



California ISO

# Resource Adequacy Modeling and Program Design Working Group

January 16, 2023

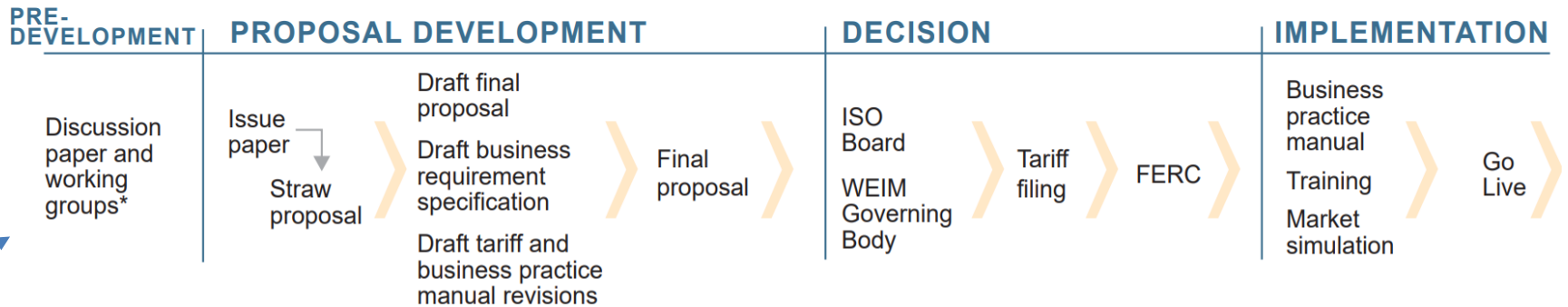
# Housekeeping Reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.
- Please keep comments professional and respectful.

## Instructions for raising your hand to ask a question

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

# Working Group in Context



Stakeholder input

*This represents the typical process, and often stages run in parallel. Stakeholder meetings, working groups and workshops may occur throughout the stakeholder process.*

We are here

# Agenda

Time	Topic	Speaker
9:00 - 9:10	Logistics	Isabella Nicosia
9:10 - 9:20	Welcome & Goals	Jeff McDonald
9:20 - 10:20	Review Problem Statement 2 & 3 Stakeholder Feedback	Jeff McDonald
10:20 - 10:35	Break	
10:35 - 12:30	CAISO Presentation: Exploring Problem Statement 2 & 3 and Data Analysis Needs	Anja Gilbert Partha Malvadkar
12:30 - 1:30	Lunch	
1:30 – 2:45	CAISO Presentation: Potential Modeling Frameworks: <ul style="list-style-type: none"><li>- Feedback on Short Term Reliability</li><li>- Reliability Visibility Mid-Term Years 2-4</li></ul>	Aditya Jayam Prabhakar
2:45-3:00	Break	
3:00-3:30	Stakeholder Presentation: DMM: “Ensuring energy and resource adequacy with storage”	Ben Dawson
3:30-4:00	Next Steps	Jeff McDonald

# WELCOME & GOALS

# RAMPD: Working group goals

Stakeholders have the opportunity to present and provide input on key components leading up to proposal development:

## **1. Develop principles/goals**

- Define and illustrate principles for resource adequacy

## **2. Form initial problem statements**

- Form problem statements reflecting stakeholder concerns

## **3. Align on priorities and establish meeting cadence**

- Balance staff & stakeholder bandwidth

## **4. Refine problem statements**

- Explore current ISO operations, functionality, processes meant to address problem statements
- Develop methodology for analysis, define data needs

## **5. Determine action items**

- Provide a bridge between working groups and proposal development

# Meeting Goals

1. **Refine Problem Statement 2 – Requirements for RA Capacity and Program Tools** through review of participant comments and discussion.
2. **Better understand issues within Problem Statement 1 - Modeling** through
  1. A CAISO presentation on short term modeling feedback received and ISO response and Mid-term potential modeling approach, and
  2. Presentation from DMM on the availability of battery storage units.
3. **Refine the path of meeting topics** through March by way of review of a proposed path and discussion.
4. **Establish opportunities, and volunteers, for participant presentations** in near-term scheduled meetings.



# REVIEW PROBLEM STATEMENT 2 AND 3 FEEDBACK

## Problem Statement 2

# Requirements for RA Capacity and Program Tools

The CAISO's current requirements and tools (e.g., outage, must-offer, bid-insertion, and resource performance and availability rules) have not been updated recently in light of evolving market and regulatory structures, and could result in:

- RA supply not available when and where needed;
- Inefficient procurement and investment (e.g. maintenance and capital upgrade) decisions; and
- Implementation challenges for the CAISO and market participants

### Sub-Issues:

- Current requirements for RA capacity
- RAAIM
- Lack of a tool to incentivize performance
- Rules for substitution and planned outages
- The need for a comprehensive review of the CPUC's Slice-of-Day reform and the translatability and transactability of WRAP

# Problem Statement 2

## Participant Comments

Theme	Stakeholders
Re-evaluate RAIM	DMM, CPUC's ED, PAO, MRP, Six Cities
Assess Flex RA	CalCCA, CDWR, CPUC's ED, NCPA, Terra Gen, SCE
Consider including / emphasizing UCAP	CalCCA, CPUC's ED, PG&E, DMM, WPTF, Terra Gen, Six Cities
Review substitution rules	CalCCA, MRP, NCPA
Review CPM & Cost Allocation	AReM, CalCCA, DMM, CPUC's ED
Energy sufficiency test	Support: Cal Advocates. Oppose: NCPA
Focus on refining CA RA before moving to address WRAP	Terra Gen
Consider the hybrid resource initiative	Terra Gen

*Note: Slice of day was mentioned by several commenters but is not included above as it is now is a separate parallel process.*

## Problem Statement 3

### LRA RA Responsibility & Cost Allocation

Market participants are concerned about inequitable costs and cost allocation. Stakeholders have expressed a need for a transparent and common framework for evaluating reserve margins and counting rules, and understanding of an LRA RA program's contribution to overall system reliability.

Sub-issues:

- ***Definitions and Requirements:*** The CAISO lacks a common definition, method of measurement, or standard to ensure that various LRAs bring a portfolio of resources that are accessible in the right place, available at right time, and provide the right attributes needed to evaluate if LRA programs are reliable.
- ***EDAM RSE Cost Causation:*** Aligning cost and benefit allocation with causation associated with the EDAM RSE, as a result of a deficiency or procurement of cure capacity.

# Problem Statement 3

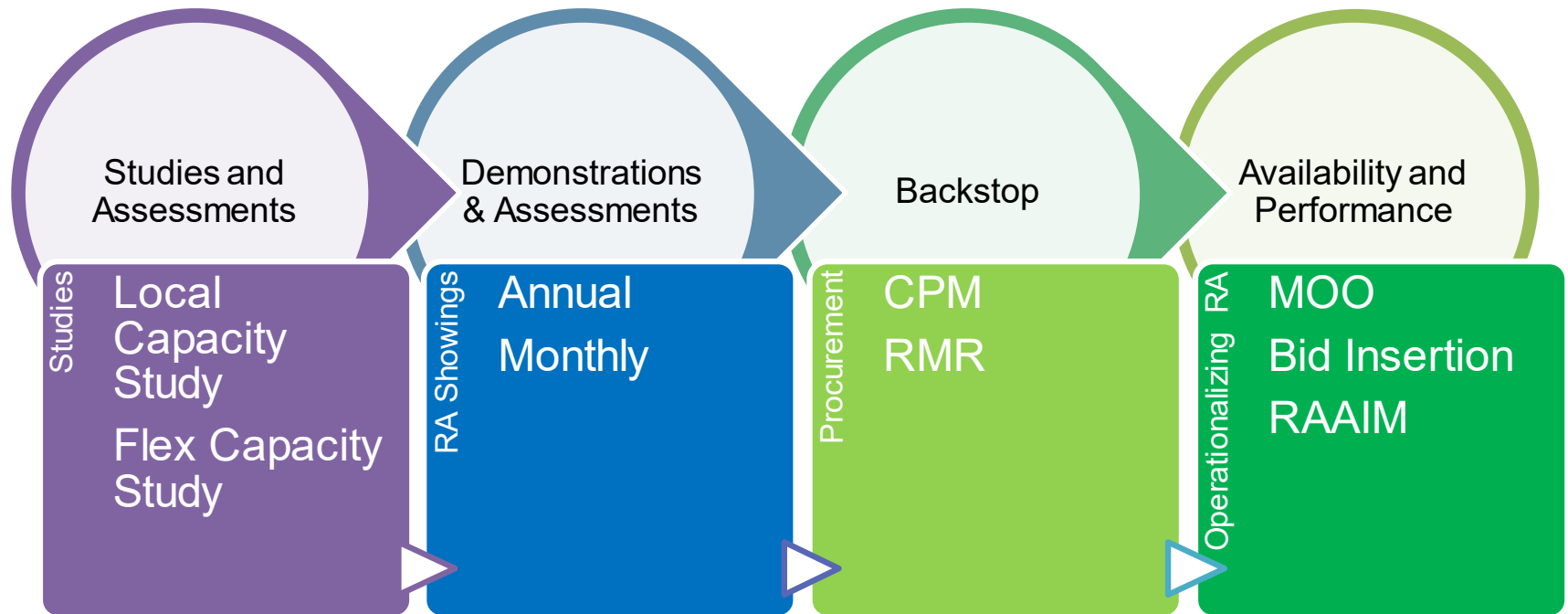
## Participant Comments

Theme	Stakeholders
Defer this issue to the LRA's authority	NCPA
PRR 1280	AReM, CalCCA
ISO BAA Rules	Not in scope: CalCCA, TEA Unsure if in scope: Six Cities, SCE
Break into two problem statements	MRP
ISO BAA EDAM RSE failure and RA deficiency should be treated separately	Six Cities

# BREAK

# **CAISO PRESENTATION: EXPLORATION OF PROBLEM STATEMENTS 2 & 3**

# CAISO RA Processes



## Key CAISO Process:

1. Capacity Procurement Mechanism (CPM) – allows the CAISO to backstop for LRA Deficiencies and Significant Events
2. Planned Outage Substitution Obligation – requires resources on planned outage to substitute resources to maintain reliability margins
3. Resource Adequacy Availability Incentive Mechanism (RAAIM) – incentivizes resources to be available to the CAISO market
4. Must Offer Obligation (MOO) – places bid/offer requirements on RA resources



# Key Resource Adequacy Challenges (Stakeholder Perspectives)

## 1. RA Requirements - Planning targets have not kept up with operating needs

- Current Planning Reserve Margin (PRM) is inadequate to meet load with increased reliance on energy-limited and intermittent resources, particularly in light of climate change
- Non-transparent RA modeling

## 2. Regulatory- Changing Structures for Procurement

## 3. Resource Counting Performance and Incentives

- Many resources are less reliable than we assume in planning and counting
- Poor maintenance/performance incentives

## 4. Regional Issues – Tightening RA Market in the West

- Misaligned regional RA programs (*i.e.*, lack of common reliability targets, resource counting rules, transmission requirements, and source specificity)

## 5. CAISO RA Program Operations

- Planned Outage Substitution Obligation processes unwieldy
  - No capacity available to substitute
  - Lack of ability to perform needed maintenance
- Misalignment with evolving CPUC Slice of Day reforms
- CAISO backstop processes cost assignment ineffective (and not fully tied to causation).

## Problem Statement 2

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# CAPACITY WHEN AND WHERE NEEDED

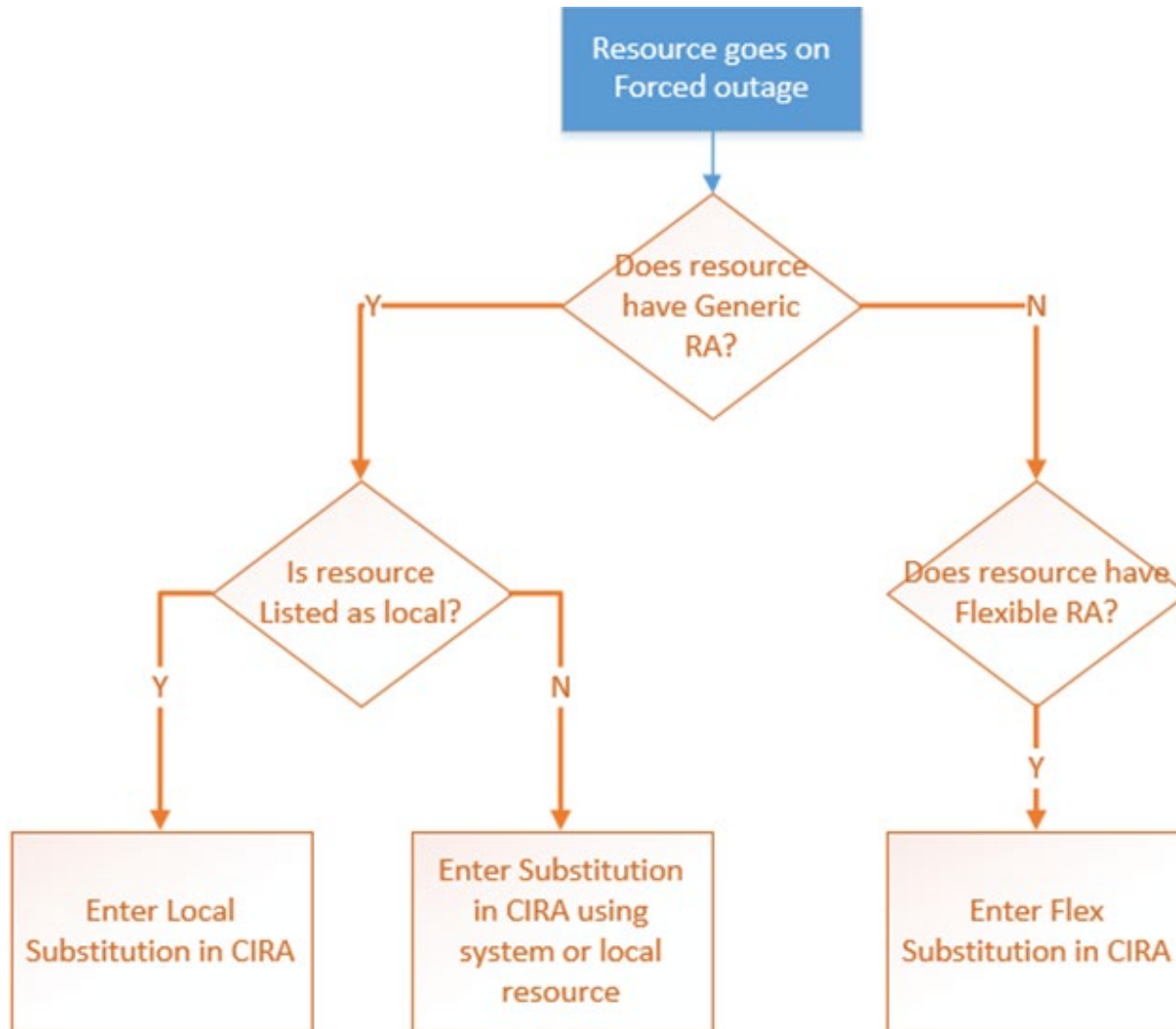
## Scheduling coordinators are required to report outages of capacity to CAISO

- CAISO requires substitution of all RA capacity out on a planned outage with few exceptions
- RA resource may elect to provide substitute capacity for a forced outage to avoid exposure to RAIM penalty charges

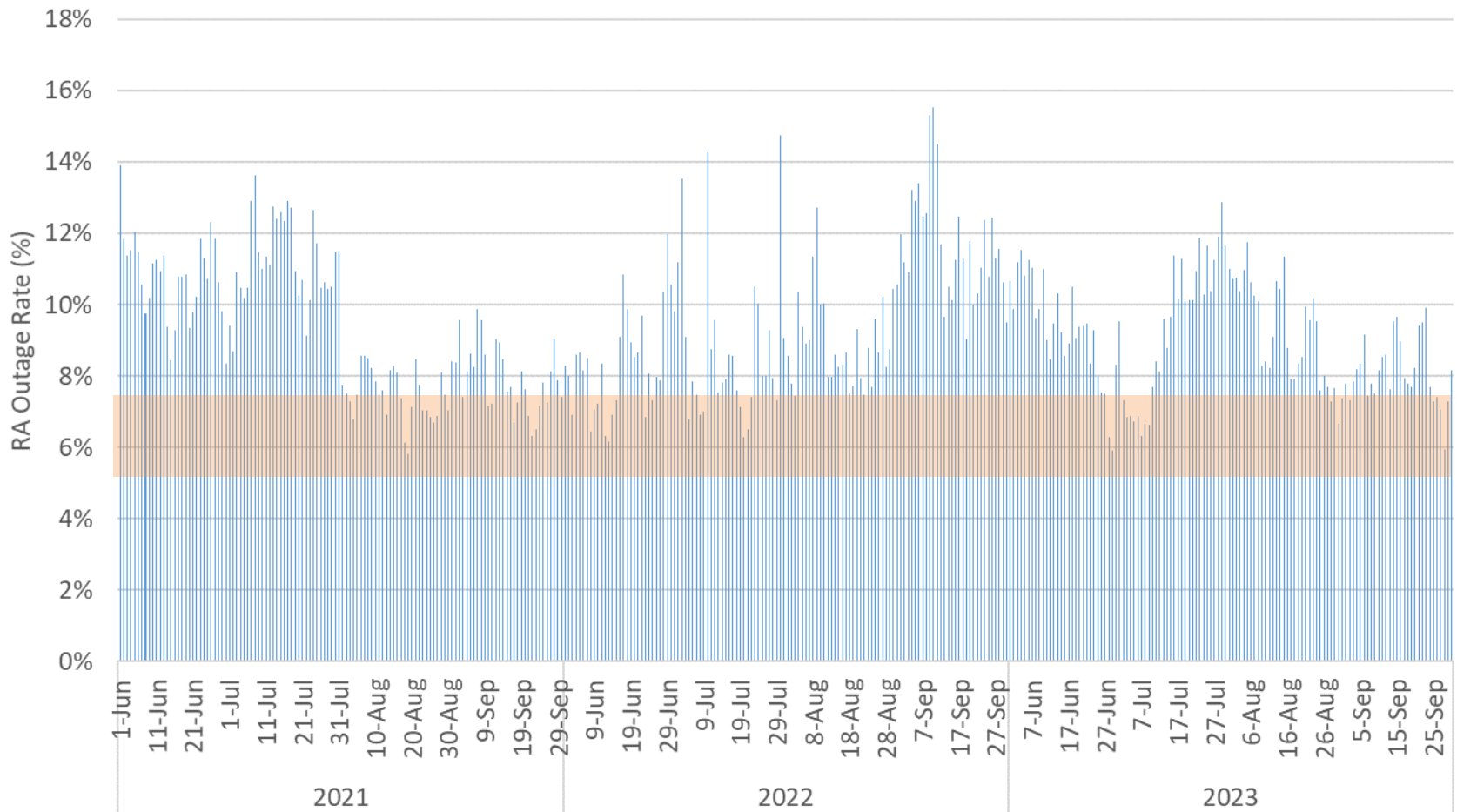
## Planned Outage Substitution

- All planned outages impacting RA resources' capacity must be fully substituted for or get denied
  - Transmission induced generation outages and off peak opportunity outages are exempt
- The CIRA Resource Adequacy Substitute Capacity (RASC) module 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 would get denied

