Resource Adequacy
Issue Paper

November 7, 2024

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Executive Summary

This issue paper builds on the stakeholder recommendations and prioritization coming out of the 2023-2024 CAISO Resource Adequacy Modeling & Program Design (RAMPD) working group. CAISO's goal for this document is to stimulate further stakeholder input on the benefits and challenges of the various policy solutions to the problems discussed in the working group sessions. CAISO, working with stakeholders, will develop straw proposals stemming from stakeholder feedback on these options.

CAISO initiated this stakeholder-guided working group to collaborate on enhancements to its resource adequacy (RA) processes amid an evolving generation mix, variable supply conditions, and changes to resource planning frameworks in California and the West. The problem statements the working group prioritized touched on four areas:

- Overall system reliability information
- Requirements for RA capacity and program rules and tools
- Disincentives to show all contracted capacity to CAISO
- Local regulatory authority (LRA) cost causation and cost allocation

Stakeholders also prioritized readiness and alignment with the California Public Utilities Commission's Slice of Day (SOD) RA framework and its anticipated impacts on the ISO's RA processes and procedures. CAISO staff recognized the urgency of this issue and held a workshop, published a whitepaper, and hosted a question-and-answer session jointly with CPUC staff to review the SOD framework and its potential impacts.[1] The consensus of the working group was that there was not a need to prioritize immediate CAISO system or process changes in advance of CPUC SOD implementation. However, as additional information and potential topics have emerged through the CPUC's SOD implementation process, the CAISO will continue to assess interoperability with existing and emerging RA programs in the three policy tracks outlined below.

Track 1: Modeling, Default Rules, and Accreditation

This track is already underway, and the CAISO is developing a process to conduct Loss of Load Expectation (LOLE) modeling of the ISO balancing authority area (BAA) in the short, medium, and long term timeframes. Using this modeling, CAISO will work with stakeholders to update the default Planning

[1] CAISO RA Processes and CPUC's Slice of Day, updated October 2024

Reserve Margin (PRM) and default counting rules in the CAISO tariff.[2] We have provided a number of alternative frameworks for the default rules with the ultimate objective of providing useful information to LRAs in PRMs and counting rules that would at minimum meet a 0.1 LOLE. As a part of Track 1, CAISO will also review different potential methodologies for an Unforced Capacity (UCAP) evaluation. Lastly, this paper discusses various alternatives for applying seasonal temperature derates of generation resources that have been adopted by other ISO/RTOs and the Western Resource Adequacy Program.

Track 2: Outage and Substitution and Resource Adequacy Availability and Incentive Reform

This policy track will focus on reforming the CAISO's outage and substitution processes to improve incentives to ensure that capacity is available when and where needed. This track will seek to create incentives for LSEs to show contracted capacity to be visible and available in the CAISO markets, and consider when and how to ease the burden on resource owners to perform needed maintenance at times that do not negatively impact system reliability. Relatedly, this track will assess whether CAISO's current RA availability and incentive mechanism (RAAIM) should be reformed or replaced when considering both the outage substitution incentives and updates to resource counting rules.

Track 3: Resource Visibility and Backstop Procurement Reform

Stakeholders recommended focusing on two subareas of backstop reform — resource visibility and backstop procurement reform.

In the section on transparency we focused in particular on information needed for the current capacity procurement mechanism (CPM) related to available backstop capacity and backstop inputs, and decision making by CAISO. For backstop procurement reform we reviewed options from simply updating the current backstop product to better reflect RA market dynamics to more foundational changes. The part of the initiative dealing with day-ahead sufficiency in the Extended Day Ahead Market (EDAM) for the CAISO BAA will examine solutions associated with the CAISO BAA resource sufficiency evaluation (RSE), including curing potential EDAM RSE deficiencies in the ISO BAA and more accurately assigning costs associated with RSE failures in the CAISO BAA.

[2] The CAISO's default PRM and default counting rules apply when a LRA has not set its own PRM target or counting rules.

Future RA Working Group Topics

As indicated in the final discussion paper not all topics were ready for policy development. As such we plan to have additional working group efforts in early 2025 to discuss 1.) changes to the requirements for and types of RA capacity, including flex RA and 2.) evolution to CAISO's deliverability methodology.

Reader's Guide: Policy Packages and Questions to Consider

Recognizing the paper's length and the numerous policy options considered, CAISO developed **illustrative** policy packages for consideration. CAISO recommends stakeholders consider and weigh different tradeoffs between policy options. Each package explores a different end-state for RA reform.

The packages are not intended to limit the options available to stakeholders, and CAISO is not proposing any of these packages. Instead, the packages are intended to illuminate interdependencies and tradeoffs.

The packages emphasize three factors to consider when designing RA policy: timing, the entity responsible for the reform, and the approach taken. Timing relates to when the given actions would take place (e.g., in the forward planning process or closer to the operational timeframe). The entity performing these functions relates to the load serving entity (LSE), LRA, or CAISO. The third factor explored is if the method is more of a mandate or incentive. A mandate approach is akin to a requirement. An incentive based approach leverages market pricing, incentives, and penalties to change behavior.

These three factors are also correlated. For example, an end state, or final package of RA reforms, that relies on forward planning is likely to be administered by an LRA and be a requirement or mandate. In contrast, an end state that happens closer to the operational time frame or afterwards is likely to be administered by the CAISO and uses an incentive based approach to effectuate a change in behavior.

Lastly, not all design changes can be examined through the lens of timing, entity responsible, and approach. As a result the attributes where these factors apply are marked in an asterisk below. If unmarked, the policy suggested should be considered an interchangeable option.

We look forward to hearing stakeholder perspectives on their preferred packages to meet our collective policy objectives in consideration of the various tradeoffs as highlighted in the questions below.

Figure 1: Illustrative Policy Packages for Discussion of Tradeoffs and Interdependencies

Attribute	Package 1: Edge Improvements	*Package 2: Forward Planning: Leans towards requirements set by LRAs and other LRA implemented reforms	*Package 3: Operational Measures: Leans towards incentives and CAISO implemented reforms
Description	• *Low hanging fruit* • *Minor implementation changes*	*Emphasis on stronger UCAP, buffer for outage and substitution, and more forward backstop curing*	*Emphasis on stronger RAAIM, pooled approach for outage and substitution, and later backstop curing*
PRM	Update default PRM using current portfolio and analysis	Two default PRMs to translate between paradigms - PRM 1 applies to LRAs using ELCC - PRM 2 applies to LRAs using exceedance	One Default PRM and Counting with ELCCs Updated over time for PRM and ELCCs to reflect tight correlation of availability and performance with events
Accreditation Requirements	CAISO enablement of simple UCAP design – May not be unit specific or applied only to a limited set of resources as an incentive	*UCAP Applied to Thermal/Storage based on 20% tightest Hour Supply Cushion (30% weight) and Emergency conditions (70% weight) CAISO partnering with LRAs to determine if a supply cushion exists and how to calculate	*UCAP Applied to Thermal/Storage based on 20% tightest Hour Supply Cushion CAISO partnering with LRAs to determine if a supply cushion exists and how to calculate
Visibility	• Increased RA and non/RA visibility for better CPM and EDAM RSE cure capacity	• Increased RA and non/RA visibility for better CPM and EDAM RSE corrections • 9:00 AM Bidding Deadline	• Increased RA and non/RA visibility for better CPM and EDAM RSE corrections • 9:00 Bidding Deadline

Backstop	• Maintain current backstop criteria • Maintain current CPM caps • Maintain current EDAM Correction Processes and Cost Allocation	• Energy and Net Peak Capacity Assessment (and Requirements) based on LRA requirements • CPM Soft Offer Cap adjusted to reflect seasonal differences in Market Prices • Monthly Energy and Capacity Products to correct	• Portfolio Analysis based on LRA agreed upon methodology • CPM Soft Offer Cap Adjusted to Reflect Market Opportunity Costs • EDAM Corrective Capacity Procured considering avoided EDAM RSE Penalty Costs (Could be monthly, weekly, or daily products.)
Outage & Substitution Processes	• Emphasize use of bulletin board • Include urgent outages	• *Planned outage buffer provided by each LRA • Include urgent outages	• *Outage pool whereby SCs can make capacity available to the pool and be paid if it is needed. SCs can also procure from the pool. Suggests a first right of refusal to access the SCs own capacity. • Include urgent outages • Update rules to consider like-for-like capability for substitution
Performance and Availability Incentives	• UCAP at CPUC • Minor RAAIM Revisions (Daily RAAIM)	• * RAAIM applied to Emergency Conditions and RSE EDAM Failures • RAAIM is even stronger for LRAs that opt out of UCAP LRA provisions and LSE contracts expected to address performance and availability incentives for wind/solar/hydro/DR	• *Pay for Performance (higher price level than RAAIM, could be applied during RMO, EEA watch, and EEA1-3 events, no exemptions)
Cost Allocation for CAISO BAA EDAM RSE failure (and revenue allocation)	• Status quo	• *Corrections/Penalties" assigned to LSEs based on LRA requirements	• *Corrections/Penalties to LSEs based on Default PRM and Counting • Applied to RA Suppliers as an availability incentive

Questions for Consideration:

CAISO developed the following questions for consideration. CAISO is interested in specific guidance from stakeholders on these topics. These questions will also be in the stakeholder comment template posted following the November 18, 2024 workshop.

Overall:

- What recommendation does your organization have for which attributes to put together to create a holistic RA process at the ISO? Please highlight how your recommendation considers interdependencies and tradeoffs that meets the overall objetives of RA.

Track 1: Modeling, Default Rules, and Accreditation

- What key iterations would your organization prefer to see explored in the RA modeling inputs & assumptions in order to have the most accurate assessment of the reliability of the CAISO BAA?
- With the goal of updating the default RA rules in CAISO's tariff in mind, what combination of resource counting rules and resulting planning reserve margin makes the most sense for the CAISO BAA? How frequently should these be revisited?
- What kind of UCAP design and implementation method would best capture relevant considerations for resource availability in CAISO's RA fleet?
- What improvements to CAISO's unit testing program could better reflect the capacity of resources in weather conditions that correlate with peak load?

Track 2: Outage and Substitution and RAAIM Reform

- Does your organization favor an approach to outage and substitution that occurs in the annual/monthly procurement horizon and set up by LRAs (e.g. a mandatory substitution buffer), or one that is closer to the operating time window and administered by the CAISO (e.g. an outage substitution pool funded by SCs taking outages)? What specific approach to outage and substitution would your organization like to see proposed in the future straw proposal and why?

- How does your organization's preferred approach to outage and substitution interact with LRA planning rules, UCAP, and an availability and incentive mechanism?
- For availability and incentive reforms, where/when should these incentives be managed? For example, for what resources should incentives be managed in LRA/LSE tariffs/contracts or in a standardized mechanism implemented by the CAISO? If managed by a CAISO mechanism, how does your organization's preferred approach to UCAP relate to the availability and performance incentive design if not all LRAs resources move to UCAP and if UCAP does not apply to all resources?
- What specific approach to reforming or removing RAAIM would your organization like to see proposed in the future straw proposal?
- If your organization would like to see RAAIM reformed, what are all the aspects that should change (e.g., incentive level of RAAIM, when RAAIM is applied, eliminating the deadband, changing applicability, etc.)?

Track 3: Resource Visibility and Backstop Procurement Reform

- Particularly in light of the CPUC's slice of day reforms, should CAISO assess energy sufficiency and/or net peak needs and update CPM authority?
- Does the decline of capacity offers into the Competitive Solicitation Process (CSP) indicate a need for policy change in the soft offer cap methodology or other aspects of the Capacity Procurement Mechanism (CPM) program? If so, what should these changes be and how would they help ensure capacity is available for backstop procurement when operators need it?
- If the soft offer cap were to be changed from its current cost-based approach, what market role would the new methodology be creating for the CPM program and why is that an improvement on the current framework?
- What impediments exist today to showing all contracted capacity as RA or offering it into the CSP? What structures and processes would help promote visibility and access to this capacity?
- Does your organization support developing a causation-based approach to allocating EDAM RSE failure surcharges? If so, how should this approach be structured and what, if any, are the key barriers that must be overcome?
- Are there new capacity products that could enhance CAISO's approach to the EDAM RSE? If so, how should they be structured and priced?

1 Resource Adequacy Modeling: A CAISO Reliability Assessment

Problem Statements

In the July 2024 Revised Discussion Paper, the Track 1 problem statement related to modeling includes these two sub-issues:

- *A comprehensive evaluation of the sufficiency of the current or expected CAISO BAA RA portfolio in forward time frames (e.g., monthly, yearly, multi-year) does not exist today. Such an assessment would provide the ISO and stakeholders an understanding of the overall CAISO BAA level of system-wide reliability, LRA contributions to overall system reliability, and the implications of an RA resource fleet with an increasingly diverse mix of fuel and technology types.*
- *There is a need for additional information regarding the sufficiency of the LRA RA programs to meet 0.1 LOLE.*

Objectives

Based on these problem statements, CAISO identified a need to evaluate resources in its BAA as mentioned above. Today, CAISO produces an annual Summer Loads and Resources Assessment. Starting with the Summer Assessment's modeling framework, CAISO has initiated a process to evaluate the CAISO BAA's reliability in the next year using a probabilistic loss of load assessment and multi-hour stack analysis. CAISO's RA program historically has been designed to work in conjunction with the resource adequacy requirements adopted by the CPUC and other non-CPUC jurisdictional LSEs to ensure that capacity procured is available when and where needed.

The RA Modeling & Program Design working group identified challenges with today's RA systems and processes. A CAISO reliability assessment will equip CAISO and stakeholders with powerful new tools to address these challenges. The ISO's RA assessment:

- Provides a clear, consistent modeling methodology describing appropriate resource counting rules, reserve margins, and reliability targets that capture the energy and capacity value of resources given the grid's increased dependence on energy storage and variable energy resources
- Produces actionable forward information on the reliability of the entire RA fleet, including deficiency and risks from the evaluated RA portfolio

- Instills confidence in internal and regional partners in California's RA fleet
- Addresses the ISO's limited visibility to resources not shown as RA which, in the current showings process, makes it difficult to determine operational reliability risks in advance

Benchmarking: Other Western LOLE Modeling

Various other resource planning entities in the Western Interconnection make use of LOLE assessments to model the reliability of expected future resource portfolios. The CPUC's RA program and the Western Power Pool (WPP)'s Western Resource Adequacy Program are both working towards incorporating some kind of one day in ten year LOLE threshold standards into their resource adequacy and planning programs.

Since 2023, the CPUC's Energy Division performs its LOLE analysis for its Integrated Resource Planning process to assess system reliability needs using the SERVM model. This is done by setting a PRM that enables the preferred system plan to meet a 0.1 days per year loss of load expectation under various future supply and demand scenarios. Energy Division has also performed a year-ahead LOLE assessment to set its annual system planning reserve margin for its RA program.[3]

A component of WPP's Western Resource Adequacy Program, the Forward Showing Program's Advance Assessment, also uses a one in ten LOLE threshold to determine its monthly Forward Showing Planning Reserve Margin requirements and ELCC values for wind, solar, and storage resources.[4]

Beyond WECC, nearly all other system operators in North America use Loss of Load Expectation as a planning tool to set reserve margin requirements. For example, the Midcontinent System Operator (MISO) conducts an annual Loss of Load Expectation study to determine a planning reserve margin and other resource adequacy deliverables. MISO uses these study results as inputs into its planning resource auction to procure incremental capacity.[5] MISO also performs an "outyear analysis" to produce planning reserve margin projections several years out for informational purposes only.

Options for Consideration: Proposed Modeling Framework

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[3] CPUC Loss of Load Expectation Study for 2026

[4] WPP Western Resource Adequacy Program – Advance Assessment Business Practice Manual

[5] MISO – Resource Adequacy Planning Year 2023-2024 LOLE Study Report

During the 2023-2024 RA Modeling & Program Design working groups, CAISO staff proposed a scope for forward-looking reliability studies over various time horizons. Stakeholders asked questions and provided feedback enabling CAISO to refine its approach since the early working group meetings.

CAISO's proposed **near-term** year-ahead modeling approach entails a probabilistic assessment of the adequacy of next year's contracted RA resources in the ISO BAA to meet a 0.1 LOLE target. This stochastic assessment uses the survey results from the LSEs that provided their projected RA-eligible resources to cover 100% of their load plus PRM as set by their LRA. Now that the ISO has received these LSE survey responses, the modeling team has combined data from these surveys and additional available ISO RA data to create several modeled supply scenarios. These scenarios are detailed in an inputs and assumptions document which was published on October 7 for stakeholder review and feedback.[6] Assumptions were similar to CAISO's Summer Assessment, including:

- Stochastic load, solar generation, and wind generation profiles (500 sets of hourly, time synchronized profiles for each)
- Hydro profiles for non-dispatchable/run-of-river hydro resources
- Demand response data
- Import and retirement assumptions
- Forced and planned outage rates to create 500 outage profiles for each generation resource

The combination of the LSE survey responses and additional CAISO information will inform the modeling time frames, focusing on near-term modeling first. Initial results included multiple scenarios using different resource assumptions. The ISO will continue to meet with stakeholders to review draft results and discuss iterations and refinements. Beyond this modeling effort, CAISO is also seeking feedback on the frequency and timing of this year-ahead assessment. Specifically, stakeholders have said that it may be more efficient to coordinate with the CPUC and other state agencies to avoid duplicating existing reporting with a recurring CAISO survey process. This will be a topic of discussion in initiative workshops.

[6] RA Modeling and Program Design Year-Ahead Modeling Workshop – October 8, 2024

For the **mid-term** assessment, CAISO proposes to look two to four years out (i.e., one year to three years beyond the year-ahead assessment detailed above). Studying this period will help answer the question of whether the current level of contracted capacity *and* authorized procurement is sufficient to meet future RA needs. This assessment will provide an LOLE analysis, as well as various accreditation options by resource types for each of the three years studied to show how a resulting PRM would be impacted.

Finally, a **long-term** analysis, looking five to ten years ahead, would examine future grid scenarios consolidated from existing integrated resource plans across CAISO.

2 Revisiting CAISO's Default Resource Adequacy Rules

Problem Statements

As a part of the RA Modeling & Program Design working groups, the following sub-issues were identified as a part of the larger RA problem statement:

- *There is a need for additional information regarding the sufficiency of the LRA RA programs to meet 0.1 LOLE.*
- *The CAISO default PRM should be assessed in light of changes in the RA resource mix and evolving reliability needs within the CAISO BAA. CAISO's default PRM and default counting rules should meet at least a 0.1 LOLE at the CAISO BAA level.*

This section contains background information about CAISO's current default PRM and default counting rules.

Objectives

In updating the default RA rules in the tariff, CAISO seeks to model counting rules and a PRM that balance the following objectives:

- Counting rules included in the CAISO tariff should reflect the relative contribution of different resource types—and individual resources—to maintain BAA-wide and local reliability
- The PRM in the CAISO tariff should be designed alongside counting rules to create a coherent set of RA standards
- If these standards are adopted by an LRA, the resulting compliant LSE portfolios could reasonably be expected to meet at least a 0.1 LOLE

Background

Section 40 of CAISO's tariff indicates that RA procurement requirements for LSEs are largely determined by the CPUC or other LRAs. These requirements include how much capacity LSEs must procure, in the form of a reserve margin percentage over forecasted load for each LSE. The requirements also define how much capacity a RA resource counts toward meeting that forecasted demand plus reserve margin. This contribution is determined by qualifying capacity (QC) criteria which specify methods of RA accreditation.

These LRA-determined PRMs and QC values, respectively, are inputs into the ISO's RA processes, including LSE RA plan submissions and the determination of resources' net qualifying capacity (NQC) values. However, the CAISO tariff *does* specify a default PRM and default QC criteria, which would be utilized if

LRAs have not specified their own QC values or reserve margins. CAISO has never had to apply these default rules. It is important to review and update the default rules as needed to address the evolving needs of the grid and the RA program. This is particularly relevant because, during the working group process, LRAs indicated that they rely on the CAISO default rules when developing their own requirements.

Evolving Challenges with Default Rules

CAISO has been in close contact with its reliability partners across the state to evaluate the impact of the changing QC values coming from the CPUC, the largest LRA in the CAISO BAA, as it implements its Slice of Day RA program. In light of these changes, CAISO needs to reexamine and refresh its default counting rules and PRM so that LRAs setting their PRM requirements have an updated benchmark that reflects the evolving needs of the grid. The default rules should satisfy RA planning and procurement objectives that collectively support on-going system-wide reliability.

CAISO understands that some LRAs use the CAISO's default reserve margin of 15% to set their PRMs. Additionally, some LRAs incorporate the CPUC's counting rules for wind and solar and technology factors as reflected in the CAISO's NQC list (which are, at least in draft, based on CPUC LRA counting rules), to set wind and solar accreditation. With the CPUC's shift to a 24-hour Slice of Day framework and to exceedance-based counting for wind and solar resources, NQC values and technology factors in the CAISO NQC list will increase in 2025 in some summer months compared to values set by the CPUC based on effective load carrying capability (ELCC) in previous years. In light of the CPUC's shift to Slice of Day and adoption of this exceedance-based counting approach, the CPUC is actively reforming how it calculates its reserve margin.[7] Similarly, all LRAs should develop counting rules and PRM levels hand in hand to ensure a reliable RA portfolio.

Non-CPUC LRAs may simply adopt higher NQC values (or, for partially contracted resources, the highest LRA QC value applies to the entire resource) for wind and solar based on the CPUC's exceedance values at coincident peak without commensurately revisiting their PRM levels. These LRAs would then be

[7] CPUC Loss of Load Expectation Study for 2026, and corresponding Appendix A

able to meet RA obligations with fewer resources overall, potentially reducing the reliability of the RA portfolio available to CAISO.

Finally, CAISO recognizes that the CPUC's local regulatory authority represents about 90 percent of the CAISO balancing area coincident peak demand. The combination of resource counting rules and PRM levels across the entire CAISO balancing area must collectively meet a 0.1 LOLE to ensure RA requirements reflect the resources necessary to maintain reliability across the BAA.[8]

Current Default Qualifying Capacity Criteria

According to the ISO tariff, "default QC criteria apply only where the CPUC or other Local Regulatory Authority has not established and provided to the CAISO criteria to determine the types of resources that may be eligible to provide QC and for calculating QC for such eligible resource types."[9] The table below contains a summary of the current default counting rules in the CAISO tariff for various resource types.

