DAY 1: RA Enhancements Fifth Revised Straw Proposal

July 14 - 16, 2020

Agenda – Day 1

Time	Topic	Presenter
9:00 – 9:10	Welcome and Introduction	Isabella Nicosia
9:10 – 9:30	Production simulation: Determining UCAP needs and portfolio assessment	Karl Meeusen
9:30 – 11:30	Unforced Capacity Evaluations	Bridget Sparks & Lauren Carr

*Agenda items may move times/days as time permits

Agenda – Day 2

Time	Topic	Presenter
9:00 – 9:10	Welcome and Introduction	Isabella Nicosia
9:10 – 9:50	Must Offer Obligations and Bid Insertion	Lauren Carr
9:50 – 10:30	Planned Outage Process Enhancements	Karl Meeusen
10:30 – 12:00	RA Imports	Karl Meeusen

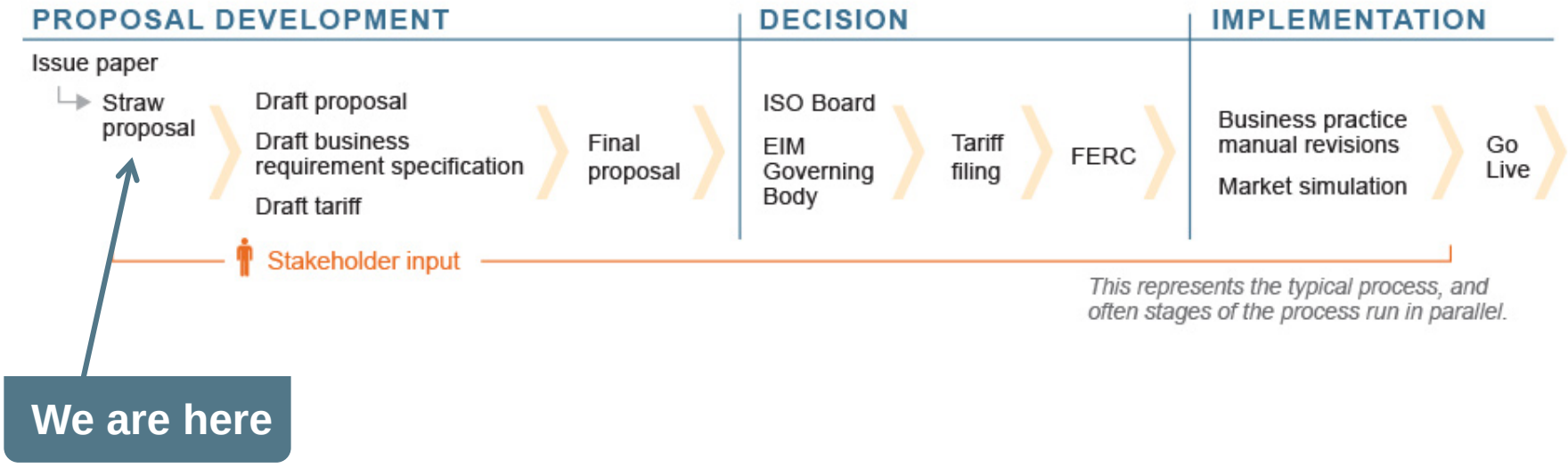
*Agenda items may move times/days as time permits

Agenda – Day 3

Time	Topic	Presenter
9:00 – 9:10	Welcome and Introduction	Isabella Nicosia
9:10 – 9:25	Additional discussion on modifying real-time must offer obligation	Greg Cook
9:25 – 9:55	Transition to UCAP and UCAP for Local RA	Karl Meeusen
9:55 – 11:10	Operationalizing Storage	Gabe Murtaugh
11:10 – 11:50	Backstop Capacity Procurement	Bridget Sparks
11:50 – 12:00	Next Steps	Isabella Nicosia

*Agenda items may move times/days as time permits

Stakeholder Process



Resource Adequacy Enhancements Policy Development Schedule

Date	Milestone
July 7	Fifth revised straw proposal
July 14-16	Stakeholder meeting on fifth revised straw proposal
July 30	Stakeholder comments on fifth revised straw proposal due
Oct 12	Draft final proposal
Oct 19-20	Stakeholder meeting on draft final proposal
Nov 3	Stakeholder comments on draft final proposal
Aug 2020 - Q1 2021	Draft BRS and Tariff
Q1 2021	Final proposal
Q1 2021	Present proposal to CAISO Board

