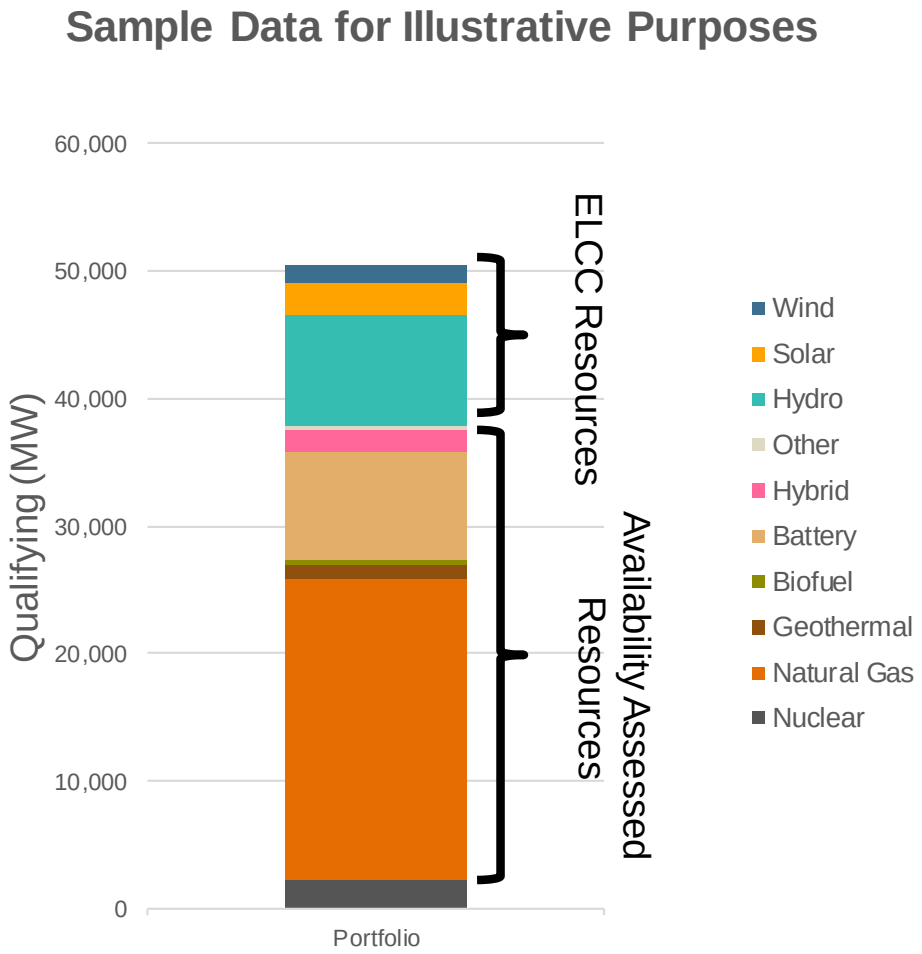
* Proposals 1 and 2 are being actively considered for default rules.

Proposal 1: Reasonable expected output approach uses average ELCCs for hydro, wind, and solar; and expected output for storage and thermal resources

+ QC values are directly tied to the ability of resources to provide reliability.
+ Less computationally intensive.

– Resource QC values may not be perfectly interchangeable.
– Interactive effects between all resources types may not be captured.

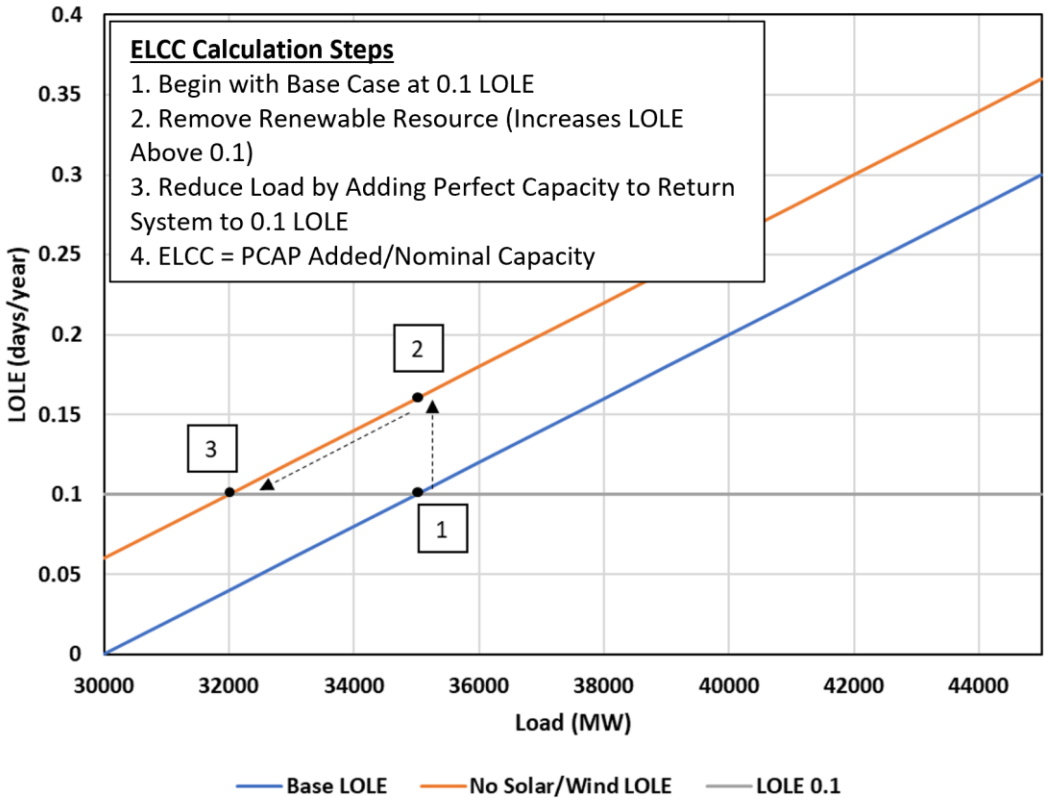
In addition, the assessment of availability of resources in the critical hours may be designed or adapted to work well with UCAP proposals.



Proposal 2: Average ELCC for all resources, values resources based on the perfect generating capacity it displaces

+ Resources are on a level playing field.
+ PRMs are predictable and primarily dependent on demand variability, not changes in the portfolio.
+ Resource characteristics, such as energy limits and outages, are accounted for in the model.

– Average ELCC values are resource intensive to calculate.
– Care may be needed to ensure an average ELCC works with an implemented UCAP proposal and reductions in the eligible capacity are not duplicative.

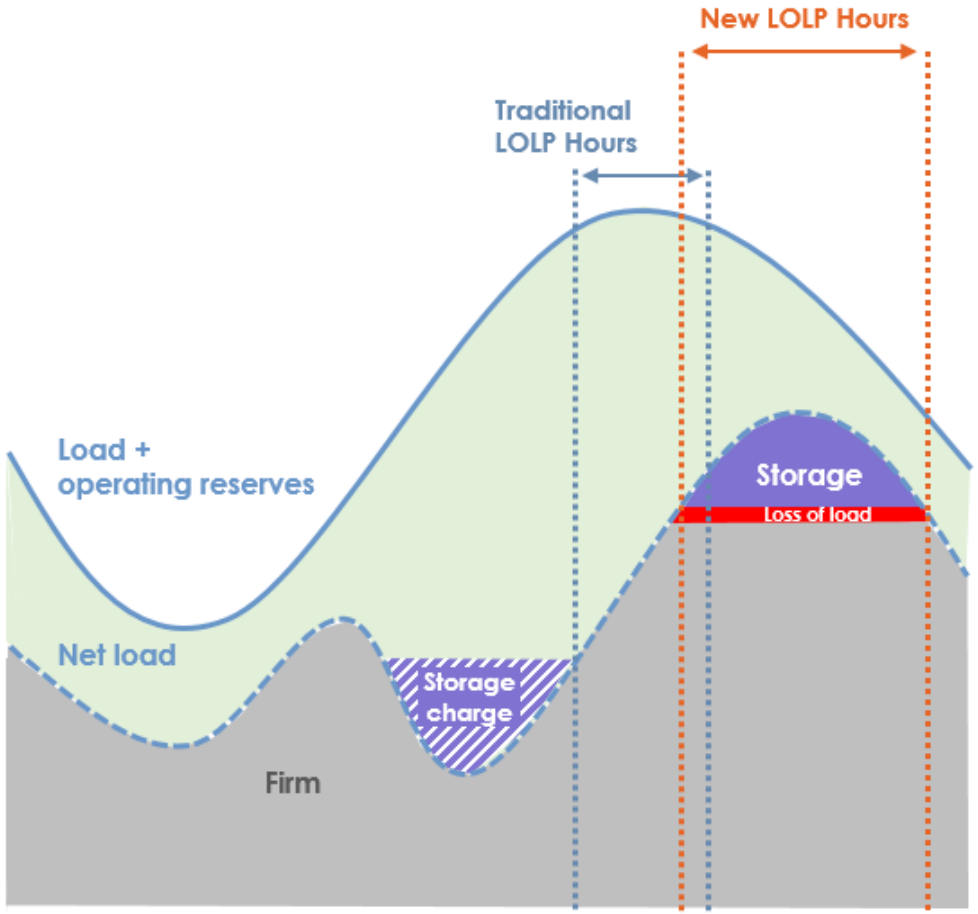


Source: Kevin Carden, Astrapé, November 19, 2024 presentation

Proposal 3: Marginal ELCC based on critical hours, values resources based on what capacity they can provide during critical hours

+ All resources are on a level playing field.
+ QC directly relates to the value of the resource in incrementally reducing unserved energy.
+ Less computationally intensive.