Figure 2: Current CAISO Default QC Methodology

Resource type	Current CAISO Default
Wind & solar	Based on monthly historic performance over a three year rolling average from noon to 6pm. These hours were intended to represent gross peak hours, i.e. the peak energy demand in the CAISO BAA, *not* the hour that requires the most energy net of wind and solar contributions
Energy storage	Based on CAISO testing of a resource's sustained output over a four-hour period (and not to exceed that resource's maximum instantaneous discharge capability)
Thermal	Based on "net dependable capacity" defined by NERC Generating Availability Data System information (GADS)

[8] CAISO Reply Comments on CPUC R. 23-10-01
[9] CAISO Tariff Section 40.8.1.16

Dispatchable hydro	Based on net dependable capacity defined by NERC GADS minus variable head derated based on an average dry year reservoir level
Demand response	Based on a resource's average monthly historic demand reduction performance during that same month during the RAAIM Availability Assessment Hours

Current Default Planning Reserve Margin

Section 40.2 of the current CAISO tariff requires that LSEs must indicate to CAISO the relevant planning reserve margin from the appropriate LRA, whether that is the CPUC or another local regulatory authority. These corresponding PRMs must be provided in the form of a percentage of the annual or monthly demand forecast for each LSE. If an LSE does not provide this PRM as a part of its RA plan submission, the CAISO tariff requires that the LSE must comply with a default fifteen percent PRM over the LSE's peak hourly demand for each month. This 15% reserve margin is meant to ensure procurement of an amount of capacity over and above the predicted demand that is necessary to provide adequate operating reserves and to account for contingencies such as generator outages and forecast error.[10]

Benchmarking

Other ISOs, RTOs, and regulatory authorities count resource adequacy supplies using a mix of different capacity accreditation rules. Every planning area will have a slightly different combination of preferred counting rules based on that system's characteristics, particularly, its existing and planned generation fleet.[11] Several other ISOs and RTOs in North America administer centralized capacity markets. They set the accreditation guidelines, reserve margins, and other rules in order to maintain consistent capacity market requirements. CAISO has a unique RA program structure. No centralized capacity market exists within the CAISO BAA. Instead, CAISO partners with the CPUC and other LRAs as described above to

[10] CAISO Business Practice Manual for Reliability Requirements, Version 74

[11] Electric Power Research Institute. Resource Adequacy for a Decarbonized Future. 2022.

ensure appropriate capacity is procured bilaterally between LSEs and RA suppliers.

Under Slice of Day, the CPUC's resource adequacy program, compliance will shift from a single capacity check in the coincident[12] peak demand hour to a capacity check in every hour of a 'worst day' (24 total) each month. The CPUC will continue to assess RA compliance on a year-ahead and monthly basis. SOD will also check storage charging sufficiency by adding battery charging to the hourly demand requirement. Under SOD, counting rules for wind and solar resources will transition from ELCC to exceedance values. Although capacity counting for storage and demand response will not change under SOD in 2025, these resources are subject to certain rules for showings across 24 hours. See below for a summary of these rules.

Figure 3: CPUC QC Methodology Summary

Resource type	CPUC Counting Rules
Wind & solar	24 hour exceedance profiles for each month of the year
Energy storage	Optimized to dispatch state of charge across 24 slices, limited by a charging sufficiency requirement
Thermal	Flat PMax value, subject to availability limits
Dispatchable hydro	Flat PMax value
Demand response	Load Impact Protocol profile

In other ISOs and RTOs, stakeholders are discussing changes to accreditation methods for many of the same reasons these policy conversations are happening in California: a changing resource mix, forecasted load growth, and increasing frequency of extreme weather. Generally, the other grid operators are

[12] Across all load serving entities.

focusing on revising counting rules for thermal resources, variable energy resources, and energy storage.

Figure 4: Selected North American Counting Rule Methodologies

Resource type	ISO/RTO Current Counting Rules				
	PJM	MISO	NYISO	ISO-NE	SPP
Wind & solar	Marginal ELCC with resource performance adjustment (RPA) factor	Two-step Direct Loss of Load method: class-based marginal reliability contribution with resource-specific historical adjustment	Unit specific derate to capacity accreditation factor	Peak hour median production	ELCC (proposed)
Energy storage			Different factors depending on storage duration and total capacity	2 hour output	ELCC (proposed)
Thermal			UCAP - EFORd	Max deliverable output	EFORd (proposed)
Demand response			4 hour duration requirement for “Special Case Resources”	Demand reduction value relative to baseline	Load reduction capability during forecasted peak

The Forward Showing Program, a component of WPP's Western Resource Adequacy Program (WRAP), determines qualified capacity contributions (QCC), i.e. accreditation for each resource type.

Figure 5: WRAP QCC Methodology

Resource type	WRAP QCC methodology [13]
Wind & solar	Based on seasonal ELCC analysis in different "VER Zones"
Energy storage	Based on average ELCC analysis
Thermal	UCAP ("equivalent forced outage factor during capacity critical hours")
Dispatchable hydro	Based on performance capability during "capacity critical hours"
Demand response	Five hour continuous load reduction capability

How Modeling Can Inform Updates to CAISO Default Rules

CAISO's RA Modeling efforts described in the previous section will lead to a stakeholder discussion about how a resource portfolio analyzed for loss of load expectation might be used to set the CAISO's default planning reserve margin in order to demonstrate a set of RA rules that meets a 0.1 LOLE. As a part of this process, various accreditation methods will be discussed with stakeholders, including a UCAP mechanism laid out in the next section. CAISO also has the ability to produce ELCC values for different resource classes as a part of this modeling effort.

In order for CAISO's default PRM to account for forced outage rates and resource availability, default qualifying capacity criteria must be able to represent resources' value to reliability in times of need. One approach is to offer a combination of different counting rule schemes and corresponding PRMs depending on different purposes. Overall, the goal of "CAISO's default PRM and

[13] WPP Western Resource Adequacy Program - Qualifying Resources Business Practice Manual

default counting rules to meet at least a 0.1 LOLE at the CAISO BAA level" should inform whatever set of counting rules CAISO uses for its default accreditation methodology and resulting PRM. The packages in this paper's introduction provide one way of looking at different options for accreditation. Stakeholders should discuss the merits and value of these different policy options.

3 Unforced Capacity Mechanism

CAISO has traditionally relied on its Local Regulatory Authority partners to establish capacity accreditation for their RA resources. CAISO evaluates the qualifying capacity values it receives from LRAs based on factors such as transmission system deliverability and the resource's PMax and PMin to establish a Net Qualifying Capacity value for the LRAs' resources. However, CAISO does not have a mechanism to evaluate a resource's QC value based on individual unit performance or contribution to system reliability. One way of evaluating resources for these measures is to use an unforced capacity (UCAP) metric. This can be applied as a design feature of an LRA resource adequacy program or as a direct derate calculated and administered by CAISO.

Problem Statements

The approaches to UCAP laid out below may serve as a starting point for discussions with stakeholders about how to account for unit availability. After this paper is published, stakeholders should discuss how CAISO might develop a system to meet the relevant problem statements from the working group discussion paper, stated below:

- *CAISO needs consistent, transparent, and timely information on the sufficiency of the RA fleet in the CAISO BAA. Without this information, the ISO faces challenges in assessing and communicating the system-wide sufficiency of the CAISO BAA in light of the contracted RA fleet.*
- *A stakeholder initiative should evaluate how well current LRA-established PRMs and counting rules reflect forced outage rates, performance, and availability. In response to potentially changing regulatory structures at the CPUC (including the scoping of UCAP), CAISO has an opportunity to establish alternatives to the current resource counting design and eliminate/redefine availability and performance incentives while acknowledging LRA authority to establish counting rules.*
- *The availability of resources based on varying seasonal ambient derates is not consistently reflected in resource net qualifying capacity (NQC) today which creates challenges in reliably operating the grid.*

Objectives

The Electric Power Research Institute (EPRI) describes UCAP as "the amount of physical generating capacity available after accounting for a unit's forced outage

rate."[14] EPRI further characterizes UCAP as providing "a reasonable approximation of adequacy contribution for thermal resources in a large electricity system with many generators, assuming outages are uncorrelated. Furthermore, thermal resources in large systems do not typically exhibit interactive effects, unlike variable and energy-limited resources." These descriptions succinctly capture the usefulness of a UCAP accreditation mechanism. Such a mechanism could accomplish a variety of goals depending on the design details. These goals may also be met through availability and performance penalties, LSE or LRA contract incentives, and/or energy market prices. These goals include:

- **Reward good resource performance and penalize poor performance:** In order to provide an incentive for performance during critical hours, UCAP accreditation can provide an individual rating for each resource based on an assessment of key hours of reliability risk. A well-designed UCAP mechanism rewards unit owners performing proactive planned maintenance in order to minimized forced outages during critical system hours.
- **Encourage retention of more reliable resources:** the goal above is focused on performance by RA suppliers, but a UCAP mechanism could also guide LSEs' procurement decisions by giving them more information about which resources are more or less reliable.
- **Match accreditation methodologies with assumptions in reliability assessments:** the assumptions for unit availability in probabilistic RA modeling should be congruous with an availability-based accreditation methodology. Meeting this goal can be technically challenging, but ideally, a UCAP methodology would produce similar fleet availability to the portfolio outage assumptions in loss of load expectation assessments. This would create a direct feedback loop between outage rates in critical periods and the PRM level.

Approaches to UCAP Design

This section will review various approaches to UCAP accreditation design. The purpose of a UCAP counting rule mechanism is to assess a generating resource's availability when it is most needed and reflect its availability in its capacity accreditation value. Availability means how much a resource can

[14] Electric Power Research Institute. Resource Adequacy for a Decarbonized Future. 2022.

dependably generate under certain criteria when factoring in its historic forced outages and derates. UCAP is a more precise way to ensure applicable RA resources are properly valued when showing resources to meet an RA requirement. A less precise way to capture resource availability is to add a percentage factor to the planning reserve margin to roughly account for forced outage rates. If a PRM is set based on reliability modeling to build a portfolio that meets a 0.1 LOLE standard, UCAP accreditation can still be used to reach a corresponding reserve margin without risk of counting forced outages twice. There is a tradeoff between capturing fleet-wide availability within a traditional planning reserve margin construct and accrediting individual resources in a way that gives resource owners an incentive to reduce their forced outage rates.

Supply Cushion UCAP

In CAISO's previous RA Enhancements policy initiative, we proposed a detailed UCAP approach to better align a resource's capacity accreditation with its actual availability to the market during critical load serving hours. This mechanism's "final" design was described in the December 2020 Sixth Revised Straw Proposal for Resource Adequacy Enhancements Phase 2A and reviewed in a February 2024 CAISO RA Modeling & Program Design working group meeting.

The proposed UCAP approach was to apply to resource types that do not receive a QC value based on an effective load carrying capacity (ELCC) methodology from an LRA. CAISO's UCAP proposal was not finalized, so this section will review the most recent iteration from the 2020 proposal, referred to as "supply cushion UCAP." This section will highlight key design choices and questions stakeholders may want to review and discuss in light of the changes to the RA fleet and grid conditions in the last several years. Some benefits and challenges with the supply cushion UCAP method are also described below.

In summary, the supply cushion UCAP design proposed dividing each year into two seasons and retrospectively identifying the hours in each season that had the smallest buffer between shown RA and net load, outages, reserve requirements, and outages, and evaluating how often a RA resource was on a forced outage (either full or partial) during those tightest supply hours in that season. Then, each season's availability factor was weighted to place a greater value on the most recent years so that resource owners had an incentive to perform timely maintenance to retain a high capacity accreditation value. This describes the proposal for thermal and storage resources, but there are variations for other resource types as well and how to count new resources that

don't have three years of outage history. UCAP applied at a resource-specific level to provide an incentive for plant owners to perform preventative maintenance, maintain a high availability, and eliminate the free rider problems associated with class average UCAP values.

The supply cushion UCAP design assumed that CAISO would continue to maintain a database of QC values received from LRAs that are derated for transmission system deliverability and unit test results, which is currently known as a resource's net qualifying capacity value or NQC. Under the UCAP proposal, the existing NQC value was to be redefined as the "deliverable qualifying capacity" or DQC, and the newly defined NQC value was to be the resource's DQC value derated by a weighted seasonal average availability factor. A familiar, similar formula in other markets is:

$$\text{UCAP} = \text{ICAP} \times (1 - \text{EFOR})$$

Where ICAP is a unit's nameplate, tested, or deliverable capacity, and EFOR representing a forced outage rate metric.

The intent of introducing DQC as described above was to maintain the NQC value in the ISO tariff and to minimize the impact on existing RA contract provisions.

To determine the hours in each season when a resource's availability is assessed, CAISO would identify which hours fall into the most constrained 20% of hours sorted by how tight the supply cushion is in each hour of the relevant season. These supply cushion hours are a measure of real-time system RA risk and a means to align tight operating conditions with having sufficient RA resources available in those hours of tightest supply. Thus, under the proposal, shown RA for each hour was reduced by several factors to give a sense of how much supply is available for forced outages or load increases. Factors removed from total shown RA were:

- Wind and solar RA resources
- Planned outage impacts
- Forced outage impacts
- Net Load – taken from the five minute market, with 12 RTD load intervals averaged to represent an hourly value
- Contingency reserves – 6% of gross load (minimum 2,500 MW)

This supply cushion calculation would be done as a retrospective analysis, so that plant owners would not simply focus on ensuring their resources are available during certain known hours and face no accreditation penalty if forced outages were taken in a set of indicated non-supply cushion hours. However, at a fundamental level, the supply cushion formula *was* designed to select hours when the system is most constrained. Thus, SCs can generally understand that hours of high system demand should match the times when key supply cushion hours would be selected.

After the supply cushion hours were selected, CAISO would determine hourly unavailability factors (HUF) for each RA resource based on how frequently each resource was on a forced outage (full or derate) during the supply cushion hours. The HUF would be calculated for each supply cushion hour in a season by adding derates (in MW) to forced outage impacts (in MW) and dividing the sum by the resource's PMax. The hourly unavailability factor takes the form of a decimal between 0 and 1.

Then, the HUFs would be summed, divided by the total number of hours, and subtracted from 1 to produce a seasonal average unavailability factor (SAAF) in the form of a decimal between 0 and 1; e.g., if a resource were on a full forced outage for 83 of a season's 830 total supply cushion hours and fully available for the remaining hours, it would receive an SAAF of 0.90.

A weighting system was proposed to give more weight to recent performance and quickly diminish impacts of a year where a resource was frequently on forced outage. This weighting would ensure that major planned maintenance that resulted in fewer hours on forced outage would quickly produce an improved UCAP value. Percentage weights would be applied to the seasonal availability factor by year from most recent to most historic, weighted at 45% for the most recent on peak and off peak seasons, 35% for two years back, and 20% for the third year. These weighted seasonal values were called Weighted Seasonal Average Availability Factors (WSAAF). Finally, once the weights were applied, CAISO would apply the WSAAF to each resource's DQC factors to create new seasonal NQC values.

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

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

For this paper, CAISO produced updated draft class-average UCAP values using the supply cushion method described above, listed below. However, the data used to produce these values was only from the two most recent years, 2022 and 2023, with 2023 weighted at 55% and 2022 at 45% instead of the 45-35-20 weights described above. These indicative results give stakeholders a sense of an expected value for how different resource types might be counted under supply cushion UCAP.

Figure 6: Updated Fuel/Unit Type Average Supply Cushion UCAP WSAAFs for Selected Resource Types, 2022-2023 data

Fuel Type	Unit Type	On Peak WSAAF	Off Peak WSAAF
GAS	Combined Cycle	89%	86%
GAS	Combustion Turbine	89%	88%
GAS	Multi Stage Generator	86%	90%
GAS	Steam Turbine	88%	82%
HYBD	Hybrid	87%	95%
LESR	Battery Storage	89%	93%

Supply Cushion UCAP: Advantages and tradeoffs

There are several key specific features to the supply cushion UCAP approach which improve on the status quo. First, it directly integrates forced outages and derates into a generator's calculated RA qualifying capacity value. A standardized process to derate a specific resource type would result in a standard value to sell to different LSEs (regardless of the LRA program design) and the ISO could evaluate on a consistent basis. Second, greater and standardized resource accountability should produce market signals that improved operational reliability and availability. Third, to the degree the forced outage rates are generally consistent over time, such a design could promote

procurement of better performing resources. The accessibility of information on the forced outages and derates of resources that impact their availability can help buyers avoid risks and make better informed decisions when making bilateral trades or procuring replacement RA capacity.

By not explicitly designating the supply cushion hours in advance, suppliers are encouraged to maintain their units so that they can avoid forced outages during whichever hours and days appear to be the most stressed on the grid. This approach is different from simply prioritizing certain hours during each day (e.g., the RAAIM Availability Assessment Hours) regardless of real time conditions. However, this ex post calculation also presents challenges for generators when planning maintenance, because supply cushion hours may end up falling outside of predictable patterns due to exogenous market forces. On the other hand, this supply cushion calculation is relatively simple to calculate and understand compared to any attempt to calculate when each unit *would* have been dispatched *were it not on outage* such as an equivalent forced outage rate (EFORd) methodology.

Additionally, we recognize that the supply cushion approach does not directly evaluate units' contribution to overall system reliability in the way that an effective load carrying capability (ELCC) assessment does. Instead, it focuses on uncorrelated outages on a per-resource basis, which means the contracting incentives are not as directly linked to overall system need as a marginal ELCC-based accreditation method would be. This limitation may be reasonable for the CAISO BAA, as a starting point, which generally has not experienced cold weather fuel shortage correlated outages in the way that ISOs in the Eastern US have. However, see the "Capacity Testing" section below for more on reduced plant performance in high temperatures.

Defining Availability

An important element of any availability-based RA accreditation methodology is how to determine when a resource is "available." One goal of a well-designed UCAP methodology is to count resources as having greater availability if they are less frequently derated or on forced outage. A parallel RA initiative (Track 2 below) will address necessary updates to CAISO outage definitions (i.e., forced, planned, etc.) in a way that ensures a UCAP mechanism properly accounts for a resource's availability. Of note, an alignment of CAISO BAA outage types with RC West outage types would add "urgent" outages to the list of BAA outage types. For the purposes of UCAP, forced and urgent outages could both be

considered in a resource's forced outage rate calculation. A UCAP mechanism should incentivize resources to properly plan maintenance within CAISO's planned and opportunity outage processes to ensure resource owners do not wait until outages are imminent (urgent) or already happening (forced).

CAISO's Outage Management System (OMS) has the capability to produce the forced outage and derate data needed for inputs into a UCAP calculation. NERC's Generating Availability Data System (GADS) database is an alternative source of forced outage data. Both of these sources have limitations. Namely, GADS does not provide data for generators below a certain capacity and is not resource specific. OMS is not currently designed to store historic outage data, but the ISO can build out this functionality quickly if needed. Finally, for new resources, no forced outage history would be available to analyze. For any of these limitations, a default method such as substituting a class average UCAP could be used to accredit any resources without appropriate historic outage data.

Generally, nearly all "nature of work" classifications for derates and forced and urgent outages should impact UCAP accreditation, with some exceptions depending on program design. For example, until recently, MISO used an "XEFORd" methodology to accredit individual resources. XEFORd excluded NERC-defined "outside management control" (OMC) events such as transmission outages, acts of nature, labor strikes, and certain environmental limitations from each resource's forced outage rate. The question of what natures of work classifications, such as transmission forced outages, might be excluded from UCAP calculations in CAISO should be considered in future stakeholder discussions and answered with robust justification in future proposals.

Finally, a question remains: to which resource types should a UCAP mechanism apply? Dispatchable resources such as battery storage, thermal generators, and dispatchable hydro were considered in the supply cushion UCAP design. Some resource types may not reflect "availability" in forced outage rates and derates as well as in another metric like performance relative to dispatch. Other dispatchable resources might have a high availability rate, but frequently go on outage during the hours when the CAISO commits the resources. Depending on how UCAP is implemented, it could capture contribution to reliability for certain resources better than others.

Benchmarking: EFORd – Advantages and Tradeoffs

Several other ISOs and RTOs use some kind of availability-based accreditation. In the "Revisiting the ISO's Default Resource Adequacy Rules" section above,

there is more detail about different market operators' approaches to counting rules. EFORd (Equivalent Forced Outage Rate - demand) is a standard[15] representation of a unit's availability for the purpose of capacity accreditation in other markets. EFORd considers a similar performance and availability history as the supply cushion UCAP design above, but instead of examining a set percent of tightest seasonal hours, EFORd considers demand directly, i.e., when a unit *would* have been awarded a schedule had it been available. Demand can be calculated based on market prices to determine if and when each unit would have been scheduled were it not on forced outage.

Until its recent shift to ELCC accreditation, PJM used EFORd to accredit dispatchable resources. Today, PJM develops marginal ELCC values for all resource types, and then adjusts those values with a resource-specific Resource Performance Adjustment (RPA) to incentivize unit availability during key hours. This two-step method, with a class-based ELCC evaluation followed by a resource-specific adjustment within each class, has also been proposed at MISO in the form of a direct loss of load accreditation method.

Equivalent Forced Outage Rate demand, as defined by NERC, can be calculated as such:

$$\text{EFORd} = \frac{\text{FOHd} + \text{EFDHd}}{\text{SH} + \text{FOHd}} \text{ x } 100\%$$

Where:

FOHd = the number of hours a unit was in a total forced outage but would have otherwise been dispatched if *not* on outage

EFDHd = (EFDH x fp)

EFDH = equivalent forced derated hours (derated hours multiplied by the size of the derate in MW and divided by PMax or similar)

[15] NERC Generating Availability Data System (GADS) Data Reporting Instructions – Appendix F, Note #1

$$\text{fp} = \frac{\text{SH (service hours)}}{\text{AH (available hours)}}$$

Where available hours = sum of all Service Hours + Reserve Shutdown Hours + Pumping Hours + Synchronous Condensing Hours

Finally, the EFORd value is used to derate a unit's installed capacity to produce a resource-specific UCAP value.