* Dates are tentative and subject to change

PRODUCTION SIMULATION: DETERMINING UCAP NEEDS AND PORTFOLIO ASSESSMENT

Stakeholder feedback

- Most stakeholders support the CAISO developing a portfolio assessment for only RA resources
- Stakeholders were generally supportive of the CAISO's proposed stochastic model, including using the Summer Assessment as the basis
- Stakeholders continue to request additional details about the model and its potential uses
- Some stakeholders have requested additional details about the model's ability to model storage resources
  - CAISO has not had the opportunity to explore this in greater detail

CAISO is conducting an assessment of actual June RA showings using stochastic production simulation

- Production simulation was designed to demonstrate the capabilities needed to conduct an RA portfolio assessment
  - Model will also provide additional context about how UCAP requirements should be established
- CAISO will issue a supplement to this straw proposal
  - Supplement will include details regarding the inputs used in the assessment, the outcome of the assessment in terms of probabilities of stage emergencies and unserved energy
- Based on assessment, the CAISO make additional updates and recommendations regarding how best to set UCAP requirements

CAISO is leveraging an existing stochastic production simulation model to develop the portfolio analysis

- A stochastic approach allows the CAISO to assess the widest array of load, wind, and solar profiles as well as various outage profiles for other resource types
- Utilizing an existing model provides at least two benefits
  - Helps the CAISO expedite testing and implementation
  - CAISO can utilize an accepted and vetted model that has been relied on for other CAISO published studies

Current status of the CAISO's study efforts

- Testing actual RA showings with the following inputs
  - Using similar year to reflect expected hydro output
  - Using established wind and solar profiles
  - Modelling on shown RA imports
  - Using CAISO forecast (within 1% of CEC forecast)
- Will test sensitivities around the RA showings to help inform UCAP requirements (i.e. higher or lower imports, sensitivity to load forecast)
  - This relates to setting UCAP requirements and potential CPM triggers, not how it applies to UCAP
- Based on output of initial tests, CAISO will identify criteria for CPM designations

UNFORCED CAPACITY EVALUATIONS

CAISO proposes to evaluate the reliability and availability of resources by accounting for forced and urgent outages

- Current CAISO and CPUC RA framework does not account for system resources on forced outage beyond margins included in established planning reserve margin requirement
  - Instead, CAISO relies on substitution rules and Resource Adequacy Availability Incentive Mechanism (RAAIM)
- CAISO has proposed new rules to account for probability of forced and urgent outages and derates that will eliminate need for complicated replacement capacity rules
- Applying unforced capacity evaluations to RA values is intended to provide certainty CAISO will receive adequate reliability from resources to be available in advance

Several advantages for integrating forced and urgent outages and derates into RA capacity values

- Recognizing individual resource's potential contribution to reliability enables each resource to be compared and contrasted to the reliability of other resources
- Promotes procurement of better performing resources with improved operational reliability and availability
- Information on availability and reliability of resources can help buyers avoid risks and make better informed decisions when procuring RA capacity

Resource specific NQC and UCAP determinations

- CAISO proposes to calculate and publish monthly NQC and UCAP values for all resources annually
  - Once per year, a unit will have a distinct NQC and UCAP value determined for each month of the upcoming year
  - If the NQC increases mid-year, in accordance with existing procedures, the CAISO will update the resource's NQC and UCAP accordingly
- NQC process will remain similar to current approach with no major proposed changes, depending on transition approach
- CAISO proposes that the calculation of each resource's UCAP will be limited at a resource's NQC value and will consider the resource's forced and urgent outages and derates
  - UCAP values will not be affected by CAISO approved planned outages or opportunity outages

CAISO proposes to align CAISO BA outages with existing RC outage definitions (1 of 3)

- The following outage types indicate reduced generator availability and would affect UCAP values
  - **Forced Outage** – Facility/equipment that is removed from service in 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
    - Urgent outages allow facilities to be removed from service at an optimal time for overall system reliability
    - The work may or may not be able to wait for the Short Range outage window

CAISO proposes to align CAISO BA outages with existing RC outage definitions (2 of 3)

- The following outage types indicate reduced generator availability but would **not** affect the UCAP value
  - **Planned Outage** – Facility/equipment outage with enough advance notice to meet short range submittal requirements
  - **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 proposes to align CAISO BA outages with existing RC outage definitions (3 of 3)