– PRM developed with this method could loose effectiveness if mELCC QC values are not used.
– Care may be needed to ensure a mELCC approach works with an implemented UCAP proposal, and reductions in the eligible capacity are not duplicative.
– Questions remain about interoperability of this approach with other LRA programs that don't reflect it

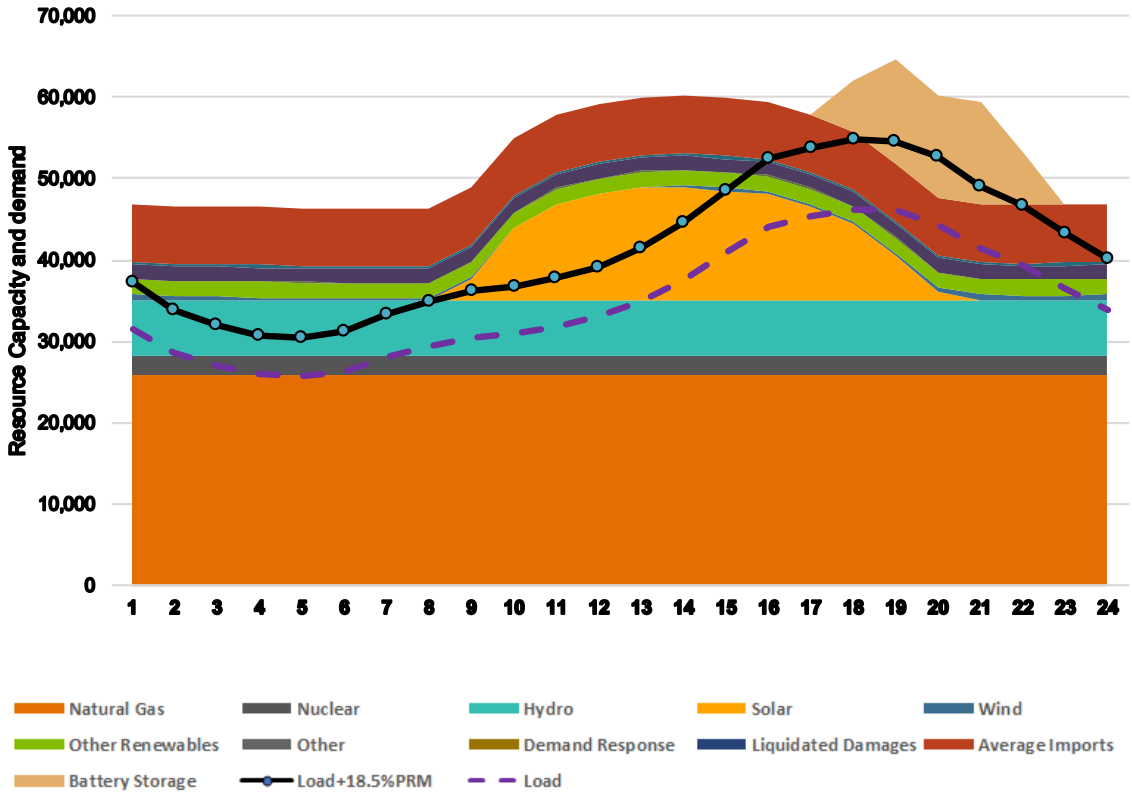


Source: Zach Ming, E3, October 11, 2023 presentation

Proposal 4: 24-hour monthly peak-day stack would rely on exceedance values, derates, and energy storage dispatch requirements to identify the largest minimum PRM a reliable portfolio could provide

+ The QC values are predetermined based on resource type, largely independent of the resource mix or demand.

– Monthly analysis of PRMs could be required.
– Contributions to reliability vary hourly and by resource type.



NEXT STEPS

What we are doing now and plan to do soon

- Incorporating updates and re-running the analysis.
- Continuing to build automated data processes to ensure consistent analysis and reduce barriers to future updates.

- Assess the qualifying capacity and planning reserve margin of the updated year-ahead analysis for the methods of interest.
- Prepare a proposal for the default tariff accounting rules and PRM.

We would like to hear your feedback on the analysis

- Please provide your organization's feedback on modeling improvements undertaken and additional improvements to consider.
- Please provide your organization's feedback on the qualifying capacity accreditation and PRM proposals discussed today.
- Please provide your organization's feedback on what additional analysis you would like performed to inform the development of default qualifying capacity accreditation and PRM approaches.
- Please provide any feedback not already captured.

Aditya Jayam Prabhakar- ajayamprabhakar@caiso.com

QUESTIONS?

LUNCH

What are you going to see this afternoon

- Focus: **accounting for ambient derates** and a CAISO **UCAP** mechanism
- Based on feedback, a discussion of a more in-depth preview of CAISO's straw proposal leanings
- Prompts for stakeholders to discuss key policy design elements that CAISO staff plan to refine before the straw proposal is released in late March

Review: RA Track 1 encompasses RA modeling, accreditation issues, and accounting for ambient derates

1. RA Modeling

- Probabilistic LOLE and deterministic modeling
- Used to inform updated tariff default counting rules & PRM

2. Defaults

- CAISO tariff default planning reserve margin & default qualifying capacity methodology
- Goal: demonstrate a framework that would achieve a 0.1 LOLE

3. UCAP

- Ensure RA supply resources are available when needed based on forced outage & ambient derate historic resource data

4. Ambient Derates / “Capability Testing”

- Account for generators’ seasonal ambient derates due to temperature during peak conditions

RA Track 1: Straw proposal conceptual preview

- CAISO continues to partner with CPUC and other LRAs to ensure appropriate RA capacity is procured and shown by LSEs
- Default counting rules & PRM should stand alone as a holistic accreditation scheme that can be adopted "off the shelf" by an LRA, and if implemented, would achieve a 0.1 LOLE
- Separately, to accommodate stakeholder concerns about CPUC UCAP alignment, consider:
  - UCAP derate via NQC process to be applied ***unless*** RA resources are accredited via an LRA's performance-based/probabilistic QC methodology (e.g., if an LRA adopts CAISO default rules)

Modeling & defaults

- Updated CAISO default rules provided as a tool to LRAs to adopt QC methodology and PRM
- Based on robust probabilistic modeling with transparent and best available inputs & assumptions

UCAP & ambient derates

- Account for RA resource forced outages through NQC process (if not accounted for in QC methodology)
- Account for RA resource capabilities during peak conditions (ambient derates) through NQC process

RA Track 1: straw proposal leanings/options based on stakeholder input

- **Default counting rules** developed through CAISO modeling
  - Reviewed various QC methodology approaches with stakeholders this morning
  - Revised Section 40 tariff language could require CAISO to issue model runs, ELCC values, PRM on a regular basis
- **UCAP**
  - Additional step to CAISO NQC process to reduce QC values based on resources' forced outage rates
  - "Supply cushion UCAP" - looks at each RA resource's forced outage rate during a portion of the "tightest" hours of each season over the past few years
  - Applies a derate to resources that do not receive a QC value from an LRA derived from a probabilistic or performance-based methodology (exceedance, ELCC, UCAP etc.)
- **Ambient derates**
  - Modification to NQC process to examine historic peak load conditions, review ambient derates due to temperature during these conditions, and derate RA resources' NQC values based on this analysis
  - Note: Testing-oriented (CAISO *or* SC-provided) program would be resource-intensive

AMBIENT DERATES

Accounting for Ambient Derates

- Modification to NQC process
  - Examine recent peak load conditions
  - Review ambient derates due to temperature during these conditions
  - Derate RA resources' NQC values based on this analysis
- **Capability testing?** Testing-oriented (CAISO or SC-provided) program would be resource-intensive
- Stakeholder feedback-informed approach (WPTF & Cal CCA)
- Historic peak load conditions: maximum energy output of prior three years on top ten peak load days
- Discuss: implications on must-offer obligation