# Forced Outage Substitution



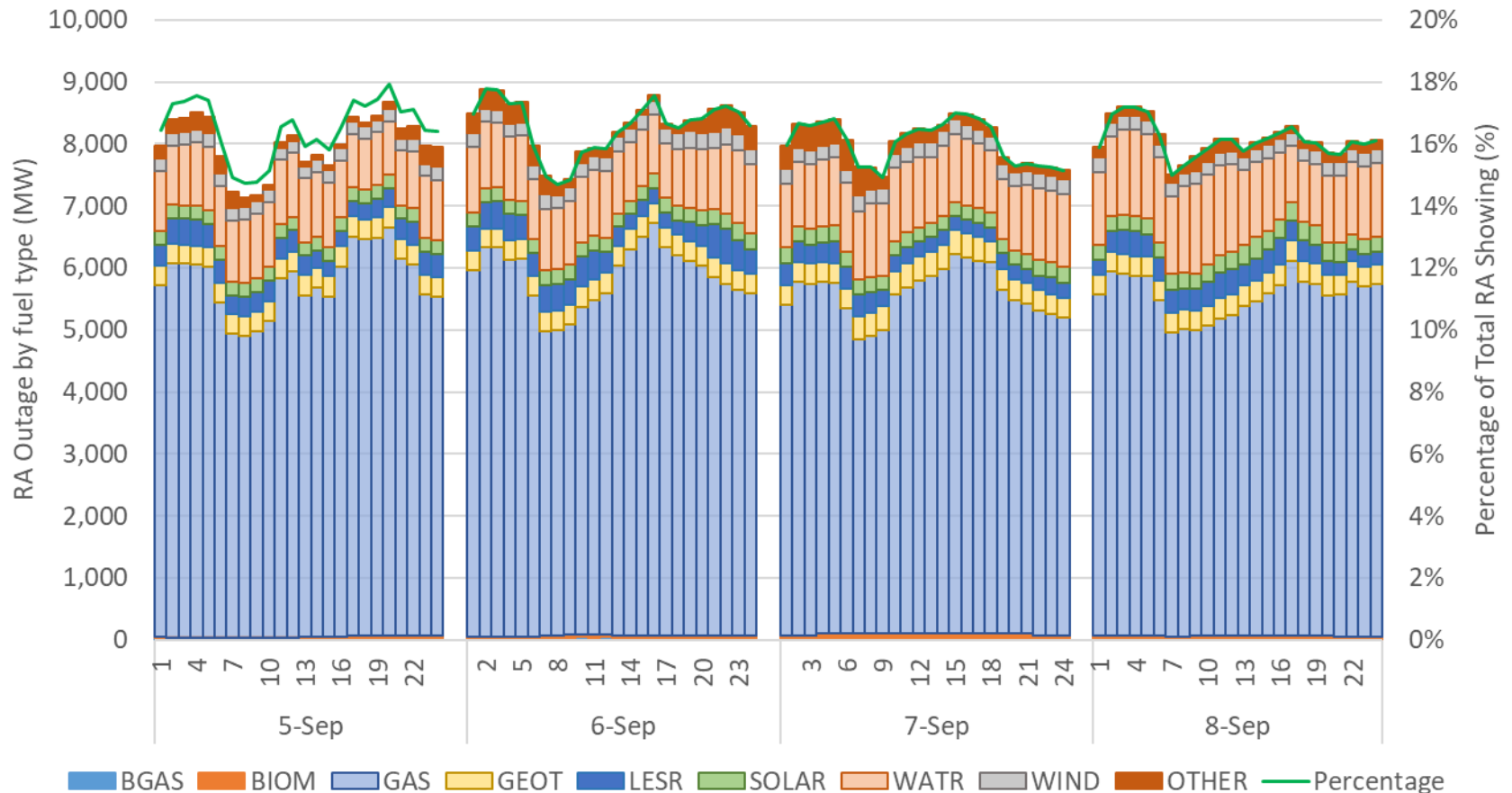
# System RA Outages for summer months for 2021 - 2023



**Key Takeaway:** The planned and forced outage rate exceeds assumptions used in state analysis (CAISO 2023 Summer Assessment; CEC 2023 Summer Reliability Outlook)

*Note: The forced outages above represent ~97-98% of outages.*

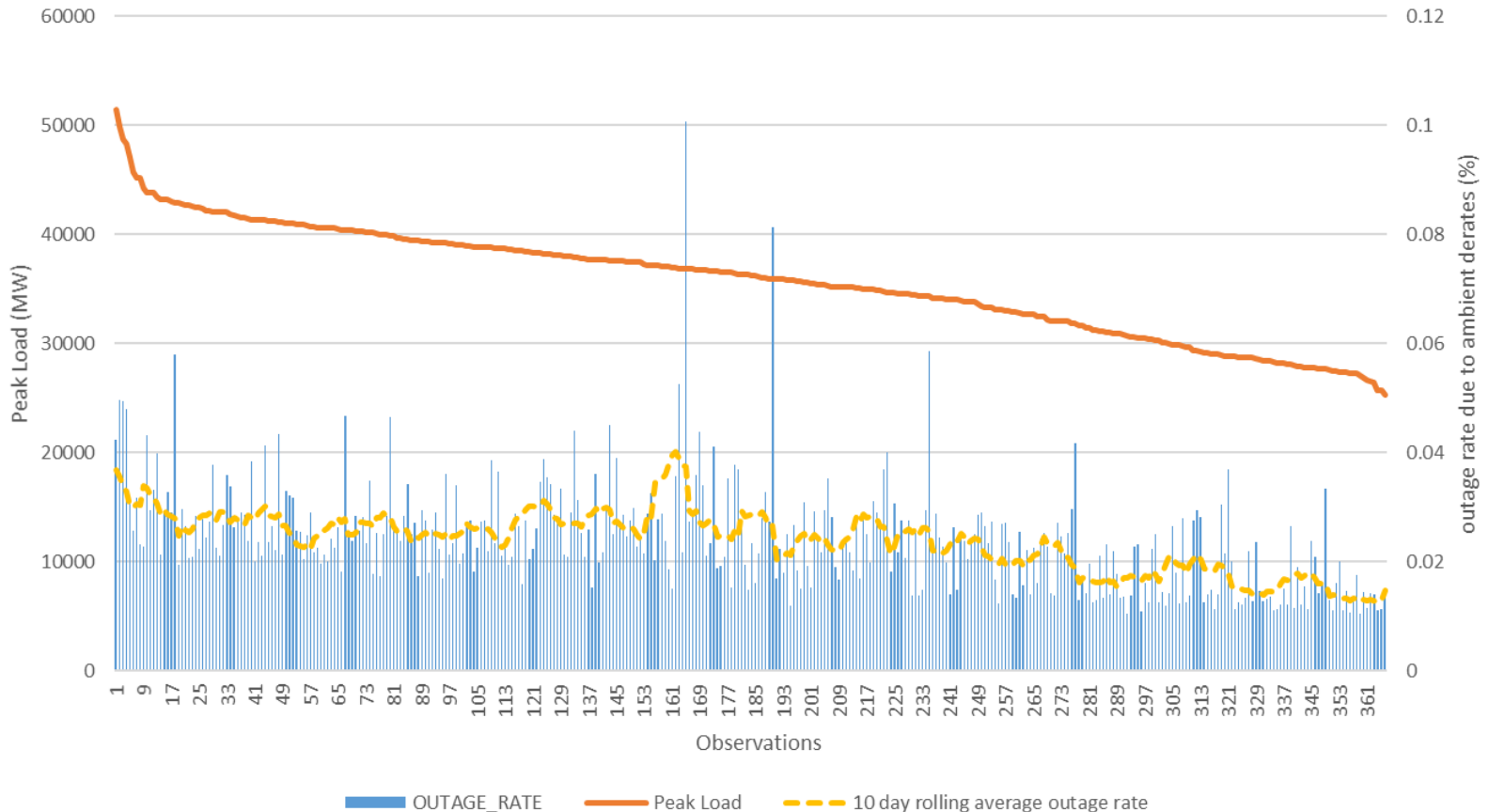
# Analysis done during the September 5 – 8 2022 – Outages for shown RA resources



**Key takeaway: Outages during extreme events exceed planned assumptions.**

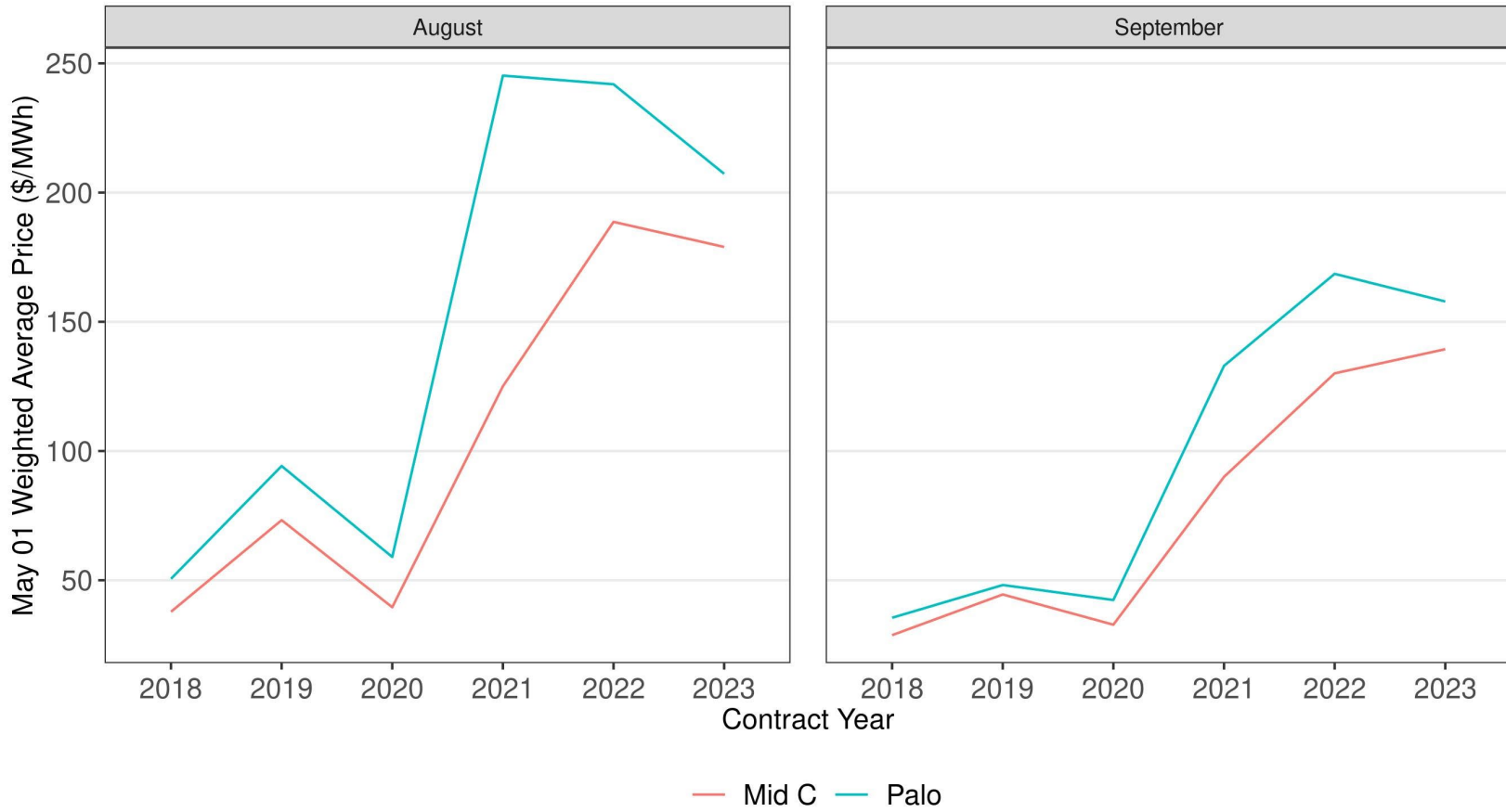


# RA Outages due to ambient derates and comparing against peak load



Key takeaway: Data suggests a correlation between peak load and ambient derates. A ~50,000 MW peak load has a ~4% ambient derate, whereas a ~20,000 MW peak load has a ~2% ambient derate.

Prices at major hubs external to the ISO increased after 2020. Implied capacity prices are significantly above the CPM soft offer cap of \$6.31/kW-month



## Discussed at last RA Working Group : Process on the CPM soft offer cap

- The soft offer cap
  - serves as both a safe harbor for resources providing offers as well as a way to mitigate resources from exercising market power
  - was designed to be high enough to cover going-forward fixed costs for marginal resources on the system
  - the CPM soft offer cap be increased from \$6.31/kW-month to \$7.34/kW-month
- Offers above the soft offer cap must be cost-justified at FERC to recover up to a resource-specific cost of service rate

## Discussion:

- What additional data or analysis, if any, would help refine the problem statement?

# INCENTIVIZING AVAILABILITY AND PERFORMANCE

## RA Availability Incentive Mechanism (“RAAIM”)

- RAAIM was developed to incent generators to make capacity available
- It has the impact today of incenting resources to provide substitute capacity in event a resource becomes unavailable due to an outage
- Assesses availability by comparing bids to applicable must-offer requirement to determine resource-specific availability percentage
- Resources are rewarded more for availability and penalized for less availability
  - RAAIM assesses average monthly bids into the day-ahead and real-time markets during 5-peak hours on non-holiday weekdays (Availability Assessment Hours).
  - These hours are determined annually for system, local, and flex RA.

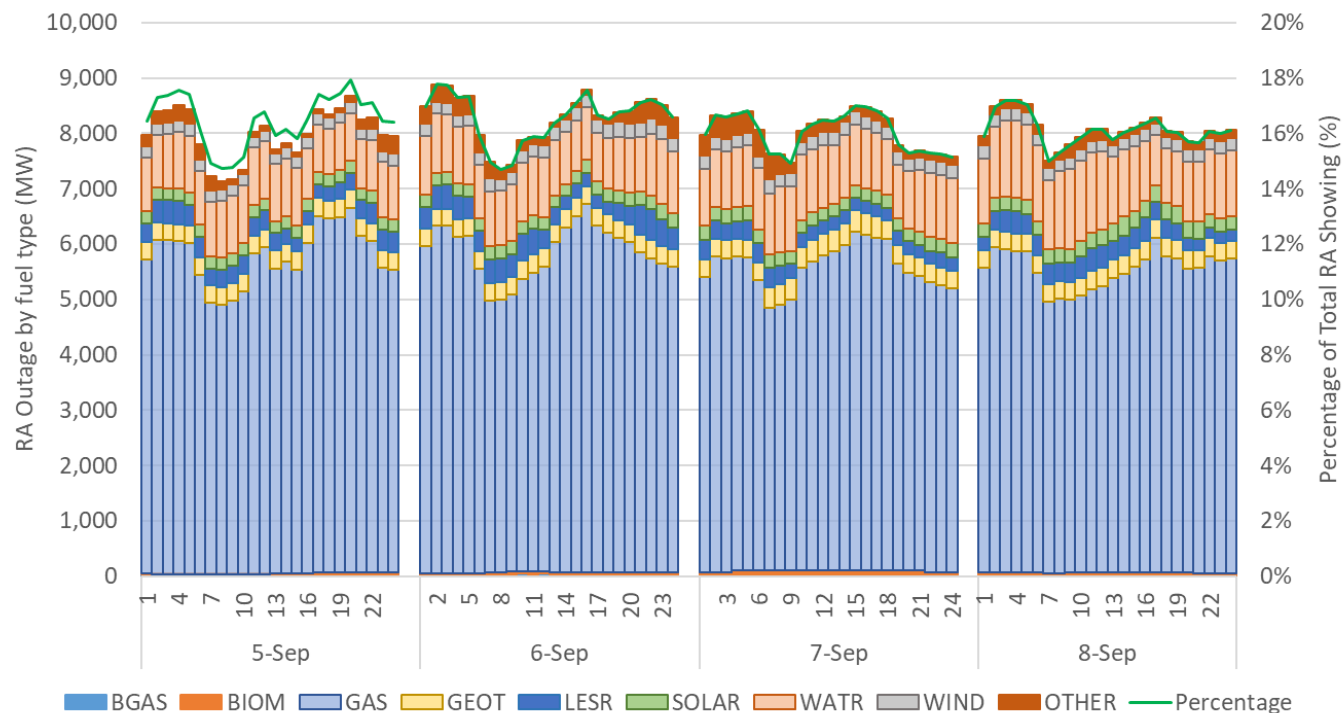
# RAAIM Incentive and Penalty



If the average falls below 94.5% the resource is subject to a \$3.79/kW-month penalty. If the average is above 98.5% it is eligible for a payment from the pool of penalties assessed.

# RAAIM Impact:

- RAAIM was designed to incent capacity to be available and not as a performance tool
- The RA non-availability charge for September 2022 amounted to \$3.5 M





## Other RAIM Considerations

- RAIM may not be sending the signal needed to incent generation to make capacity available. The following aspects of the RAIM design may warrant revisiting to improve RAIM's effectiveness.
  - The current deadband (i.e. 94.5-98.5 %)
  - The monthly netting process
  - The carry-forward provisions
  - Resources excluded from RAIM

## Discussion:

- What additional data or analysis, if any, would help refine the problem statement?