The details of which forced outage types and derates to include in a UCAP methodology are discussed in the "Defining Availability" section above. Those considerations apply to EFORd, supply cushion UCAP, and other designs. However, EFORd's main distinction lies in the time period it considers for resource accreditation. If "demand" in the equation above looks at a counterfactual market dispatch, i.e., when the resource would have been dispatched if it had been available, EFORd can capture the more direct impacts of a unit's time on forced outage throughout the entire analysis period. However, this method lacks an emphasis on hours of particular system-wide need, unless some kind of weighting is applied to certain hours. This calculation can be computationally complex.

The Forward Showing Program in WPP's Western Resource Adequacy Program uses a UCAP methodology to accredit resources that use "conventional thermal fuels such as coal, gas, biofuel, and nuclear, or Long Duration Storage." The design hinges on a value called $EFOF_{CCH}$, or equivalent forced outage factor during capacity critical hours. This function is similar to the supply cushion UCAP described above, but notably, it looks back at the last six years of forced outage and derate data for each unit, removes each unit's worst-performing year, and averages the remaining five years of data.

The different UCAP designs discussed above each have features that address different priorities. CAISO would like to hear from stakeholders about how best to design a UCAP mechanism that best addresses the problem statements developed in the RAMPD working group.

CPUC and other LRA Coordination

The California Public Utilities Commission has been developing a UCAP methodology that it can use to inform a planning reserve margin based on a resource portfolio that meets a 0.1 loss-of-load expectation threshold. For this

purpose, UCAP accounting allows the CPUC to improve its modeling of the capacity of available resources. The CPUC has also indicated in previous decisions that it "continues to see merit in the UCAP framework" for accreditation, and would like to consider UCAP designs developed by the ISO.[16] In a February 2024 RAMPD working group meeting, CPUC staff presented their work on a potential UCAP framework and indicated a desire to develop a consistent methodology between CAISO and CPUC. In the working group, CAISO stakeholders have stated that a coordinated timeline and data-sharing methodology between CAISO and the CPUC are critical priorities for UCAP development. This feedback is being considered and will be discussed in upcoming workshops.

[16] CPUC Decision 23-04-010, p. 41

4 Capability Testing: Accounting for Seasonal Resource Availability

Problem Statement

As a part of the RA Modeling & Program Design working groups, the following sub-issue was identified as a part of the larger RA problem statement:

- *The availability of resources based on varying seasonal ambient derates is not consistently reflected in resource net qualifying capacity (NQC) today which creates challenges in reliably operating the grid.*

Objectives

To address the problem statement above, CAISO aims to ensure that resources can perform in a way that matches with baseline assumptions about their availability during peak load conditions.

- Minimum requirements should be adopted such that CAISO can rely on capacity to perform consistent with its accreditation in a given season.
    - Resources' NQC values should reflect their expected ability to perform in peak load conditions.
- Such requirements should minimize partial forced outages that derate resources' below their NQC value during critical periods.

Background

As discussed in the previous section, CAISO currently evaluates the qualifying capacity values it receives from LRAs based on transmission system deliverability and compares the values to each resource's PMax and PMin to produce a Net Qualifying Capacity value for each resource.

Specifically, the CAISO tariff Section 40.4.4, "Reductions for Testing," reads:

> [A] Generating Unit […] included in a Resource Adequacy Plan submitted by a Scheduling Coordinator on behalf of a Load Serving Entity or CPE can have its Qualifying Capacity reduced, for purposes of the Net Qualifying Capacity annual report […] for the next Resource Adequacy Compliance Year, if a CAISO testing program determines that it is not capable of supplying the full Qualifying Capacity amount.

However, the test does not have specific requirements, instead simply indicating "a CAISO testing program." In practice, this means that when existing resources are subject to CAISO resource tests such as an Ancillary Services Certification

Test, a PMax or PMin test, etc., their PMax may be revised based on test results. When the generator's Resource Data Template is updated based on these test results, the ISO's NQC list will be updated the following year based on the resulting updated Master File values if the Pmax value in the Master File is updated to be *lower* than the resource's NQC value from the previous year.[17] However, each CAISO test is designed for a specific purpose. There is currently no "NQC test" in the CAISO Resource Testing Guidelines. Thus, existing tests do not necessarily provide information about how each resource might perform in stressed system conditions, particularly at high temperatures, when RA resources are needed the most.

Benchmarking

Conceptually, there are various ways to ensure that resources' accredited capacity values incorporate their seasonal maximum capabilities. Other ISOs and RTOs have more rigorous RA resource testing criteria than the California ISO. ISO New England maintains auditing provisions to establish and maintain accurate records of real power capabilities—the portion of electricity from a generator that supplies energy to load—for generators that participate in ISO NE's Forward Capacity Market.[18] Similarly in MISO, all generators that intend to qualify for MISO's Planning Resource Auction are required to perform a real power test or provide past operational data annually. MISO's Generator Verification Test Capacity test corrects each generator's test conditions to the average conditions of the date and times of MISO's four seasonal coincident peaks, measured at or near the generator's location, for the last 5 years.[19] WPP's WRAP Forward Showing Program requires qualifying resources to have Capability Tests every five years and annual Operational Tests performed and provided by participants. Capability Tests are used as the "base accredited value to which UCAP calculations are applied" to determine final accreditation.[20]

Finally, as an alternative to capability testing, performance penalties could incentivize resource owners to self-regulate their shown RA values so that they do not inflate their resources' capabilities above what is possible under peak load conditions.

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[17] California ISO Operating Procedure 5330: Resource Testing Guidelines
[18] ISO New England Operating Procedure No. 23 – Resource Auditing
[19] MISO Resource Adequacy Business Practice Manual BPM-011-r29
[20] WPP Western Resource Adequacy Program - Qualifying Resources Business Practice Manual

Options for Consideration

There are several approaches for addressing the problem statement above. CAISO could implement an NQC operational test similar to existing resource tests discussed above. This approach may be complicated because it would require significant CAISO investment to build out a centralized seasonal testing program. The programs discussed in the benchmarking section above generally rely on resource owners to submit their own test results that are adjusted to historic peak load conditions in order to capture capability. This approach allows resource owners to perform tests at a time that makes sense for their operations, provided the test is performed during weather conditions that reflect peak load conditions (or can be adjusted to reflect such conditions). The results of any testing program could be used to limit NQC values to no higher than the adjusted test result. In a similar vein, a UCAP adjustment could be applied to the tested capability instead of being applied to PMax. CAISO will discuss options for a method of addressing the problem statement above with stakeholders.

5 Planned Outage Substitution

Problem Statement

The problem statement outlines the problem this initiative seeks to fix. The problem statement for outage and substitution agreed to in the working group was:

The CAISO's existing outage substitution mechanisms should be reassessed. Both initial analysis and working group feedback indicate that the current processes and procedures likely result 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.*

Objectives

Suggested objectives for the CAISO's planned outage substitution obligation process are that they are efficient, reliable, and implementable. In updating policy, stakeholders should seek an outage and substitution process that balances the following objectives:

- **Efficient:** The process should be efficient so that capacity is available to substitute without significant calls from participants or exceptions to the process.
- **Reliable process for resources**: The process should promote reliability by allowing resources to perform needed maintenance to reduce future forced outages and reliability events at the CAISO.
- **Reliable process for CAISO**: After factoring in resources on planned outage, there should be sufficient capacity to reliably operate the grid.
- **Incent showing resources:** CAISO's process should not incentivize individual scheduling coordinators to hold back substitute capacity for their own needs as it creates a tighter RA market, limited substitution opportunities for other scheduling coordinators, and reduces the visibility CAISO operators

have to available capacity. Similarly, the RAAIM and MOO requirement should not create risks or uncompensated burdens to an LSE showing resources beyond what is needed for reliability. LSE contracted resources should be visible and operational to the market. There should be efficient processes for potential non-contracted resources to be available as substitute capacity.

- **Alignment with LRA programs**: The CAISO seeks alignment with LRAs on any outage and substitution policies. The CAISO would also like better insight into whether any LRA planning reserve margins account for planned outages.

Background

The RA program is designed to ensure the CAISO has sufficient capacity available to reliably serve load. Some LRA-set PRMs do include forced outages rates but do not appear to include planned outage rates. Any resource providing RA capacity to the CAISO has an obligation to offer that capacity into the CAISO market.[21] RA resources not available generally can be on either a planned[22] or forced outage.

Planned outages are outages submitted eight or more days prior to the start of an outage. Forced outages[23] are outages that could not be submitted eight days or more prior to the start of an outage. There are important distinctions between planned and forced outages, including the CAISO's role in managing them.

CAISO has two key processes to ensure planned outages do not cause reliability issues. First, CAISO has a planned outage process to ensure that resources do not take outages at the same time to prevent compromising reliability. Resources that wish to take planned outages must work with CAISO to schedule the outage and ensure that sufficient substitute capacity is available before approving the outage. All planned outages impacting RA resources' capacity must be fully substituted, or the outage is denied.[24] The system the CAISO takes to calculate

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[21] The must offer obligation (MOO) for various RA products and technology types is listed in the CAISO's Reliability Requirements BPM. See pp 84-89 for system and local RA obligations and 98-101 for flex RA obligations.
[22] The Tariff refers to planned outages as "maintenance."
[23] Tariff Appendix A. Definition of a forced outage, "An Outage for which sufficient notice cannot be given to allow the Outage to be factored into the Day - Ahead Market or RTM bidding processes."
[24] Transmission induced generation outages and off peak opportunity outages are exempt from providing substitution.

and assign the substitution obligation is the Customer Interface for Resource Adequacy (CIRA). The Resource Adequacy Substitute Capacity (RASC) module in CIRA runs every day at 8 am in CIRA from T-29 to T+31 to calculate and assign the substitution obligation. SCs have 24 hours to provide full substitution or their outage is denied. Second, CAISO conducts engineering studies to determine if there are any reliability concerns with the planned outages.

If a resource takes a forced outage, then, depending on the nature of work, they are subject to RAAIM. If over the course of the month the resource is unavailable less than 94.5% of the assessment intervals, the scheduling coordinator is charged a RAAIM penalty of $4.40/kW-month (60 percent of the CPM Soft-Cap Price). There are currently many exemptions to RAAIM, based on resource, contract, outage, and MOO types.[25]

When a resource submits a forced outage after CAISO has rejected the same, or a substantially similar maintenance outage, CAISO considers this a planned-to-forced outage. These type of forced outages create operational concerns because CAISO cancelled the maintenance outage for a reason, but the outage persisted and became a forced outage. This outage reporting behavior could undermine RA rules; intentionally waiting to report planned maintenance outages as a forced outage gets around the requirement that substitution is required for all planned outages. This type of behavior potentially violates the CAISO tariff and FERC rules depending on the circumstances. The CAISO submitted PRR 1122 in January 2019 to amend the Outage Management BPM and stated planned-to-forced outages are generally inappropriate and may result in FERC referral. The PRR also noted it could be appropriate if delaying an outage posed operation risks or if circumstances changed.

Current Challenges & Stakeholder Feedback

CPUC Implications

As the CPUC shifts to Slice of Day in 2025, the CAISO will continue to publish one NQC value per resource. In addition, showings to the CAISO will be based on the single NQC value. The NQC values for wind and solar resource contracted with CPUC-jurisdictional entities will be based on the exceedance values at the coincident gross peak hour. Of note, the CEC's forecasted

[25] See Figure 19: RAAIM Exemptions in Section 6 of this document.

coincident peak demands used to set RA requirements for 2025 also shifted to earlier in the day in several months when solar is more abundant. As a result, several 2025 solar NQC values are higher in summer months compared to 2024 NQC values.

To the extent LSEs have excess capacity in some months from variable energy resources (VER), this capacity could be leveraged for substitute capacity. Under the CAISO's current substitution rules, VER NQC can be used for planned outage substitution for any resource (*e.g.,* substitute solar for gas). The CAISO observes this may only be applicable to suppliers who are also LSEs. This challenge already exists today, as the CAISO does not have a requirement for generation-specific like-for-like substitution.

Under CAISO's current substitution rules, with higher VER NQCs in 2025 due to the interactions described above, there could be higher substitution obligations for solar on planned outages particularly in certain summer months. Although, the CAISO does not expect a significant amount of planned outages in summer months, these factors could make it more challenging to substitute for VER outages.

CAISO recommends the policy phase discuss options to adapt. For example, CAISO could have a rule that resources that provide substitute capacity must be able to produce in the same or similar hours as the resource they are providing substitute capacity for. Examples of approaches that could examine what constitutes the same or similar hours includes a profile similar to SOD, the same technology type, or using an ELCC to provide a comparison. If CAISO required a a single marginal ELCC based value for substitution purposes, it would allow CAISO to have a direct comparison of the reliability contribution of different resource types.

Substitution is not occurring for forced outages

Most forced outages were not replaced with substitute RA capacity in the summer months of 2022 and 2023.[26] For June to October 2022 the average substitution for forced outages ranged between zero to one percent. For June to October 2023 the average substitution ranged from one to 11 percent. However,

[26] The forced outage data represents the worst outage of the day for a resource minus what was substituted on a daily basis which was later averaged over the number of days in that month.

if just looking at the summer months of June, July, and August in 2023 the substitution rate averaged one to three percent.

Figure 7: Average June - October 2022 Forced Outage RA Substitutions

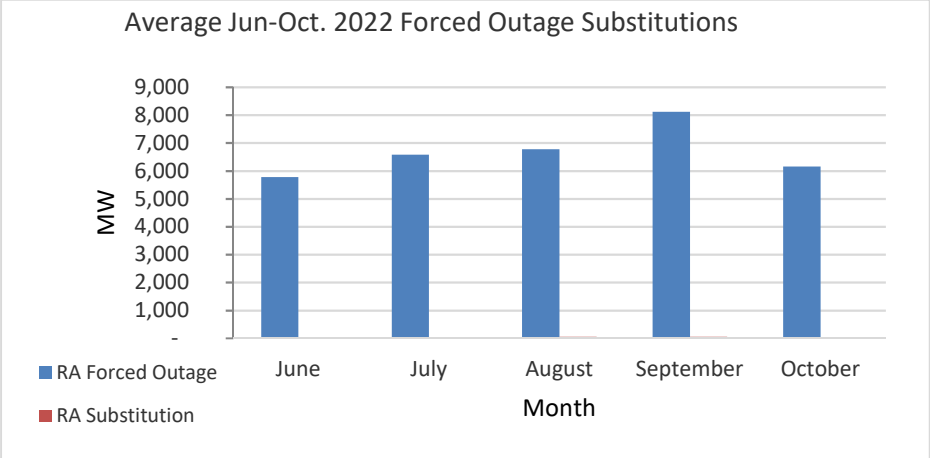
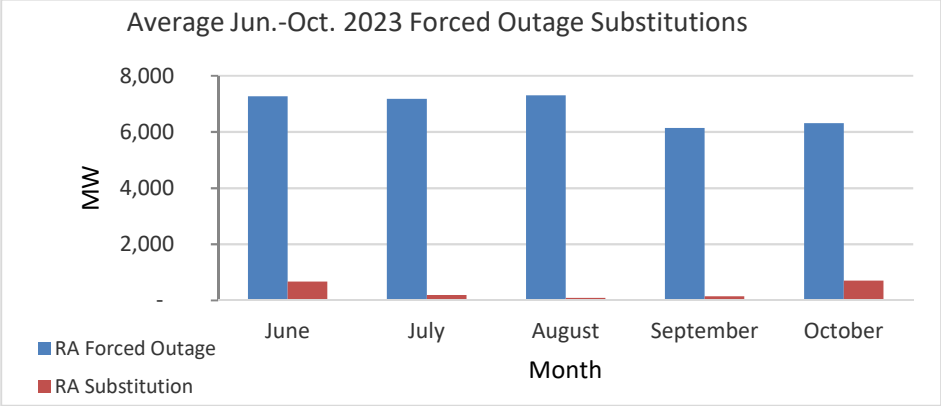


Figure 8: Average June – October 2023 Forced Outage RA Substitutions



The figures above do not reflect the reliability implications of forced outages, but only compare the amount of forced capacity outages that do not have replacement capacity.

The lack of forced outage substitution is not surprising, but highlights a challenge with the current incentives. While planned outages are required to obtain substitute capacity, forced outages are not. Additionally, since the costs of RAAIM for forced outages is often significantly less than the costs of obtaining substitute capacity, the economic incentives are set up to wait until a forced outage occurs (or at imminent risk) to do the needed work.

The RASC timeline does not account for either long lead-times or give flexibility for approving the CAISO's acceptance of a planned outage

During the working group phase, stakeholders highlighted a need for RASC to account for both the long-lead times that planned outages can take and operate the SC approval process at a slower pace. Stakeholders highlighted that planning for generator outages typically starts during summer the year before the outage occurs. This work requires scheduling crews and contractors based on availability. The CAISO heard stakeholder's challenge that these long lead times could not be reflected in RASC to "lock them in." Stakeholders found the 24-hour time limit on accepting the CAISO's approval of a planned outage as similarly problematic, particularly in ensuring that all third party SCs are checking their emails and able to respond.

Bilateral contracting is not a good fit for procuring substitute capacity

Stakeholders highlighted that bilateral contracting is neither efficient nor liquid enough for procuring substitute capacity. There is a mismatch between the desired duration of contracts being bought versus sold. For example, a planned outage may be a week, but non-RA capacity is typically sold for an entire month. Contracts are also not dynamic enough for entities procuring substitute capacity. For example, if a plant's outage plans change, the procured substitute capacity can be wasted as it is procured but never used. There is also not a liquid market to procure substitute capacity. Parties seeking substitute capacity compete against LSEs who seek the same capacity for their compliance showings.

There is a lack of substitution capacity

A tight RA capacity market makes it very hard to find substitution. Current high RA capacity prices, coupled with a comparatively low RAAIM penalty price, dampens the incentive to substitute RA due to forced outages. In addition, the numerous RAAIM exemptions for forced outages increases the problem of lack of substitution.[27, 28]

Generators potentially delaying maintenance outages - Reliability challenges for the CAISO

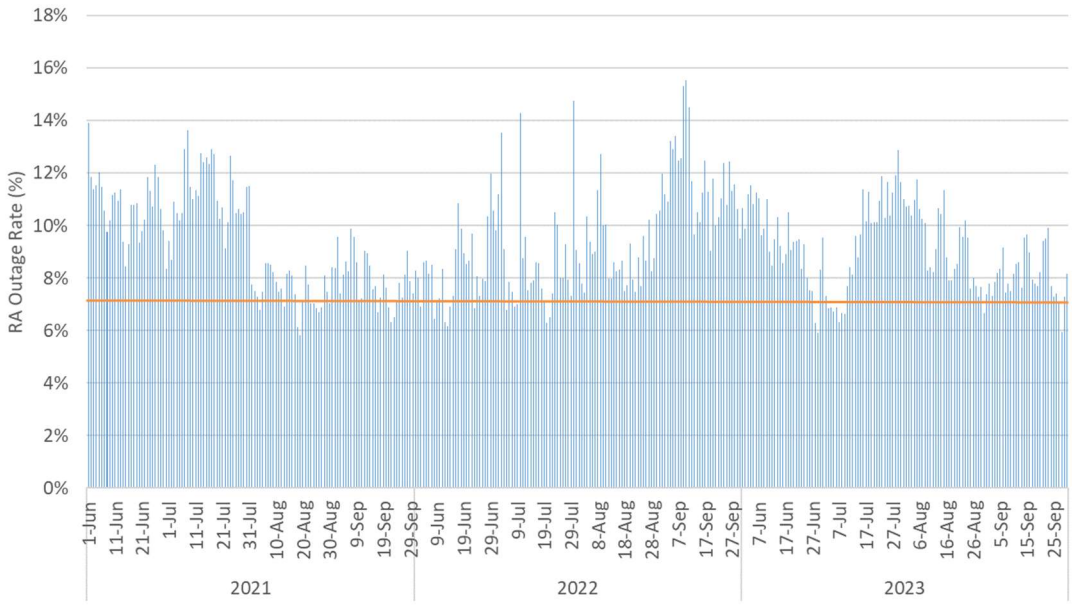
The lack of substitute RA capacity may affect the ability of generators to take maintenance outages. This can later result in unavailable capacity during critical

[27] See Figure 19 in Section 6 of this document for a full list of RAAIM exemptions.
[28] For additional context on the market dynamics between the bilateral RA market and RAAIM see the current challenges section 6 on Availability and Incentive Mechanisms, subsection titled, "The Price of RAAIM does not adequately incent performance/availability or replacement."

conditions. An increase in forced outages can creates reliability challenges for the CAISO.

The figure below shows all forced and planned outages. Forced outages account for 97-98% of all of the outages. The orange line shows the 7.5 percent assumption made for forced outages by the CAISO in the *2024 Summer Loads and Resources Assessment*. The figure indicates that forced outages are often well above what is planned for. Forced outages in excess of the 7.5 percent assumption, takes away from the planning reserve margin.[29]

Figure 9: Summer 2021-2023 Planned and Forced Outage Rates



Benchmarking

CAISO is uniquely situated. More specifically, CAISO's planned outage options are constrained by the monthly nature of the RA program. All other ISOs/RTOs conduct RA procurement annually, with some having seasonal differentiation. In contrast, CAISO's RA processes defer to LRAs. As a result, CAISO's rules are not set around a uniform PRM and accreditation rules, other than the default. CAISO is not aware of any LRAs including planned outages in their PRM.

[29] CAISO's 2024 Summer Loads and Resources Assessment assumes 6% operating reserves as reqruied by NERC, 1% regulation reserves to meet operation needs like frequency response and regulation requiremtns, 7/5% to account for overall forced outage rates fo the existing fleet, and 4% load forecast uncertainty to meet a 1-in-5 load forecast level.

Some other ISOs/RTOs can require up to two years of notice for planned outages. This allows those ISOs/RTOs to include those planned outages in their LOLE studies when conducting annual capacity procurement. Because other ISOs have much greater visibility into the RA obligations of resources, the planned outage procedures are much cleaner. In contrast, the CAISO does not know which resources will be RA resources until 45 days prior to the RA compliance month. This timeline creates a complicated overlap between the CAISO's planned outage and RA processes. To the greatest extent possible, the CAISO will attempt to mitigate this overlap.