UCAP

UCAP Stakeholder Feedback

Theme	Comments
Coordinate with CPUC	Many stakeholders support
Resource-specific	Many stakeholders support
Use of CAISO Outage Mgmt System (OMS) data	Support: DMM, IEP, PG&E, AReM
Don't double count outages in both PRM and UCAP	Cal CCA, PG&E, SDG&E
Thermal and storage (if other resources have ELCC or other statistical accreditation)	ACP-CA, IEP, WPTF
New resources	Class average: IEP Exempt first year: Calpine
Natures of work	Exclude *outside mgmt control* outages: PG&E, DMM
EFORd	Support exploration: PG&E Do not support: DMM

UCAP Mechanism: design & implementation leanings

Defining availability	• Resource specific – calculated as part of NQC process • Data source: CAISO Outage Management System • Natures of work: to be determined
Evaluation hours: supply cushion	• 20% “tightest” hours for CAISO BAA per season based on supply cushion calculation • EFORd is difficult due to battery storage penetration in CAISO BAA
Implementation	• Resource types: those that have not received a probabilistic/performance-based QC methodology from an LRA • Seeking LRA feedback to achieve a UCAP that meets reliability goals

UCAP Mechanism: design & implementation leanings

Supply cushion: **shown RA** in a given hour **minus** wind & solar RA, planned/forced outage impacts, net real time average load for the hour, and 6% contingency reserves

Divide past three years into two seasons – peak and non-peak

Identify hours in each season that had tightest supply cushion

For each resource, determine forced outage rate during tightest hours

Apply weights – most recent year has greatest impact on UCAP factor

Net Qualifying Capacity = DQC × UCAP factor

Forced Outage **Natures of Work** in UCAP

Potential approach based on stakeholder feedback: any forced or urgent outage will effectively make an RA resource unavailable to CAISO for reliability purposes. However, the incentive system inherent in a resource-specific UCAP means that it makes sense to discuss potentially excluding outages that might be considered "outside management control"

Natures of work

- Plant Maintenance
- Plant Trouble
- Power System Stabilizer
- Metering/ Telemetry
- RTU/RIG
- ICCP
- AVR/Exciter
- Transitional Limitation
- Environmental Restrictions
- Ambient Due to Temp
- RIMS Outage
- RIMS Testing
- Ramp Rate
- Contingency Reserves Management
- MSS_Reservable
- Annual/monthly/other/ short term use limit reached
- Unit Supporting Startup
- Ambient Not Due to Temp
- Ambient due to Fuel insufficiency
- Transmission Induced
- New Generator Test Energy
- Unit Testing
- Technical Limitations not in Market Model

Definitions can be found in the Business Practice Manual for Outage Management, version 30:
BPM CM - BPM Details (caiso.com)

Preview: CAISO Supply Cushion UCAP—class averages 2022-2023

$$\text{On Peak NQC} = \sum \text{Weighted Seasonal Average Availability Factors}^{\text{Summer}} * \text{DQC}$$

$$\text{Off Peak NQC} = \sum \text{Weighted Seasonal Average Availability Factors}^{\text{Winter}} * \text{DQC}$$

New resources lacking outage data history: class average

Unit Type	On Peak (Summer) WSAAF	Off Peak (non-summer) WSAAF
Gas Combined Cycle	89%	86%
Gas Combustion Turbine	89%	88%
Gas Multi Stage Generator	86%	90%
Gas Steam Turbine	88%	82%
Hybrid	87%	95%
Battery Storage	89%	93%

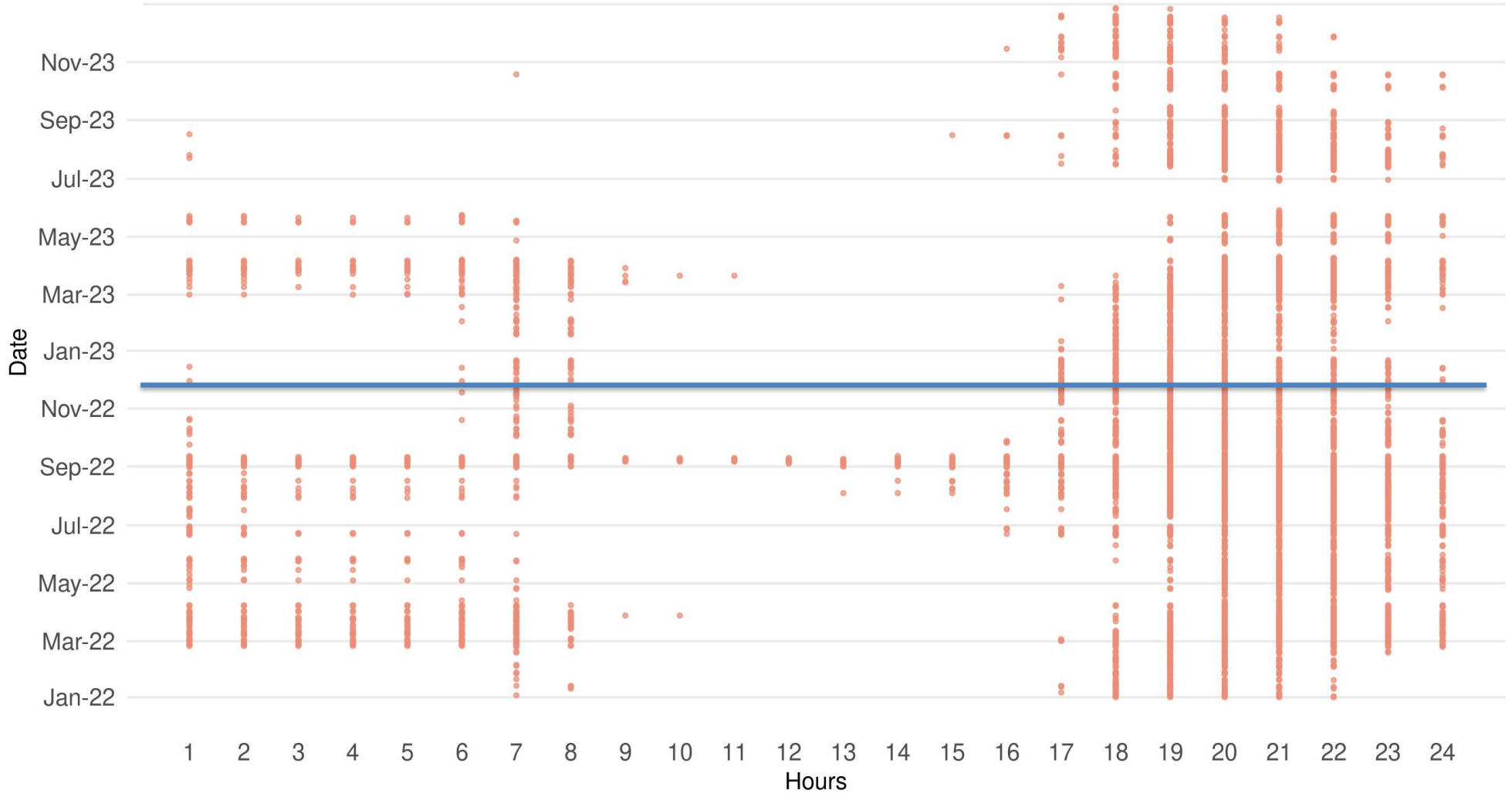
Preview: CAISO Supply Cushion UCAP—class averages 2022-2023
Assorted supply cushion percentages

Unit Type	5%	10%	15%	20%
Gas Combined Cycle	91%	90%	90%	89%
Gas Combustion Turbine	87%	88%	89%	89%
Gas Multi Stage Generator	84%	85%	85%	86%
Gas Steam Turbine	83%	85%	87%	88%
Hybrid	79%	85%	87%	87%
Battery Storage	88%	88%	89%	89%

Preview: CAISO Supply Cushion UCAP - Supply cushion hours @ 20%

2023

2022



STAKEHOLDER PRESENTATIONS

CAISO RA MPD Initiative

Joint LSEs: CalCCA; SCE; Six Cities; PG&E

- This presentation covers two high priority topics scoped at the CAISO RAMPD:
  - Outage definitions and planned outage substitution process revision
  - UCAP design and implementation methodology and RAAIM revision
- Starting with the CAISO problem statements, we define principles for considering policy options.
- We then list questions that deserve further discussion for the policy development.
- *The material is focused on the clarifying questions put forth in the presentation rather than advocacy of positions. Each of the Joint LSEs continues to consider its positions on the issues in this initiative, and this presentation is for discussion purposes only.*

UCAP and RAAIM: CAISO problem statements and options for considerations

- **Background/Problem statement from CAISO Issue Paper:**
  - **UCAP:**
    - "The RA initiative should evaluate how well current LRA-established PRMs and counting rules reflect forced outage rates, performance, and availability".
  - **RAAIM:**
    - "In light of a tight RA market, high RA prices, and market incentives, RAAIM should be assessed to see if it is meeting its intended objectives, what new objectives should be established, and if a new mechanism is needed to incent availability and/or performance".
- **CAISO's options for considerations:**
  - **UCAP:** UCAP mechanism attempts to account for a resource's availability. Design and implementations questions (defining availability; evaluations hours; resources types and LRAs coordination).
  - **RAAIM:** 1) Scarcity pricing; 2) Pay-for-Performance; 3) Redesign RAAIM (RAAIM price; Assessment hours; revised exemptions).