# REQUIREMENTS FOR RA CAPACITY

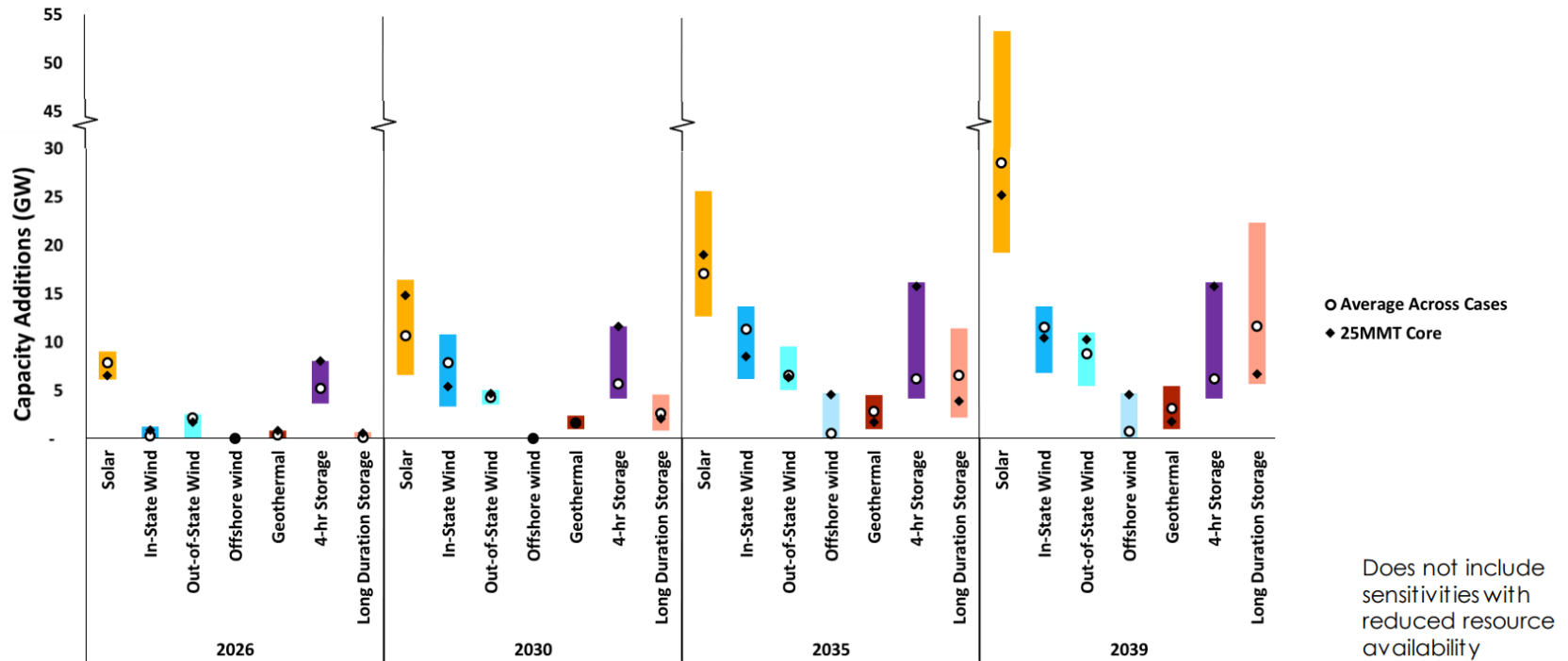
# Planning Reserve Margin (PRM)

- Each LRA sets their own PRM and counting rules.
- If an LRA does not provide a PRM or counting rule methodology, the CAISO's default tariff rules apply.
  - The CAISO default PRM (15%) was set in 2006
  - There is an interplay between the PRM and counting rules.
- Most LRAs set a PRM at 15% above forecasted monthly peak demand while some LRAs have set lower planning reserve margins.

# LRAs	2023 PRM
6	≤7%
20	15%
1	16%

Key Takeaway: The CAISO's default PRM warrants revisiting in light of changes in the RA landscape.

# Grid Resource Mix Changes



**Key Takeaway:** The growth in use limited, availability limited, energy limited resources makes it increasingly important to assess both energy and capacity.

Source: CPUC. *2023 Proposed PSP and 2024-25 TPP Supplemental Analysis*. [2023-10-20-supplemental\\_ruling\\_slides.pdf \(ca.gov\)](https://www.cpuc.ca.gov/2023-10-20-supplemental_ruling_slides.pdf)

# Flex RA 101

- Meant to address the challenge of added variability and uncertainty of variable energy resources
- ISO, CPUC, and other LRAs worked together to develop a plan to meet these challenges
  - The CPUC established a flexible capacity procurement obligation for LSEs
  - The ISO developed the Flex RA product

**Effective Flexible Capacity (EFC):** The maximum MW of flexible capacity a resource has the capability to provide based on the ISO's counting criteria.

- Program design
  - Annual Flexible Capacity Needs Assessment
  - Annual EFC list
  - Categories of Flexible RA

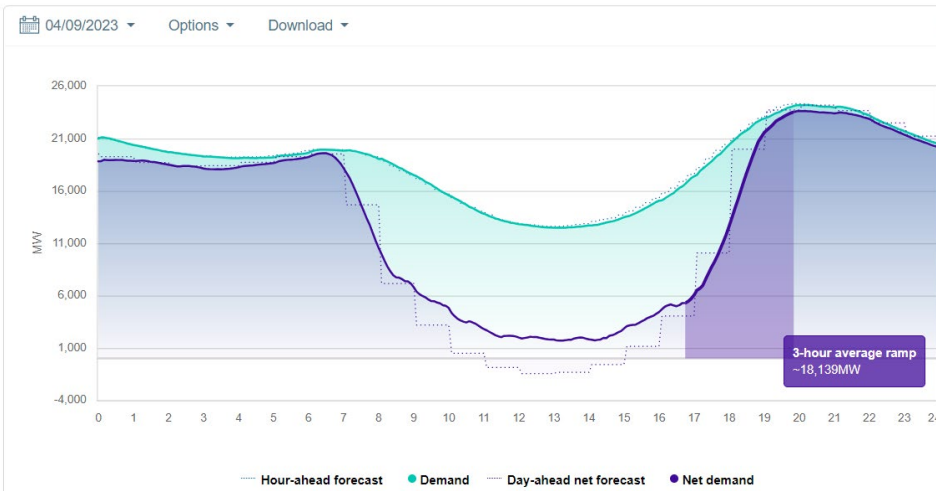
# Flex RA 101

	Base Ramping	Peak Ramping	Super-Peak Ramping
Capable of day-ahead and real-time economic bidding	5:00 a.m. – 10 p.m.	Five hour block determined seasonally	Five hour block determined seasonally
Energy Requirement	Minimum 6 hours at EFC	Minimum 3 hours at EFC	Minimum 3 hours at EFC
Daily Availability	7 days per week, all days per month	7 days per week, all days per month	All non-holiday weekdays per month
Daily Start-Up Capability	The resource must be able to provide the minimum of (i) two Start-Ups per day for every day of the month or sixty Start-Ups per month, or (ii) the number of Start-Ups allowed by its operational limits, including minimum up and minimum down time	At least one start per day	At least one start per day
Other Limitations	No monthly or annual limitations on number of starts or energy limits that translate to less than the daily requirements	No monthly or annual limitations on number of starts or energy limits that translate to less than the daily requirements	Must be capable of responding to at least 5 dispatches per month during the five-hour period of the must offer obligation

# Flex RA: new challenges

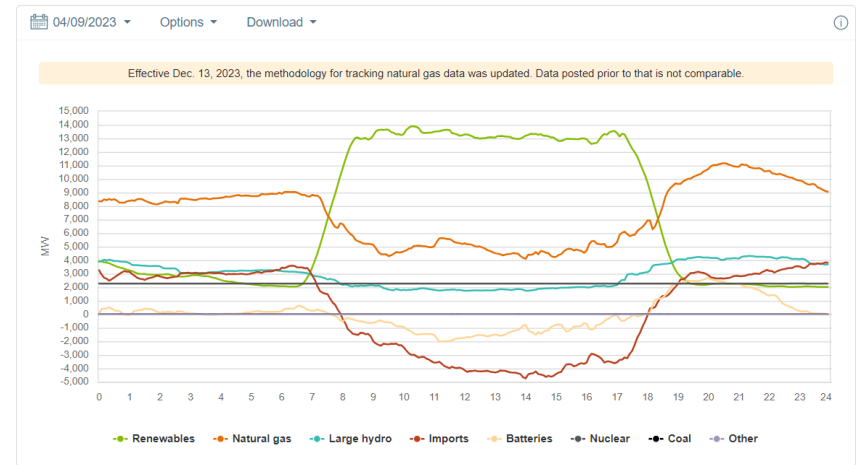
## Net demand trend

System demand minus wind and solar, in 5-minute increments, compared to total system and forecasted demand.



## Supply trend

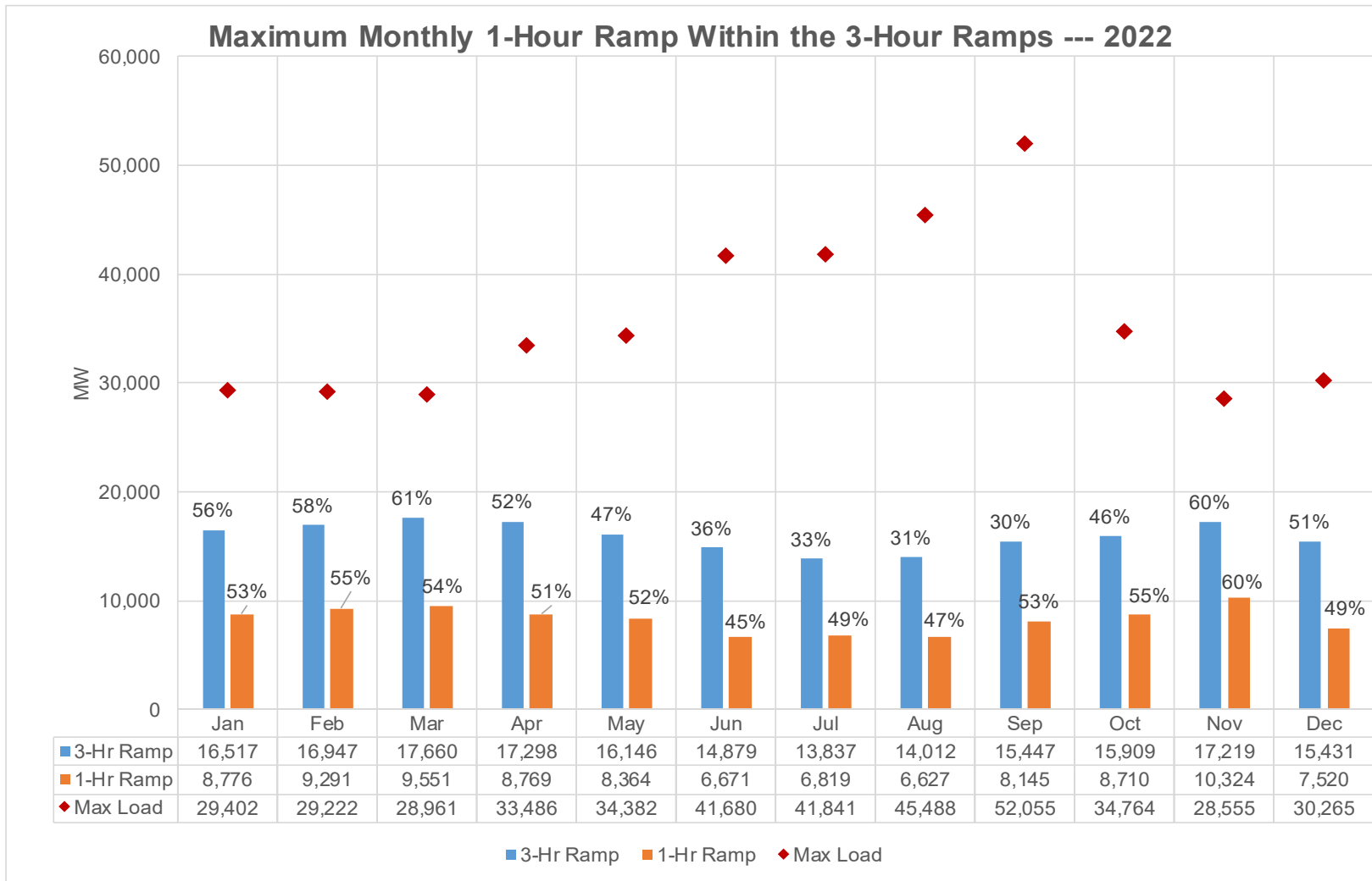
Energy in megawatts broken down by resource in 5-minute increments.



**Key takeaway: The need for fast moving resources during solar ramps continues.**

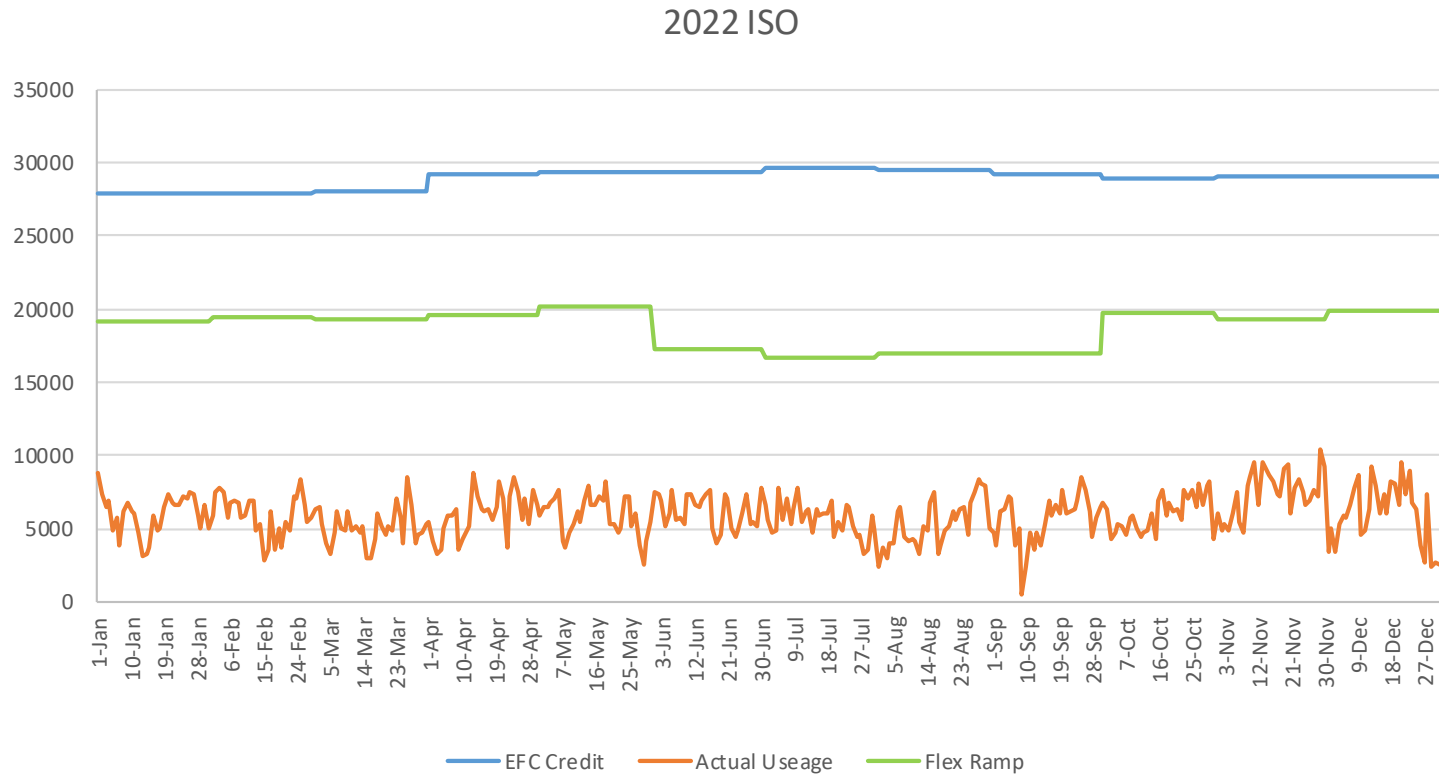


# Flex RA: new challenges



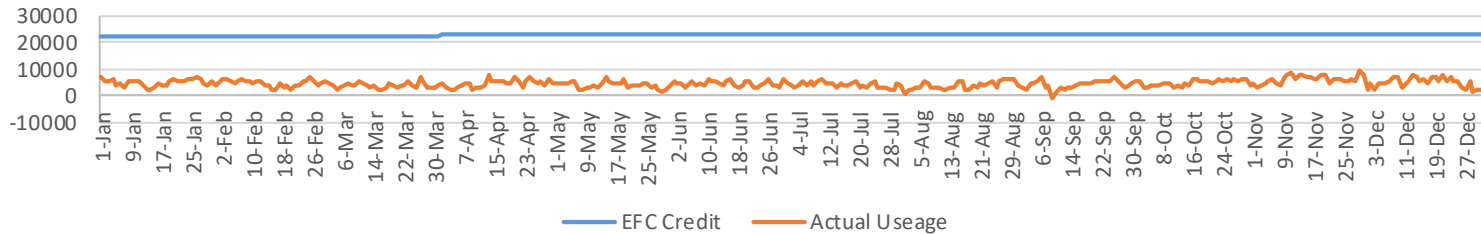
**Key Takeaway: 3-hour upward ramps can be more than 50% of the daily peak demand, indicating the need for faster ramping resources**

# Flex RA: Technology meeting EFC

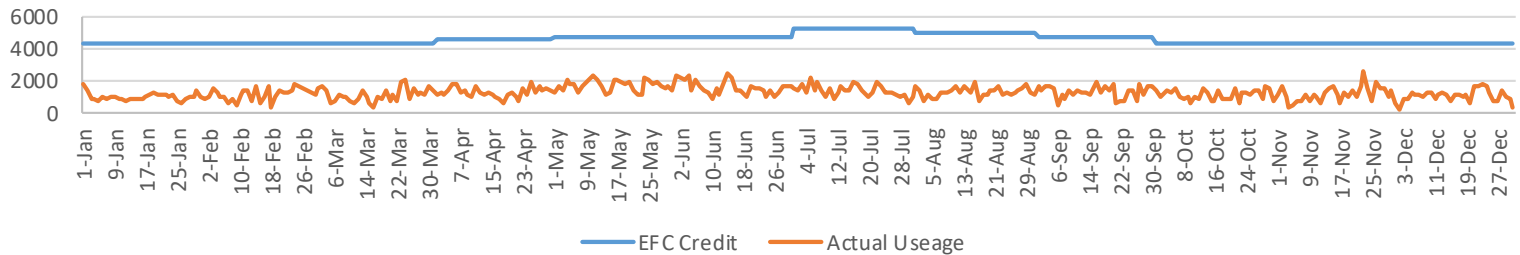


# EFC Credit vs. Actual Usage by Resource

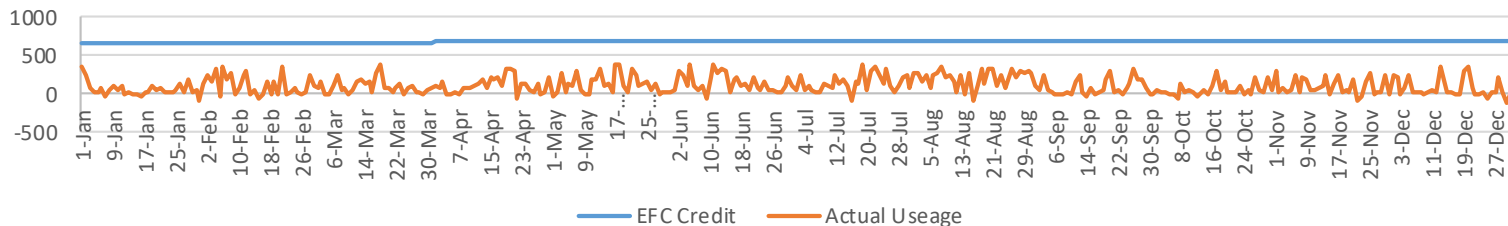
## 2022 Gas



## 2022 Hydro



## 2022 LESR (discharge only)



# Flex RA Open Questions & Challenges

Topic	Question and Details
<b>Flex RA</b>	<p>Does Flex RA need to be evaluated?</p> <p>The ISO has not recently evaluated the: 1.) need for a Flex RA product and 2.) the need for the current three categories of Flex RA.</p>
<b>EFC Resource Accreditations</b>	<p>Does the ISO's current EFC accreditation for resources need to be evaluated?</p> <p>Current data suggests the EFC accreditations do not match the EFC provided.</p>
<b>Flex RA study Assumptions</b>	<p>Do the Flex RA study assumptions need to evolve?</p> <ul style="list-style-type: none"><li>• Should the Flex RA study look at the curtailment impacts to the 3 hour net load ramp? The ISO does not have a process to account for how curtailment impacts the 3-hour net load ramp, other than using renewable one minute actual profiles. As a result the hourly forecast profiles may not accurately reflect ramping needs.</li><li>• Should the flex RA study examine how low the net load will go? Due to the rapid growth and not accounting for renewables, the current net load goes to values that would not actually materialize.</li></ul>

## Discussion:

- What additional analysis, if any, would help refine the problem statement?