Most ISOs and RTOs role with planned outages is approving outages that do not pose a reliability risk. As some examples

- MISO approves planned outages that do not violate reliability criteria but otherwise does not coordinate outages.
- PJM approves planned outages that do not violate reliability criteria and also coordinates delays or withdrawals of approval of a planned outage.[30]
- ISO-NE also approves planned outages that do not have a reliability impact and will coordinate repositioning the outage if ISO-NE determines that a reliability issue exists after it has been approved.[31] There is a stronger overlap between ISO-NE's outage practices and their availability and incentive mechanism, pay-for-performance. As there are not exemptions from pay-for-performance if a generator is on outage, the generator is incentivized to not be on any kind of outage when a scarcity condition occurs. The ISO-NE's outage coordination team will advise in advance if generators should move outages, as a sign of tight system conditions.

Options for Consideration

Definitions

In the working group, CAISO heard suggestions for new outage definitions for storage, hybrid, and co-located resources from Vistra. It also heard recommendations during the PRR 1122 process and from DMM during the working group, to enhance reporting of forced outages to indicate outages for

[30] PJM Manual. Pre-Scheduling Operations. Section 2: Generation Outage Reporting. Rev. 44.
[31] If this reliability condition cannot be eliminated by 75 calendar days prior to the start of the reliability issue, the ISO requests repositioning the planned outage. If the problem isn't resolved within 30 calendar days of written notification of the reliability issue, ISO-NE may reject the outage. See ISO-NE Operating Procedure No 5. Resource Maintenance and Outage Scheduling. Revision 23. Section III. B.3

which repairs are immediately necessary. Rather than having new outage types for every technology and to address the feedback on PRR 1122, the CAISO sees merit in alignment with the outage definitions the RC West uses. This would include the addition of an "urgent" outage type.

In Reliability Coordinator Procedure RC0630, the CAISO defines outage types, their priorities, and the study windows with timelines for outage submission.[32] The following are outages taken by generating resources:

> *Forced Outage* – Facility/equipment that is removed from service real-time with limited or no notice
>
> *Urgent Outage* – Facility/equipment that is known to be operable, yet carries an increased risk of a Forced outage occurring. Facility/equipment remains in service until personnel, equipment and/or system conditions allow the outage to occur.
>
> *Planned Outage* – Facility/equipment outage with enough advance notice to meet short range submittal requirements.[33]
>
> *Opportunity Outage* – A Facility/equipment outage that can be taken due to a change in system conditions, weather or availability of field personnel. Opportunity outages did not meet the short range window requirements.

CAISO sees merit in aligning the definitions by adding an "urgent" outage definition to its tariff, as the CAISO already has forced and planned outages. Including an "urgent" outage definition could give CAISO the ability to deny the outage if there is a reliability concern – or approve it if the outage does not impact reliability.

This update to outage types would change the outage submission requirements and outage priorities outlined in the Outage Management BPM. Forced and urgent outages would have the highest priority, followed by planned outages, and finally by opportunity outages.

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[32] RC Procedure RC0630, p13-15

[33] Outage management BPM Section 7.2 describes the short range outage submittal requirements for planned outages for the CAISO BAA.

Please refer to the Unforced Capacity Mechanism section "Defining Availability" for considerations on how the addition of "urgent" outages might be considered in UCAP calculations.

Outage Process:

Stakeholders during the working group process provided suggestions for redesigning the outage process. In order of decreasing complexity they include, developing a planned outage and substitution pool, instituting a planned outage buffer, updating the showing timelines, and rolling back the 2021 Planned Outage Substitution (POSO) enhancements. Based on benchmarking, and to provide an illustrative option, CAISO also includes an option to remove outage and substitution and replace it with strong incentives. This Issue Paper describes, expands, and highlights tradeoffs to consider with each approach. While the current outage processes have key challenges, a key consideration in outage and substitution reform is LRA jurisdictional authority.

The CAISO views the proposals that do not impact LRA jurisdictional authority over PRM setting as more viable. However, the CAISO is interested in feedback to all proposals.

1. *Removing planned outage substitution requirements: Replace with strong incentives and better information on periods of risk*

While CAISO operations has concerns with this approach, a bookend for consideration could be that stakeholders could consider the potential merits of an approach similar to ISO-NE. This could include CAISO playing a limited role with approving and coordinating outages. This could mean that the CAISO would only require outages with clear and significant reliability implications to be rescheduled or substituted. This option could be coupled with much higher consequences for not being available when the CAISO BA needs the capacity such as a strong pay-for-performance based approach, as described in Section 6 of this Issue Paper.

Stakeholders should discuss reactions to this option and any mitigation measures to this creating incentives for resources to wait to go on forced outage.

2. *Developing a Voluntary Planned Outage Substitution Pool*

A voluntary planned outage substitution pool would be a pool of resources available to be used for planned outage substitution. Scheduling coordinators that make capacity available could have access to this capacity first providing

certainty that their planned outages would be prioritized. Scheduling coordinators that need the capacity, that did not make capacity available to the pool, could procure this capacity from the planned outage substitution pool.

The benefits of the approach include:

1. **Visibility into capacity that is currently not shown or withheld for substitution purposes.** A planned outage substitution pool could remove some of the incentives for LSEs to withhold capacity from market to provide substitute capacity. This is because the pool would guarantee access to that capacity by the seller and also provide revenue if that capacity is procured by another entity.
2. **Greater capacity available for substitution**: Having a greater granularity available for a pool would allow more capacity to be available. Today most RA contracts are 30 days. For example, a daily pool could mean that what historically was sold to one SC could now be theoretically sold to 30 SCs.
3. **Lower RA Costs:** More capacity available for substitution could also lower RA costs.
4. **Sends direct incentives:** A pool of capacity made available for SCs to be procured by SCs sends direct incentives. This sends the right signal to minimize outages and procure substitute capacity.

In designing the pool there are various options to consider, including: the time granularity of procurement from the pool, the approach to transactions, the source of capacity, the price of the capacity, and access to the pool. Procurement from the pool could operate at a daily, weekly, monthly – or combination of all three. A daily procurement construct was suggested in both the CAISO's former RA Enhancements initiative[34] and by Stakeholders during the RAMPD working group. Example approaches that could be considered for transactions include a bulletin board, a CAISO administration of matching supply and demand, or an auction mechanism. Depending on the approach to the transaction, sellers could make the capacity available at their cost, at the cost of CPM soft offer cap price, or another price as suggested by stakeholders. In terms of where this capacity would come from, the CAISO hypothesizes this capacity

[34] In the former RA Enhancements Initiative, procurement from the pool was daily. It suggested a calendar that would show in advance on a daily basis the potential availability of additional system RA headroom. The objective was to provide an available pool of resources for substitute capacity, which would allow other resources to take planned outages without providing substitute capacity.

could come from capacity that is under an RA contract but currently held for substitution purposes or uncontracted capacity. Lastly, the CAISO recognizes stakeholders may be reticent to offer into the pool, lest they not be able to access capacity for their own substitution purposes. To overcome this challenge, the CAISO suggest that sellers of capacity could have the first right to this capacity. If it is not needed by the seller, it can be made available to other participants in the pool.

The CAISO would like to hear back from stakeholders on the time granularity of the pool (e.g., daily, weekly, or monthly), approach for transactions, source of capacity, price of capacity, and any recommendations for prioritization of access to the capacity in the pool.

3. *Establishing a Planned Outage Buffer:*

A monthly planned outage buffer, or planned outage reserve margin, would estimate planned outages into RA requirements and allow the CAISO to approve or deny outages based on said buffer. This proposal was discussed in the former RA Enhancements Initiative[35] and also proposed by MRP during the RAMPD Working Group.

This option would simplify the planned outage process as there would a clear margin for scheduling outages without substitution. This would provide sufficient flexibility for resources to schedule maintenance in a timely manner with little risk of outage cancelations or rescheduling. It also could lower the bilateral capacity costs as SCs would have less need in include the costs to cover planned outage replacements. Lastly, it could provide an up-front assumption in the PRM for planned outages and reduce the incentive to withhold excess capacity from the bilateral capacity market.

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[35] The RA Enhancements Initiativethat previously suggested the CAISO would establish two new elements of the RA program 1.) the CAISO would no longer allow for anything other than short-term and off-peak opportunity outages between June 1 and October 31 and 2.) the UCAP capacity requirement would increase during the non-summer months, to create a planned outage reserve margin. No substitute capacity would be allowed or required for an outage. A new capacity outage calendar would track all planned outages for each day until RA showings are made for a given month. Once RA showings were made, the CAISO would track how much additional capacity can take a planned outage under the planned outage reserve margin.

There are also challenges to the buffer approach. First, it requires all LRAs to account for planned outage substitution in their PRMs. With LRA approval, it could also include the CAISO adding a buffer on top of the LRA requirements. However, it is unclear where this capacity would come from if LRAs do not update their PRMs to account for planned outages. Lastly, a simple buffer funded by LSEs might not meet an efficiency objective. For example, CalCCA in their comments against a buffer, explained it, "would shift the burden of generator outages from the party that can control outages (the generator) to a party that cannot (the load-serving entity (LSE))"

The ISO is interested in stakeholder feedback on reactions and alternative proposals to this approach. The CAISO is also interested in if process or approaches are needed to facilitate priority when it comes to outages.

4. Moving to Annual or Seasonal Showings:

MRP suggested the CAISO simplify the RA process to help with outage and substitution by moving to annual showings. This would change the compliance program to a year-ahead showing and the month ahead process would be between suppliers and the CAISO. MRP's suggestion also would allow LSEs to count resources not yet COD during the year ahead process.

As a key objective of the outage and substitution process is alignment with LRA programs, the CAISO is concerned this approach is not viable unless LRAs also move to annual showings. Another key objective of the outage and substitution track is for all RA to be visible to the CAISO. Moving to an annual showing could result in overly conservative showings for portfolios that have large amounts of resources that have monthly variability (e.g., hydro, DR).

The CAISO recognizes one way to overcome the challenge of the variability could be to move to seasonal showings. This would change the current 12 RA showings a year to four showings a year. However, the option to move to seasonal showings does not overcome misalignment with LRA monthly RA programs. The CAISO would like to hear if there are any LRAs or LSEs that support or oppose a change to an annual or seasonal RA showing.

For stakeholders that comment with their support of moving showings to seasonal or annual, the CAISO would also like to hear what accompanying reforms are suggested for the planned outage substitution process.

5. Rolling Back the 2021 POSO Rules

The prior POSO process allowed RA resources to submit planned outage requests months in advance, but CAISO did not provide its notification regarding the need for the resource to provide substitute capacity until 20 days prior to the month. During the time between the planned outage request and the CAISO's study, the resource did not know if substitution will be required. This introduced uncertainty regarding the need for substitution and the approval of the outage.

The RASC process implemented in 2021 removed this uncertainty by requiring all planned outages to provide substitute capacity. If the resource is unavailable, they have an obligation to find substitute capacity, not be shown and take the planned outage, or face consequences.[36]

Cal Advocates suggested rolling back the 2021 POSO rules as a short term option for correcting challenges with the planned outage substitution process. CAISO's understanding of the root cause of their concern is that the change from POSO to RASC and the requirement to provide substitute capacity for all planned outages could be unnecessarily increasing ratepayer costs. This is because not every MW is needed for replacement by the market. CAISO is concerned with rolling back RASC in favor of POSO because the prior process introduced uncertainty with the need for substitution and the approval of the outage. CAISO anticipates that CalAdvocate's core concern could be better ameliorated through a long term solution such as the buffer or pooled approach, described above.

[36] See CAISO Tariff Section 40.9.6.1.

6 Availability and Performance Incentives

Problem Statements

The problem statement outlines the problem this initiative seeks to fix. The problem statement for availability and incentive mechansims agreed to in the working group was:

- *In light of a tight RA market, high RA prices, and market incentives, RAAIM may be an ineffective incentive mechanism to ensure capacity is bid into the market. For example, RAAIM is applied only to a fraction of the RA fleet, the current deadband provides insufficient incentive to be available and both the monthly netting process and carry-forward provisions mute incentives. In some cases this can result in incentivizing less reliable generation to be contracted and discouraging scheduling coordinators from showing all of their RA resources to the CAISO. Additionally, when RAAIM does not incent capacity to be available, it creates operational backstop challenges for the CAISO, as substitute capacity has not been shown, resulting in potential reliability risks.*
- *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. The need for either RAAIM reform or RAAIM elimination as well as any exploration of a new availability and performance mechanism should be done in concert/consideration of any counting rule changes to encourage all RA-eligible resources to be shown.*

Objectives

A well-functioning RA program should have proper incentives in place for resources to be available and perform. Providers of RA capacity receive a payment for making their resource available to the market, and they face consequences for not being available or performing. For RA to have “teeth” there needs to be consequences for not being available and/or not performing. These consequences to discipline capacity to be available and perform can be effectuated up front via UCAP or after-the-fact through: standardized performance and availability incentives applied by the CAISO (e.g. RAAIM), tariff or contract incentives applied by either the LRA or LSE, and/or energy market prices.

The availability and incentive mechanism track seeks feedback from stakeholders on 1.) who should apply penalties and incentives—the CAISO, LRAs, LSEs, or a combination of these entities and 2.) which resources should be standardized by the CAISO versus left to LRAs and LSEs to provide appropriate incentives. While in theory the CAISO does not have to play a role,[37] a standardized process led by CAISO improves the efficiency and translatability of LRA RA procurement and showing processes. This standardized process could also include a common way to value resources across different LRAs in the footprint (e.g. UCAP applied by the CAISO) and consistency in how availability and performance and availability incentives are applied.

To the degree the CAISO plays a role, the policy phase will also discuss how strong of an incentive should be applied. For example, should penalties apply anytime availability and performance is not reached, during the current RAAIM availability assessment hours, only apply during critical conditions, or during potential RSE EDAM failures. In addition, the policy phase will discuss the severity of the incentive or penalty for availability and performance.

This RA policy effort also has the objective of balancing the UCAP design with reforms to availability and performance incentives. As the working group develops UCAP, it will have to discuss if – or the extent to which –an additional availability and performance incentive is still needed to provide even a stronger incentive during critical periods or to align cost allocation with cost causation (e.g. assigning a portion of the EDAM RSE failure penalties or corrective capacity to poor performing generators and providing a portion of the EDAM RSE failure revenues made when supporting other BAs). There will be an inconsistency of UCAP design if not all LRAs to adopt UCAP or if UCAP is not applied to all resources. FERC recognized that having both a capacity performance/availability derate and an availability incentive mechanism does not necessarily constitute a double penalty for capacity resources. The CAISO's RAAIM provides an incentive to provide capacity to the market that has been sold, whereas the

[37] For example, the ISO tariff includes exemptions for RAAIM, including cases where the LRA includes resource counting that incentivizes availability and performance, such as the case with hydro. The CAISO also understands the CPUC is developing a DR QC counting approach to better capture DR's availability and performance, that may fit under this category as well.

capacity derate from UCAP reflects the quantity of dependable capacity going forward.[38]

The policy phase also has the objective of aligning with outage and substitution rules. Today, with the CAISO's cost of RAAIM far below the cost of finding substitute capacity, there is little incentive to replace capacity. This initiative seeks to align incentives for availability so that there is sufficient capacity to operate a reliable grid.

Background

All ISOs and RTOs have some form of an availability and incentive mechanism. The CAISO's version is RAAIM, which evaluates bids in determining a resource's availability. RAAIM was developed to replace the Standard Capacity Product (SCP), which was an outage-based tool. When it was developed in the CAISO's Reliability Services Initiative, the purpose was described as a tool to maintain real-time reliability during forced outages and to incent scheduling coordinators to provide ISO forced outage substitute capacity in the event a resource becomes unavailable for a long period of time.[39] In other words, it was developed to create an incentive to follow applicable must-offer obligations (MOOs) and provide replacement capacity when resources go on outage. While RAAIM provides an incentive to provide substitute capacity, it unfortunately also provides an incentive to only show the minimum RA capacity types and amounts to meet LRA PRM requirements to avoid RAAIM penalties.

Resources that go on forced outage, depending on the cause of the outage, may be subject to RAAIM if the resource does not provide substitute capacity. All three types of RA, system, local, and flexible, are subject to RAAIM. Performance is measured monthly, based on the availability of the resource's bids and self-schedules in the market during the designated availability assessment hours (AAH).

The concept of the AAH was originally developed as part of the SCP. It was maintained as part of Reliability Service Initiative – Phase 1 (i.e. RAAIM). The

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[38] For example, if a number of resources are close to retirement or in need of major capital upgrades, a UCAP only incentive might not be sufficient and "real time" penalties might be more appropriate.

[39] See both the Reliability Services Initiative Second revised straw proposal meeting October 29, 2014, slide 25 and the Reliability Services Initiative. Working Group. December 10, 2014. Slide 7.

objective was to determine the hours of greatest need to maximize the effectiveness of the availability incentive structure. These hours and days differ, depending on the RA product provided.[40] CAISO determines the hours annually and publishes them in the Reliability Requirements BPM.[41]

Resources subject to RAAIM are paid, charged, or neither each month, depending on their average capacity availability during the AAH. Resources whose average capacity is greater than the availability standard of 98.5 percent are eligible to receive an incentive payment for the month. Resources whose average monthly capacity availability is less than the availability standard of 94.5 percent are charged a non-availability charge for the month. Resources that perform between 94.5 and 98.5 percent face no penalty. The RAAIM price of $4.40/kW is set at 60 percent of the CPM soft offer cap price of $7.34/kW-month.[42]

Data Analysis

The CAISO reviewed prior data to understand the extent to which RA is performing under stressed grid conditions, to inform reforms to RAAIM. The analysis is based on September 2022 during peak periods, and shows mixed results on the performance of the RA fleet during stressed grid conditions.

The analysis compares critical and non-critical periods. Critical periods are the stressed grid days including Restricted Maintenance Operation (RMO), Emergency Assistance Alert (EEA) Watch, and EEA 1-3 Alerts.[43] Non-critical periods are defined as all hours outside of these stressed grid conditions. The analysis compares RA performance through different time frames. It compares:

- **RA Showing Value (red dashed line):** The monthly RA showing value which is what the CAISO expected as a result of what was shown on a monthly RA supply plan.

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[40] See CAISO's Reliability Requirements BPM Version 74, pg. 94 for the 2024 AAHs for each RA product.
[41] See section 40.9 of the CAISO Tariff
[42] Se tariff Section40.9.6.1(b) and Section 43A.4.1.1.
[43] See Emergency Notification Fact Sheet or Operating Procedure 4420 for more details on emergency notifications.

- **Operational RA (blue bar):** Operational RA which reflects available RA going into the day ahead market and is the summation of the monthly supply plan total, minus forced outages, plus substitute capacity.
- **Bid in capacity (empty circle):** Bids represent what the resource made available to the real time market (RTPD/HASP)
- **Real time market awards (filled circle for energy and ancillary services, a cross-hatched circle for just energy awards):** The market award for energy and ancillary services represent what was needed to fulfil both energy and operating reserve. The market awards for energy represent the market award only for energy in real time.
- **Meter (filled diamond):** The meter readings represent how well the resource responded to the market awards.[44]

The data in Figure 10 below reflects performance in September 2022, during peak hours (HE17-21). In examining the data it is clear that not all RA is substituted for, as represented by the delta between the RA showing red dotted line and operational RA blue bar chart values. Operational RA is slightly lower in critical periods than non-critical periods. As RAAIM assesses if a resource is bidding in accordance with its must offer, it is worth noting that available bid in capacity exceeded RA during critical hours, driven by solar and wind. However, bid in capacity was below both supply plan commitments and operational RA during non-critical hours.

Figure 10 below also highlights the potential need for a performance incentive mechanism. Performance, as measured by meter readings, are below the market awards for energy during both non-critical and critical periods. Poor performance was more pronounced during critical periods; almost ten percent of capacity did not perform as dispatched. While this RA capacity that did not respond to market dispatch faced uninstructive imbalance energy, they did not incur a penalty for their negative impact on reliability.

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[44] Operational RA is made up of only RA capacity. However, non-RA MW are included – in what was bid, what was awarded, and what was metered—to the extent that a resource providing RA was made of up RA and non-RA MW. To understand the total non-RA by resource type for September 2022, hour ending 17-21, by resource type the CAISO has also calculated the MW above RA as a percent of total bid in capacity. Analysis indicates the percent of non-RA MW by resource type includes: 22% for hydro, 10% for other, 9% for batteries, 6% for nuclear, 4% for gas, 1% for imports, 70% for solar, and 58% for wind.