UCAP principles for consideration in the development and adoption of any UCAP methodology.

- Be **adopted and implemented** simultaneously **by the CPUC and CAISO** to avoid the use of significantly **different qualifying capacity ("QC") values between the CPUC and CAISO** and complications that could stem from those differences in programs;
- Be adopted **in tandem with an adjustment to the PRM** to reflect the shift of resource outage uncertainty from the PRM to the QC value;
- Be adopted **in conjunction** with **changes to CAISO's** Resource Adequacy Availability Incentive Mechanism ("**RAAIM**");
- Be at the **resource-specific level** to avoid QC value distortions that are inevitable when applying an average-based approach;
- Use **public data** so that resource owners can reasonably calculate a QC value;
- Feature **reasonable timing** for **implementation**.
- Accommodate **LRA discretion** regarding the implementation of **UCAP or alternative qualifying capacity methodologies** for the individual LSEs that they regulate.

Questions on UCAP design challenges/methodology elements

1) UCAP requires **consistent forced outage definitions** and **exemptions** for outages out of generator control (transmission; fuel).

- CAISO's Outage Manage System (OMS) system **categorizes some forced outages differently** than Generating Availability Data System (GADs).
- CAISO current forced outage definition is based on the request timing (submitted seven days or less prior to the start of outage) Tariff 9.3.6.4.1(c).

5) PRM takes into account operating reserves, **forced outages** and demand forecast error.

- If UCAP sufficiently accounts for forced outages, **PRM** would only need to cover **operating reserves and forecast error**.
- Dependent on resource QC and resource UCAP calculation.
- How is the PRM calculated today? How should the **PRM be revised** with the UCAP methodology?

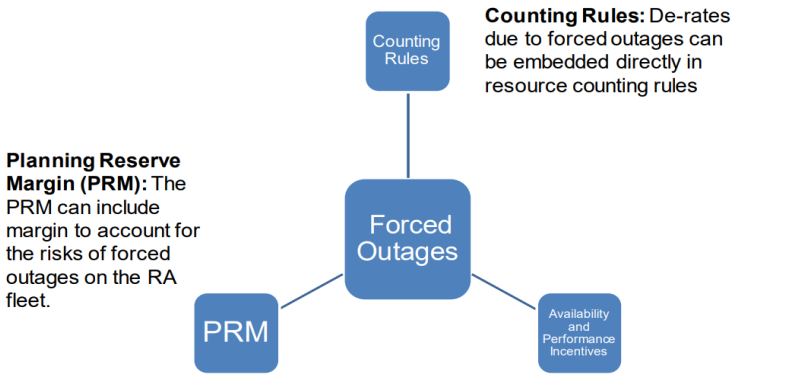
6) UCAP implementation

- CAISO Tariff defers to LRAs to establish QC criteria. However, CAISO could **reduce the QC** based on **performance** (section 40.4.5, currently unused).
- CAISO could set **two default PRMs** for UCAP and ICAP based on LRA implementation.
- Need to assess the potential for contract revisions if NQC changes to UCAP-NQC.
- **Simultaneous implementation** by the CAISO and the CPUC.

2) Which resources?

- **UCAP is "resource specific".**
- Require **clarity** between the UCAP methodology and the QC methodology.
- Some QC methodologies **already have the ability to "measure" the resource's availability** (exceedance or ELCC).
- Which **resources** UCAP should **apply** to - if there are exceptions, why?

Tools to Account for Forced Outages



***Source**: CAISO RA MPD Presentation Feb 13th 2024.*

3) Performance/availability assessment hours.

- CAISO proposes to assess performance based on a **supply cushion** to calculate **seasonal UCAP**. Other ISOs/RTOs use a **EFOR methodology**. Consider "Use both? Or investigate both before deciding on one?"
- There should be an indication of **the hours falling in the supply cushion** in advance**.** Would UCAP be calculated for **all RA-eligible** resources or **only shown RA** resources?
- What will be the basis in terms of data for calculating UCAP? How **many years** of data will be included? How will each **year be weighted**?

4) RA Availability Incentive Mechanism (RAAIM).

- **RAAIM to be revised** as it doesn't work as intended.
- **Clarify** the requirement to **provide substitution for forced outage** if UCAP is implemented.
- What will be the **process to "cure"** extended forced outages? What will be the process to **convert** an extended **forced outage to planned** outage?
- Should CAISO apply **penalties based on performance on critical hours** (based on the supply cushion or a limited critical hours)?

Next steps

- Please submit written comments on the February 10, 2025, workshop by Tuesday, February 25, 2025, through the ISO's commenting tool using the link on the working group webpage: California ISO - Resource adequacy modeling and program design (caiso.com)
- CAISO staff is available for meetings with individual stakeholders.
- More detail on straw proposal and workshop timelines will be discussed tomorrow.

End of Day 1

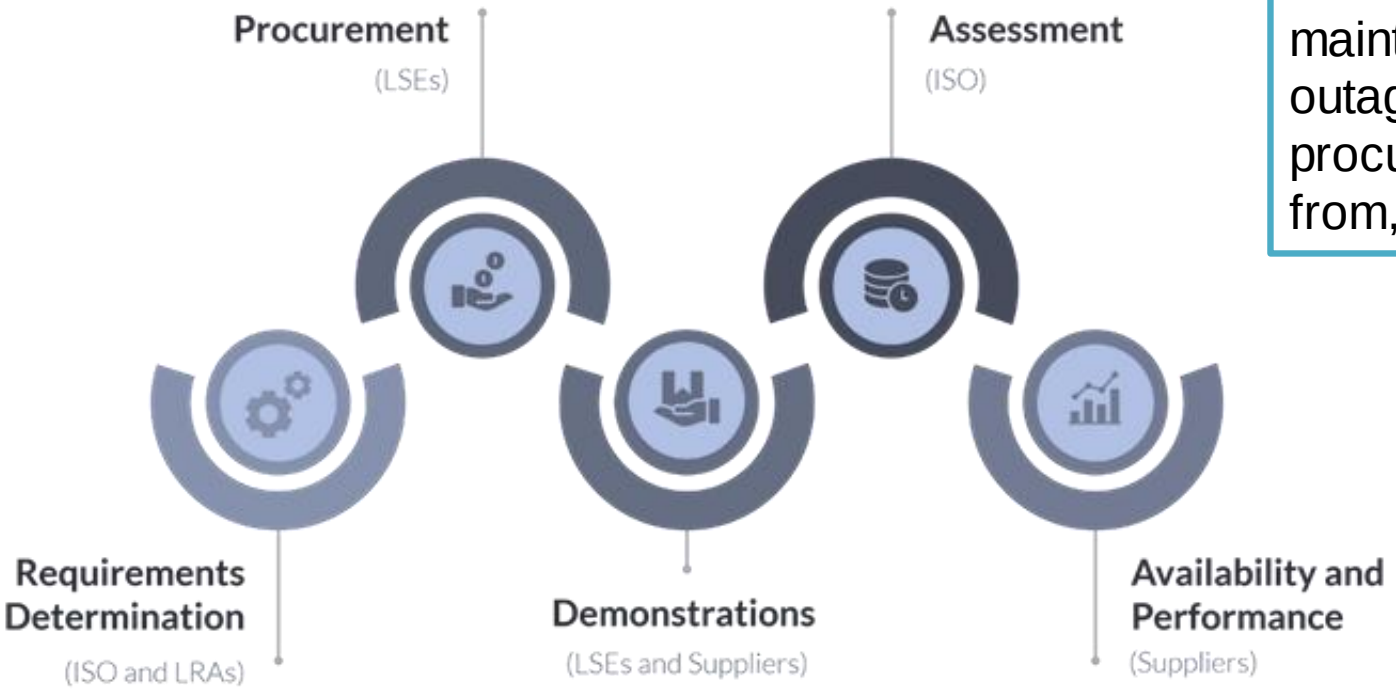
Preview – Tomorrow's agenda: Tracks 2 and 3

Time	Topic	Speaker
9:00 - 9:15 AM	Welcome & Framing	Partha Malvadkar
9:15 - 10:00 AM	Track 3: Visibility	Hilary Staver
10:00 - 10:20 AM	MRP Visibility	Nuo Tang
10:20 - 10:35 AM	Break	
10:35 - 11:30 AM	Track 2: Outage and Substitution	Anja Gilbert
11:30 - 12:00 PM	Stakeholder Presentations	LSEs & DMM
12:00 - 1:00 PM	Lunch	
1:00 - 3:00 PM	Track 2: Availability and Incentive Mechanisms	Anja Gilbert
2:45 - 3:00 PM	Next Steps	Partha Malvadkar