## Must Offer Obligation (MOO)/Bid Insertion

- Any resource providing RA capacity to the CAISO has an obligation to offer that capacity into the CAISO market so that the CAISO can manage and dispatch the system reliably.
- Current MOO:
  - Day Ahead: 24 x 7 must offer obligation
  - Real Time: 24 x 7 must offer obligation
  - Resources receive bid insertion, unless exempt.
- CAISO's fleet is increasingly energy, availability, and use limited which may warrant a re-examination to of the MOO and bid insertion rules.
  - In addition, the timing of bid-insertion (consideration of 9AM instead of 10AM) has crossover to EDAM RSE.

# Recap of the suggested MOO/Bid Insertion Proposal from RA Enhancements Phase 2

## Suggested Changes

- **Storage and hybrid resources:** Suggested updating the DA/RT MOO to include the charge capability
- **Use-limited and conditionally available resources:** Suggested updating the MOO to apply, unless the underlying technology has a different offer obligation.

## Clarifications

- **Eligible Intermittent Resources:** Energy above the resources' NQC could not be used to support an export from non-RA capacity.
- **Demand Response:** LRAs were asked to share the days and hours in which DR resources are obligated to bid into the market (e.g., such as contract provisions, approved program designs, or decisions).

## Discussion:

- What additional analysis, if any, would help refine the problem statement?



## Deliverability

- The deliverability assessment methodology is a CAISO methodology developed for generation interconnection study purposes pursuant to the CAISO tariff, and is used in support of RA assessments.
- The CAISO has a current initiative which is reviewing the deliverability assessment methodology to ensure deliverability requirements strike the appropriate balance between reliability and cost containment, and the reliability requirements are not unduly burdensome.  
<https://stakeholdercenter.caiso.com/StakeholderInitiatives/Generator-deliverability-methodology-review>

# CAISO BAA RSE Cross Over Issues - Curing and Settling CAISO BAA Day-Ahead RSE Shortfalls

## Potential Topics:

Explore the creation of a new CAISO process/mechanism to cure expected RSE shortfalls (+ associated cost allocation)

- Challenges with identifying shortages given existing RA timelines, bid insertion rules, and exemptions
- Option to enhance methodology to allocate CAISO BAA RSE failure surcharges and revenues

Crossover RA issues: RAAIM, Bid Insertion, Backstop (CPM)

## Discussion:

- What additional analysis, if any, would help refine the problem statement?

# LUNCH

# MODELING STUDY SCOPE

# Modeling Approach Shared with Working Group on 11/1

The world is changing, more VERs, probabilistic modeling of risks necessary. RA modeling will be around three time horizons to answer these specific questions:

Question	Sufficiency Analysis of	RA Timeframe	What are we looking for?
Are the year ahead RA showings adequate?	RA Showings	Year Ahead	Does the ISO BA have a MW shortfall or excess?  Approach: Similar to Summer Assessment but with only RA showings; since year-ahead showing requirements are only 90% of total requirements, develop assumptions for last 10%
Is the current level of authorized procurement and contracted capacity sufficient?	Existing installed capacity + authorized procurement	Years 2-4	Do we have enough collectively and who needs to bring more?  Approach: LOLE and ELCC by resource types
Is the LT plan producing resource adequate portfolios to meet reliability targets?	Resource plans by consolidating information from all IRPs	Years 5-10	To determine if the ISO BAA has sufficient resources for years 5 to 10.  Approach: Find a way to translate that to PRM, ELCC for all resources, LOLE hours, etc.

Objective is to provide transparent, timely information to stakeholders and assess if the shown RA fleet and forecasted eligible RA capacity in the CAISO BAA for the year ahead timeframe is sufficient to meet a 1-in-10 LOLE

# SHORT TERM STUDY SCOPE

# CAISO appreciates all the feedback provided on the short term study scope

High level theme	CAISO Response
Ensure consistent assumptions with LRA requirement setting and planning	CAISO will coordinate with CPUC and other LRAs, as applicable to modeling
Issue stack analysis for each study time frame	Multi-hour stack analysis by peak day for each month can be developed
Provide additional information on imports	CAISO will provide aggregate showings information (RA resources by fuel type, resource specific imports, non-resource specific imports, etc.)
Include adjacent energy-only resources that are used for on-site charging	CAISO to evaluate how to incorporate this data



# Survey discussion

- Based on stakeholder feedback, the CAISO could engage with Load Serving Entities (LSE) to collect the following data:
  - Short term – 100% year-ahead, non-binding, soft showing
  - Mid-term: all RA-eligible resources + authorized procurement
  - Long-term: all resources + resource plan information
- Each LSE to ensure that the resources provided meet their LRA RA obligations

For discussion - CAISO could survey Load Serving Entities (LSE's) to provide projected RA showings, projected RA contracts, and planning information

For the year ahead, monthly projected RA showings

Summary	January	February	March	April	May	June	July	August	September	October	November	December
Monthly Peak Load (MW)												
PRM (%)												
Reserve requirement (NQC Capacity MW)												
yes, if $\text{sum} \geq \text{requirement}$												
CAISO Resource ID	January	February	March	April	May	June	July	August	September	October	November	December
Resource1												
Resource2												
Resource3												
Resource4												
Resource5												
Resource6												
Resource7												

Example

Is the current level of authorized procurement and contracted capacity sufficient?

# MID TERM STUDY SCOPE

# The ISO's stochastic model, with RA-eligible resources and authorized procurement will be modeled in the mid-term assessment

## Resources modeled

- All installed RA-eligible capacity
- Authorized procurement

## Study methodology

- Probabilistic assessments (stochastic production cost simulation models)

## Outputs

- LOLE
- Capacity shortfall or surplus to get to 0.1 LOLE
- ELCC by resource types by year

# Mid-term survey - for discussion

- Information that CAISO may need –
  - projected estimates of contract capacity including incremental new additions and retirement assumptions.
  - CAISO resource IDs and queue numbers for new resource additions.

Summary	2025	2026	2027						
Annual Peak Load (MW)									
PRM (%)									
Total contracted capacity for peak month (MW)									
	yes, if sum >= requirement								
New RA from authorized procurement orders									
Resource ID	CAISO queue number	Resource Name	Installed Capacity	COD	Fuel Type	NQC	Deliverability	Location	Area
Resource1									
Resource2									
Resource3									
Resource4									
Resource5									

Example

# BREAK



# Ensuring energy and resource adequacy with storage

Resource Adequacy Modeling and Program Design Working Group  
January 16, 2024

Ben Dawson, Ph.D.  
Department of Market Monitoring  
California Independent System Operator

[DMM Battery Storage Report \(July 7, 2023\)](#)

## Overview – storage availability during availability assessment hours

- In the near-term storage and solar make up much of the new development
  - Installed capacity of storage increased around 100% in 2023
- Storage availability was approximately the fleet average for 2023 based on bid in capacity (~90%)
- Other analysis indicates 20% or more of the storage may be unavailable during the availability assessment hours (AAHs) due to special storage constraints



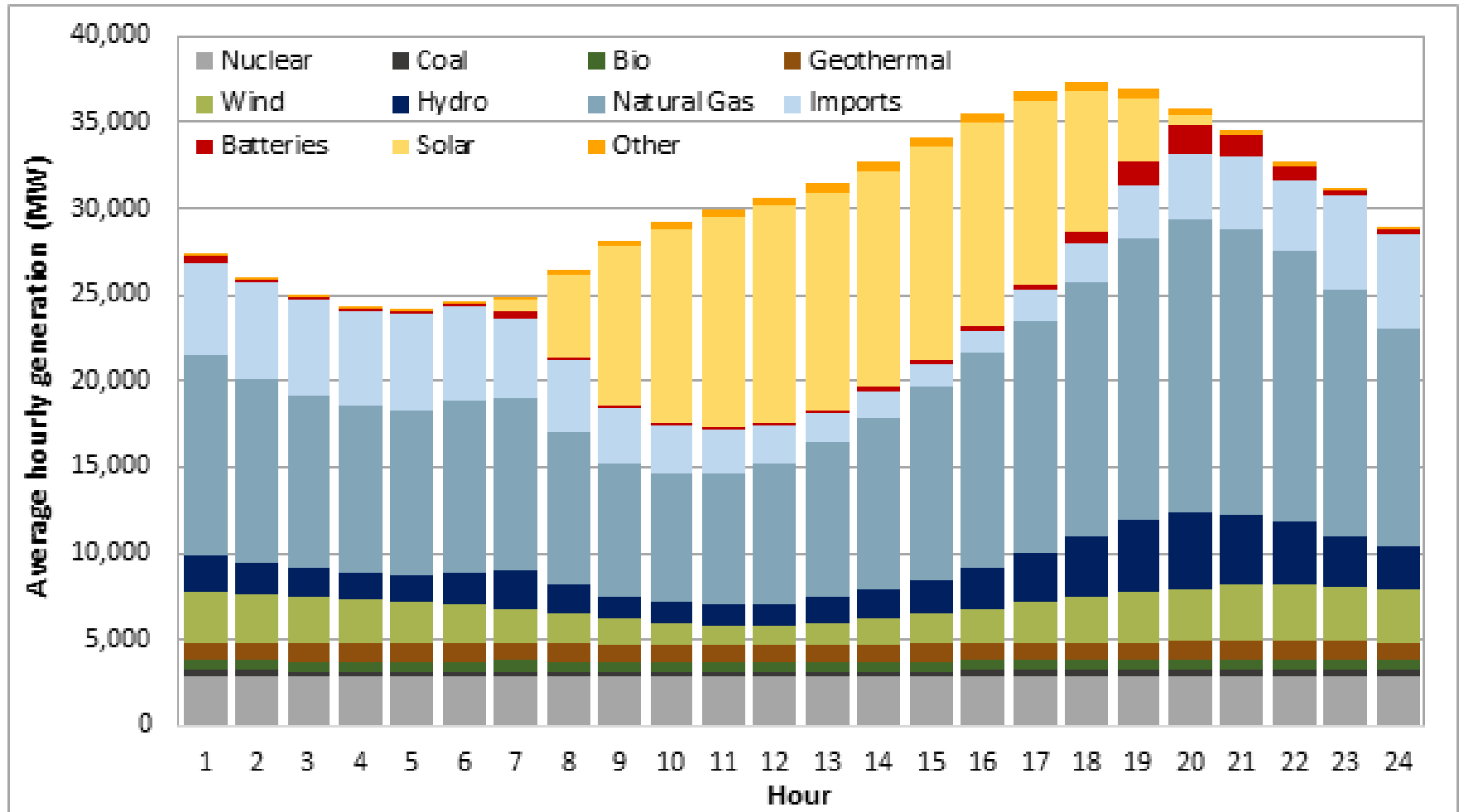
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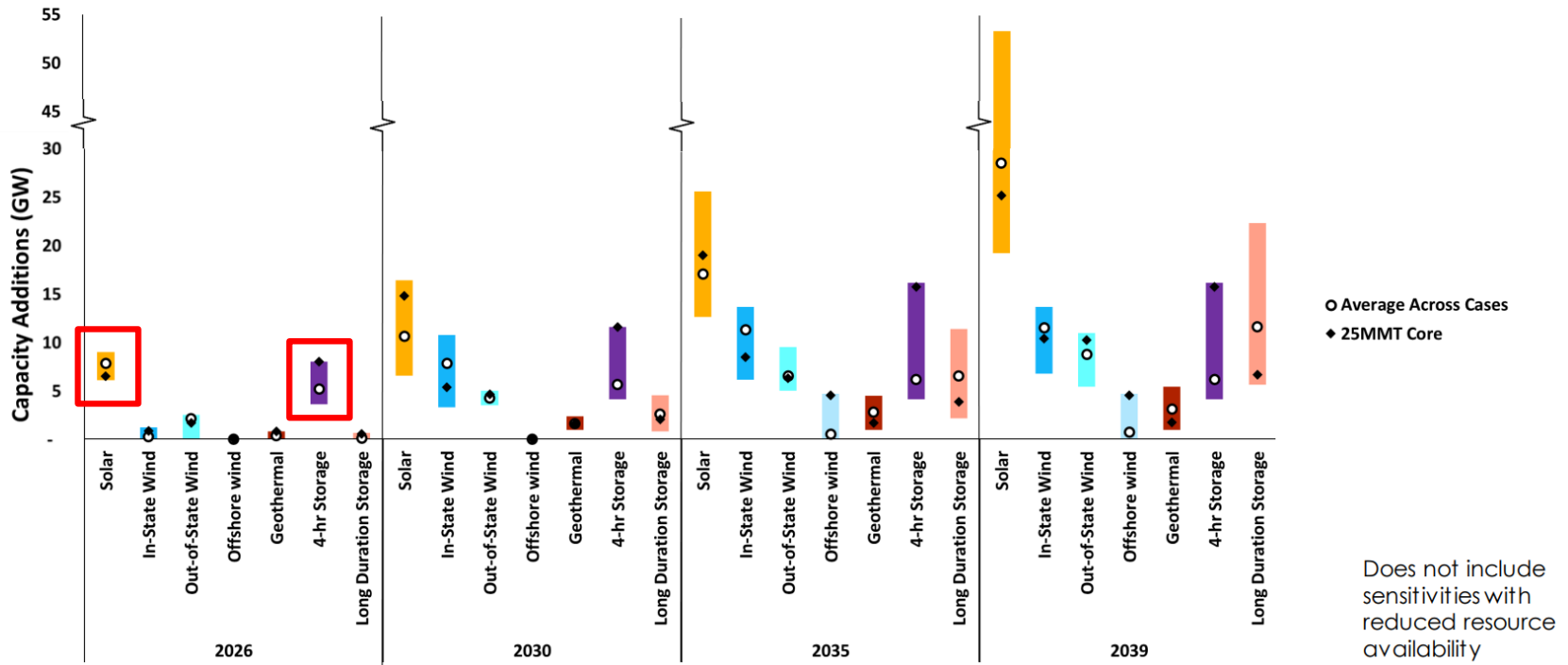
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- **Other analysis indicates 20% or more of the storage may be unavailable during the availability assessment hours (AAHs) due to special storage constraints**