Figure 10: September 2022 RA Availability and Performance

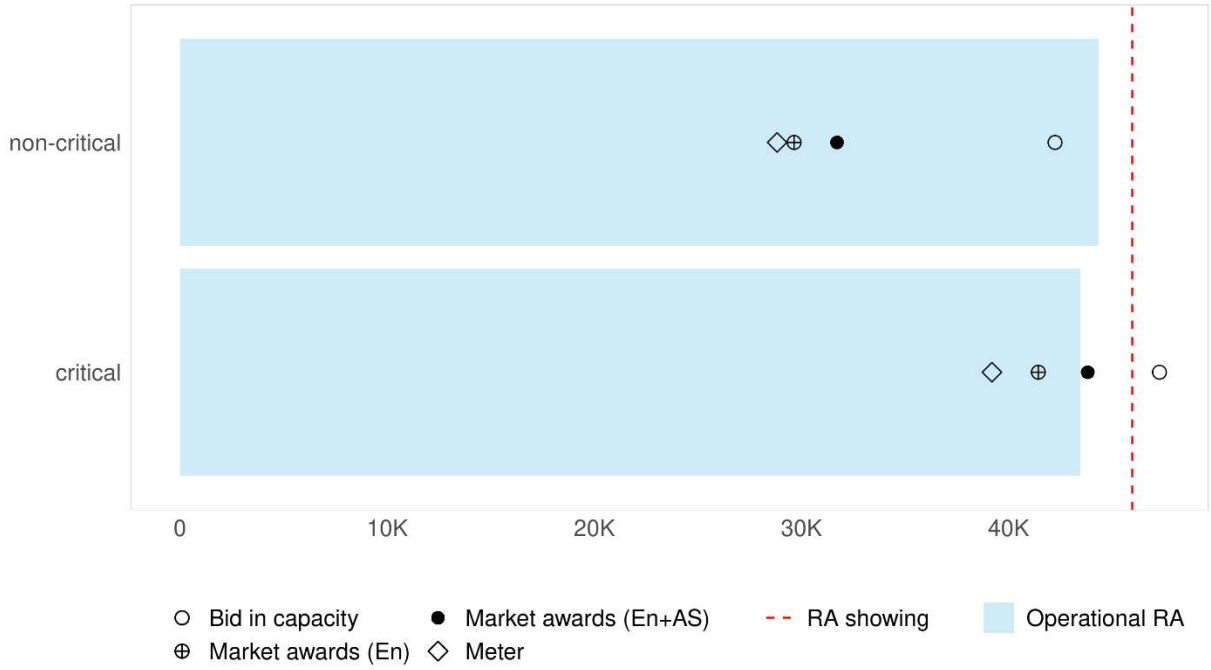
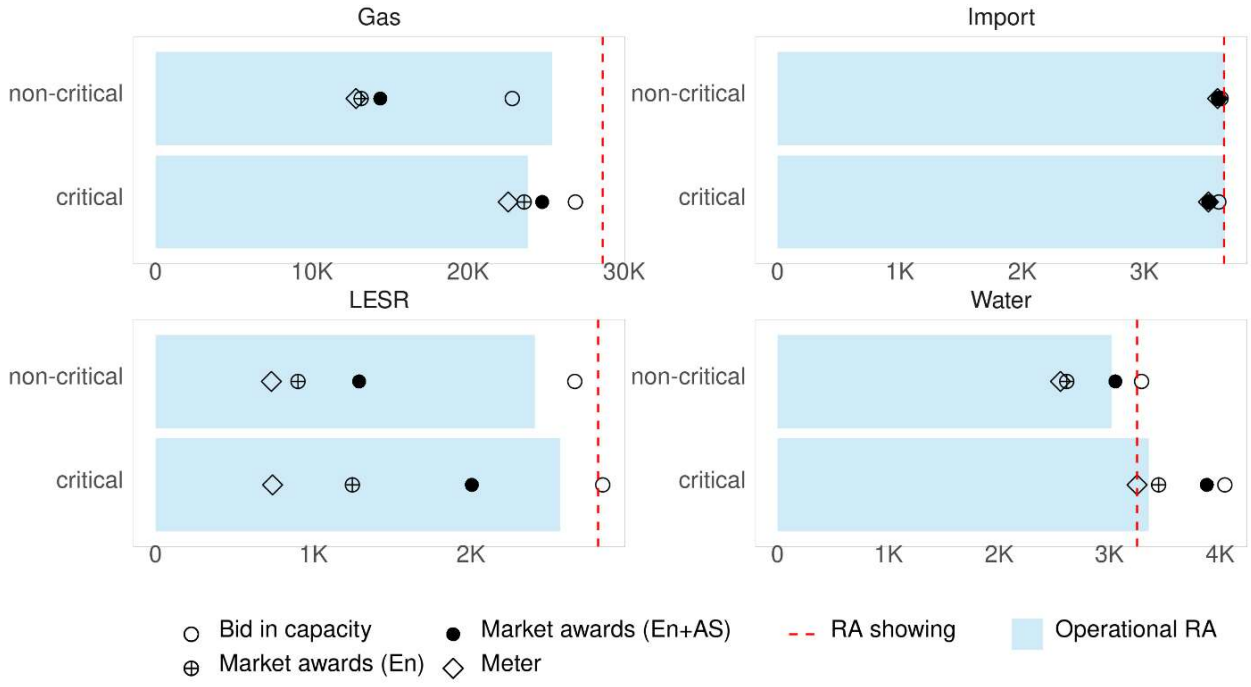


Figure 11 below uses the same time period of September 2022, during peak hours (HE17-21) to assess resource-specific performance. Looking at this at a resource type basis helps understand if the data on the RA fleet is uniform across resource types or if certain resources are weighting the results. When considering forced outage rates, gas and LESR had higher forced outage rates than hydro or imports. In considering RA performance, during peak hours (HE17-21), hydro and LESR resource types bid in capacity exceeded RA obligations on average. In contrast, during the same time intervals, gas bid below its RA obligation and imports largely met their capacity obligations. However, when considering performance, battery capacity dispatch response appears to be less effective during this limited sample event.[45] Similarly, both gas and hydro resources fell short of performing up to their market awards.

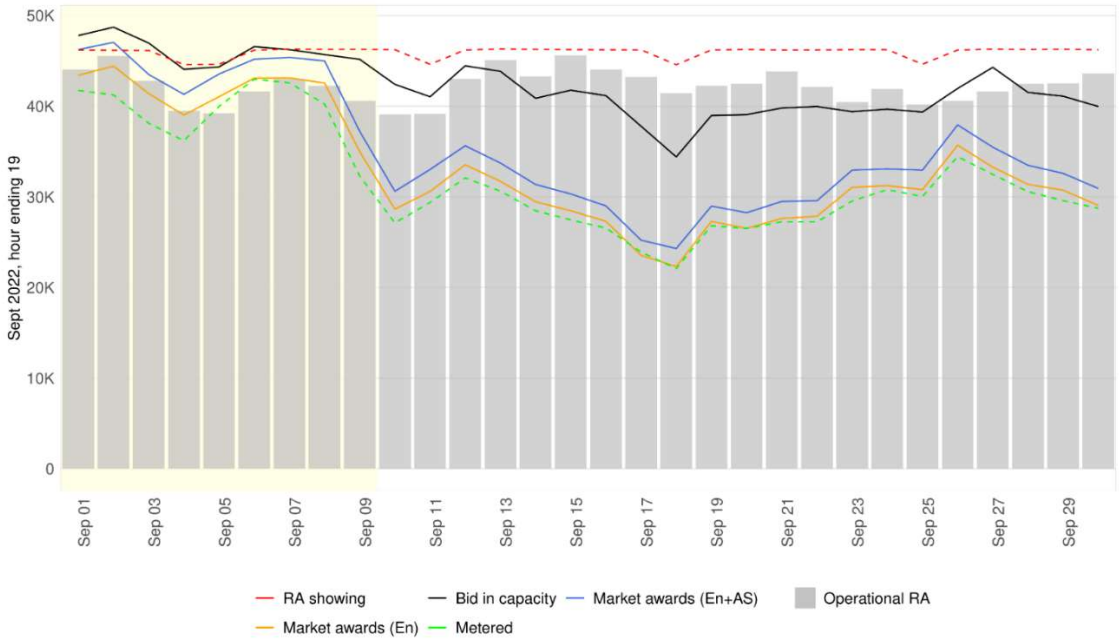
[45] The bid in capacity reflect the max limit from energy and ancillary serves up. The metered values are impacted by regulation up and down deployment. However, the data is taking from the peak hours HE 17-21, as a result there would not be a big impact from regulation down at the system level during this time.

Figure 11: September 2022 RA Availability and Performance for Gas, LESR, Import, and Water Resources



The CAISO further looked at this performance across the month to identify trends. Figure 12 below for all RA in September 2022 for hour ending 19 demonstrates that on a daily basis bid in capacity from RA resources was close to the RA showing at the system level during critical periods (highlighted). However, for non-critical days, bid in capacity had a greater divergence from the amount the CAISO had planned on as a result of the monthly showings. The graph also indicates the extent to which resource performance, measured by metered output (green dashed line) dipped below energy awards (orange line).

Figure 12: September 2022 Daily RA Availability and Performance



The next four graphs look at resource level performance with greater granularity of daily performance. Critical days have a yellow highlight behind them. Non-critical days do not have a yellow highlight. The data again looks at September 2019, and in this case focuses on hour ending 19.

Looking at gas resource performance below, in Figure 13, indicates that bid in capacity was above operational RA but below RA showing during critical periods. The graph also indicates the extent to which gas resource performance, measured by metered output (green dashed line) dipped below energy awards (orange line).

Figure 13: September 2022 Daily RA Availability and Performance for Gas

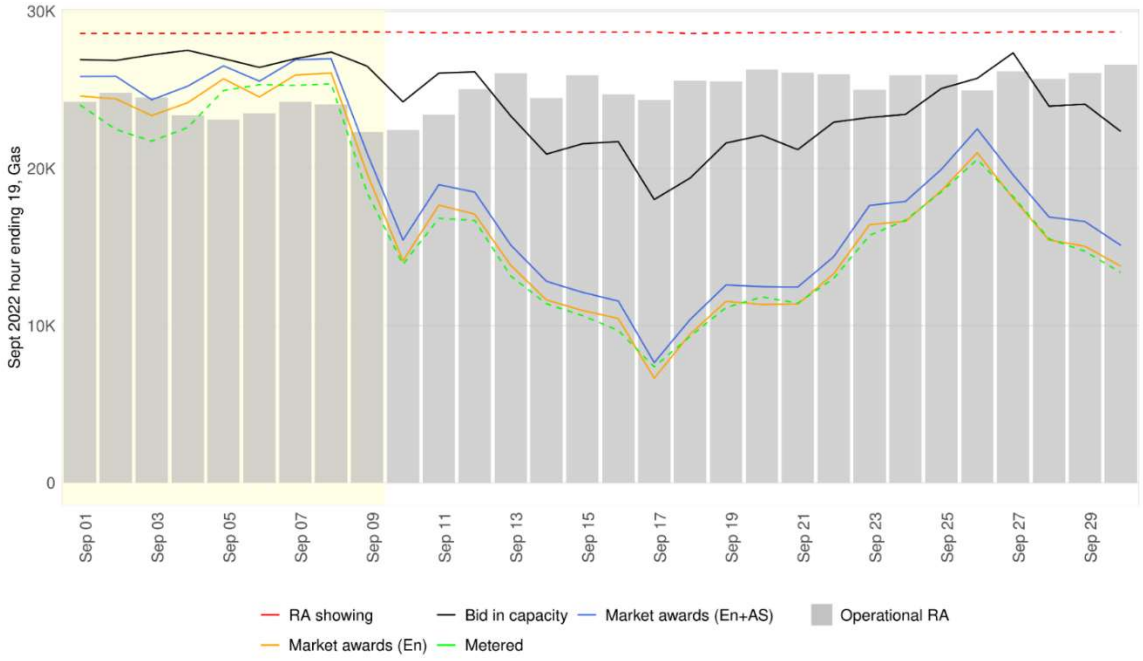


Figure 14 below specific to hydro resources, indicates that bid in capacity from hydro resources was well above RA showing during critical and non-critical periods. The graph also indicates the extent to which hydro resource performance, measured by metered output (green dashed line) dipped below energy awards (orange line).

Figure 14: September 2022 Daily RA Availability and Performance for Hydro

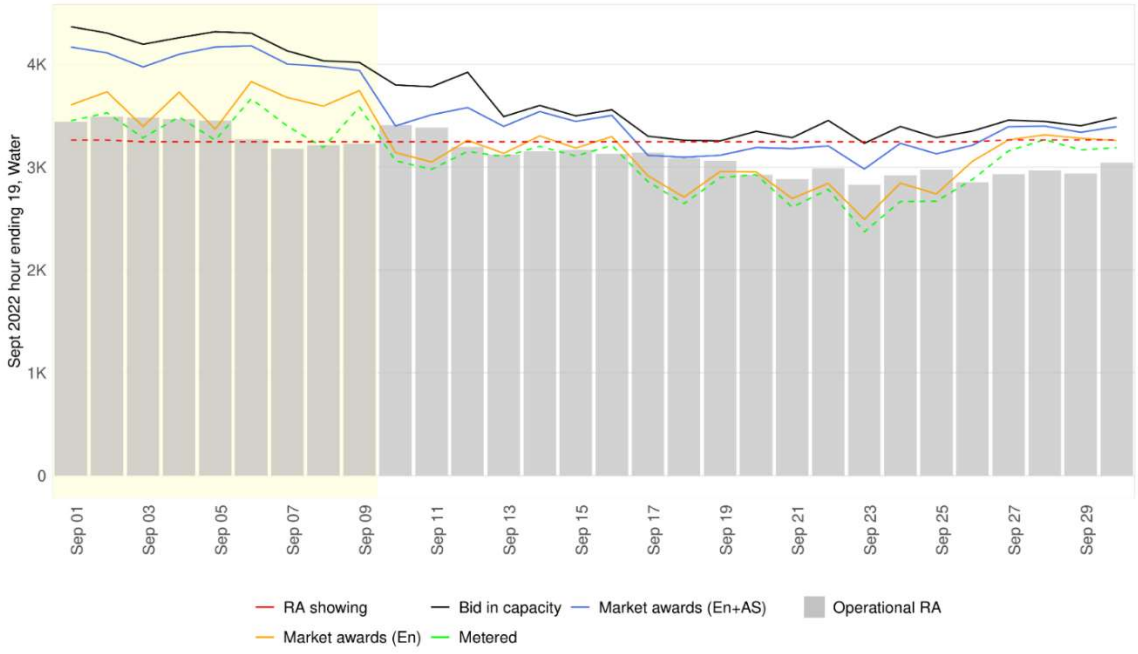


Figure 15 below specific to system RA imports, indicates that bid in capacity was at RA showings for both critical and non-critical periods. The graph shows resource performance, measured by metered output (green dashed line) largely mirrored energy awards (orange line).

Figure 15: September 2022 Daily RA Availability and Performance for Imports

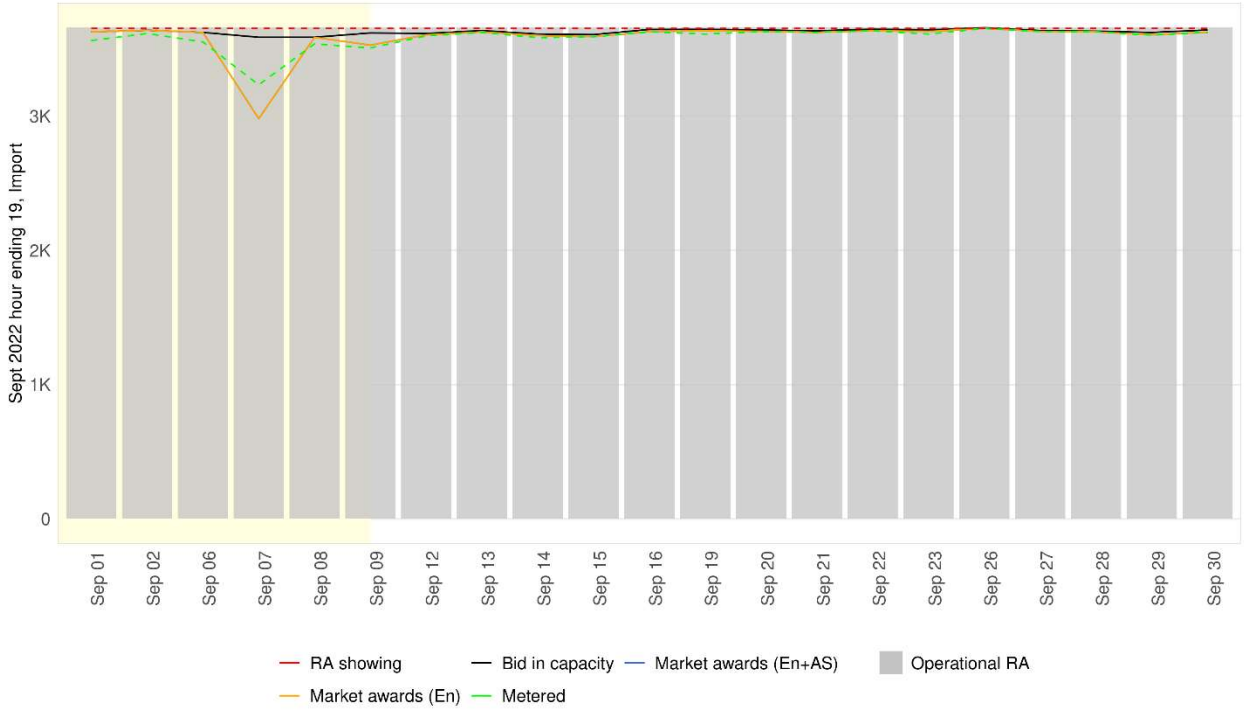
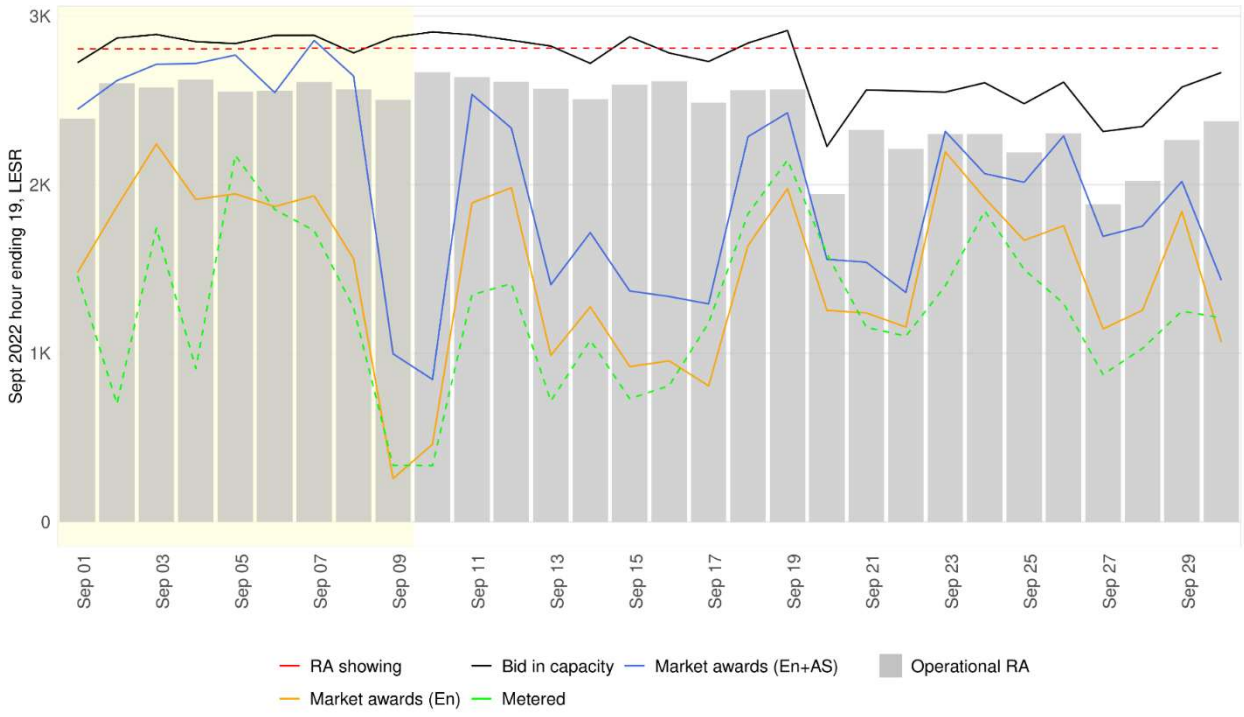


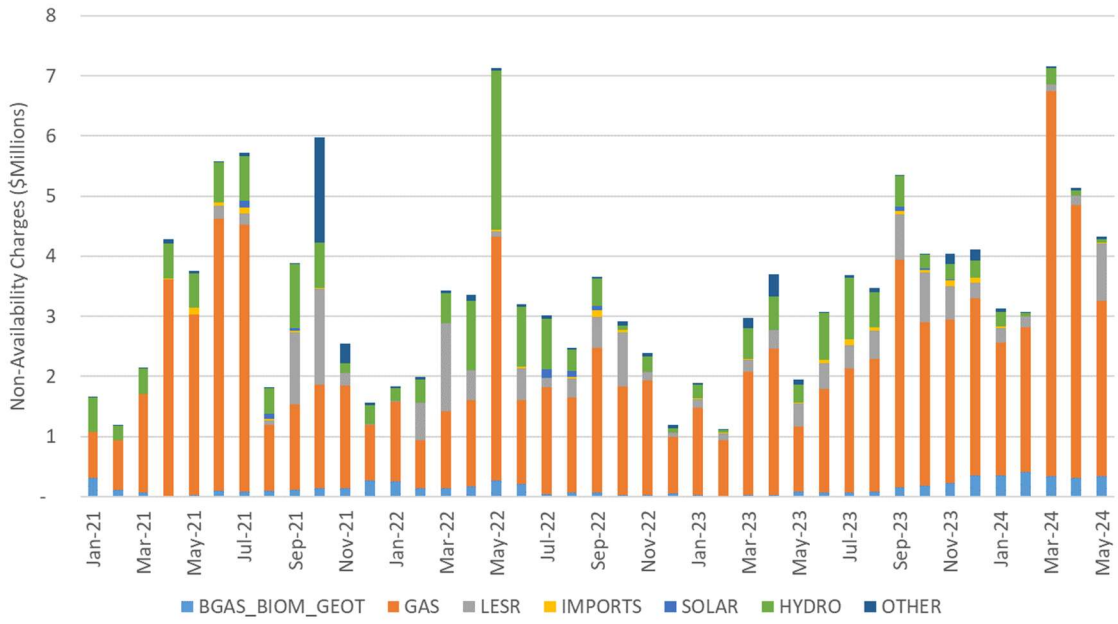
Figure 16 below specific to imports, indicates that bid in capacity from LESR (batteries) was at RA showing values during critical periods, and dipped below showings for more than half of non-critical periods. The graph also indicates the extent to which LESR resource performance, measured by metered output (green dashed line) fluctuated below and above energy awards (orange line).

Figure 16: September 2022 Daily RA Availability and Performance for LESR



In looking broadly at RAAIM settlement data across resource classes, non-availability charges are on an upward trajectory, and are higher in March and April of 2024. This may reflect that from a cost perspective it is more economic to face RAAIM charges than procure substitute capacity.