RA package options and leanings

Topic	Summary
Modeling and Defaults	Updated defaults provided as a tool to LRAs to adopt our default rules based on state-of-the-art, transparent probabilistic modeling
UCAP	• Addition to CAISO NQC process to reduce QC values based on resources' forced outage rates • "Supply cushion UCAP" - looks at each RA resource's forced outage rate during a portion of the "tightest" hours of each season (876 hours in each summer and non-summer season) over the past few years to develop a UCAP factor • Applies a derate to resources that do not receive a QC value from an LRA derived from a probabilistic or performance-based methodology (exceedance, ELCC…)
Ambient Derate	Outage data-driven approach to capture ambient derates during historic peak conditions in NQC
RAAIM	New mechanism, Measuring Unavailable RA (MURA), which would assess unavailability during stressed grid conditions and allocate the penalty costs collected from under performing-RA to load
Outage and Substitution	• New processes for conditional approval of outages (without substitution) and a pool design (when substitution is needed) • New definition added for "urgent" outage which functionally is akin to a forced outage
Visibility	Monthly reporting requirements for RA-eligible capacity not shown as RA

Anticipated benefits putting the pieces together



More efficient processes for maintenance with conditional outages and a pool to procure substitute capacity from, if needed. (T2)

Greater insights ahead of requirements from modeling and visibility efforts. (T1 & T3)

More accurate demonstrations from UCAP design. (T1)

Improved availability due to a more accurate UCAP and an improved availability mechanism. (T1 & T2)

Proposed schedule

		Q1	Q2	Q3	Q4
Resource Adequacy Modeling and Program Design					
	Track 1: Modeling, Defaults, and Accreditation	**Policy development**		**Decision (Default Counting Rules/PRM)**	**Implementation (Default Counting Rules/PRM)**
	Track 2: Outage & substitution and availability and incentive mechanisms	**Policy development**		**Decision**	
	Track 3a: Backstop reform and long-term EDAM RSE solutions	**Policy development**			
	Track 3b: RA status visibility	**Policy development**		**Decision**	**Implementation**

TRACK 3: RESOURCE VISIBILITY

RA Track 3 covers multiple areas related to CAISO's backstop procurement mechanisms

1. Resource Visibility

- New reporting requirements for RA-eligible capacity not shown as RA

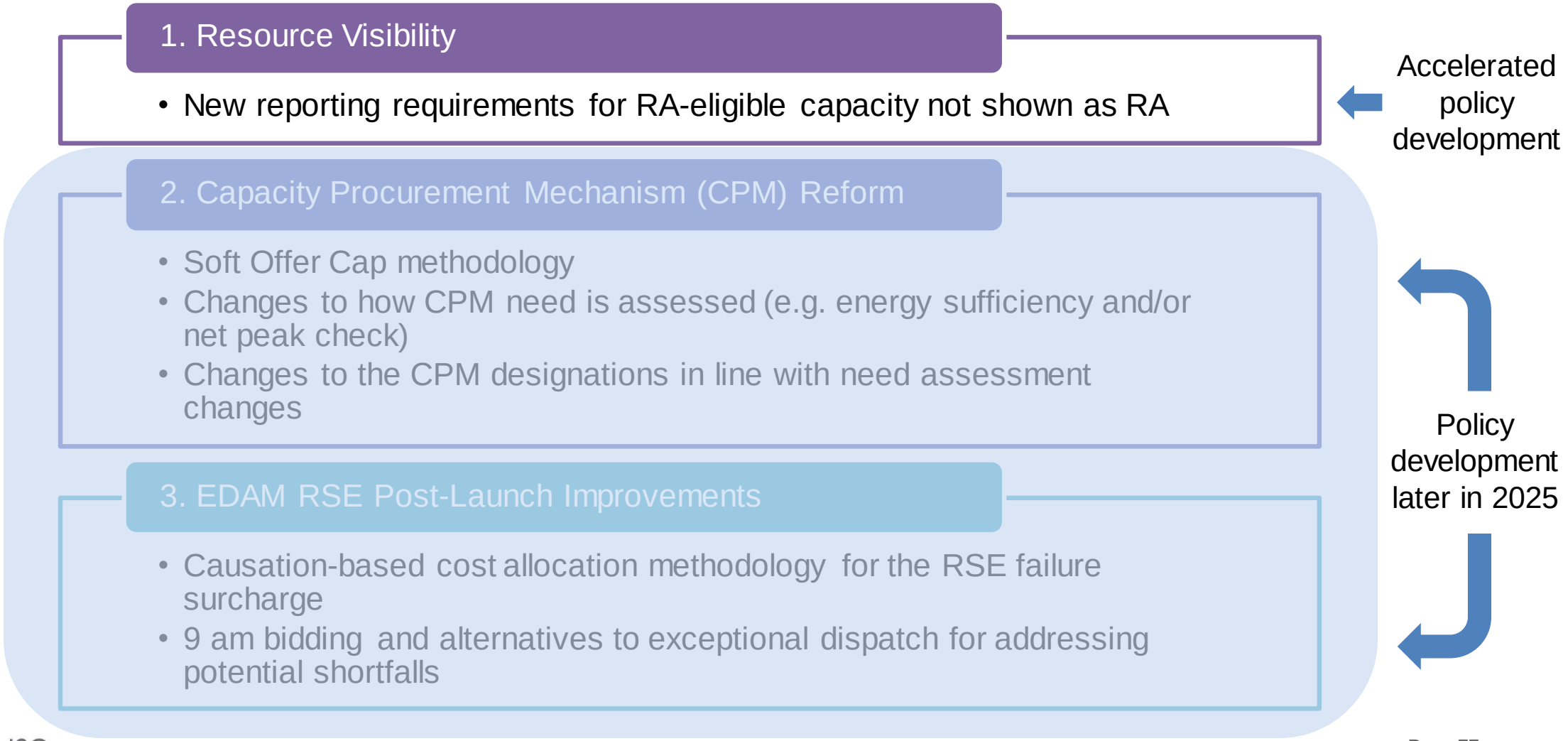
2. Capacity Procurement Mechanism (CPM) Reform

- Soft Offer Cap methodology
- Changes to how CPM need is assessed (e.g. energy sufficiency and/or net peak check)
- Changes to the CPM designations in line with need assessment changes

3. EDAM RSE Post-Launch Enhancements

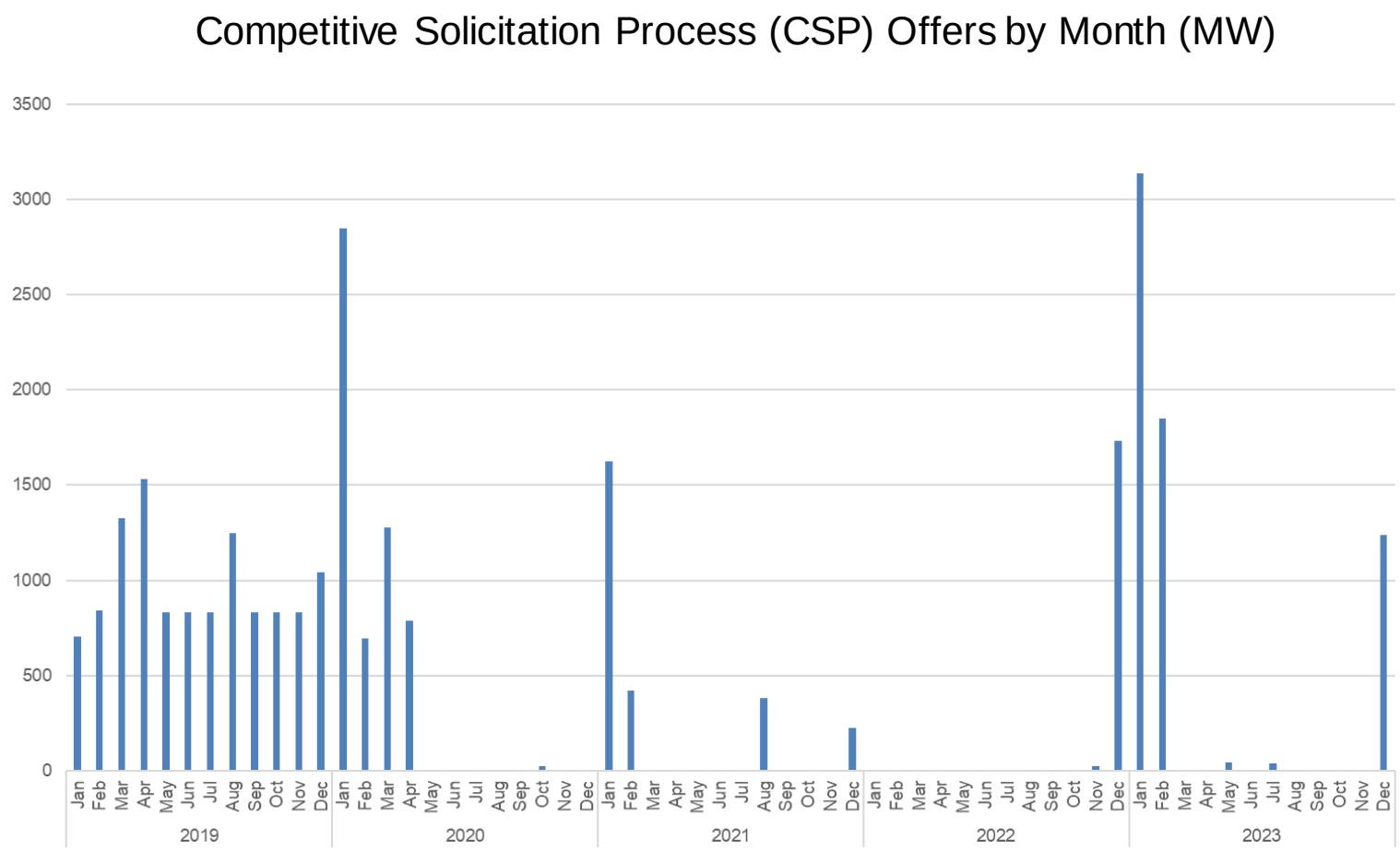
- Causation-based cost allocation methodology for the RSE failure surcharge
- 9 am bidding and alternatives to exceptional dispatch for addressing potential shortfalls