# CAISO fuel mix comprised of about 30% solar and wind in 2022 (excluding “behind-the-meter” solar)

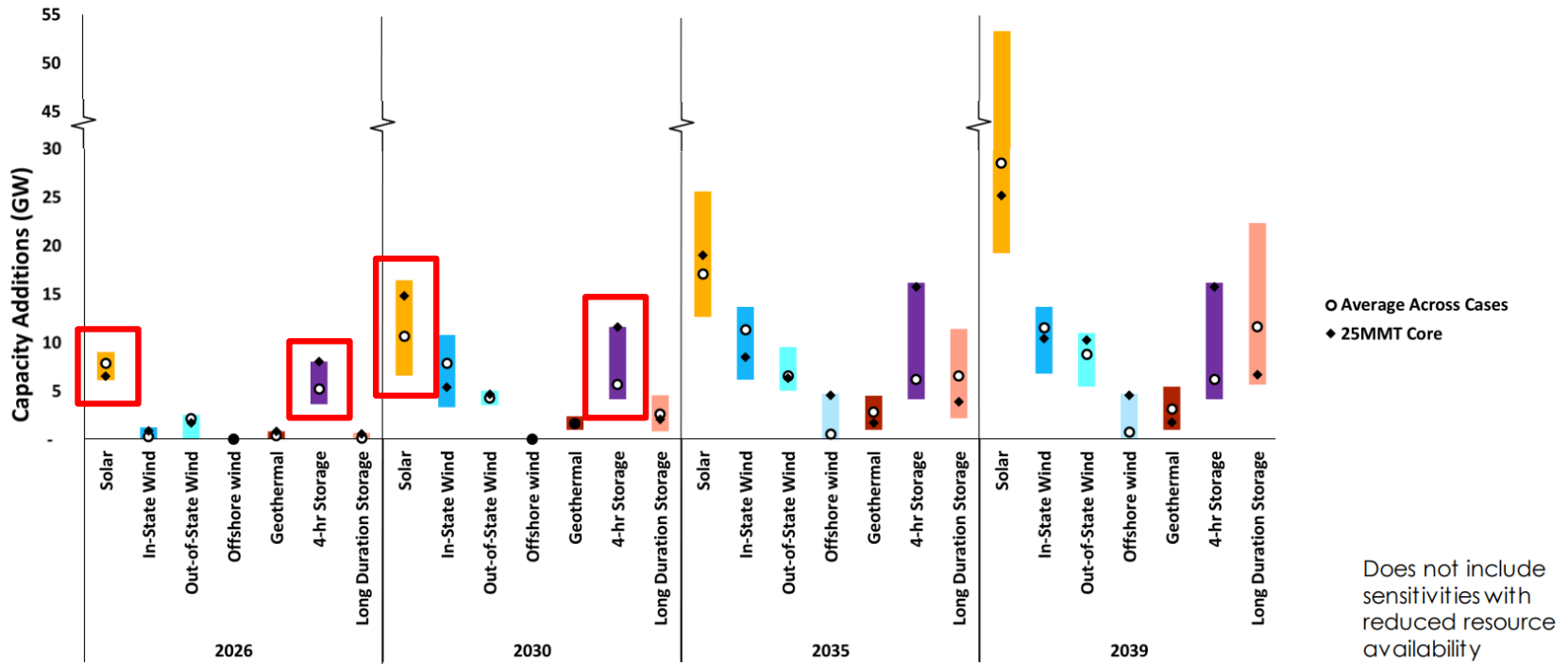


# California Public Utility Commission proposed preferred system portfolio new build



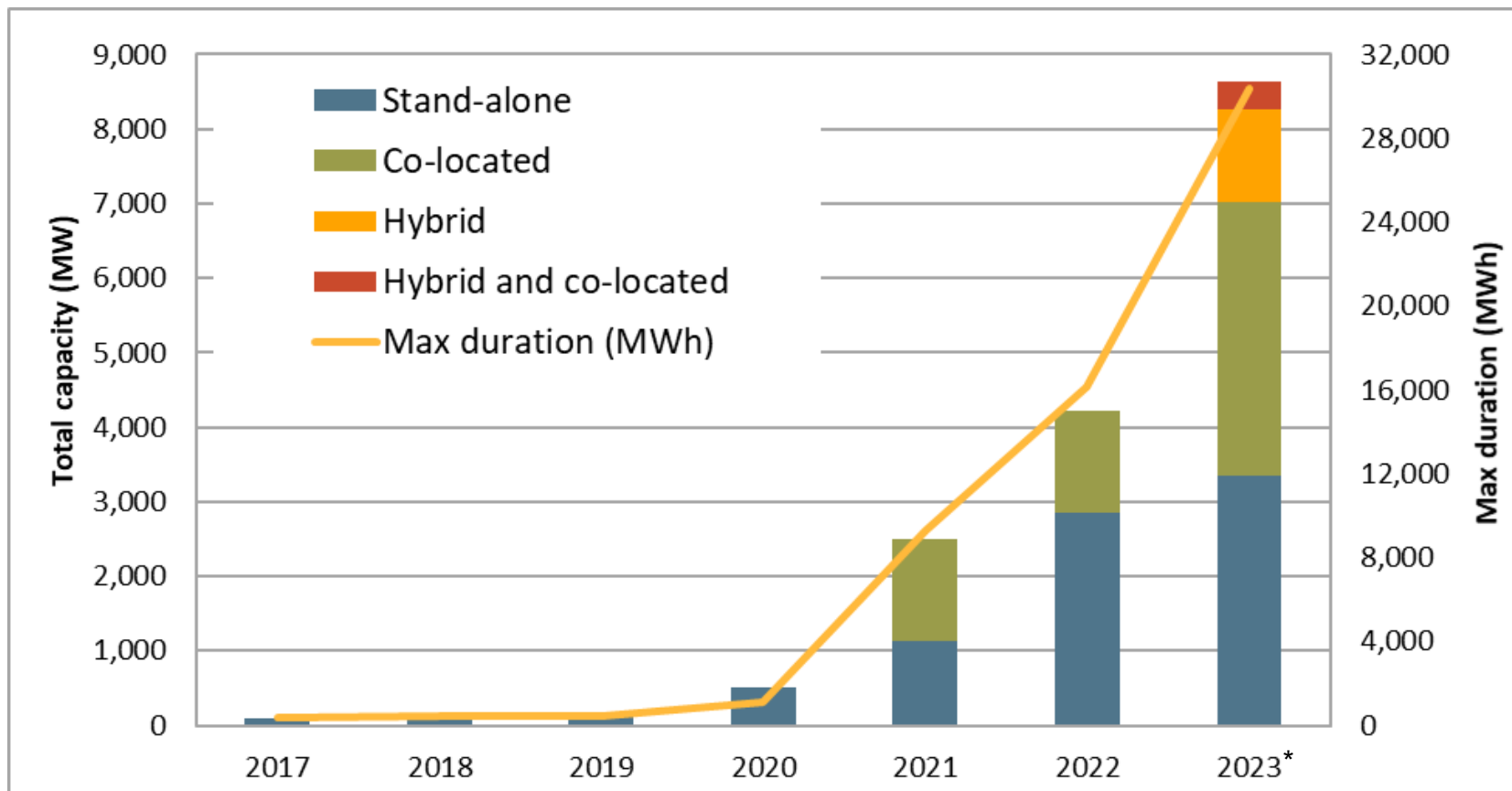
Source: CPUC. *2023 Proposed PSP and 2024-25 TPP Supplemental Analysis*. [2023-10-20-supplemental ruling slides.pdf \(ca.gov\)](https://www.cpuc.ca.gov/2023/10/20/supplemental-ruling-slides.pdf)

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Most storage is being designed so that they can discharge at maximum capacity for 4 hours.



\*as of December 20, 2023

# Resource availability in 2023

## Procured RA resource capacity and bid availability\* during 'RMO+' hours

Fuel Category	Pmax total	NQC total	Procured capacity	DA bids and self-schedules	RT bids and self-schedules
Gas	29,955	29,270	28,720	93%	92%
Solar	14,190	1,846	1,848	58%	63%
Hydro	10,369	7,182	6,456	91%	87%
Wind	7,488	1,143	1,126	57%	80%
Imports	2,649	2,649	2,649	91%	84%
Storage	5,011	4,724	4,605	90%	90%
Nuclear	2,935	2,915	2,887	99%	99%
Other	6,323	3,373	3,398	83%	82%
<b>Total</b>	<b>78,920</b>	<b>53,102</b>	<b>51,689</b>	<b>90%</b>	<b>89%</b>

\* Bids and self-schedules are capped at individual resource RA values

# Resource availability in 2023

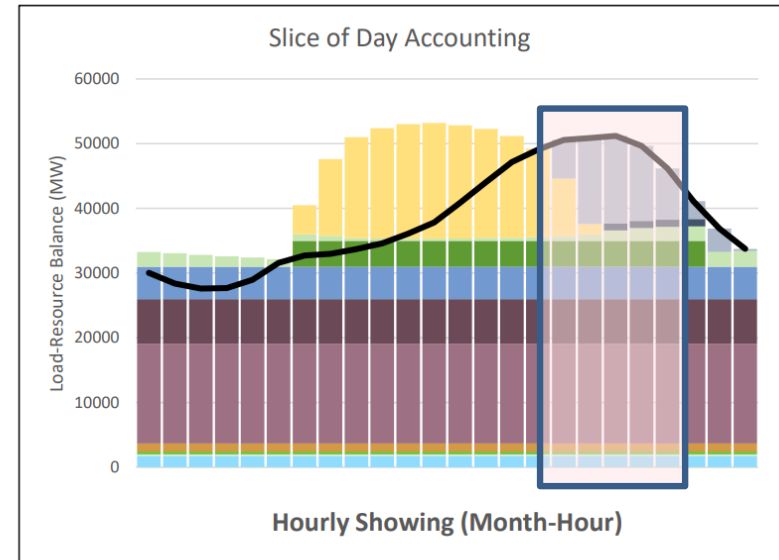
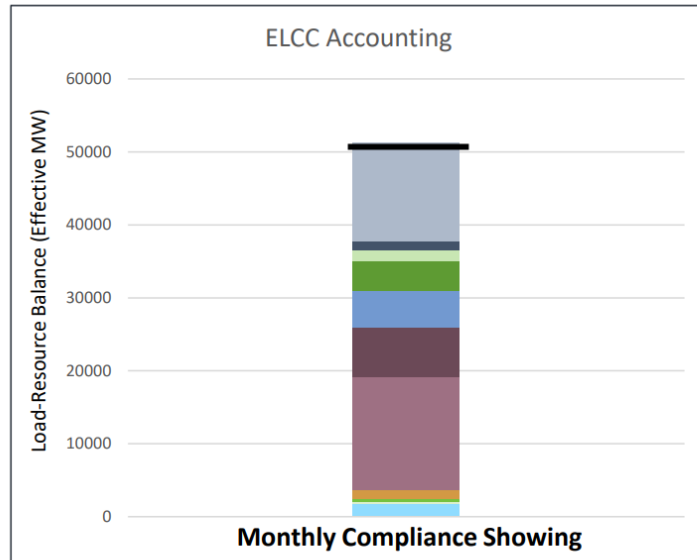
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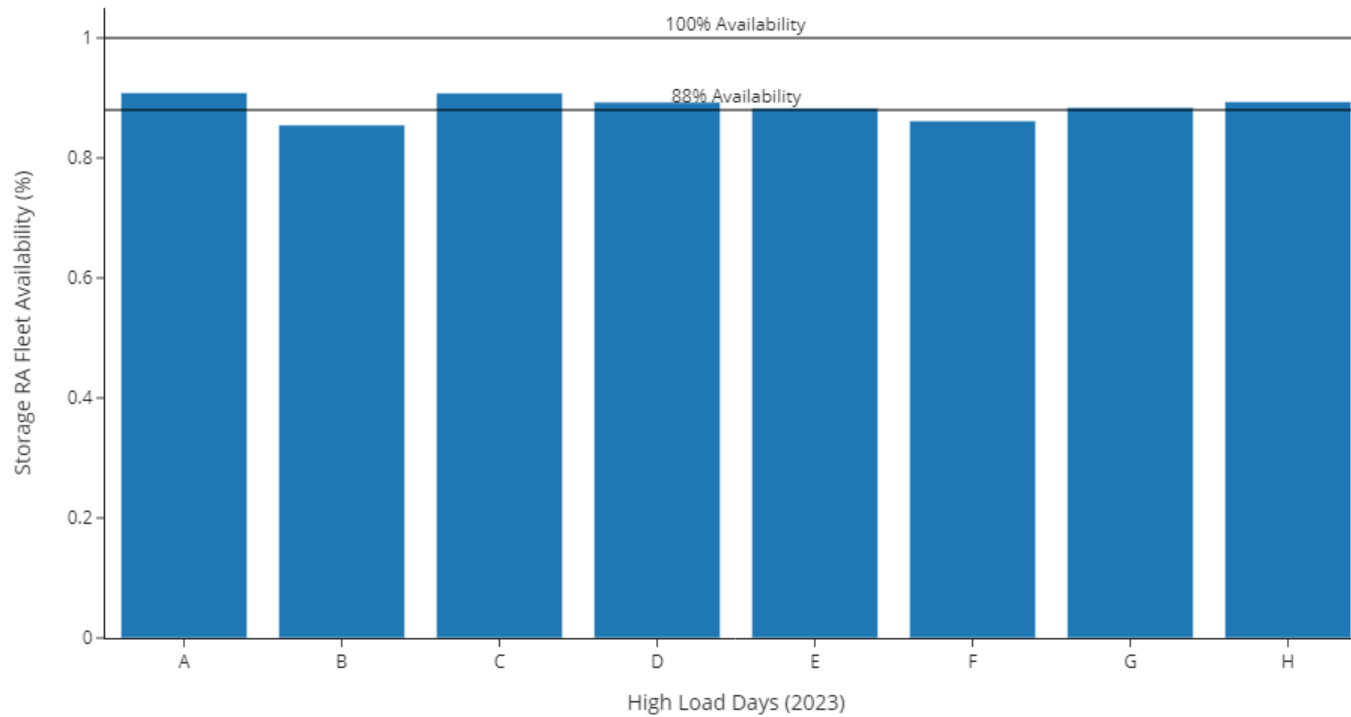
# CPUC slice-of-day framework changes



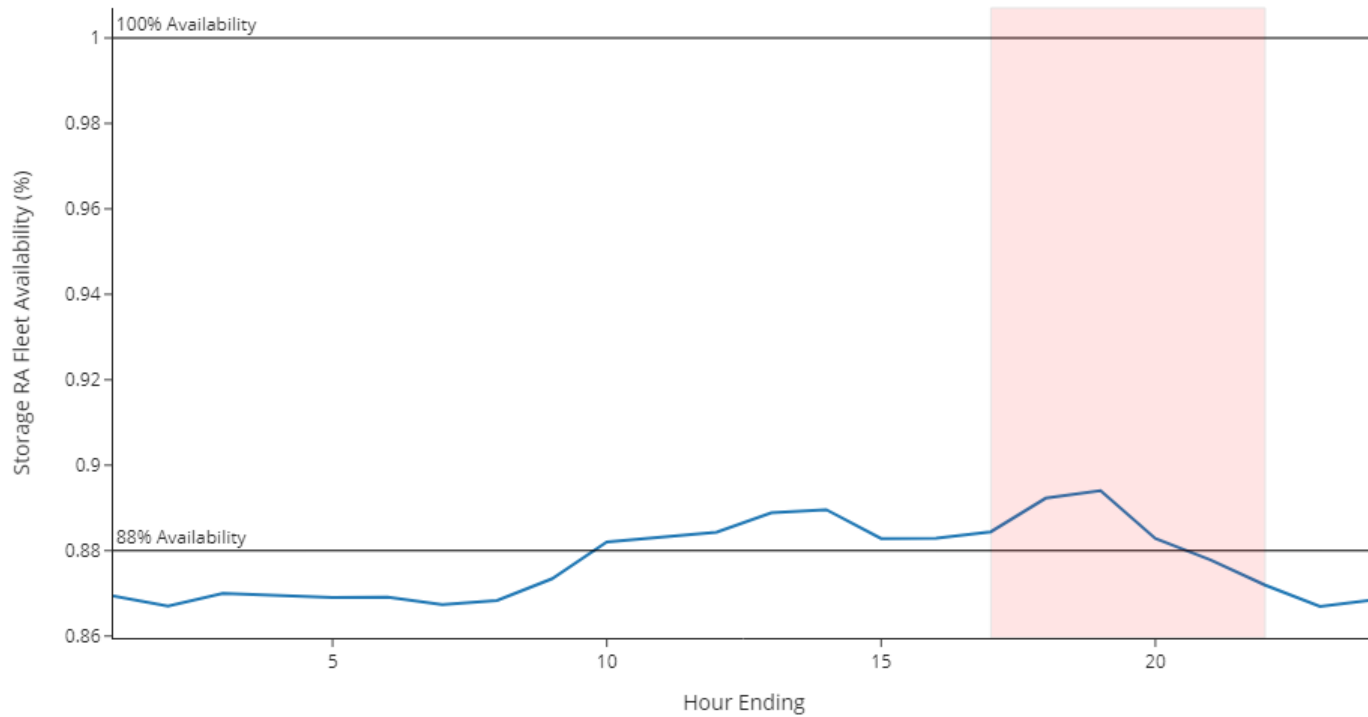
Slice of Day disaggregates monthly capacity values into month-hour capacity values using probabilistic modeling and statistics.

Source: Pappas, Nick (2023). *Resource Adequacy Reform in California: Slice of Day* [PowerPoint slides]. OMS. [PowerPoint Presentation \(misostates.org\)](https://www.misostates.org)