Figure 17: Jan 2021-May 2024 - Non-Availability Charges by Fuel Type



On a resource specific basis, RAAIM charges are increasing for gas. This may reflect broader trends of an inability to take maintenance outages or a preference to take the lower RAAIM penalty rather than find higher priced capacity in the bilateral market.[46] Additionally, the CAISO is observing RAAIM charges decrease for storage although in just examining September 2022 tight system condition performance, their performance was comparatively poor relative to other resources.

[46] For additional context see the current challenges section below titled, "The Price of RAAIM does not adequately incent performance/availability or replacement."

Current Challenges & Stakeholder Feedback

The Price of RAAIM does not adequately incent performance/availability or replacement

The current RAAIM price is insignificant as compared to either the cost of procuring substitute capacity or the reliability consequences CAISO faces during stressed periods. High bilateral RA prices as compared to RAAIM is a disincentive to replace capacity. It also can create incentives for resources to overstate capacity values (e.g. not account for ambient derates) or provide capacity that is not available.

The CAISO does not have access to bilateral capacity prices. Instead, in this issue paper we refer to third party reports. This includes the CPUC's analysis based on survey data and CalCCA's analysis which is based on FERC Electronic Quarterly Reports (EQR) data.

The CPUC Energy Division 2022 Resource Adequacy Report's monthly weighted average capacity prices for CAISO resources are as low as $4.59 / kW-mo in March and as high as $13.51/ kW-mo in September. [47] Both of these figures are below the cost of RAAIM. This includes the cost of RAAIM before and after June 1, 2024 ($3.79 and $4.40, respectively).

The CAISO's cost of RAAIM is also substantially lower than both CalCCA's analysis of weighted average prices and marginal prices. CalCCA analysis of public capacity transaction data in FERC EQR data shows that the weighted-average price for capacity delivered to the CAISO system continued to rise to over $13/kW-month in 2023. The 85th percentile of transactions in August and September 2022 ranged from $20 to $30/kW-month, indicating an even higher cost of incremental procurement. The anecdotal marginal prices reported by CCAs for summer 2023 of RA transactions over $60/kW-mo and as high as $82.94/kW-mo. [48] These market dynamics suggest RAAIM likely not effective as an availability incentive resulting in limited incentives for resources to be available when needed.

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[47] California Public Utilities Commission. 2022 Resource Adequacy Report. Available At: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/2022-ra-report_05022024.pdf

[48] Cal CCA. California's Constrained Resource Adequacy Market: Ratepayers Left Standing in a Game of Musical Chairs. Updated January 16, 2024.

The hours RAAIM is assessed and the monthly netting are not calibrated to reliability events, muting incentives in key hours

RAAIM is set using the availability assessment hours and performance is averaged over the course of the month. However, the combination of monthly averaging of RAAIM performance and the AAH does not incent resources to be available on the days or hours the grid most needs those resources. For example, if a resource was not available during two extreme load days in a month, it would not be penalized by RAAIM. Similarly, if a critical grid condition occurred outside of the AAH, there would not be an incentive to be available.

If stakeholders' collective goal is to have an availability and incentive mechanism incent resources to be available when needed, a daily RAAIM, a RAAIM applied during critical days (e.g., EEA watch and EEA 1-3), or RAAIM applied during the hours the CAISO BAA fails the EDAM RSE would better reflect this objective.

The CAISO would like stakeholder feedback on if RAAIM should remain the same or change. Examples of changes include a daily RAAIM, applying it only to critical days (e.g., RMO, EEA watch, and EEA 1-3 days), during the hours the CAISO BAA fails the EDAM RSE, or based on a different approach.

The RAAIM deadband mutes the effectiveness of RAAIM

Removing the deadband could also improve the effectiveness of RAAIM as resources would receive either an incentive or penalty for their performance, rather than neither. In examining resource performance relative to the deadband for September 2022, the CAISO found that 15% of generic RA MW bid within the deadband and 39% of the flex RA MW bid within the deadband. As a result, these resources were neither assessed a RAAIM penalty or payment.

Figure 18: September 2022 - Percent of Generic and Flex RA Operating in the RAAIM Deadband

	Deadband MW	Total MW	% of RA fleet operating within the deadband
Generic RA deadband	3,197	21,360	15%
Flex RA deadband	6,606	16,940	39%

The CAISO would like to hear back from stakeholders if there is a reason why the deadband should remain and feedback on if it should be removed.

The exemptions from RAAIM make RAAIM ineffective

Many resources provided to the CAISO as RA capacity are not subject to RAAIM which can be divided into five categories, including: (1) resource-based; (2) contract-based; (3) outage-based; (4) MOO-based; and (5) flex-only capacity. See the table below for additional details.

Figure 19: RAAIM Exemptions

Exemption Type	Category	Details
Resource-based Exemption (Tariff Section 40.9.2)	Fully exempt (Tariff Section 40.9.2(a))	(1) Resources with a PMax less than 1.0 MW; (2) Non-specified resources that provide Resource Adequacy Capacity under contracts for Energy delivered within the CAISO Balancing Authority Area; (3) Participating Load that is also Pumping Load; and (4) Legacy RMR Units.
	Exempt from generic RAAIM 40.9.2(b)	(1) VERs, CHP, Run-of-River; and Hybrid. (2) Load-following MSS, as long as the LF MSS is its SC and it is shown as generic RA (3) QF contracts that sare either a.) pre- August 22, 20210 and are in effect per CPUC D. 07-09-040 b.) the earlier of the existing/amended contract terminates or is requested by the SC
	Exempt from flex RAAIM 40.9.2(c)	(1) A combination of use-limited resources (2) load-following MSS
Contract-based Exemption 40.9.2.1.	Acquired 40.9.2.1.	Capacity that was under contract before SCP was created is exempt. These resources were exempt under SCP which rolled over to RAAIM.

Outage-based Exemption: These are exemptions from substitution which means that RAAIM also does not apply	Outage in a Nature of Work	The tariff exempts certain nature of work categories that relate to "(i) an administrative action by the resource owner; (ii) a cause outside of the control of the resource owner, (iii) or a short-term use limitation; or (iv) a non-Run-of-River Resource hydroelectric Generating Unit's management of water-related operational or regulatory limitations." The hydro-limitations only apply to a hydro unit whose QC was established by an LRA using historical hydro conditions. The specific outage nature of works include planned outages with the nature of work/opportunity status of either "transmission induced" or "off peak opportunity" (See: The Reliability Requirements BPM, sections 9.2.1 and 9.3.3)
	Short-notice opportunity outage (Tariff section: 9.3.1.3.7)	Relatively short outage submitted to the CAISO shortly before it would be taken if CAISO analysis reflects grid conditions allow the outage without a reliability impact.
	Off-peak opportunity outage (Tariff section: 9.3.1.3.6)	Outage that can be completed entirely during off-peak hours.
Must-offer obligation based exemption: Reduces exposure to RAAIM	Exemption from the standard MOO that apply for generic or flex RA (Tariff section: 40.6.1 and 40.6.2)	For example, under section 40.6.2(c), "Long Start Units not committed in the Day-Ahead Market will be released from any further obligation to submit Self-Schedules or Bids for the relevant Operating Day."
Flex-only Capacity Exemption: This is an exemption from substitution which means that RAAIM also does not apply	Tariff section: 9.3.1.3.	The CAISO has the ability to approve a planned outage that is just providing flex RA without providing substitution.

Benchmarking

Some ISOs and RTOs have a "pay-for-performance" approach based on reserve shortage conditions, including PJM and ISO-NE. These approaches tend to act as both a reward and penalty relative to their obligation during scarcity events. A similarity with RAAIM is that they are self-funded mechanisms with the penalties levied as the source of the incentive payment. Three key differences with RAAIM include: it applies to all resource types, in some cases it is applied to non-capacity resources (as an incentive), and it has a significantly higher price.

ISO-NE's pay-for-performance approach is triggered during Capacity Scarcity Conditions.[49] Implemented in June of 2018, their pay-for-performance mechanism compensates or charges generators based on their performance relative to their Capacity Supply Obligations during Capacity Scarcity Conditions. Resources that fail to deliver energy during scarcity events or experience significant outages may face financial penalties through pay for performance charges. In 2023 penalties were $3,500/MWh for any deviations from their capacity supply obligations. These values have increased over time with the period beginning on June 1, 2024 and ending on May 31, 2025, the Capacity Performance Payment Rate the current rate being at $5,455/MWh and starting in June the rate will increase to $9,337/MWh. [50]

Resources that perform well and contribute to system reliability are rewarded through pay for performance credits. [51] ISO-NE also has a monthly[52] and annual[53] stop-loss mechanism to prevent unlimited risk to resource owners for poor performance. Of note, their pay-for-performance is not just for resources with supply obligations; resources without capacity supply obligations are also

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[49] A CSC occurs when ISO-NE is short of one or more of the three reserve requirements and the Reserve Constraint Penalty Factor ("RCPF") is setting the real-time reserve prices: (a) system-wide 10-minute reserve requirement; (b) system-wide 30-minute reserve requirement; and (c) local 30-minute reserve requirements that exist to meet the second-contingency requirement in import-constrained areas.

[50] ISO-NE Tariff Section III.13.7.2.5 Capacity Performance Payment Rate. Effective Date: March 1, 2024 – Docket No. ER22-983-000. "For the Capacity Commitment Period beginning on June 1, 2025 and ending on May 31, 2026 and thereafter, the Capacity Performance Payment Rate shall be $9,337/MWh."

[51] Potomac Economics. 2022 Assessment of the ISO-NE Electricity Markets. June 2023 p. 45

[52] At a monthly level, it is limited to the product of the forward capacity auction starting price multiplied by their obligation. ISO-NE Tariff. III.13.7.3.1 Monthly Stop-Loss.

[53] At an annual level it is capped at the capacity obligation times the difference between three months revenue and 12 months of the forward capacity market clearing price. ISO-NE Tariff. III.13.7.3.2 Annual Stop-Loss.

eligible. ISO-NE's pay-for-performance has been infrequently used; there have only been three capacity scarcity conditions in its six years of operation.[54]

PJM's pay-for-performance model rewards resources for performing above commitments while penalizing those that do not during emergency periods. It was implemented in 2016 in response to capacity shortfalls that occurred during the 2014 Polar Vortex. Their penalty is based on a yearly net CONE of the local delivery area, a divisor (i.e., assumed 30 emergency action hours per year), and the number of real time settlement intervals in an hour.[55] They too have stop loss provisions but they are only annual.[56]

A key lesson learned is getting the penalty right. For example, during Winter Storm Elliot, PJM assessed $1.8 billion in non-performance penalties on 81 of its members as a result of 40,000MW of unavailable resources. This was negotiated down to $1.25 billion, an amount that was unopposed by the utilities involved.[57] This equates to a penalty of about $31.25/kW, a significantly higher penalty than RAAIM at $4.40/kW-mo.

Options for Consideration

CAISO recognizes there are a variety of methods to reflect the true availability of units for a reliable system in modeling, accreditation and incentives. To date, neither the CAISO nor the CPUC account for the impact forced outages and unit derates have on system reliability beyond the established planning reserve margin requirement. Instead, the CAISO relies on operational tools such as planned outage substitution rules and RAAIM to discipline capacity closer to operations. However, with the potential introduction of a UCAP approach allows the potential to capture some of the variability in availability up front.

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[54] Potomac Economics. 2023 Assessment of the ISO-NE Electricity Market. Section 6.2

[55] PJM. Follow-Up Education on Performance Assessments and Obligations. Slide 15-16. For example, if the local delivery area net cone is $300/MW-day, then the non-performance charge would be [($300/MW-day * 365 days/30]/12 = $304.17/MW-interval.

[56] PJM. Follow-Up Education on Performance Assessments and Obligations. Annual stop loss provisions are one and a half times the applicable local delivery area net CONE x 365 days x max daily capacity performance UCAP MW commitment from June of the delivery year through the end of the billing month for which the non-performance charge was assessed. December 22, 2022.

[57] Inside Lines. FERC Approves Winter Storm Elliott Settlement Agreement December 20, 2023.

However, UCAP is not a silver bullet to capture all availability and does not necessarily eliminate the benefit of a layered approach with availability and performance incentives. Other ISOs/RTOs also combine up front availability in resource accreditation while also instituting performance penalties if it does not materialize. Any RAAIM reform option will have to weigh the extent to which UCAP is adopted by an LRA and which resources it applies to – or if there is a need to discipline capacity though a performance mechanism.

Reforms to RAAIM could take a multitude of approaches. If the ISO were to remove the current RAAIM design, it could be replaced on one end of the spectrum with a reliance on scarcity pricing and the other end of the spectrum with strict non-performance penalties. A middle ground could look like a version of pay-for-performance with an upside for over performance and a downside for under-performance. If the ISO keeps the current RAAIM framework, it could fix some of the known gaps in RAAIM design and align it with RSE penalties for not showing enough capacity in the day ahead.

Scarcity Pricing[58]

Scarcity pricing occurs when market prices exceed the offer price of the most expensive available resource. This occurs when the supply offered into the market fails to meet the demand for a given market product. Under these conditions, there is no "marginal cost of production". Markets primarily enact scarcity pricing through reserve shortage pricing. CAISO uses a Scarcity Reserve Demand Curve (SRDC) during periods when supply cannot meet the minimum procurement requirements for ancillary services. If supply fails to meet any of CAISO's ancillary service requirements within a region or sub-region, the Scarcity Reserve Demand Curve clears the ancillary services market at administratively determined prices.

During the RA working group Vistra suggested the CAISO eliminate RAAIM and rely on scarcity pricing to act as the incentive mechanism. Enhanced scarcity pricing could also alter the incentives for capacity availability. Without considering portfolio effects of entities with multiple resources, additional scarcity would incent individual generators to perform as the forgone energy revenues would

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[58] Scarcity pricing policy discussions are occurring in the Price Formation Enhancements initiative. Stakeholders are invited to participate in shaping the future of scarcity pricing in this initiative.

factor into resource decisions. However, depending on the price level, timing, and trigger mechanisms – scarcity pricing alone could undermine the foundational purpose of a resource adequacy framework and/or not provide sufficient incentive for availability and performance.

Pay-for-Performance

CAISO could also institute a version of a pay-for-performance mechanism. This type of approach has been implemented in ISO-NE and PJM. Similar to RAAIM it could be self-funding where the underperforming resources would pay the higher performing resources for their performance. As mentioned above, three key differences with RAAIM include: it applies to all resource types, in some cases it is applied to non-capacity resources (as an incentive), and it has a significantly higher price.

As some design considerations:

- **Inncetive/Penalty:** In order to incent non-RA capacity to be available, stakeholders could decide not to cap payment at the resource's PMAX. If RA resources only under-perform, they all would be penalized. If resources only over-perform, they would not receive a payment because there would not be a pool of resources to fund the payment.
- **Assessment:** The assessment could compare the CAISO market award for energy and ancillary services with metered performance. This would be irrespective of the accreditation method used. This could further act to discipline what accreditation method a resource selects to be closer to what it can provide.
- **Trigger:** Pay-for-performance could be triggered when there are scarcity conditions such as RMO, EEA Watch, and EEA 1-3; but stakeholders could also consider expanding the use to include instances when the CAISO BA was insufficient to pay the EDAM RSE and had to take corrective actions or pay penalties. As an example of what pay-for-performance could look like if a resource under-performs or over-performs, see the Figure below. This example assumes that the penalty was administratively set at $9,337/MWh, similar to ISO-NE. This example also assumes that under and over performance are equal which may not be the case.

Figure 20: Example of Resource-Level Pay for Performance

	Under Performance Penalty	Over Performance Payment
Supply Plan Quantity, NQC (A)	100 MW	100 MW
Resource Performance, MW (B)	90 MW	110 MW
Resource Performance, % (C)	90%	110%
Settlement = (|[B-(C x A)]| x $3,500	= |100 - (0.9 x 100)| x $9,337	= |100 - (1.10 x 100)| x $9,337
Total	($93,370)	$93,370

While there may be criticism that this approach could incent resources to under-show resources on a supply plan, there are two mitigating factors that could prevent this behavior. First, these resources would only be paid during shortage conditions. Second, their total supply plan obligation remains unchanged. Therefore, if one resource under-shows in order to have capacity available for pay-for-performance incentives the entity would also need to have another resource provide the missing capacity from the under-shown resource.

Stakeholders should further discuss if there should be caps on how large a penalty can be. In other markets such as ISO-NE and PJM there are few exemptions but there are stop loss provisions which cap losses.

Redesign RAAIM

Redesigning RAAIM requires addressing the shortfalls of the current design. The ISO suggests the following menu of reforms to RAAIM as a starting point for discussion.

Figure 21: RAAIM Design Challenges and Options

Current Design Challenge	Future Design Enhancement Option(s)
The cost of RAAIM has not incented capacity to be available	Change the RAAIM price to • Tie to bilateral prices • 100% of the CPM soft offer cap

	• Align with RSE failure payments and surcharges
When RAAIM is applied (the AAH and monthly netting) does not incent performance on critical days. Current netting mutes RAAIM as a penalty; over performance on some days compensates for under performance on other days.	Consider applying RAAIM: • Daily • Only applying RAAIM on critical days such as RMO, EEA watch, EEA 1-3, etc. • When the ISO BAA fails the RSE
RAAIM does not apply to all resources	Remove the RAAIM exemption for resources under 1MW. The ISO has observed an uptick of resources registered under the 1MW threshold and hypothesizes this does not reflect the size of the resource but an incentive to not be subject to RAAIM.[59]

Recognizing the interdependencies with other policy changes, the CAISO outlines the pros and cons with some of the approaches and their intersection with other policy changes where applicable in the Figure below.

Figure 22: RAAIM Considerations in light of Other Policy Measures

Potential Approaches	Assumptions	Pros	Cons
Lower Reliance on RAAIM relative to UCAP	Assumes that every LRA and every type of resource accreditation fully accounts for the true availability of the resource in resource counting	Stronger incentives if non availability results in a loss of future capacity value.	Possible risk that either LRA counting rules holistically or LRA counting rules for certain resource types will not appropriately account for availability during stressed periods. Would not account for performance.
Remove RAAIM with reliance on incentives from	Scarcity pricing levels high enough to incent performance and availability particularly	Provides an added value stream to generators to be available and	Risk to load. Does not discipline existing capacity to be available in advance or after the fact. Undermines purpose of

[59] For example, in July and August 2023, 18% of supply plan demand response capacity was associated with resources sized less than 1 MW and thus were exempt from RAAIM. CAISO Department of Market Monitoring. Report on Demand Response Issues and Performance. P. 9.

Scarcity Pricing	in light of high payment streams.	respond to scarcity pricing.	capacity structure and compensation.
Remove and Replace with a Pay-for-Performance like mechanism	Does not consider only availability but also the performance—which changes the design of the process from emphasizing availability to emphasizing performance.	Could better incentivize RA to be available and dependable during key conditions.	If undersized will have limited impact. If oversized, it could over-penalize without cause. Need to learn from challenges experience during extreme events in PJM and ISO-NE.
Reform RAAIM	Assumes RAAIM reform based on current known challenges with: alignment with market dynamics, the current deadband, the monthly netting, which resources are subject to RAAIM, and the hours RAAIM is applied.	Could correct current known challenges	Limited changes may still not prove durable in the long-term. RAAIM burdensome for many resources with current applicability
Replace RAAIM with allocation of RSE Failure Surcharges, RSE EDAM Revenue Payments (received when supporting other EDAM BAs)	Assumes tracking of LSE performance as compared to obligation.	Better aligns EDAM availability incentive requirements with existing RA requirements.	RSE failure surcharges are on a BAA not LSE basis. A methodology and tracking system would need to be developed to assign costs/benefits to LSEs based on monthly showings and resource availability.

7 Resource Visibility and Backstop Procurement

Introduction

This section focuses on the backstop procurement portion of CAISO's RA program. Backstop processes are tools at CAISO's disposal for maintaining grid reliability when a resource need arises beyond the capacity brought to market by LRA RA programs. While the CAISO has several backstop tools that operate on different timelines, this phase of the RA reform process will focus primarily on the capacity procurement mechanism (CPM). Building off of the discussions in the RAMPD working group, this initiative will focus on challenges and potential solutions related to two areas of backstop reform — resource visibility and backstop procurement policy.

- The resource visibility area will include an initial effort focused on visibility into the status of capacity not shown as RA. This will help identify available backstop capacity, making implementation of CAISO's existing backstop processes more effective. In the longer term this area will also involve consideration of policy changes that could help ensure CAISO's tools and process are effective given the shifting portfolio and evolving LRA program design.
- The backstop procurement policy area will be a full review of the CPM framework and products to better reflect RA market dynamics and reliability needs. This will include examining how the month-ahead RA and CPM processes will interact with the Extended Day Ahead Market (EDAM) Resource Sufficiency Evaluation (RSE), including ways to build on the at-launch processes being discussed in the day-ahead sufficiency intiative.[60]

The goal of the program review in this initiative is twofold. The first part is structural reform. CAISO received a wealth of stakeholder feedback in the RAMPD working group on how the program could be updated. The western energy landscape and resource mix are changing, and capacity offers into the competitive solicitation process (CSP) from which CPM capacity is procured have fallen in the past five years. Stakeholders offered a variety of perspectives on why this is happening and how the program might adapt. This feedback

[60] California ISO - Day-ahead sufficiency (caiso.com)

contains multiple visions for what the CPM could become and the market role it could play, some of which are mutually exclusive with each other.

As CAISO looks at the range of options, we believe it will be crucial to stay as aligned as possible with the various LRA resource adequacy programs, including the CPUC's IRP and Slice of Day frameworks. However, we also recognize the challenges with implementing CAISO's RA processes with a bifurcated structure and disparate LRA programs. The CAISO believes options worth exploring include a peak and net peak hour check applied to all LRAs or a portfolio sufficiency check on energy and capacity with input, and assumptions and requirements built from the LRA programs.

To this end, this initiative will provide a platform to more fully explore the options for structural CPM reform. Given the breadth of suggestions and the interdependences between CPM design and LRA RA programs, integrated resource planning, the EDAM RSE, and other parts of CAISO's own RA functions, CAISO anticipates that this part of initiative may require relatively more time to complete.