RA Track 3 covers multiple areas related to CAISO's backstop procurement mechanisms



Resource Visibility

- **Goal**: Provide operators with enhanced visibility into the capacity available for Capacity Procurement Mechanism designations, especially in higher-risk months



Themes in Stakeholder Feedback

- Overall neutrality to support regarding new visibility requirements, especially for capacity sold outside the balancing authority area

- Concern that reporting requirements not carry additional obligations or availability requirements

- Continued interest in approach to credited DR programs

Straw Proposal Options

- Monthly reporting requirements for RA-eligible capacity not shown as RA:
  - Sold outside the CAISO BAA
  - Held for substitution
  - Held for anticipated outages
  - Not contracted
  - Contracted but not needed to meet LSE's requirement
- This information could be collected on a year-ahead basis in addition to monthly
- Potential second phase to address additional changes/categories as appropriate

STAKEHOLDER PRESENTATION: MRP

BREAK

RA Track 2: Availability and Incentive Mechanisms & Outage and Substitution

Outage and Substitution

- New processes for conditional approval of outages (without substitution) and a pool (when substitution is needed)
- New definition added for “urgent” outage

Availability and Incentive Mechanisms

- New mechanism to incent availability during tight grid conditions

TRACK 2: OUTAGE AND SUBSTITUTION

Track 2: Outage and Substitution Reform

Proposal: Allow conditional approval of planned outages without substitution.

If taking a planned outage would result in a reliability impact, procure from a pool.

Conditional Approval of Outages

- Recognizing reliability conditions can change and the negative reliability consequences of the former POSO process, the CAISO cannot always give certainty of when outages could be taken that would never impact reliability (when the SC does not provide substitute capacity)
- However, the CAISO is open to exploring allowing *conditional* outages
  - Receiving a conditional outage approval would mean the resource does not have to provide substitute capacity
  - If reliability conditions change, the CAISO may go back to the SC and indicate when substitute capacity must be provided
  - If capacity is required, the SC would be able to procure from a substitute capacity pool

Considerations for Conditional Outages

- What metric should be used to determine what is conditionally approved?
  - Supply plan showings
  - Gross net peak value
  - Other?

Pool Design

There are various attributes and options to consider with the pool design. Highlighted in bold below are the straw proposal leanings.

Product Definition

- Granularity: hourly, **daily**, weekly, monthly
- Participation: **voluntary** or required
- Type of RA: local, **generic**, flex
- Quantity: MW, marginal ELCC

Visibility

- Options: none, **calendar**, new tool

Access Priority

- Options: none, **right of first refusal** (the SC that provides capacity can access it at any point for substitution, if not sold)

Price to Buy/Sell

- Options: administratively set, SC set, **SC set w/cap**

Procurement Mechanism

- Mechanism Options: administrative matching, reverse second price auction (DMM); reverse dutch auction (MRP); least cost auction
- Timeline Options: Before T-28 and/or between T-28 to T-8

Addition of Urgent Outage Type

- Update definition to include “urgent” outage which would be a type of “forced” outage but align with RC west definitions

- After the short-range study window (i.e., a rolling weekly deadline), these are the outage types considered:
  - **Urgent**: A facility/equipment that is known to be operable, yet carries an increased risk of a Forced outage occurring. The facility/equipment remains in service until personnel, equipment and/or system conditions allow the outage to occur.
  - **Opportunity**: A facility/equipment outage that can be taken due to a change in system conditions, weather or availability of field personnel
  - **Forced outages**: A facility/equipment is removed from service real-time with limited or no notice

STAKEHOLDER PRESENTATIONS: LOAD SERVING ENTITIES AND DMM

CAISO RA MPD Initiative

Joint LSEs: CalCCA; SCE; Six Cities; PG&E

- This presentation covers two high priority topics scoped at the CAISO RAMPD:
  - Outage definitions and planned outage substitution process revision
  - UCAP design and implementation methodology and RAAIM revision
- Starting with the CAISO problem statements, we define principles for considering policy options.
- We then list questions that deserve further discussion for the policy development.
- *The material is focused on the clarifying questions put forth in the presentation rather than advocacy of positions. Each of the Joint LSEs continues to consider its positions on the issues in this initiative, and this presentation is for discussion purposes only.*

Planned outage substitution process: CAISO's problem statement and options for considerations

- **Background/Problem statement from CAISO Issue Paper:**
  - **"RA Substitution process should be reassessed as this procedure likely results in:**
    - Inefficiencies as multiple SCs hold back RA capacity for outage substitution for a partial-month outage.
    - Artificial tightness in the RA bilateral market due to holding back capacity for outage substitution.
    - Potential maintenance delays if substitute capacity is not available.
    - Higher forced outage rates because planned outages cannot be scheduled and the resource ultimately experiences a forced outage".
- **CAISO's options for considerations:**
  - **Outage definitions to align with Reliability Coordinator Procedure RC0630:**
    - Forced; urgent; planned and opportunity outage.
  - **Outage process revision options:**
    - 1) Voluntary Planned Outage Substitution Pool; 2) Planned Outage Buffer; 3) Annual or Seasonal Showings; 4) Remove planned outage substitution requirements: replace with strong incentives and better information on periods of risk; 5) Rolling Back the 2021 POSO Rules

Questions on outage definitions

- Does the **new "urgent" outage type change** the current CAISO **forced outage definition** (i.e.; Maintenance Outage submitted 7 days or less prior to the start date for the Outage are considered as Forced Outage)?
  - The issue paper stated it will give the CAISO the ability to deny the outage if there is a reliability concern. CAISO already has this authority. What are the **benefits of the definition change**?
- What is **the timing** and what are **the requirements** associated with each outage type?
- How the **outage** will be approved? What will be the **approval process**?
- Are there **risks** that the outage **won't be approved**?
- What will be the **substitution requirements** for each **outage type**? **Penalties**?
- In terms of UCAP: Can you **convert** a **forced** outage to a **planned outage**? Under what circumstances? What will be the **process** with a UCAP framework for **"curing" extended forced outage**?

Planned outage substitution process revision options

- **Principles to evaluate planned outage substitution revision options:**
  - **Clear and efficient:** provide **clarity on the substitution rule**: i.e., clarity if substitution should be provided and who should provide the substitution based on clear criteria.
  - **Promote advance planning:** allows generators to **submit** planned outage requests **well in advance**.
  - **Be flexible:** allow to have planned outage **requests on short notice** (2 months to 8 days out).
- **Only the Voluntary Planned Outage Substitution pool meets the principles**
  - **Pros: granularity** (daily; weekly; monthly); **simpler transactions** (can pool multiple substitution needs into a single transaction)
  - **The following features of the pool needs to be discussed:**
    - What will be the process for **outage approval** by CAISO with the pool?
    - **How** will the pool be **operated**? What will be **the pool timeline** to access substitution capacity? What will be the intra-month process?
      - Between T-28 and T-8 (before the forced outage definition applies)?
    - **Price of the capacity**: Auctions? Administrative prices with cost justifications? Mix of both?