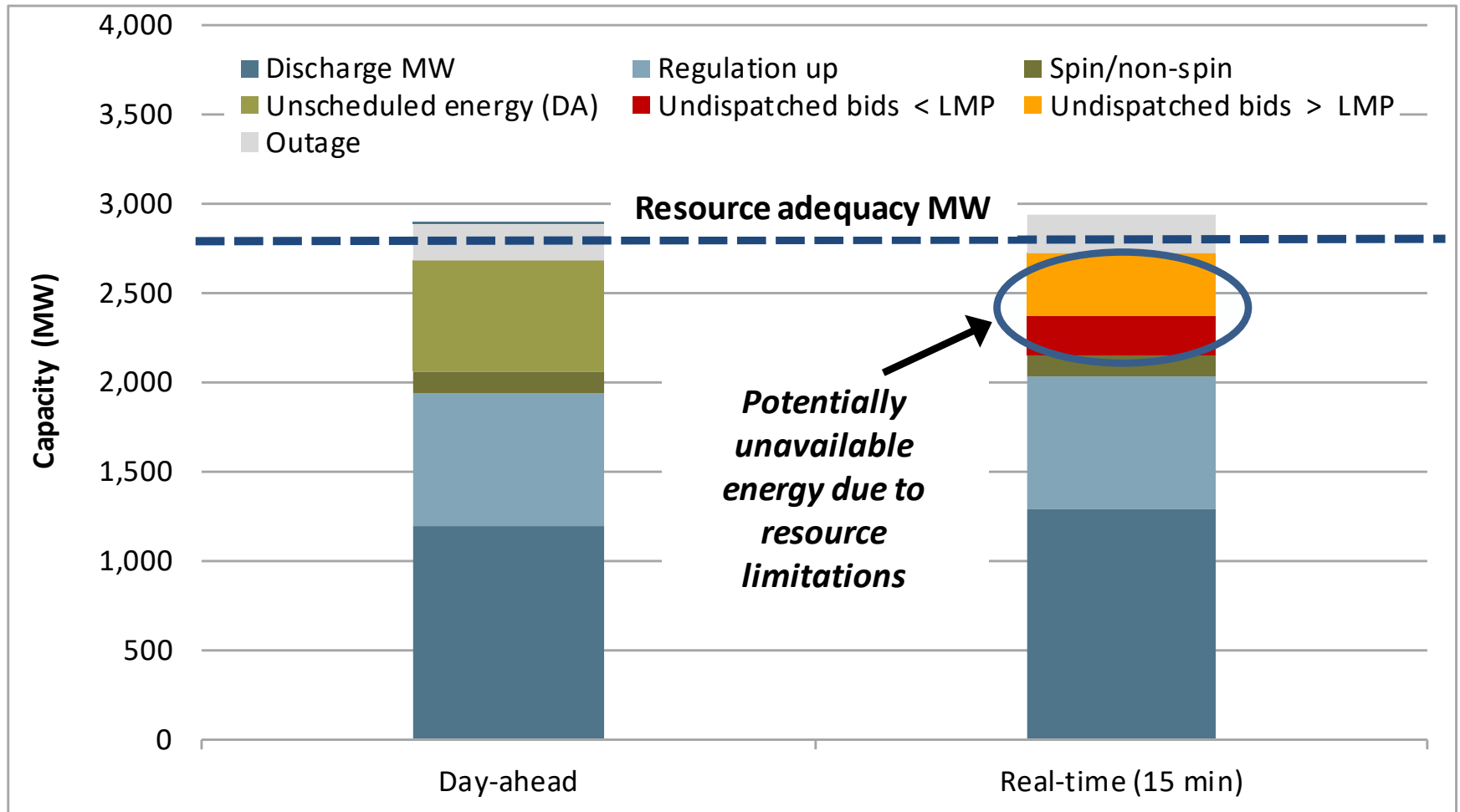
# Storage outages for RMO+ days in 2023



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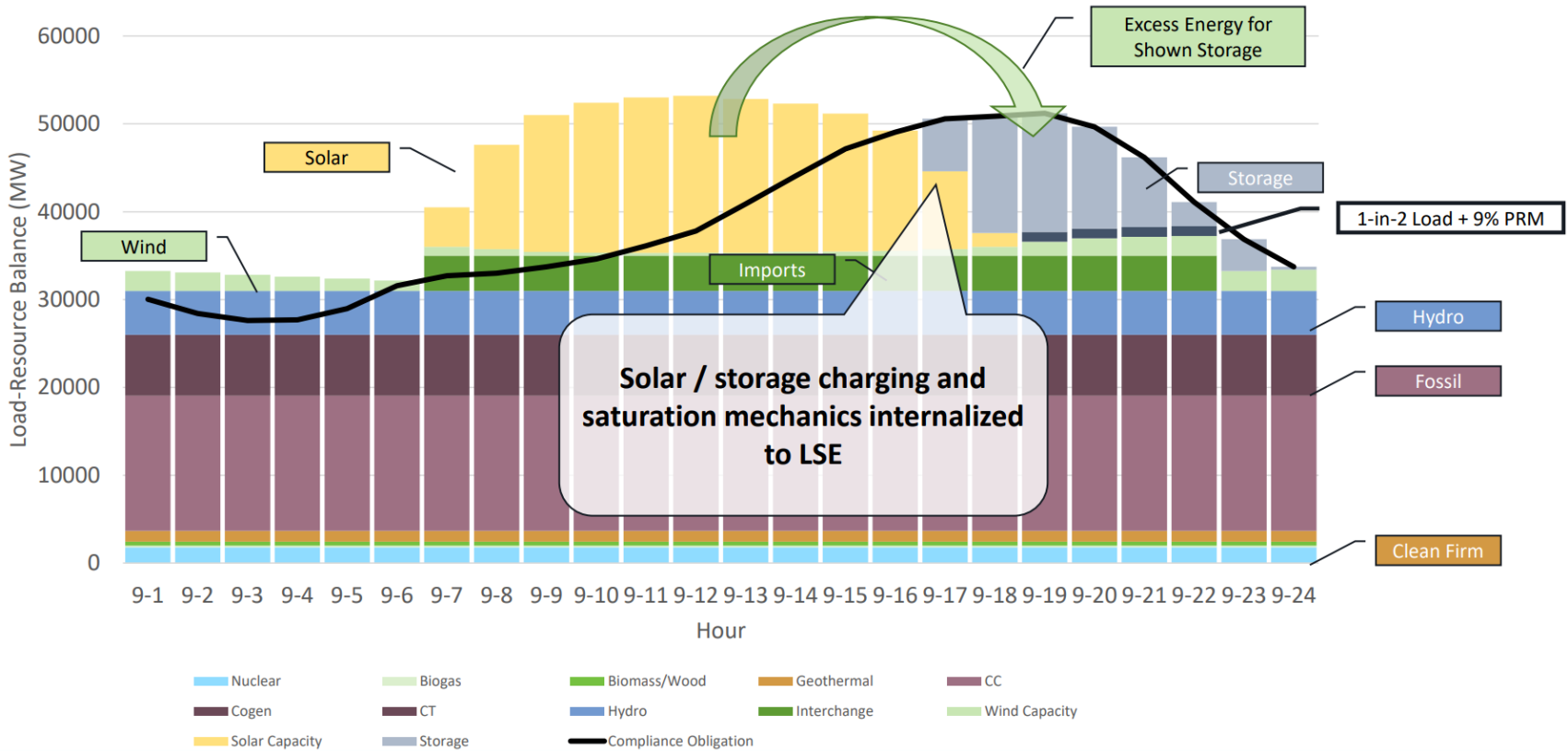


# Up to 20% battery capacity may not be available in critical hours due to limitations. (2022 data)



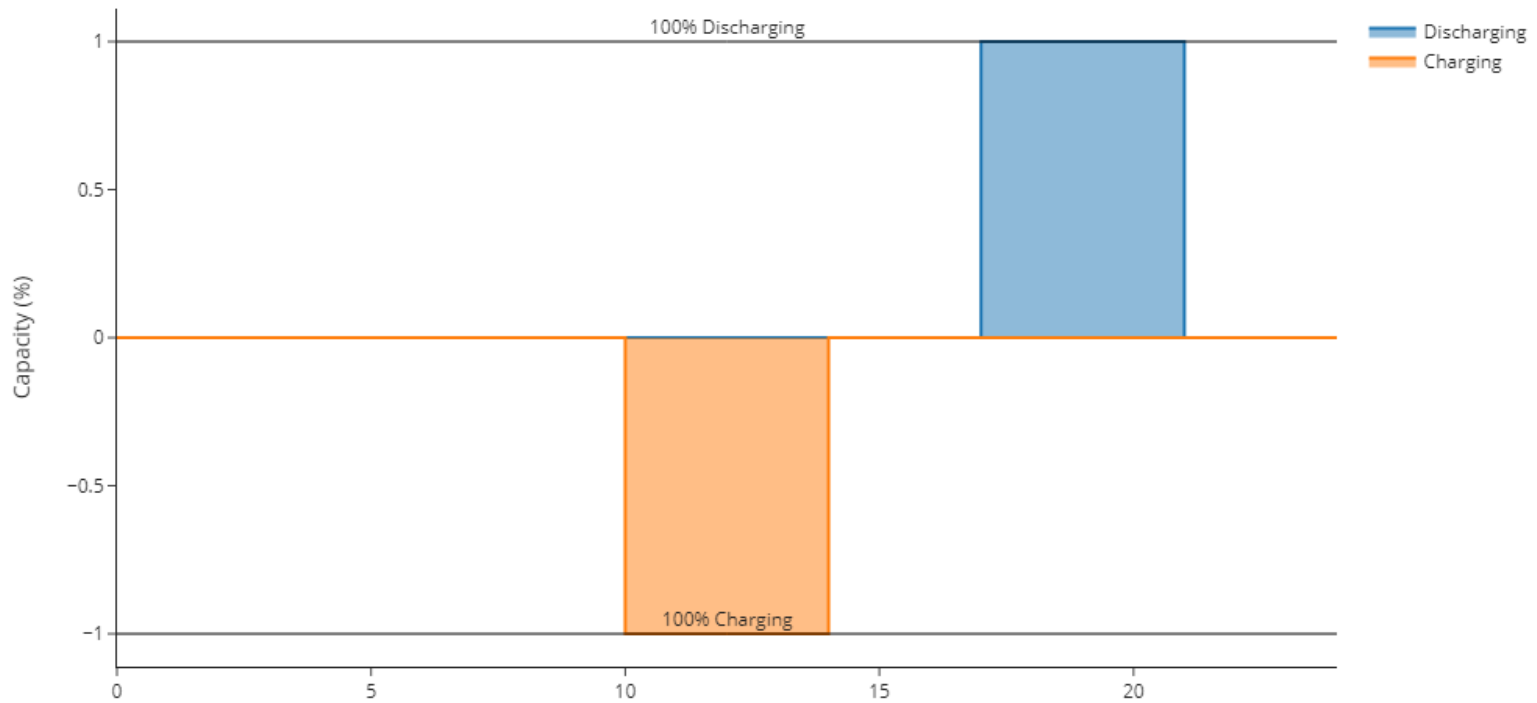
# New slice-of-day framework

## The Hourly Framework: September 2024, LOLE Study Baseline Portfolio

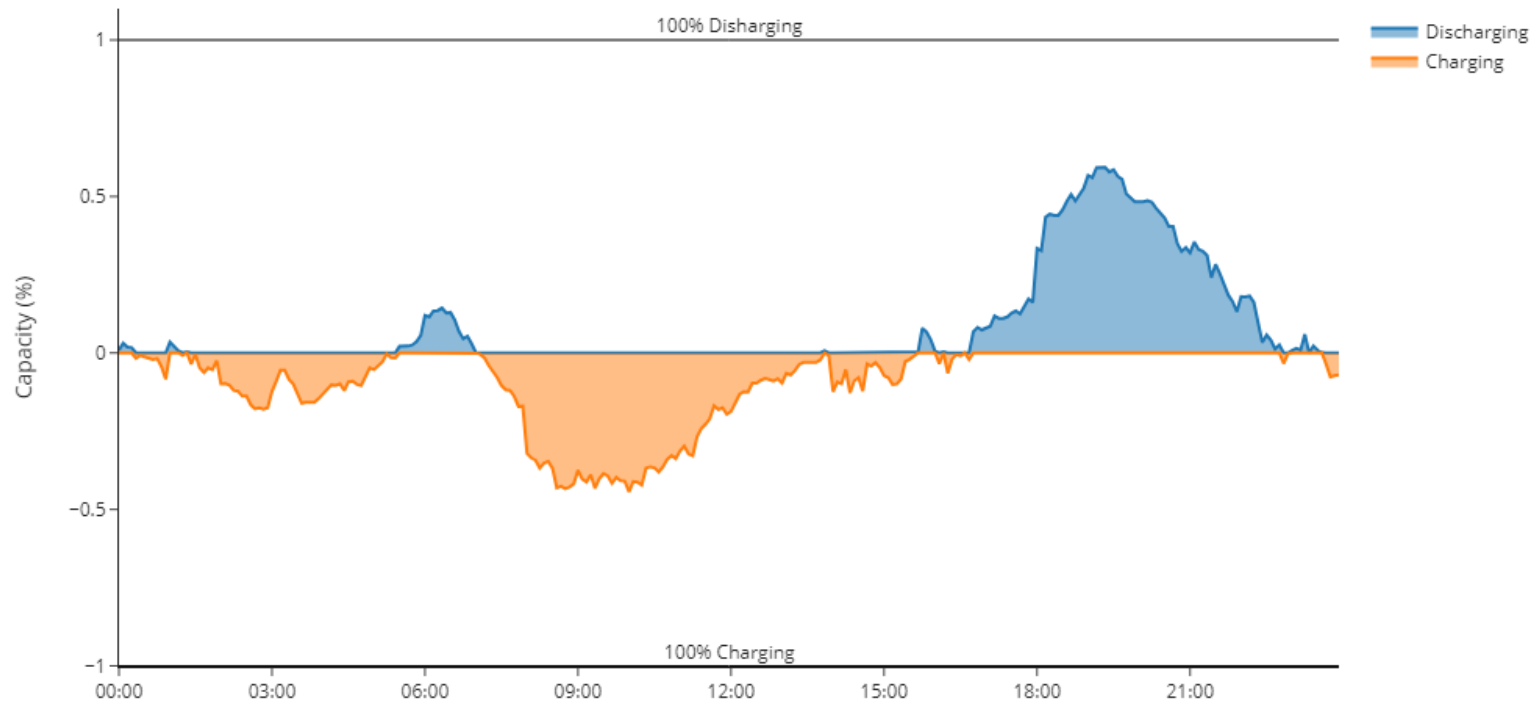


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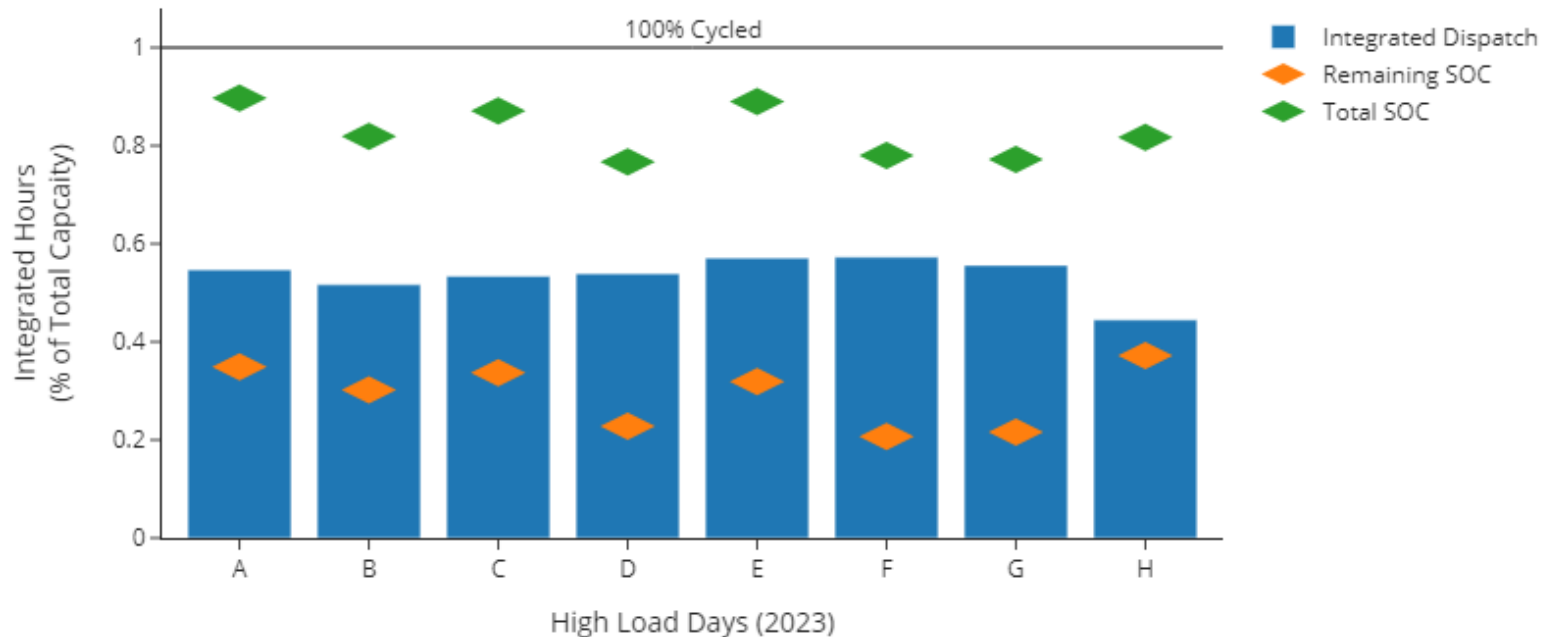
# Storage operations: idealized discharge and charging



# Storage operations: metered discharge and charging



# Storage operations: metered discharge and charging



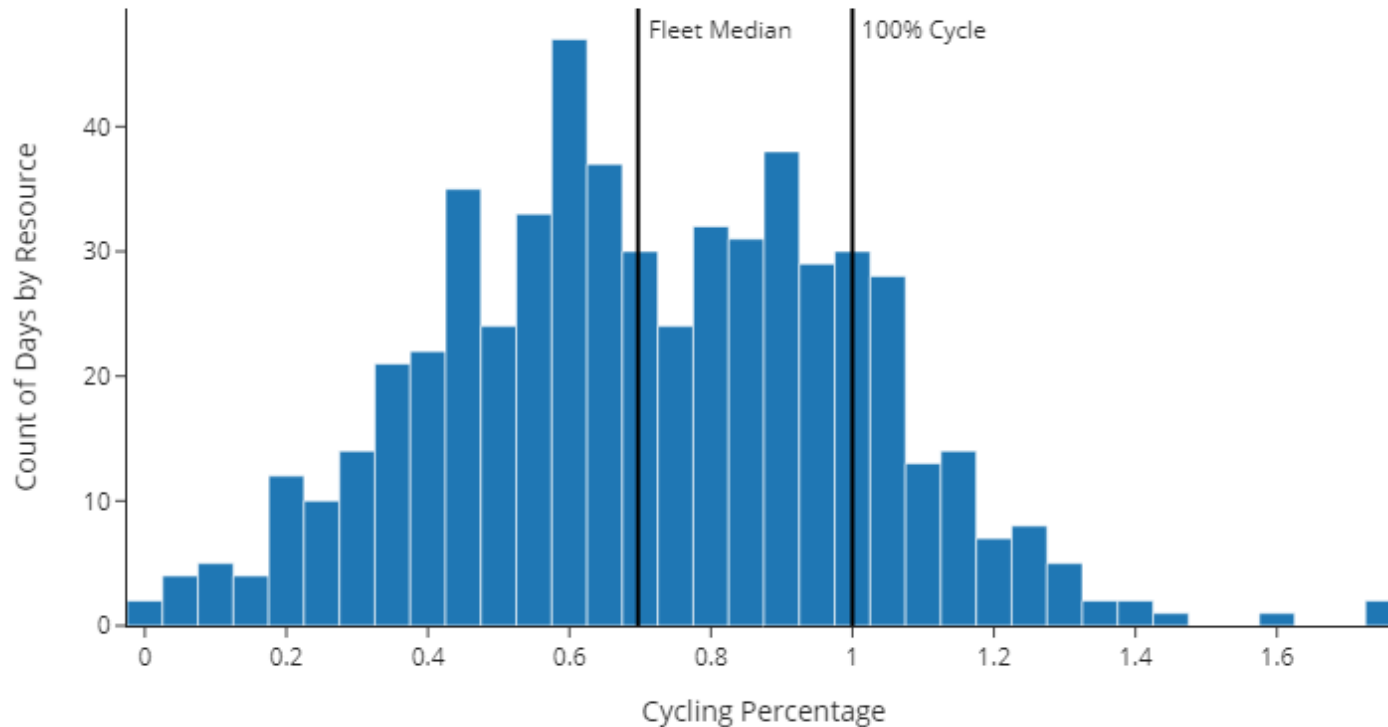
## Variable definition

- Integrated dispatch: sum of the fleet-wide energy discharged in a day
- Remaining SOC: fleet-wide SOC at the end of the day
- Total SOC: integrated dispatch + remaining SOC