The second focus of this initiative is immediate improvement of the existing CPM's backstop and program functions. The working group identified some non-structural changes that could make the existing CPM framework more effective and potentially inform long-term reform. CAISO currently has very little visibility into the availability of capacity in the BA that is neither shown as RA nor bid into the CSP. Such capacity could be in a variety of positions, from contracted as RA to a LSE within the CAISO BA but not shown to contracted outside the CAISO BAA to operating without any capacity contract. Some of these categories are CPM-eligible and could be bid into the CSP but aren't, while others are categorically ineligible.

The distribution of capacity across these categories has implications for current CPM operations and future CPM reform. It matters most urgently in months when there is not enough capacity offered into the CSP to meet the CAISO's CPM procurement need. Knowing the status of capacity that is neither shown as RA nor bid into the CSP could help CAISO operators identify additional capacity that might be available for a CPM contract in order to ensure reliability. Longer-term, understanding this distribution would help CAISO understand why CSP bids may be dropping and what that means for how the CPM framework should be updated.

To this end, the more immediate focus of this initiative will be to develop a new reporting process for capacity that is not shown as RA. CAISO staff plan to advance this effort on an accelerated timeline compared to structural CPM reform, and especially welcome stakeholder focus and input on this topic in the November 14th workshop and comments.

Finally, one aspect to consider as we review CAISO's backstop role and processes is the relationship between the month-ahead and day-ahead timelines. The procurement conducted on a month-ahead basis influences the "baseline" state of resource availability going into each day. This creates a linkage between LRA RA programs, the month-ahead CPM process, RAAIM, and the daily EDAM RSE process. If LSEs bring sufficient capacity to meet a 0.1 LOLE, which is facilitated by LRA PRMs and RA requirements being effectively calibrated to a 0.1 LOLE, we anticipate that EDAM RSE failures should be rarer than if they do not. Similarly, if CAISO has a robust month-ahead backstop process we would also expect EDAM RSE failure to be rarer, because CAISO would have more ability to address reliability concerns that are visible that far ahead. Conversely, if the backstop authority and/or front stop procurement is less effective in securing a portfolio that would meet a 0.1 LOLE, the CAISO BAA could be increasingly at risk of RSE failure and/or seeing more reliability risks emerge in the day-ahead timeframe. If the resource fleet is less reliable (with higher forced outage rates as framed in the RAAIM section) we could also be at a higher risk of EDAM BAA failures.

These linkages between the month-ahead and day-ahead timeframes have always existed. But the EDAM launch throws them into sharper focus because of the benefits that will be lost by failing the EDAM RSE and cost of potentially correcting failures. Below are some of the considerations on overlapping issues between the monthly CPM process and the EDAM RSE topics discussed in this chapter.

Figure 23: Linkages Between Monthly CPM Activity and the EDAM RSE

Options for Consideration	What Deficiencies Require Backstop?	What Data/Information Informs Decisions?	What products should be procured to Correct?	How should Costs be Allocated?
Monthly Backstop	Current Definitions? Net Peak capacity? Energy sufficiency?	Portfolio Assessment? Stacking Analysis Based on LRA Requirements?	Monthly RA? Targeted Products (e.g. Energy Vs. Capacity) based on Operational Needs.	Current Methods? Reforms to consider DR credits? Based on product specific deficiencies by LSEs? Other alternatives
EDAM RSE Failures	Reliability risks revealed by potential RSE shortfalls	Process discussed in day-ahead sufficiency initiative Bids made available by moving day ahead bidding deadline to 9 am	Exceptional dispatch More granular capacity products (e.g. hourly/daily product or energy/flex)?	Peanut Buttered to Load? Based on Analysis of LSEs bringing Insufficient Capacity? Underperforming RA Resources? (and credits to overperforming?)

Based on stakeholder feedback, we expect to consider both reforms to our current CPM processes and enhancements to CAISO's at-launch approach to the EDAM RSE for the CAISO BAA. However, we also believe that we will need close consideration of how to align incentives between the processes and how much to rely on one of the mechanisms versus the other in ensuring resource adequacy and passing the EDAM RSE in the CAISO BAA.

Problem Statements

The problem statements outline the problem this initiative seeks to fix. The problem statements for backstop procurement reform agreed to in the working group were:

- *The ISO lacks visibility into the contract and availability status of resources not shown as RA, preventing the ISO from efficiently and reliably running its current CPM processes.*
- *Some stakeholders note they lack visibility into the ISO's CPM decision making processes.*
- *In the current tight RA market, the ISO's CPM may not be producing all of its intended results particularly given the frequent lack of bids into its Competitive Solicitation Processes.*
- *As grid reliability needs evolve (e.g. to address changing needs for battery storage) the ISO's CPM process may need to evolve to obtain specific attributes necessary for reliability.*
- *While the ISO proposes to utilize its existing exceptional dispatch authority to resolve reliability concerns highlighted by potential capacity shortages identified by the EDAM RSE, stakeholders have expressed concern that:*
    - *The option to exceptionally dispatch resources might not be available during critical periods.*
    - *The cost allocation should be reexamined to align better with cost causation, if feasible.*

Objectives

CAISO's backstop processes should work in harmony with the PRM setting and counting processes needed to meet reliability objectives. They should:

- Efficiently obtain capacity with the right attributes when and where needed to maintain reliability
- Not adversely impact the bilateral market and procurement
- Address market power as appropriate
- Facilitate efficient CAISO RA program operations
- Provide visibility into RA and non-RA resources allowing for efficient decisionmaking by CAISO operations staff

When examining CAISO's role in backstop, CAISO stakeholders highlighted both reliability and harmonization with LRA programs as key priorities. In recent years, the CAISO's most challenging operational conditions have been centered around

the net peak hours in the summer, when the sun starts to set and demand remains high. Additionally, a significant increase in battery storage in the CAISO BAA fleet raises questions about the need to ensure sufficient charging is energy available.

CAISO is committed to coordinating with stakeholders and LRAs to harmonize programs to the extent possible and seeks modifications to CAISO's RA program that appropriately balance effectiveness, simplicity, and flexibility in coordination with all LRAs in the CAISO footprint. Within a reformed CAISO framework, our RA processes would likely not mirror the 24 hour slice of day framework adopted by the CPUC, but would be able to accommodate different LRA programs and result in sufficient resources both from an energy and capacity standpoint to maintain reliability.

Foundational to the CPUC's resource adequacy program, other LRA RA programs and CAISO's RA processes and procedures is ensuring sufficient capability to maintain reliability. Given the changing resource mix, this requires an RA framework sufficient to meet both energy and capacity needs, including resources to meet storage charging demand.

To address the escalating need to evaluate energy sufficiency, potential backstop reforms could include the CAISO conducting both a gross peak and net peak capacity assessment and an energy sufficiency assessment.

CAISO's approach to the EDAM RSE upon EDAM launch in 2026 is being addressed in the day-ahead sufficiency initiative. In the longer term however, the ISO is open to enhancements to its at-launch approach. These enhancements should help CAISO pass the EDAM RSE as efficiently and cost-effectively as possible and allocate the costs of failing the RSE to those market participants most responsible for the failure. The goal in the latter case is to encourage all market participants to contribute to passing the RSE so that the CAISO balancing area can receive the full benefits of EDAM participation.

Background

The Capacity Procurement Mechanism Program

The Capacity Procurement Mechanism (CPM) is a core part of CAISO's backstop procurement authority. When there is a deficiency in LSE RA plans or in specific extenuating grid circumstances, CAISO has the tariff authority to conduct backstop procurement to fill the gap and maintain reliability.

CAISO uses the CPM to address six tariff-defined circumstances, referred to as designations. [61] Four of the designations correspond to different types of RA deficiencies while the significant event and exceptional dispatch designations address extenuating grid circumstances. CPM designations rely on capacity willingly offered to CAISO by scheduling coordinators through annual, monthly and intra-monthly competitive solicitation processes (CSPs). In CAISO's CSPs, SCs may offer their capacity to CAISO at prices up to a soft offer cap, currently set at $7.34/kW-month, or a resource-specific cost-based price approved by FERC. Any offers above the soft offer cap must be cost-justified at FERC to recover up to a resource-specific cost based rate.[62]

The soft offer cap is designed to mitigate market power but generally be higher that the going forward costs of most generators in the CAISO footprint which the CAISO is likely to procure. However, it is currently lower than both bilateral HUB prices for energy[63] and anecdotal reports on prices generators are selling at in bilateral RA contracting processes. The soft offer cap meets its designed objective of being high enough to cover going-forward fixed costs for marginal resources on the system, and it likely provides a reasonably effective way to mitigate market power. However, it is not currently cost competitive with bilateral market prices, particularly during stressed periods. Because of these market dynamics, the ISO hypothesizes that the lack of offers in the CSPs is driven by a combination of most capacity being under contract and sellers of any available capacity having alternatives above the soft offer cap. If CAISO is unable to procure capacity via the CPM, the CAISO BA could have increased risk of insufficient capacity.

Another relevant factor is the increasing amount of battery storage resources interconnecting to the ISO BA grid and shown as RA, with over 15,000 MW more planned for by 2035 in the CPUC's latest cycle of Integrated Resource Planning.[64] One example of how this is changing reliability planning is the CPUC's requirement in its Slice of Day RA framework that LSEs must show sufficient capacity and associated energy to charge battery storage on a 24-hour

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[61] Tariff section 43A.2 describes the six sets of circumstances, or designations, under which the ISO has CPM procurement authority.

[62] See tariff section 43A.4.1.1.1.

[63] We note that energy prices and and capacity prices are not analogous but make the comparison due to the fact that there is an implicit capacity component in the HUB energy prices.

[64] Decision 24-02-047, Decision Adopting 2023 Preferred System Plan and Related Matters, and Addressing Two Petitions for Modification, Table 4, pg 68.

basis to meet their load profile plus a planning reserve margin. While CAISO does not anticipate modifying its structures to mirror the CPUC's Slice of Day framework, CAISO recognizes there soon may be the need to look at charging energy as a part of the backstop processes to ensure the CAISO BA has sufficient capacity and energy in all hours in the right locations.

The solutions in the current tight RA market will not be simple. In previous initiatives, participants expressed concern that increasing the soft offer cap could interfere with bilateral processes both by directly leading suppliers to demand higher prices and driving significantly higher deficiency costs. CAISO is interested in feedback on what short term approaches the ISO could take to increase reliability in a tight supply market where many LSEs have challenges meeting their LRA-mandated requirements. CAISO also solicits feedback on what long term approaches it could take to foster a more stable, reliable, and efficient backstop process.

The Competitive Solicitation Process

The Competitive Solicitation Process (CSP) is CAISO's current mechanism for identifying capacity available for a CPM designation. Through the CSP, scheduling coordinators may voluntarily offer capacity that has not already been shown as RA for a CPM designation. CSPs are run on three recurring timeframes: annual, monthly, and intra-monthly. These correspond to the types of CPM designations, providing a pool of up-to-date offers on the timelines appropriate to the CAISO decision-making on each type of designation (Figure 24).

Figure 24: CSP Timeframes and the CPM Designation Decisions they support[65]

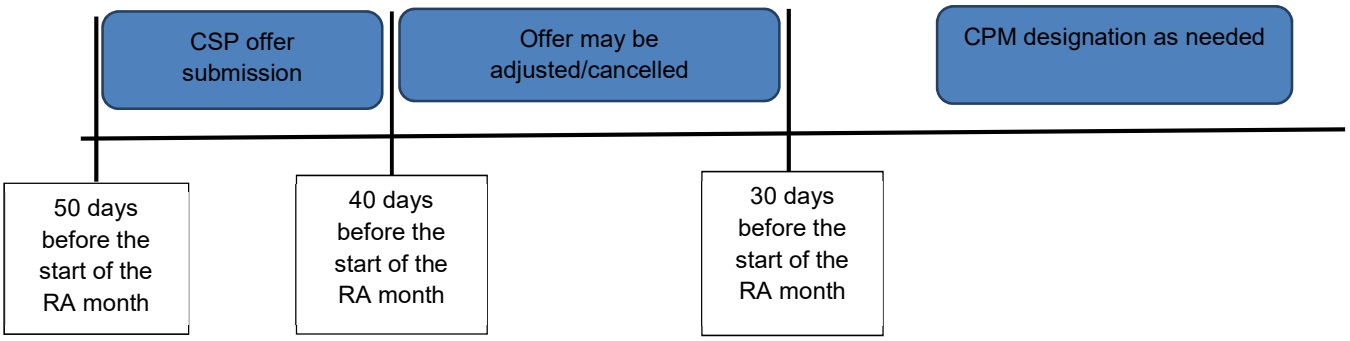
Timeframe	CPM event covered in a CSP
Annual	• Insufficient cumulative local capacity in RA plans • Insufficient cumulative system capacity in RA plans • Insufficient cumulative flexible capacity in RA plans • Collective deficiency in local area
Monthly	• Insufficient cumulative local capacity in RA plans • Insufficient cumulative system capacity in RA plans • Insufficient cumulative flexible capacity in RA plans • Insufficient cumulative system capacity due to planned outages

[65] Business Practice Manual for Reliability Requirements, Version 74, October 5, 2023. Section 5.1, page 48.

Intra-monthly	• Significant event • Exceptional dispatch

In the monthly timeframe, CSP offers may be submitted in CIRA up to 40 days before the start of the RA month and adjusted down in price or quantity up to 30 days before the start of the RA month. At that point all offers are finalized, and may not be withdrawn until ISO operators have completed the CPM process and awarded designations to the selected resources (Figure 25).[66]

Figure 25: Timeline for monthly Competitive Solicitation Process



In theory, all available capacity not shown as RA can be offered into the CSP. If this was done, the CSP offer list would provide transparency into the full pool of resources available for CPM procurement. However, offering capacity into the CSP is voluntary, and there are many reasons why a supplier might choose not to.

One reason is loss of flexibility. Once CSP offers are finalized, suppliers may not withdraw them until the current CPM designation cycle is complete. If an offer is selected to receive a CPM designation the scheduling coordinator may not turn it down, and the resource acquires a must offer obligation equivalent to that of an RA resource for a minimum of 30 or 60 days depending on the type of CPM designation.[67] This prevents capacity offered into the CSP from being used for other purposes until the offer is released (if not selected) or the CPM designation term expires (if it is selected). Suppliers wishing to use capacity for other purposes such as RA substitution or reliability capacity in a market outside the

[66] Id at 51.
[67] Id at 167.

CAISO BAA may not offer that capacity into the CSP. This means the CSP offers usually represent only a subset of CSP-eligible capacity, and the CSP process gives no visibility into how much CSP-eligible capacity is not offered and for what reasons.

This creates several limitations for ISO operators making backstop procurement decisions. First, it limits visibility into what additional capacity may be available if CSP offers are insufficient to meet the CPM procurement need in a given month. This is a growing concern given the decline in CSP offers since 2020, discussed further in the following section. It also makes it harder to identify potential drivers of such long-term trends in CSP results. The ISO can see that offers have been declining but not why, and this ambiguity has implications for reliability planning. If offers are declining because more resources are taking on a market obligation through programs like RA that are still within the CAISO BAA, the decline in CSP offers may not be indicative of a reliability risk. But if, for example, more CSP-eligible capacity is being sold for reliability services outside the CAISO BAA, the decline in CSP offers may correspond to a meaningful decline in resources available to serve the CAISO BAA. The CSP process therefore creates only part of the visibility the ISO needs to make optimal backstop decisions in today's changing energy landscape.

The Extended Day Ahead Market Resource Sufficiency Evaluation

As established in the EDAM design, the RSE will be conducted each day at 10 a.m. prior to running the day-ahead market. The RSE will evaluate each BAA's offered supply, including the forecast output for variable energy resources (VERs), against its demand forecast, imbalance reserve requirements and ancillary services requirements across the 24 hourly intervals of the day-ahead market.

BAAs that fail the RSE in any hour of the 24-hour evaluation period might be removed from the pool of passing entities and could lose diversity benefits in real-time. More specifically, BAAs that are deficient after the integrated forward market (IFM), or that fail to comply with the tagging requirements, will be evaluated individually in the Western Energy Imbalance Market (WEIM) RSE. BAAs that are sufficient and comply with the tagging requirements will be pooled together and evaluated as a whole.

Additionally, EDAM BAAs that fail the RSE are subject to an RSE failure surcharges designed to incentivize sufficient forward procurement. There are three types of RSE failure surcharges: (1) on-peak upward failure surcharges; (2)

off-peak upward failure surcharges; (3) downward failure surcharges. Upward failure surcharge calculations include a failure multiplier (0, 1.25 or 2) that is dependent on the magnitude of the failure quantity, relative to the deficient BAA's upward imbalance reserve requirement.

These three types of surcharges are assigned to deficient BAAs. The EDAM tariff requires the ISO to then distribute the collected funds as a revenue to EDAM BAAs who pass the RSE. This feature is an acknowledgement of the fact that the net EDAM transfers (including transfers of imbalance reserves) from passing BAAs help cure (fully or partially) the deficient BAA in the integrated forward market. Each BAA participating in EDAM is responsible for developing its own methodologies for allocating RSE failure surcharges and revenues within its own BAA.[68]

CAISO has been addressing its at-launch processes leading up to the RSE in the Day-Ahead Sufficiency initiative. CAISO's existing tariff authority provides the ability to cure serious reliability risks, including those potentially highlighted by EDAM RSE deficiencies, through its exceptional dispatch authority. However, in the course of the RAMPD Working Group stakeholders expressed interest in exploring or developing alternative approaches. CAISO has also expressed a willingness to work with stakeholders to explore alternative methods to resolve a potential capacity deficiency identified by the EDAM RSE.

Current Challenges & Stakeholder Feedback

CSP Trends and Resource Visibility

Identifying when backstop procurement is necessary and finding resources to procure both rely on CAISO having adequate visibility into the resource fleet. This process can play out at many different timescales, but in this section we will focus on the month-ahead CPM solicitations. As discussed in the RAMPD working group, improved visibility into the resources internal to the CAISO BAA could help explain recent trends in CPM solicitation results, improve functioning of the CPM program, and potentially point to policy improvements.

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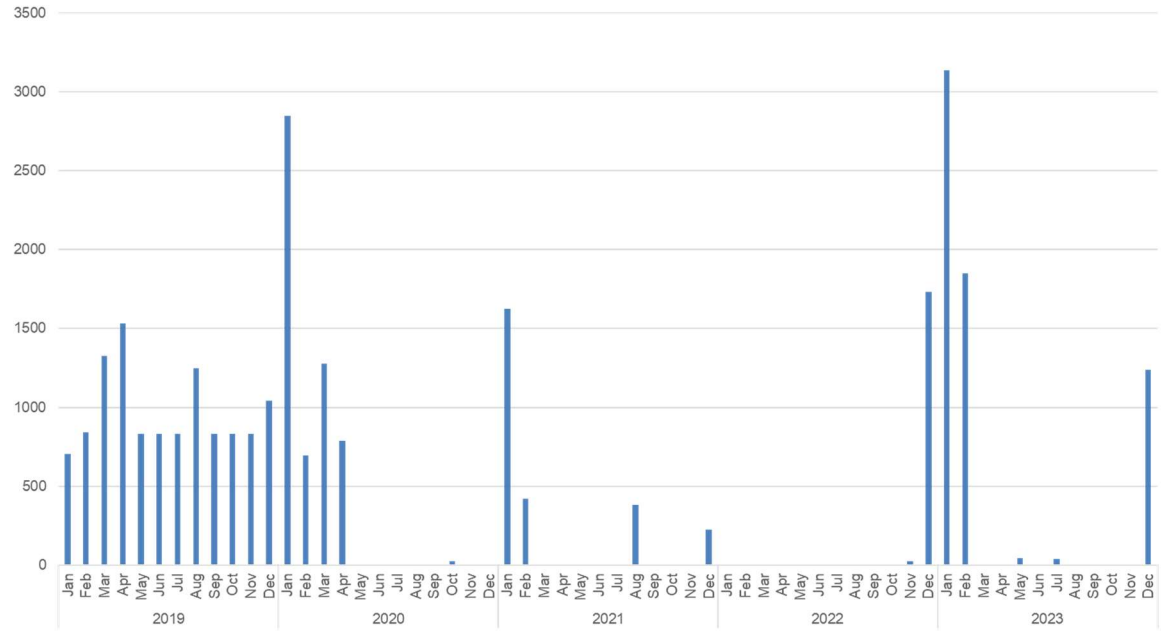
[68] Extended Day-Ahead Market ISO Balancing Authority Area Participation Rules Track A1 Final Proposal, pg 27. August 25, 2023.

CAISO's current source of month-ahead resource visibility is shown RA. The month-ahead showings of load-serving entities and the corresponding RA supply plans suppliers file with CAISO document a pool of committed capacity designed to be sufficient to meet projected load. Resources shown as RA can still experience outages or derates that affect their actual availability in the month, but overall RA resources are the portion of the resource fleet the ISO has the best visibility into on a month-ahead basis.

CAISO does not have the same visibility into resources not shown as RA. CAISO operators have almost no visibility into the status of this portion of the fleet on a month-ahead basis. This affects CPM implementation because resources not shown as RA form the pool of potential CPM capacity. Conducting efficient and effective backstop procurement requires understanding what capacity is available.

The CPM program's Competitive Solicitation Process (CSP) is designed to provide this understanding. Suppliers can offer capacity not shown as RA into the CSP each month, and CAISO operators can draw on these offers for CPM designations. However, as shown in Figure 26 below, bids into the CSP solicitations have dropped sharply since 2020.

Figure 26. Total Capacity Bid into the Competitive Solicitation Process by Month, 2019-2023 (MW)



When the offer pool is small enough, instances can and have occurred where not enough capacity is offered to meet CAISO's need for CPM procurement.[69] More broadly, the CAISO BAA resource fleet and market landscape have both evolved rapidly in this timeframe, and it is possible that the drop in bids is related to a broader trend in capacity commitments. Historically high prices in the bilateral RA market make it more likely that capacity previously bid into the CSP might be sold as RA instead. More capacity may be held back for substitution, or sold outside the CAISO BAA.