LUNCH

TRACK 2: AVAILABILITY AND INCENTIVE MECHANISMS

Track 2: Availability Assessment Reform

Proposal: New mechanism, **Measuring Unavailable RA (MURA),** which would assess unavailability during stressed grid conditions and allocate the penalty costs collected from under performing-RA to load.

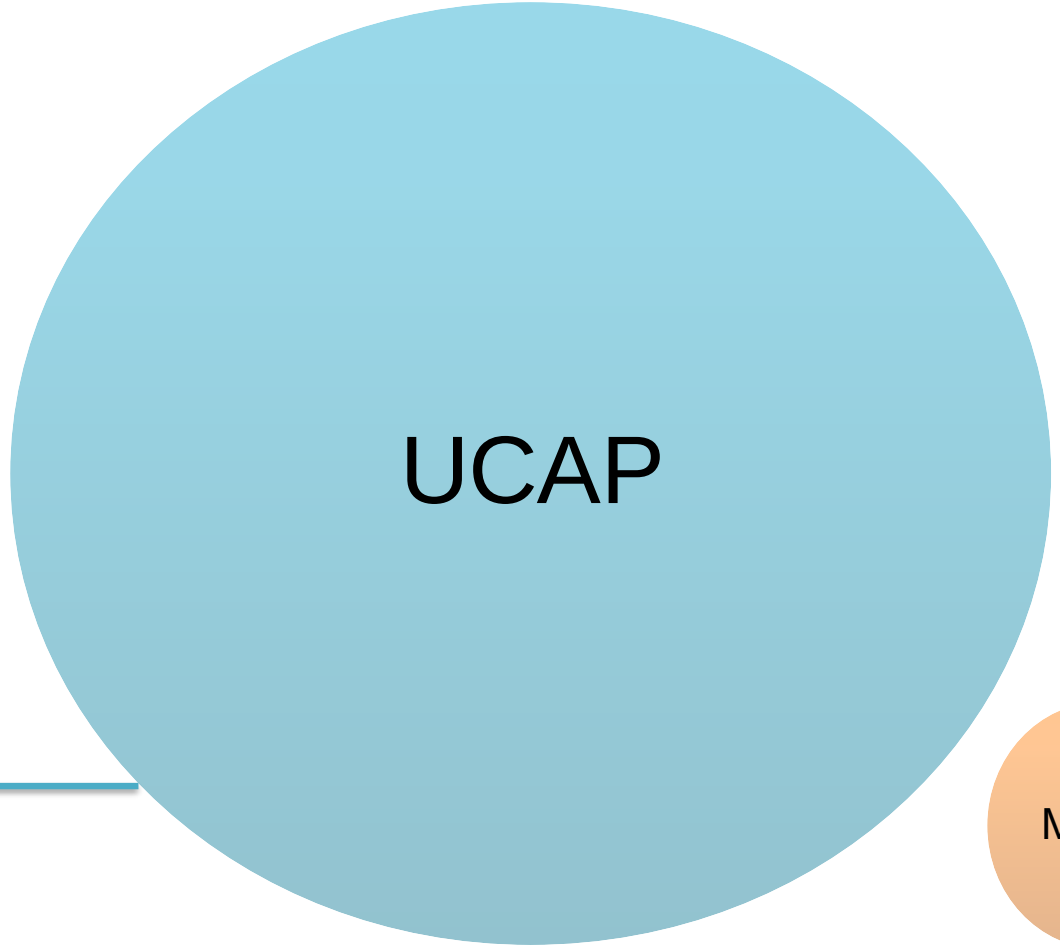
As this is a new mechanism, certain RAAIM features will no longer exist: AAH, allocating penalty collected to over-performers, deadband, exemptions (implicitly reflected in the MOO and outage cards), etc.

Key questions for stakeholder feedback on defining:

- Availability
- Assessment period
- Price of penalty
- Cost allocation of penalty collected

UCAP / Availability Mechanism Crossover

UCAP Answers: What was the resource's availability based on forced outage rates in times of need (~900-1800 hours a year)?



MURA Answers: What was the resource's unavailability based on if they met their MOO during critical hours (~10-50 hours a year)?

Looks back: Year ahead accreditation based on historic data (past few years)

MURA

Assesses current performance: Tallied daily for applicable Tx/RMO/EEA events

MURA: Design Options

Availability

- **RA: Meet the Must offer obligation (MOO)**

Resource adequacy resources have a MOO to bid into the CAISO market the amount of NQC the resource has shown in their supply plan.

The WG can revisit the MOOs and outage cards and will discuss if there should be another approach to defining availability.

Assessment Period

- AAH
- **Tx/RMO/EEAs**
- Reserve shortages

The CAISO recommends starting with Tx/RMO/EEAs as the assessment period. There are tradeoffs between number of events and the extent it meets the policy objective.

The WG will discuss when the penalty should be applied.

Price of Penalty

- VOLL
- **RA benchmarking**
- Scaled RTD price

The CAISO recommends starting with RA benchmarking.

The WG will discuss the philosophy of different approaches to penalty pricing.

Cost Allocation

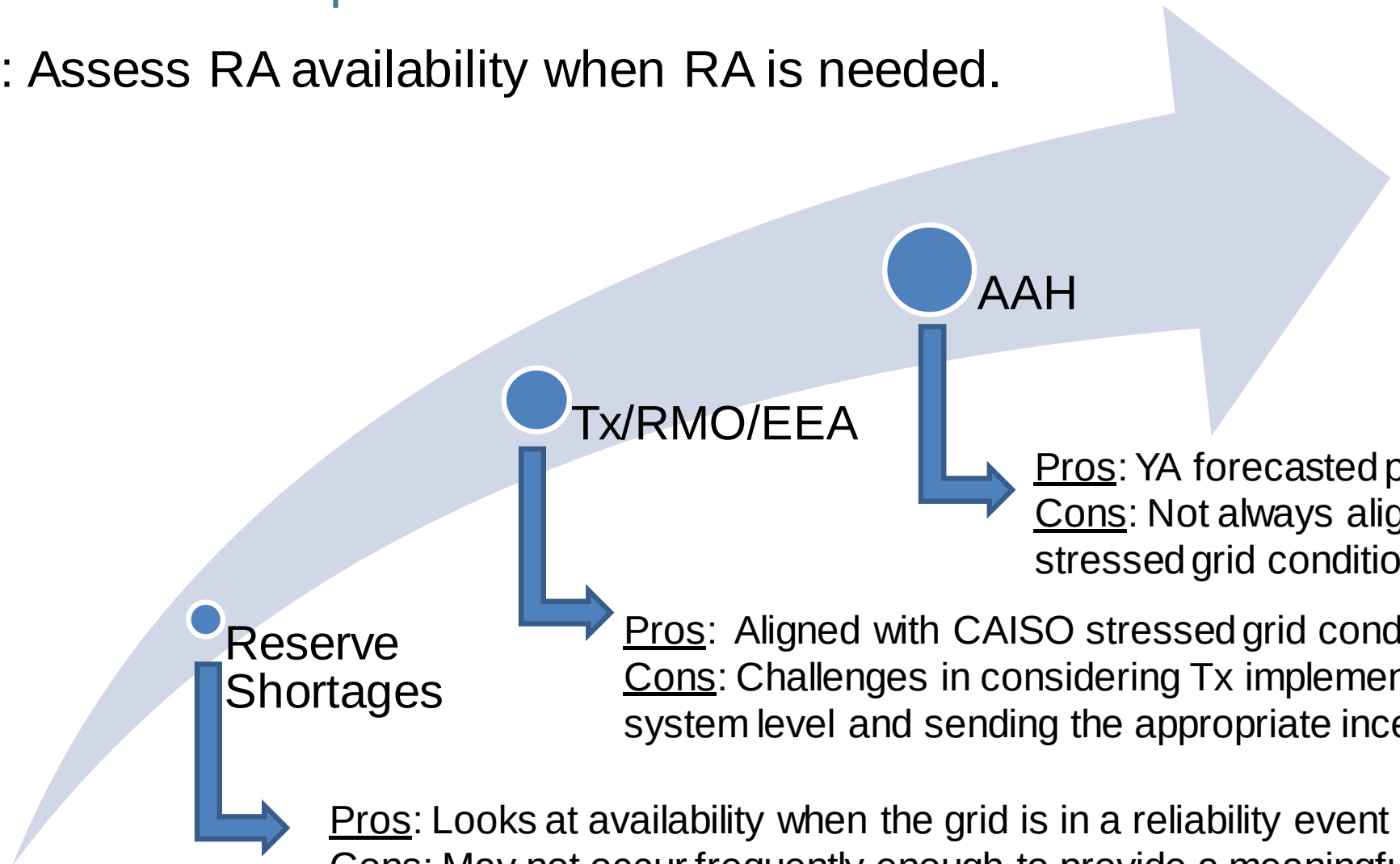
- **Load**

The CAISO recommends starting with allocating the penalty collected to load in line with cost causation- as unavailable RA deteriorates the level of service load procured from RA to be available.