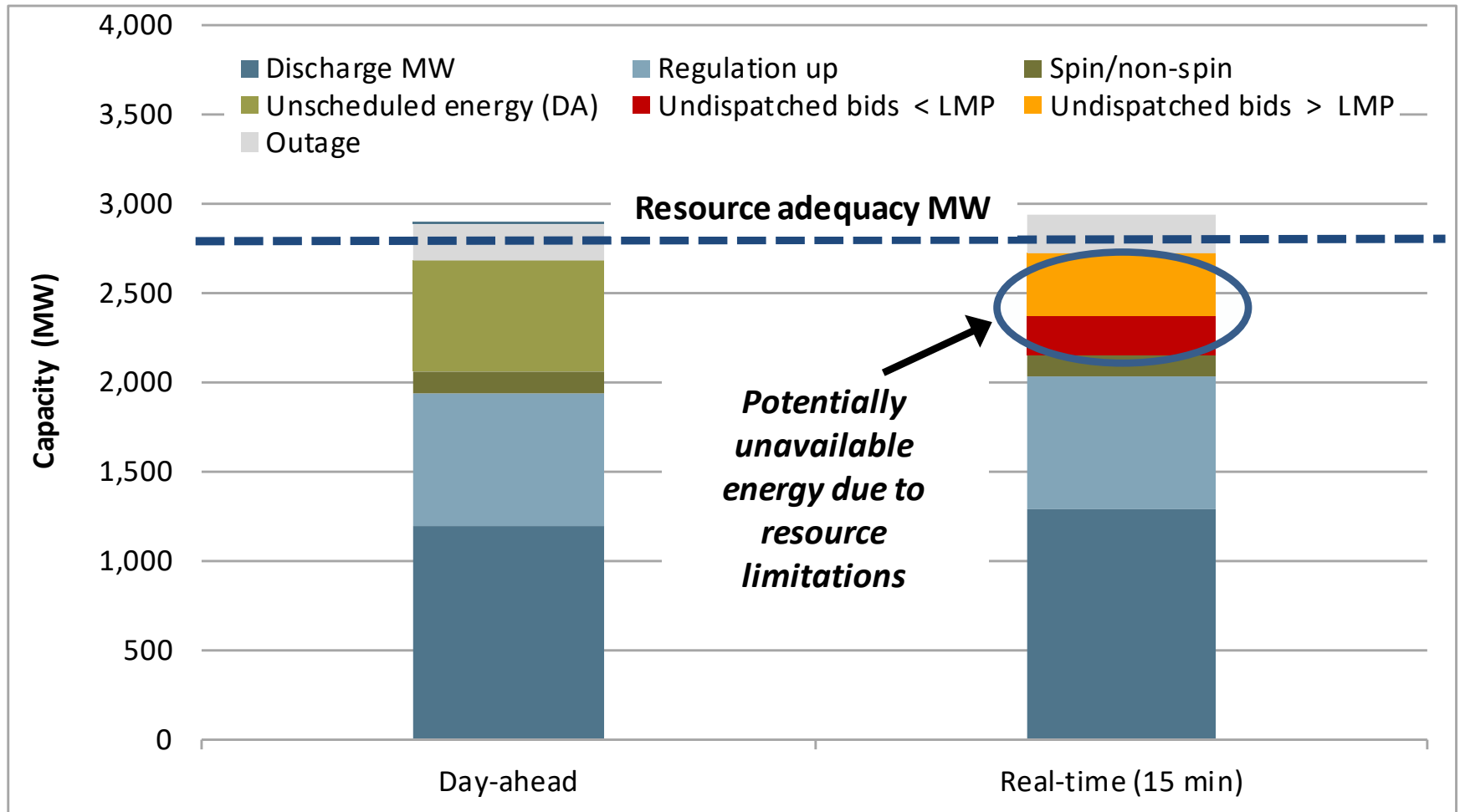


# Storage operations: metered discharge and charging

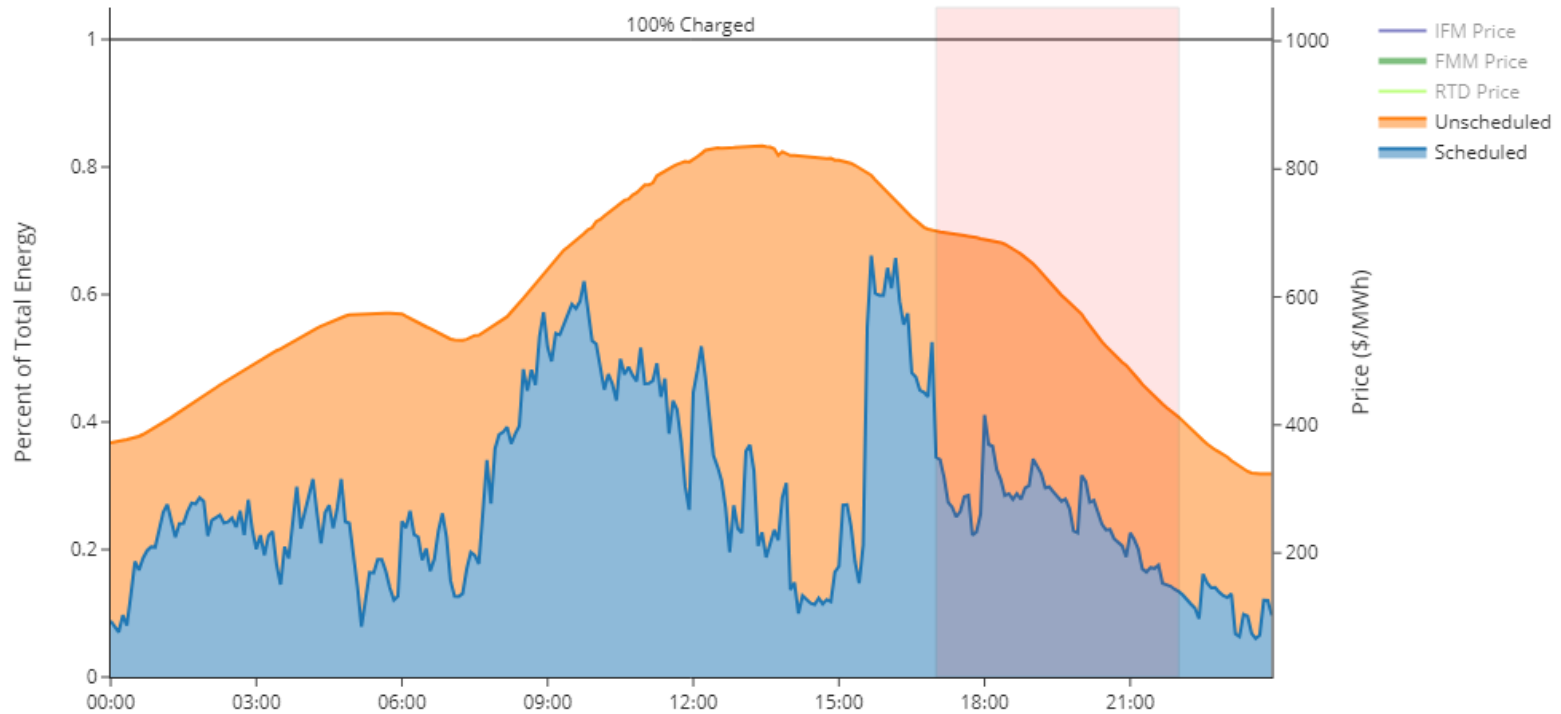
## Battery-level integrated hours during RMO+ days



# Up to 20% storage capacity may not be available in critical hours due to limitations.



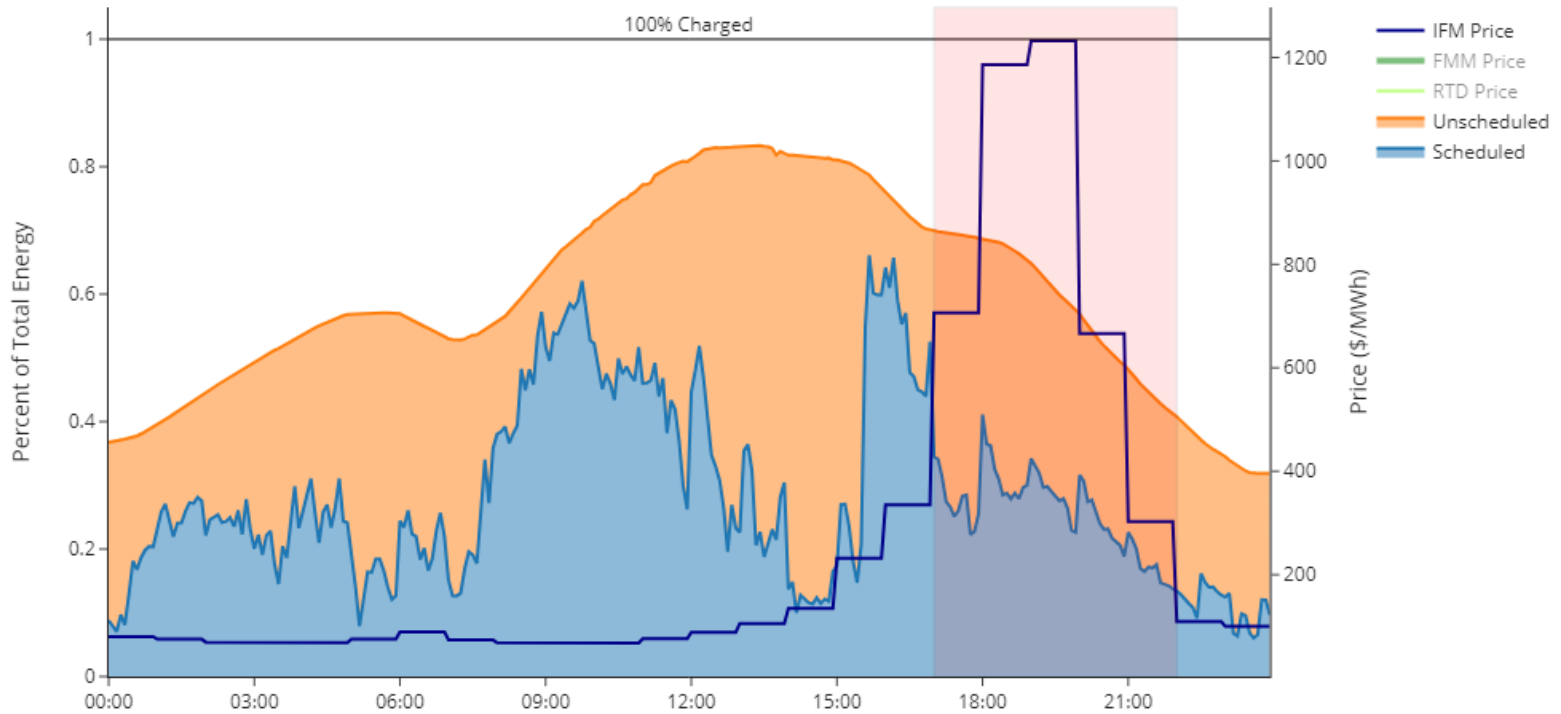
# Storage operations: state of charge



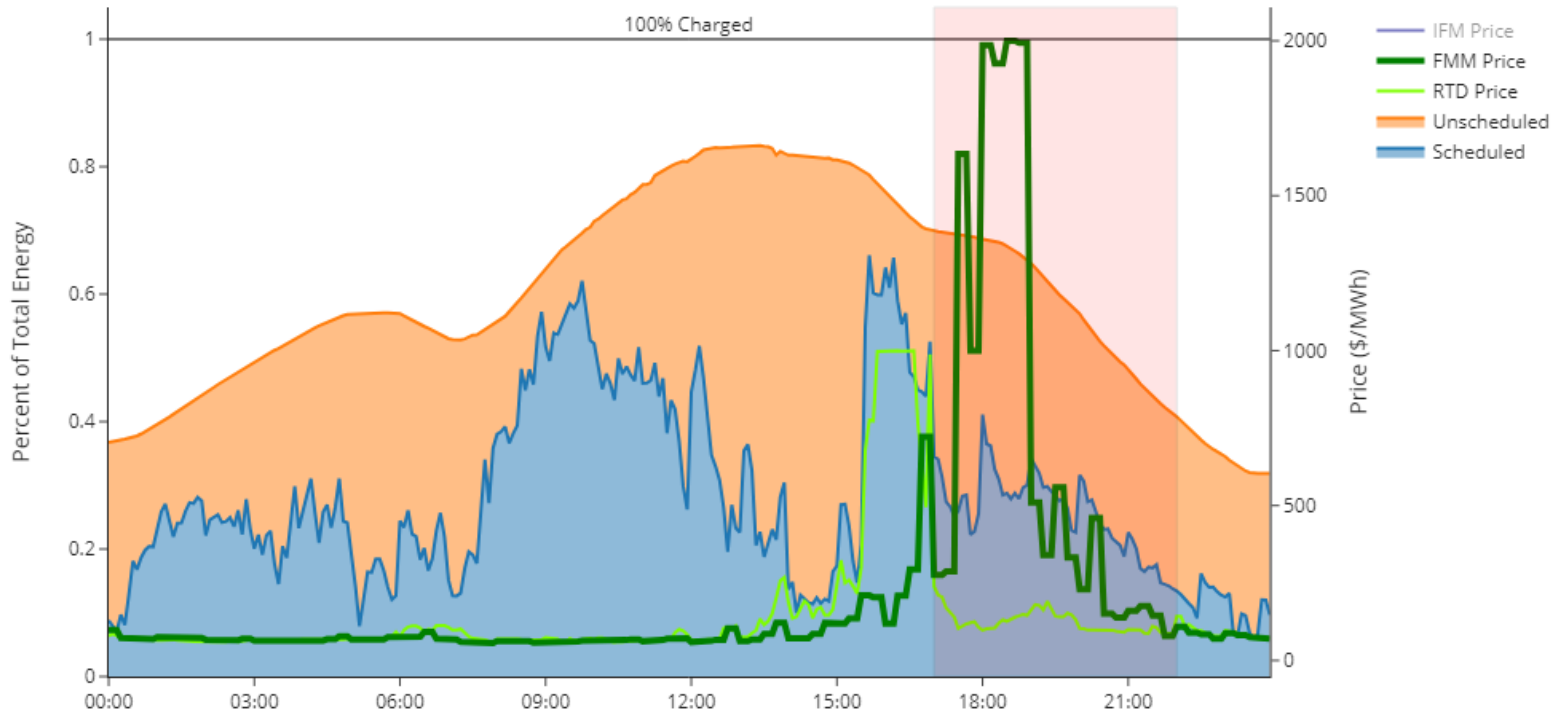
## Variable definition:

- **Unscheduled:** the state of charge of the RA storage fleet on a percentage basis
- **Schedule:** the percent of the storage SOC scheduled (for charging and discharging)