Better visibility into the status of capacity not shown as RA will help CAISO conduct existing backstop processes more effectively and understand how any emerging trends should be incorporated into backstop program design.

Energy Sufficiency/Assessing Net Peak Hours

CAISO's backstop procurement authority through the CPM is currently limited to six designations. These allow CAISO to address reliability risks associated with resource adequacy deficiencies and respond to several types of unusual events. As the resource fleet and reliability planning landscape evolve, however, it may be prudent to revisit these designations to maintain complementarity between the CPM and LRA resource adequacy programs.

One area where this may be timely is compatibility with the CPUC's recently adopted slice-of-day (SOD) RA framework. The CPUC adopted SOD in part to better ensure energy sufficiency in all hours of the day, and previous CPM reforms have taken a similar focus. Furthermore, the SOD framework uses exceedance values to calculate the reliability contribution of wind and solar on an hourly basis. In the first phase of the Resource Adequacy Enhancement Initiative,[70] CAISO found that the increasing use of availability-limited resources in local capacity areas meant that some areas were at risk of energy insufficiency

[69] See, for example, CAISO's requested action to suppliers for addition capacity offers outside the CSP process in August 2021.
[70] Conducted 2018-2021, record available at California ISO - Resource adequacy enhancements (caiso.com)

even when they had enough eligible RA capacity to meet peak demand.[7172] In 2021 FERC approved CAISO tariff amendments adding an energy sufficiency criterion to the local capacity technical studies and expanding CAISO's backstop procurement authority to include local energy sufficiency.[73] Since then CAISO has been able to assess local area reliability in all hours of the day and conduct CPM procurement to ensure energy sufficiency if needed.

CAISO currently has no counterpart for this assessment at the system level. CAISO checks that the RA plans show enough NQC to meet forecasted monthly demand in the peak hour. If such an assessment used consistent ELCC values for all resources, it could examine the contribution of different resource types to meeting the reliability needs across all hours in the applicable time period; however, with different program designs applying different counting methodologies (e.g. some LRAs using ELCC and others applying an exceedance value) the assessment is increasingly complex to capture all the needs. Currently CAISO neither conducts the necessary analysis to assess system-wide energy sufficiency nor has the authority to conduct CPM procurement if an energy insufficiency risk is discovered when evaluating the aggregate of all resources. The CAISO sees merit in evaluating options to assess energy sufficiency across the day. Of primary focus may be assessing resource sufficiency in net peak periods where grid conditions have been most challenging, in addition to the gross peak.

EDAM RSE Failure Surcharge Cost Allocation

In Track A1 of the EDAM ISO balancing Authority Area Participation Rules initiative the ISO worked with stakeholders to develop an interim cost allocation methodology for RSE failure surcharges.[74] The interim methodology allocates RSE failure surcharges to scheduling coordinators based on their MW of metered

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[71] CAISO considers availability-limited resources as those that have significant dispatch limitations such as limited duration hours (e.g., per year, season, month, or day) or event calls (e.g., per year, season, month or consecutive days) that would limit the resources' ability to respond to a contingency event.

[72] Resource Adequacy Enhancements Phase 1 Final Proposal Section 5.2.

[73] In May 2021 in docket ER21-1551, FERC approved ISO tariff amendments adding an energy sufficiency component to the local capacity technical study and expanding the ISO's backstop procurement authority to include addressing local energy sufficiency. These tariff amendments were developed in Phase 1 of the Resource Adequacy Enhancements Initiative.

[74] Track A1 began in April 2023. The record is available at: California ISO - Extended day-ahead market ISO balancing authority area participation rules (caiso.com)

demand as a portion of total ISO BAA metered demand, in each hour the ISO BAA was assessed RSE failure surcharges.[75]

During development of the interim methodology, many stakeholders expressed interested in a cost-causation-based rather than a pro rata approach. Several stakeholders proposed tiered approaches in which a portion of the surcharges would be assigned to LSEs with month-ahead RA deficiencies or whose month-ahead supply portfolios (RA + Non-RA) are less than their daily peak LSE metered demand.[7677]

The ISO chose not to adopt the RA-based approach for several reasons. First, it was not broadly supported by stakeholders, even as an interim solution. Second, LSEs across the ISO BAA have different RA requirements depending on the local regulatory authority, making it problematic to allocate surcharges based on RA deficiencies when the RA requirements are not consistent. Finally, month-ahead RA showings are a measure of forward capacity procurement, while the EDAM RSE is a day-ahead test of how well those forward showings are operationalized. An LSE meeting its forward showing requirement does not ensure, or necessarily incentivize, meeting a day-ahead obligation.[78]

The month-ahead supply portfolio approach, which was proposed jointly by PG&E, SDG&E, Six Cities, BAMx, avoided the complications associated with RA compliance by looking at the total month-ahead supply portfolios, including both RA and non-RA resources. However, this approach would require significant

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[75] Track A1 Final Proposal at 28.
[76] In response the June 14, 2023 track A1 workshop, SCE proposed a two-tier methodology for allocating RSE failure surcharges, where the first tier is based on month-ahead RA showing deficiencies. This proposal was supported by the CPUC Public Advocates Office. For more detail on this stakeholder-proposed methodology, please refer to the stakeholder comments submitted on June 28, 2023: California ISO - All comments (caiso.com)
[77] In response to the June 14, 2023 track A1 workshop, four stakeholders (PG&E, SDG&E, Six Cities, BAMx) proposed a two-tier methodology for allocating RSE failure surcharges. In the first tier, surcharges are allocated to LSEs whose month-ahead supply portfolios (RA + Non-RA) are less than their daily peak LSE metered demand. In the second tier, surcharges are allocated pro-rata to LSE metered demand. For more detail on this stakeholder-proposed methodology, please refer to the stakeholder comments submitted on June 28, 2023: California ISO - All comments (caiso.com)
[78] Extended Day-Ahead Market ISO Balancing Authority Area Participation Rules Track A1 Final Proposal, pg 28. August 25, 2023.

changes to ISO systems and was not implementable by day of EDAM, so it could not be used as an interim solution.

While the ISO adopted the pro rata approach as the best interim solution, the Track A1 Final Proposal committed to revisit the methodology to develop a longer-term solution in a future initiative.[79] Stakeholders also expressed desire to revisit this methodology during the RAMPD working group conversations, including the theme of interest in a more causation-based approach. The final RA Working Group Discussion paper identified this issue as in scope for this initiative, and staff intend here to develop a longer-term cost allocation methodology whose implementation is not constrained by the EDAM launch timeline.

Addressing Reliability Risks Identified Through the EDAM RSE Process

In the RA Working Group several stakeholders expressed interest in finding alternatives to using CAISO's exceptional dispatch authority to address reliability risks identified during the EDAM RSE process. The main impetus for this interest was the potential cost impacts of using exceptional dispatch to cure shortfalls, especially compared to incurring the RSE failure surcharge or developing alternative curing approaches. [80] An RSE shortfall could be as short as one hour, and non-RA resources that receive an exceptional dispatch order must be offered a 30-day (minimum) CPM contract.[81] This initiative can provide a platform for further discussion of potential alternative approaches and capacity products.

Options for Consideration

Reporting on Status of Non-Shown Capacity

To address the need for greater visibility into the portion of the CAISO BAA resource fleet not shown as RA, CAISO encourages stakeholders to think about how new reporting requirements could be structured to provide the ISO with

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[79] *Id.*

[80] E.g. the comments of CalCCA, Cal Advocates, and NCPA on the April 29-30 RA Working Group meeting, questions #3 and 7: California ISO - All comments (caiso.com)

[81] Tariff section 43A.3.6. "Exceptional Dispatch CPM Capacity designated under Section 43A.2.5 for an Exceptional Dispatch CPM System Reliability Need shall have an Exceptional Dispatch CPM Term of thirty (30) days."

monthly information about capacity not shown as RA in the following categories:[82]

- **Sold outside the CAISO BAA.** As WRAP and potentially other RA programs develop across the western US, there will be increasing opportunities for capacity inside the CAISO BAA to contract with entities outside the BAA. This is important information for ISO to be aware of for both backstop and reliability planning reasons. Resources contracted outside the BAA cannot accept a CPM designation even if they would otherwise be eligible, so outside contracting reduces the pool of capacity available for backstop procurement. Outside contracting also has implications for reliability studies, because resources located inside the CAISO BAA are assumed by default to be available to help meet CAISO load. Knowing which resources are committed elsewhere can improve the accuracy of reliability studies by avoiding overestimation of the resources actually available to meet CAISO load. Collecting this information would also align with similar stakeholder requests expressed in the RAMPD working group meetings.
- **Held for substitution.** This refers to capacity that is contracted for RA but not shown to the CAISO in order to ensure compliance with RA substitution rules. The ISO notes that this category to evolve with substitution rules changes being considered in this initiative.
- **Held for anticipated outages.** This refers to capacity that, whether contracted for RA or not, is not shown to the CAISO due to anticipated ambient derates or other outage events that suppliers anticipate might prevent it from operating to its full capacity.
- **Not contracted.** As discussed above, there are many reasons why a CSP-eligible resource might not be offered into the CSP. If the CAISO had visibility into the full theoretical pool of CSP-eligible resources it would have a better sense of how well the CSP process is functioning as well as what capacity might be procured by, if necessary, soliciting resources that were not offered into the CSP.
- **Contracted but not needed to meet LSE's requirement**. Stakeholders indicated that RAAIM and MOO concerns can act as impedements to showing additional capacity above what is required to meet the minimum LSE's requirements.

[82] This reporting requirement would fall under the CAISO's existing tariff authority in Section 4.6.7.1.

This reporting would be done in the month ahead process in alignment with the RA showings. As described above, today CAISO receives information about the RA fleet through the CIRA platform. Since this platform is already operational its use could be expanded to include reporting on the status of non-RA resources as well. Stakeholders are encouraged to consider other platforms or means by which this reporting might be done efficiently.

Creation of a Combined Process for Accessing Unshown Capacity

In the working group processes, several stakeholders identified challenges with showing different resource types beyond what's required to meet LRA-set PRM requirements. Challenges identified included: 1. RAAAIM financial penalties, 2. Substitution holdback needs for planned outages, 3. Contracted resources without deliverability, and 4. Opportunities to sell to other entities outside the BAA. While the CAISO operations needs visibility into all resources in the BA, we recognize that physical, contractual, regulatory or economic limitations, will likely limit our ability to fully access all the resources we have visibility with as Resource Adequacy.

However, stakeholders also suggested that among the resources that are either contracted but not shown or non-contracted but available, the CAISO should consider a more efficient and coordinated process to access and consider those resources. As discussed previously, Chapter 5 discusses a voluntary pool as one option for sourcing capacity for planned outage substitution. This approach could be applied to finding capacity for various backstop purposes as well.

Stakeholders appeared in agreement that a coordinated structure that would 1. remove the disincentives for providing additional capacity (beyond what is required to meet minimum requirements) and 2. offer incentives to allow CAISO and SCs to access and use unsold and unshown capacity, would be beneficial. Such a structure would also have to address commercial concerns to make participating attractive and fit SC and LSE needs. Ideally all capacity within the CAISO BA that is currently held back for substitution, contracted by a CAISO BA LSE but not needed to meet the LSE's requirements in a month (e.g due to the burdens of RAAIM or MOO), and uncontracted capacity, would all have an incentive and method to at a minimum be visible to the CAISO operations, but also be available to meet our reliability needs (including any RA backstop and substitution functions). CAISO is open to feedback on how to remove these barriers and create a visible pool of resources for the various CAISO, LRA and

SC functions. CAISO would like to understand, at a starting point, stakeholder's perspectives on:

1. What impediments exist today to showing all contracted capacity as RA or offering into the CSP?
    a. Complying with the Must Offer Obligation?
    b. Financial Impacts of RAAIM?
    c. Need to holdback for Prioritized Substitution for planned outages?
    d. Payments not reflecting burden and options to sell elsewhere?
    e. Lack of incentives?
    f. A combination of the above

2. What structures could help address such impediments?
    a. Eliminating RAAIM Penalties for resources "showing" capacity but not counting as RA to meet a requirement?
    b. Providing Incentives or Payments
        i. Associated with the EDAM RSE when CAISO BA receives RSE payments for supporting other areas?
        ii. For capacity used to support others planned outage substitution?

Revisiting the Treatment of Credited Demand Response Programs

In the RAMPD working group several stakeholders expressed interest in harmonizing the treatment of credited demand response programs between the CAISO and the California Public Utilities Commission.[83] These demand response programs are administered by the investor owned utilities and their capacity is distributed among all CPUC-jurisdictional load serving entities as a credit. The CPUC treats these credits as RA capacity when assessing each LSE's RA compliance, allowing them to contribute to meeting each LSE's RA requirement. However, these demand response programs do not appear on RA plans and thus are not visible to CAISO. This can result in an LSE that meets all of its RA requirements at the CPUC still being allocated CPM procurement costs associated with an RA deficiency. The Alliance for Retail Energy Markets (AReM), California Community Choice Association (CalCCA), and the Six Cities

[83] See the May 2024 comments of the Alliance for Retail Energy Markets (AReM), the California Community Choice Association (CalCCA), and the Six Cities in the RA Working Group: California ISO - All comments (caiso.com)

all asked in the working group that the CAISO consider ways to remove this discrepancy and ensure that LSEs deemed RA-compliant by their LRA are not assigned CPM costs as if they were deficient.

The ISO understands the desire to harmonize the treatment of these programs between CAISO and the LRAs. The key obstacle to CAISO considering these programs in CPM cost allocation is that they are not shown on RA plans. The CAISO tariff does not provide for considering resources outside the RA plans for the purposes of allocation CPM costs.[84] Additionally, not being shown on the RA plans means that credited DR programs do not currently have a must offer obligation, are not subject to RAAIM, and do not otherwise meet the requirements for RA resources. Treating credited DR programs as RA for the purposes of CPM cost allocation would accord these programs the benefits of being RA without the obligations.

There have been conversations in the past about bringing these demand response programs onto the RA supply plans,[85] and CAISO is open to revisiting that conversation. CAISO is open to feedback on how the treatment of credited DR might be harmonized between the CAISO and LRA programs, whether through having these programs be shown as RA or through other alternatives proposed by stakeholders.

Soft Offer Cap Reform

The RA Working Group discussion revealed a range of stakeholder positions on whether and how the CAISO should respond to the increasing gap between the current soft offer cap ($7.34/kW-month) and the bilateral RA market. Some stakeholders argued that the current cap value and methodology are appropriate, as the soft offer cap was designed to be cost-based and not to compete with bilateral prices. Conversely, others proposed changing the methodology to include an opportunity cost adder based on bilateral market costs, which would increase the soft offer cap. These stakeholders argued that this would make the CSP more competitive with the bilateral market and better ensure that capacity was available for backstop when operators need it. Other stakeholders offered incremental changes to the soft offer cap methodology such as making it more temporally granular. The CAISO welcomes stakeholder proposals on soft offer cap reforms, and encourages stakeholders to elaborate on how proposed

[84] See Tariff section 43A.8

[85] See the record for Proposed Revision Request 1280.

changes to the soft offer cap would change its market role and why those changes are appropriate.

Expansion of CAISO's Capacity Procurement Mechanism Authority

Given the increase in availability-limited resources and the changes to LRA RA programs, it may be appropriate to update the CPM program to consider both reliability in net-peak hours and energy sufficiency at a system level. Allowing CAISO to consider more than just capacity available in the peak hour could help the CPM framework adapt to the changing resource mix and maintain grid reliability as LRA RA programs continue to evolve. Updating the CPM program this way would require both a new reliability assessment(s) and new or expanded CPM designations.

For the assessment, the simplest incremental approach could be an additional hour assessment at the net peak. Checking available capacity in an hour where demand remains high but solar production has dropped would complement the current peak hour assessment where solar exceedance values reflect midday solar production. Assessing system-wide energy sufficiency would require an additional assessment, potentially similar to that currently conducted for the local capacity technical studies.

CAISO partially explored the concept of an updated reliability assessment in Phase 1 of the Resource Adequacy Enhancements Initiative.[86] The portfolio assessment approach discussed there was based on the production simulation model CAISO currently uses to conduct the Summer Reliability Assessments.

In the RAMPD working group Middle River Power proposed another approach: expanding CAISO's backstop procurement authority to require achieving a 0.1 LOLE. This would be a significant change to the CPM program and raise questions about integration between CAISO's RA program and LRA programs, but CAISO is open to further conversation on this topic if stakeholders are interested.

Expanding the CPM program in any way will also require consideration of cost allocation. During the RAMPD working group some stakeholders raised concern that LSEs that meet all LRA RA requirements might be allocated CPM costs for

[86] See the Resource Adequacy Enhancement Initiative Phase 1 Fifth Revised Straw Proposal, p. 40.

energy sufficiency if CAISO came to a different conclusion about energy sufficiency needs than the LRAs setting the RA requirements. There are already some CPM designations for which RA-compliant LSEs can still receive a cost allocation, but CAISO is open to input on how to approach cost allocation for a resource with a CPM designation and contract based on system-wide energy sufficiency.

EDAM RSE Failure Surcharge Cost Allocation

CAISO is open to alternative cost allocation methodologies for the EDAM RSE failure surcharge, especially those that move towards a cost causation approach. The final proposal in track A1 of the EDAM ISO BAA Participation Rules initiative identified the proposal put forth by PG&E, SDG&E, Six Cities, BAMx as a starting point for a conversation about a longer-term approach to surcharge allocation that is not constrained by the EDAM launch timeline.[87] That proposal consisted of a two-tier methodology for allocating RSE failure surcharges. In the first tier, surcharges are allocated to LSEs whose month-ahead supply portfolios (RA + Non-RA) are less than their daily peak LSE metered demand. In the second tier, surcharges are allocated pro-rata to LSE metered demand. One aspect of this approach that would need further development is how to map LSE metered demand to the scheduling coordinators that constitute the market participants visible to CAISO.

CAISO is open to input on whether these or other stakeholders still support this approach or see other alternatives. Another approach, discussed above in the section on RAAIM reform, would be to allocate all or a portion of the failure surcharge to resources that do not perform during days where failures occur.

New Capacity Products Associated with Addressing EDAM RSE Shortfalls

Stakeholder feedback in the RAMPD working group suggested that there may be interest in a backstop capacity product with a shorter contract duration that the 30-day minimum used in CPM. Whether used to address reliability concerns identified through the EDAM RSE or through other means, a shorter-term product could be a more cost-effective way to address some reliability risks. If CAISO is to develop a new backstop capacity product, this initiative must address several key questions:

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[87] That proposal can be found in the responses to question 4 of BAMx, PG&E, Six Cities, and SDG&E in the comments on the June 14, 2023 stakeholder workshop.

- What specifications must a resource meet in order to be eligible for an award?
- What is the market commitment for resources granted an award?
- What is the compensation structure and would offer prices be capped?
- What is the appropriate term for the award (e.g., one day)?
- What process would the CAISO use to receive bids and award offers?
- How would the CAISO BAA allocate the costs of this cure capacity?

CAISO welcomes feedback on these questions and looks forward to working with stakeholders on this topic.

Moving the Day-Ahead Market Bidding Deadline to 9:00 am

Another measure that would help the CAISO prepare to pass the EDAM RSE each day would be earlier information about resource offers. The bidding deadline for the day-ahead market is currently the same as the binding RSE run, with both occurring at 10 am. This means that operators must estimate whether an RSE failure is likely to occur before all resource offers are submitted. Upon EDAM launch this will require operators to estimate how much additional capacity is likely to be offered into the market between when the estimate is finalized around 9 am and the bidding deadline at 10 am in order to detect if a failure is likely to occur.

If resource offers were available earlier, preparations for passing the RSE at 10 am would be simpler and more accurate. If operators had access to all day-ahead resource offers by 9 am there would be no need to estimate additional offers before 10 am. Operators could determine whether an RSE shortfall would occur at 10 am based on actual resource offers, and if this analysis revealed any reliability risks there would still be time to act in response. The CAISO appreciates that bidding by 9 am would require changes to existing processes for day-ahead market participants and is interested in feedback on whether this change might be approached.

Governing Body Role

CAISO staff believe that this initiative should be presented only to the CAISO Board of Governors (the Board) for decision, because the proposed tariff amendments are limited to CAISO's balancing authority area's resource adequacy rules. For these reasons, the initiative falls outside the scope of authority of the Western Energy Markets (WEM) Governing Body.The WEM Governing Body has joint authority together with the Board over any proposal to change or establish any ISO tariff rule(s) applicable to the EDAM or WEIM Entity balancing authority areas, EDAM or WEIM Entities, or other market participants within the EDAM or WEIM Entity balancing authority areas, in their capacity as participants in either the WEIM or EDAM. This scope excludes from joint authority, without limitation, any proposals to change or establish tariff rule(s) applicable only to the CAISO balancing authority area or to CAISO-controlled grid. Charter for WEIM Governance § 2.2.1. None of the tariff rule changes contemplated in this initiative would be "applicable to WEIM Entity balancing authority areas, WEIM Entities, or other market participants within WEIM Entity balancing authority areas, in their capacity as participants in WEIM." Rather, the proposed tariff rules would be applicable "only to the ISO balancing authority area or to the ISO-controlled grid." Accordingly, the matters scheduled for decision fall outside the scope of joint authority. While the WEM Governing Body, "may provide advisory input over proposals to change or establish tariff rules that would apply to the real-time market but are not within the scope of joint authority," no aspects of this initiative would apply to the real time market. Accordingly, this initiative falls outside of the WEM Governing Body's advisory role as well.

Stakeholders are encouraged to submit a response in their written comments to the proposed classification of as described above, particularly if they have concerns or questions."

Next Steps

Please submit comments on this Issue Paper and the November 18-19th workshops by December 5, 2024 using the comment template that will be available prior to the call on the webpage linked above. Please note, the comment template will include the questions from the Reader's Guide in addition to new questions that emerge from the workshop discussions.

Below is a draft timeline of next steps:

- November 18th: Issue Paper workshop
- November 19th: Mid-term and long-term modeling workshops
- December 5th: Stakeholder comments due
- Mid December: Input sessions on Straw Proposal development
    - Stakeholder presentations welcome – contact CAISO policy leads to present
- By February: Initial Straw Proposals published