The WG will discuss the incentives created with allocating the revenue collected from penalties to different parties.

Assessment Period Options: Tradeoff Discussion

Objective: Assess RA availability when RA is needed.



Historical Frequency of Grid Emergency Events

Summary of Restricted Maintenance Operations, Flex Alerts, Transmission and Energy Emergencies Issued from May 2022 to Present

	Flex Alert	Restricted Maintenance Operations	Transmission Emergency	EEA Watch	EEA1	EEA2	EEA3
2022	11	16	10	9	6	5	1
2023	0	6	2	2	1	0	0
2024	0	18	23	1	0	0	0
2025	0	2	0	0	0	0	0
TOTALS	**11**	**42**	**35**	**12**	**7**	**5**	**1**

Note: Source last updated January 22, 2025

Price Options

VOLL — Value of Loss of Load

- Represents the economic consequence of a loss of load event

RA Benchmarking — Bilateral RA Prices

- Represents the contractual cost of bilateral RA prices either in the forward or historic context

RTD — Real Time Prices

- Represents the real time impact that unavailability could contribute towards
- This could be scaled based on the level of scarcity (e.g., EEA 3 penalty as 10x RTD)

What is the penalty price of RAAIM set by?

- The current RAAIM mechanism is 60% of the capacity procurement mechanism soft offer cap price, which puts RAAIM at $4.40/kW/mo
- The soft offer cap:
  - Is a proxy for the system marginal capacity cost and serves as a ‘safe harbor’ value that capacity owners are allowed bid up to, and receive that value for compensation if designated for a CPM award
  - Was set as a subset of the fixed costs for a new resource and includes insurance, ad valorem, and fixed operations and maintenance costs, but not capital and financing costs or taxes
  - Costs’ were set using a mid-cost 550 MW advanced combined cycle resource with duct firing capability.

Penalty Approaches: Value of Loss Load

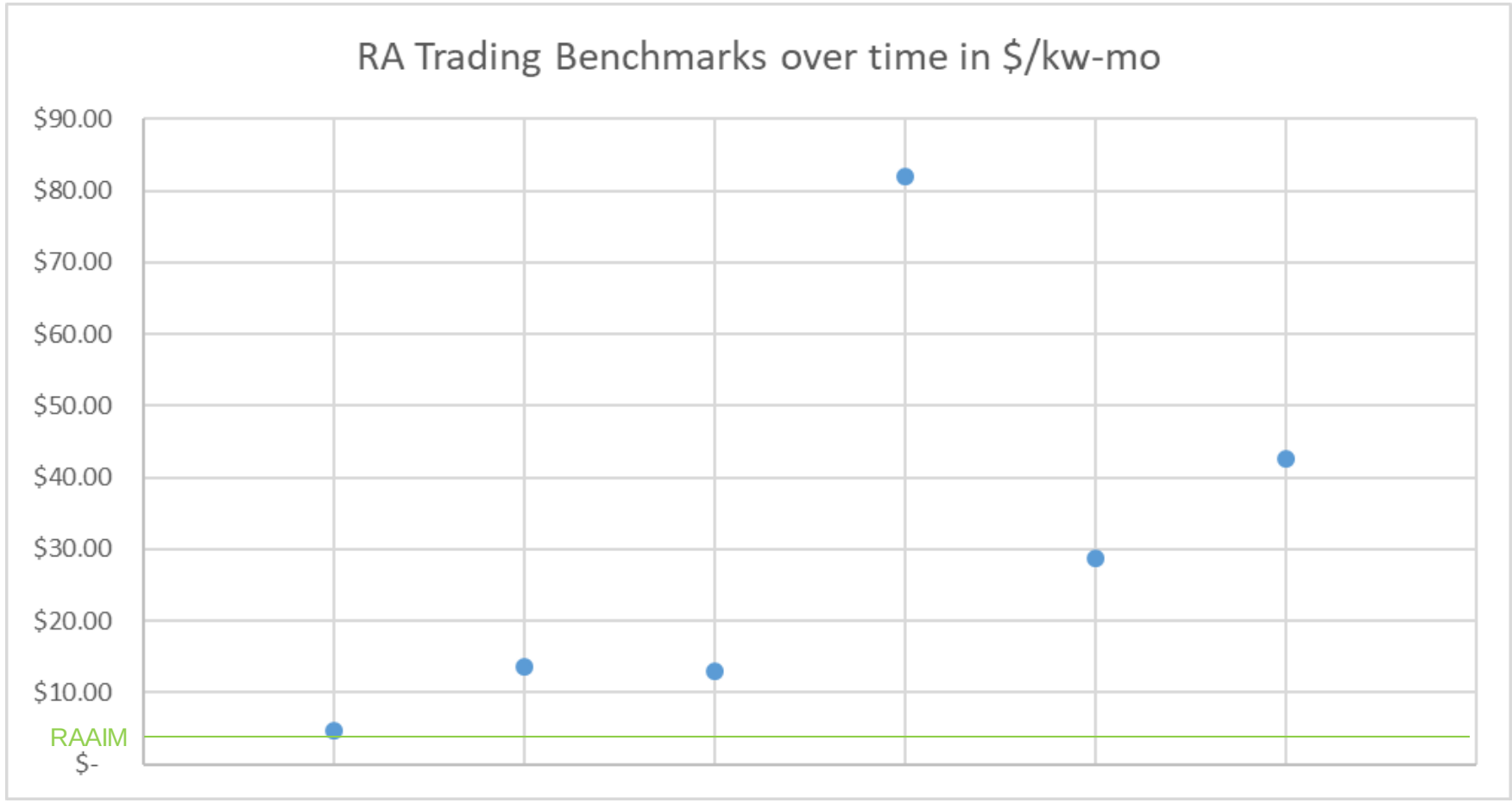
- VOLL represents an estimation of the economic cost to consumers for an involuntary interruption of electricity supply. It essentially quantifies the value that consumers place on reliable electricity service.

- Instead of tying availability and incentive mechanisms penalty prices to the CPM soft offer cap, they could be anchored to and scaled based on VOLL estimates.

How VOLL could be used

- The general principle in many markets is to design the Operating Reserve Demand Curve (ORDC) so that it reflects the Expected Value of Lost Load (EVLL).
  - EVLL represents the risk-weighted cost of load shedding. It's the product of the consequence of load shedding (VOLL) and the probability of load shedding occurring (LOLP, or loss of load probability). EVLL = VOLL * LOLP
  - As the LOLP increases (meaning reserves are becoming more scarce and the risk of load shedding is rising), the price of reserves should increase proportionally, approaching the VOLL as the probability of an outage approaches 100%
- Applied at CAISO, this would mean:
  - Conduct studies to estimate the economic cost of outages for different customer types
  - Set administrative penalty prices for various levels of reliability, derived from the VOLL estimates. For example, the penalty price for reaching an EEA 3 (which could lead to load shedding) could be set at or near the estimated VOLL.

Bilateral RA Trading Prices Over Time



Penalty Approaches: Factor of Real Time Pricing

- The RTD price represents the actual cost of serving load in a 5 minute interval.
- Could be scaled to align with the grid condition (e.g., EEA 3 at 10x RTD)
- Arguments for using the RTD price: If load has procured RA for a desired level of service and unavailability increases those prices, should the price returned be commiserate with the increased prices unavailable generation is contributing to?
- Arguments against using RTD:
  - Using energy as a penalty for RA may not reflect the unavailability consequence
  - Unavailable RA may not be the sole driver for high marginal real time prices
  - Scenarios exist in which penalty prices may too low to incentivize availability during stressed grid conditions

Price Options: Pros and Cons

VOLL — Value of Loss of Load

- Pros: As scaled, could represents the economic consequences of a loss of load event
- Cons: If not appropriately scaled, could be prohibitively high (e.g., MISO's recent VOLL estimates are at $35,000/MWh)

RA Benchmarking — Bilateral RA Prices

- Pros: If priced right, represents an equivalent value of missing capacity
- Cons: Challenges in data lags with RA trading prices

RTD — Scaled Real Time Prices

- Pros: Represents the economic consequences that unavailable RA contributed to
- Cons: Using energy as a penalty for RA may not reflect the unavailability consequence; unavailable RA may not be the sole driver for high marginal real time prices; scenarios exist in which penalty prices may too low to incentivize availability during stressed grid conditions

Next Steps

- Comments due: February 25th
- Track 3 visibility straw proposal: March 7th
  - Stakeholder meeting: Week of March 17th
- Track 1 and 2 straw proposals: April 7th
  - Stakeholder meeting: Track 1 and 2: April 23rd
- Items for future working group discussion (per 2024 discussion paper):
  - Flexible Resource Adequacy reforms
  - 2024 Policy Catalog item: Maximum Import Capability enhancements