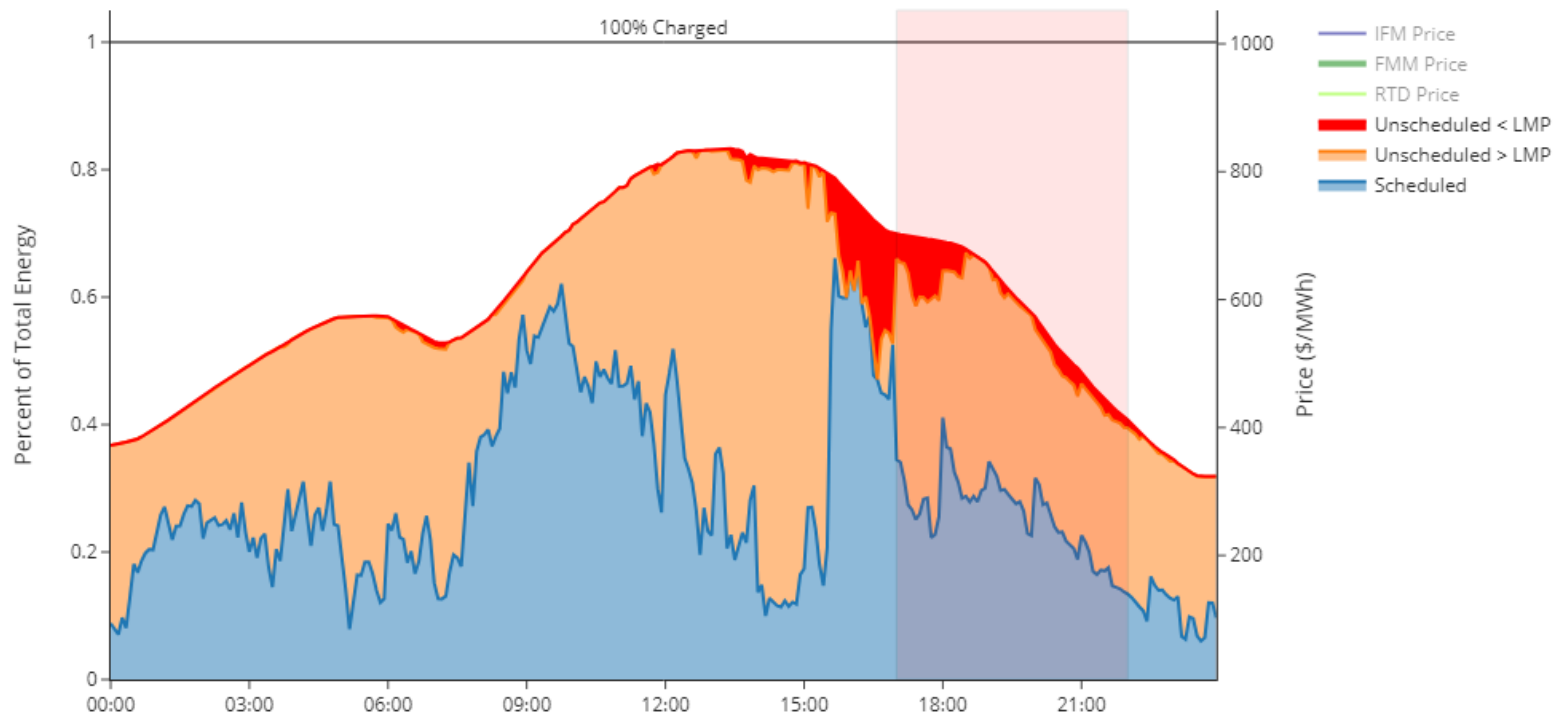
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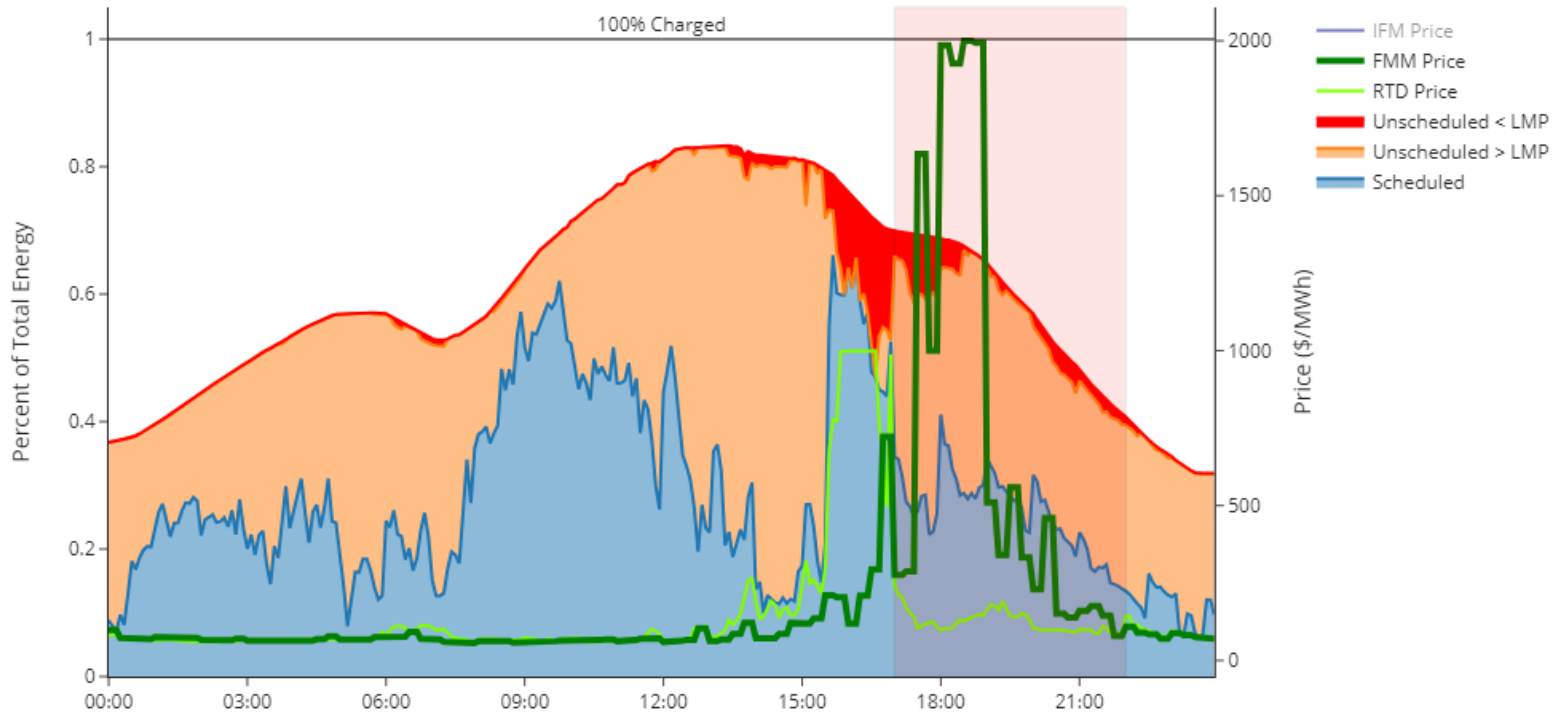
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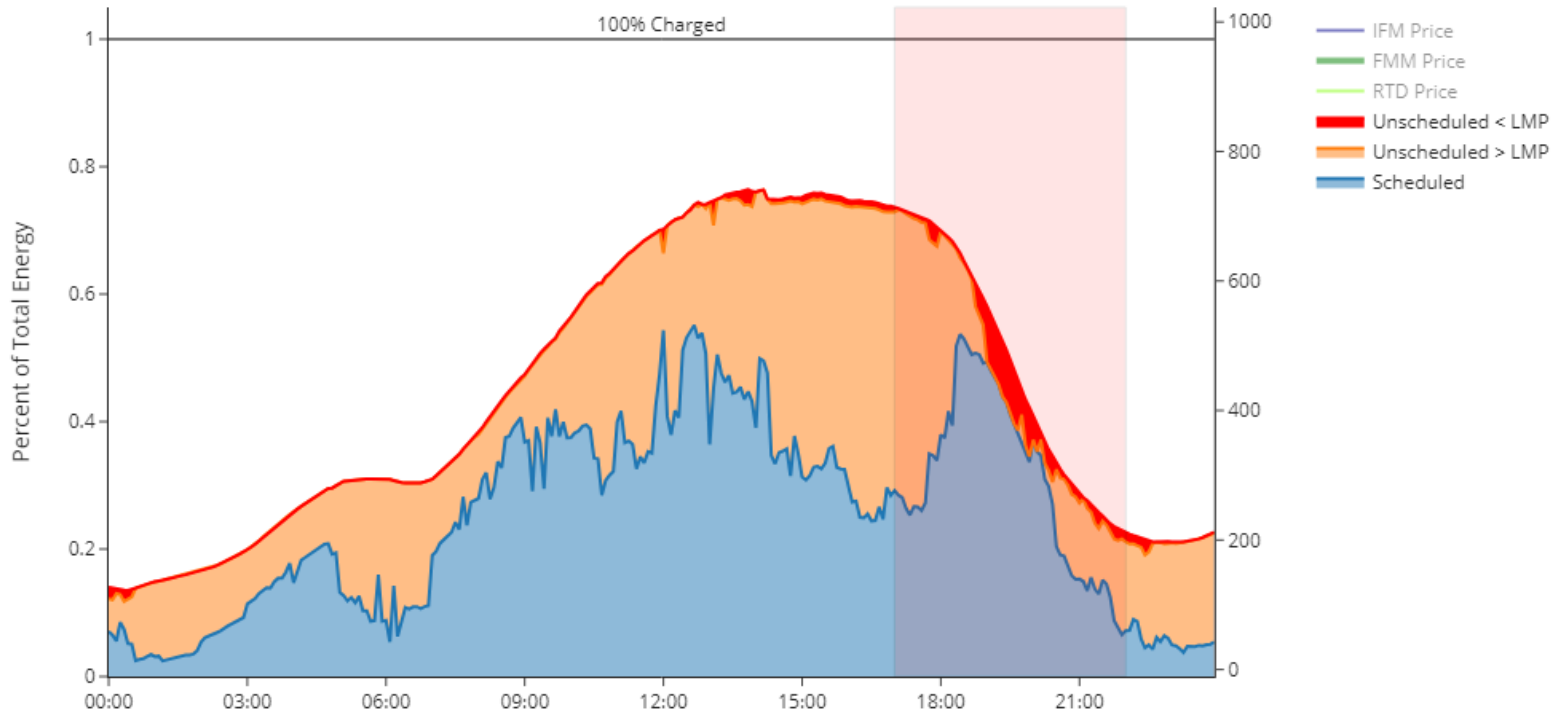
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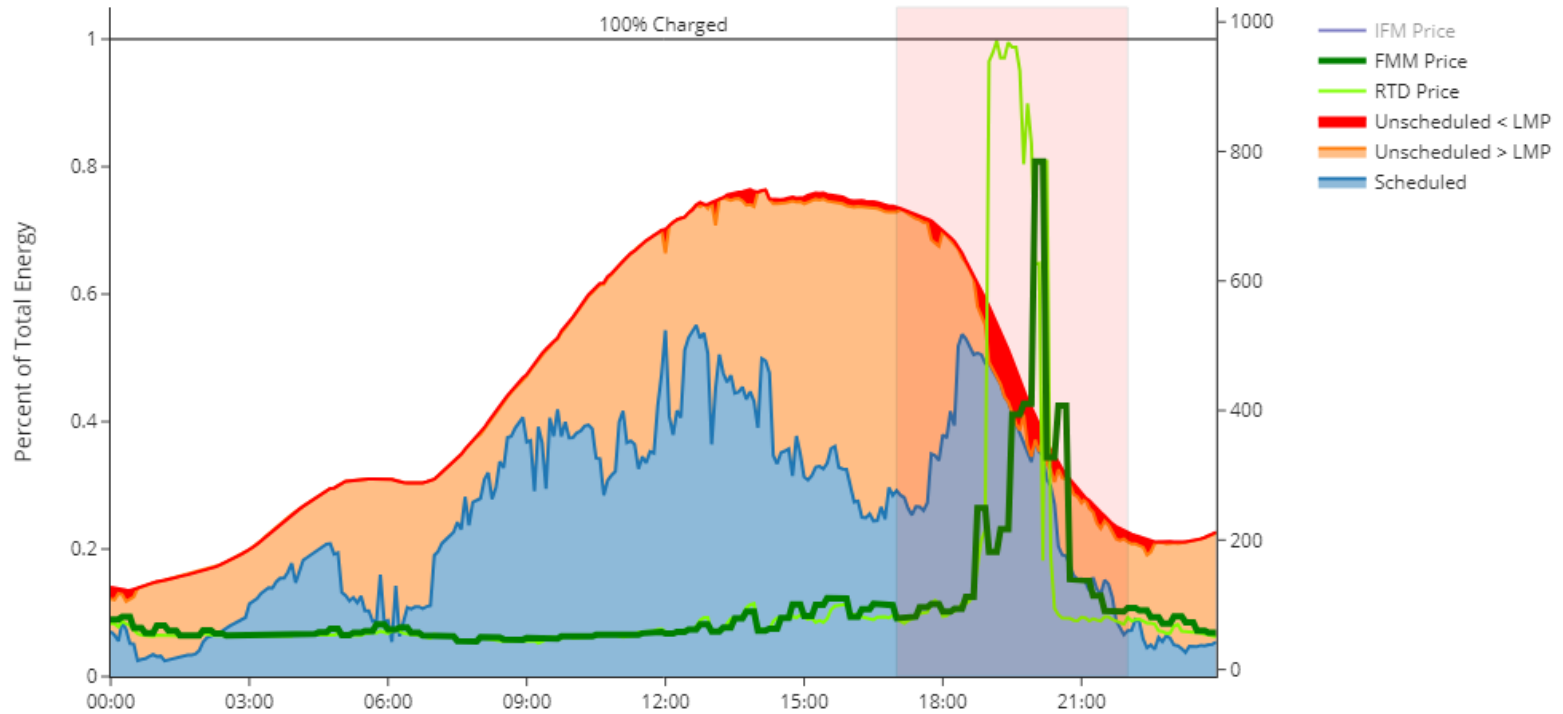


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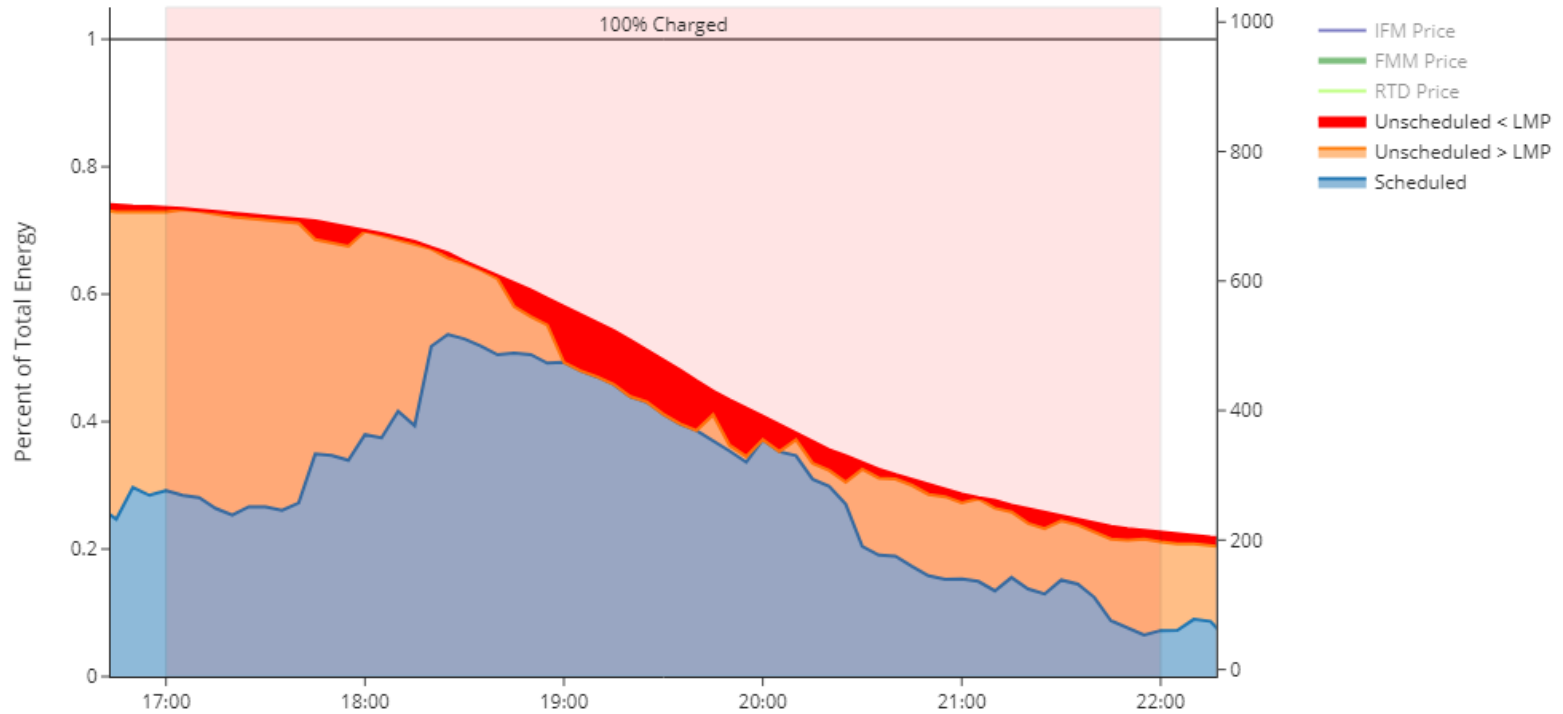




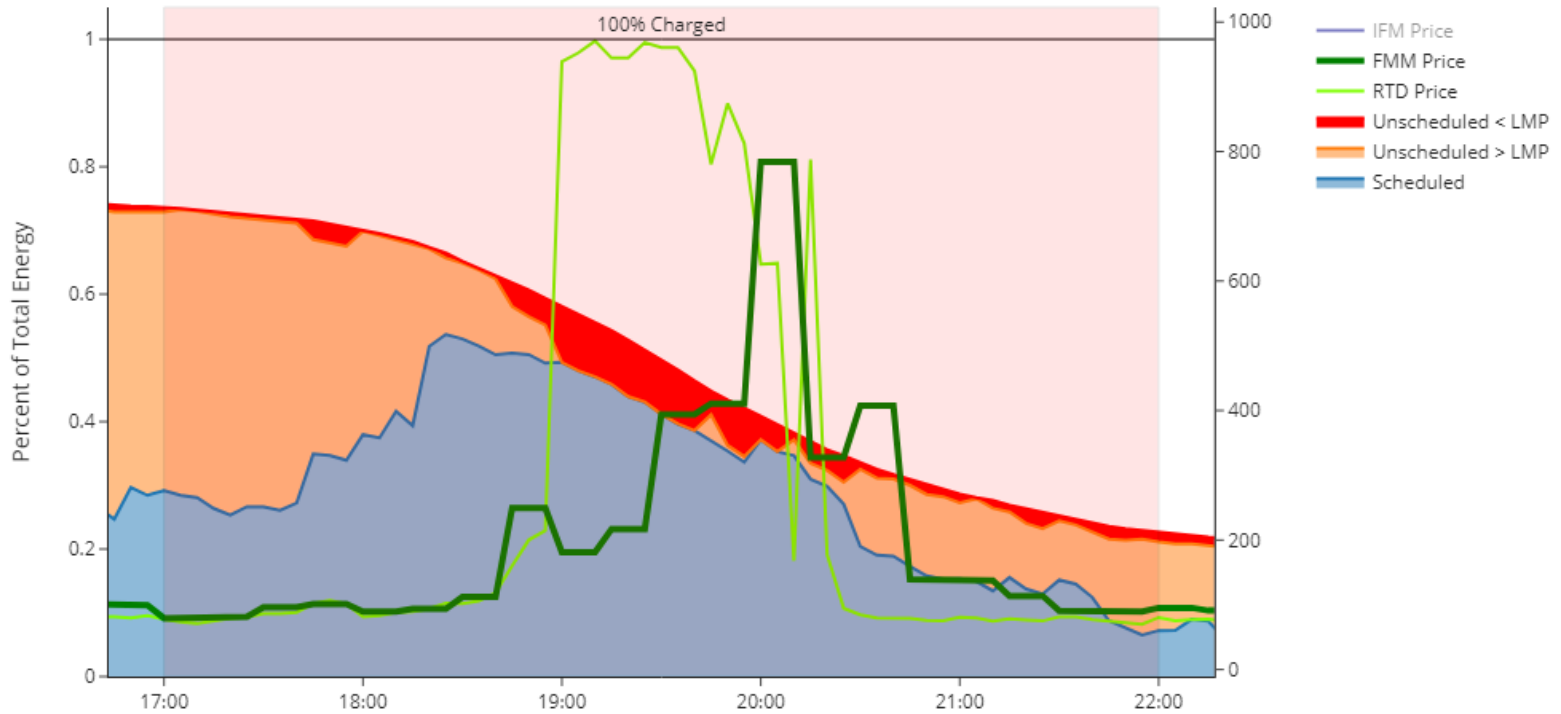
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# Storage operations: state of charge



# Storage limitations

- State-of-charge limitations
  - Regulation awards may deplete SOC reaching full capacity
  - The ancillary service SOC may influence SOC in adjacent hours, e.g. it has to be able to charge to deliver regulation down
- Parameters not captured in the market model, e.g.
  - Cell balancing
  - Foldback occurring when SOC is near extremes
- Bidding, market rules, and operations
  - Lack of a must offer obligation for charging leading to insufficient SOC
  - Bidding predominantly in the real-time market
  - Exceptional dispatches

# NEXT STEPS

## Next steps

- Next working group meeting: February 13 (virtual)
- Please submit written comments on the January 16<sup>th</sup> working group meeting by Wednesday, January 30<sup>th</sup>, through the ISO's commenting tool using the link on the working group webpage: <https://stakeholdercenter.caiso.com/Comments/MyOrgComments>
- Please contact Jeff McDonald ([jmcdonald@ceadvisors.com](mailto:jmcdonald@ceadvisors.com)) to indicate if you would like to present, the topic you would like to present on and, how this topic relates to your proposed problem statement.

# Proposed Schedule Through March 2024

Date	Topics
January 16 (hybrid)	<ul style="list-style-type: none"><li>• Refine problem statements 2&amp;3 and review associated data analysis needs</li><li>• Review stakeholder feedback on short-term focus</li><li>• Review modeling on mid-term focus</li></ul>
February 13 (virtual)	<ul style="list-style-type: none"><li>• Review stakeholder feedback on mid-term focus</li><li>• Review modeling: long-term focus</li><li>• Deep dive: counting rules</li></ul>
February 27 (hybrid)	<ul style="list-style-type: none"><li>• Review modeling overall</li><li>• Deep dive: planned and forced outage and availability incentives</li></ul>
March 13 (hybrid)	<ul style="list-style-type: none"><li>• Deep dive: backstop processes</li><li>• Panel discussion: backstop measures</li></ul>