- These outages would not be included in the resource's UCAP value because they do not indicate reduced availability of a generator
  - **Operational Outage** – Transmission Facility/equipment that is removed from service in the normal course of maintaining optimal or reliable system conditions but remains available if needed upon short notice
  - **Informational Outage** – Facility/equipment outage entered for informational reasons including increased situational awareness, for BA/TOP internal purposes or to satisfy the RC Data Specification in WebOMS
- These outages would also be adopted for the CAISO BA to ensure full alignment with RC outage definitions

CAISO proposes an exemption process for forced outages caused by rare events

- UCAP should reflect the reliable, dependable capacity available to ensure sufficient resource availability to meet operational needs
- Excluding outages that predictably occur as a part of normal operations poses reliability risks by overestimating the availability of resource adequacy resources
- Rare outlier events that cause longer duration outages would not necessarily represent the true forced outage rate of the resource going forward
- CAISO proposes after the fact review process to exempt large outlier events that are outside normal utility operations, significantly affect the resource's UCAP value, and are unlikely to recur within the same UCAP calculation period

CAISO will consider an outage for an exemption if it meets the following criteria

- **UCAP Exempt Outage**
  - An outage caused by a natural disaster, act of the public enemy, war, or insurrection. The cause must occur at the plant location and directly affect operability of a generating unit for 5 consecutive days or longer, has not occurred in the previous three years, and could not be avoided through the exercise of Good Utility Practice
- UCAP exempt outages submitted by the generator's SC with sufficient justification within 30 days of the conclusion of the outage will be reviewed by the CAISO, and if approved, exempted from the UCAP calculation for the season in which the outage occurred

Additional detail regarding outages caused by wildfires in response to stakeholder comments

- California has a known fire season in which it is reasonable to assume recurrence of generator outages due to nearby wildfires or PSPS events
  - These outages would not be subject to a UCAP exemption
  - These outages are a function of the location, weather patterns, and wildfire risk
  - These events are recurring and can significantly impact the availability of the resources located in fire prone areas, thus impacting the CAISO's ability to reliably serve system load year after year

UCAP METHODOLOGY: SEASONAL AVAILABILITY FACTORS

CAISO has updated seasonal availability factor proposal for UCAP evaluations

- CAISO will develop and utilize a seasonal availability factor based approach for UCAP determinations during the tightest system conditions
- Resource availability factors will incorporate historical derates and forced and urgent outages
  - Excludes planned and approved opportunity outages
- CAISO believes this updated UCAP determination proposal, based on seasonal availability factors, is best applied to the following resource types:
  - Thermal, Hydro, and Storage resources
  - For resources with QC values calculated using an ELCC methodology, CAISO will use ELCC value as the UCAP value

CAISO proposes to calculate resource availability on a seasonal basis measured on tight supply cushion hours

- CAISO proposes to utilize two seasons for UCAP evaluations
  - On-peak: May-September (summer)
  - Off-peak: October-April (winter)
- Considers different impacts of availability during seasons across the year to better reflect unit reliability
- A large supply cushion indicates less real-time system resource adequacy risk because more energy remains available to respond to unplanned market events
- A low supply cushion indicates the system has fewer assets available to react to unexpected outages or load increases, indicating a high real-time system resource adequacy risk

New proposal assess forced outages during 20% of tightest supply cushion hours

- Today we assess 5 RAAIM hours per day, which is roughly 20% of all hours
- Using RAAIM as inspiration, we are proposing to calculate UCAP based on the top 20% of tightest supply cushion hours for peak and off peak months
- Advantages
  - Penalizing resources for being on a forced outage when the grid really needed them
  - Unlike RAAIM, these assessment hours can fall at any point in the day, and thus resources are incentivized to always be available
  - Simpler than an EFORd methodology, or weighting of all hours
  - Provides consistency across evaluation periods

Defining Top 20% Tightest Supply Cushion Hours

- **Supply Cushion = Daily Shown RA** (excluding wind and solar) **– Daily Planned Outage Impacts – Daily Forced Outage Impacts – Net Load – Contingency Reserves**
- Supply cushion represents how much shown RA MWs are leftover after we take into account outages, serving net demand, and covering contingency reserves
- Contingency Reserves represents Regulation Up, Spin and Non-Spin Reserves
- Measured in MWs
- Because net load is a 5 minute measure, to convert the supply cushion into an hourly value we take the mean of the supply cushion across all 12 RTD intervals to represent the supply cushion in each operating hour

Stakeholder comments on Supply Cushion Definition

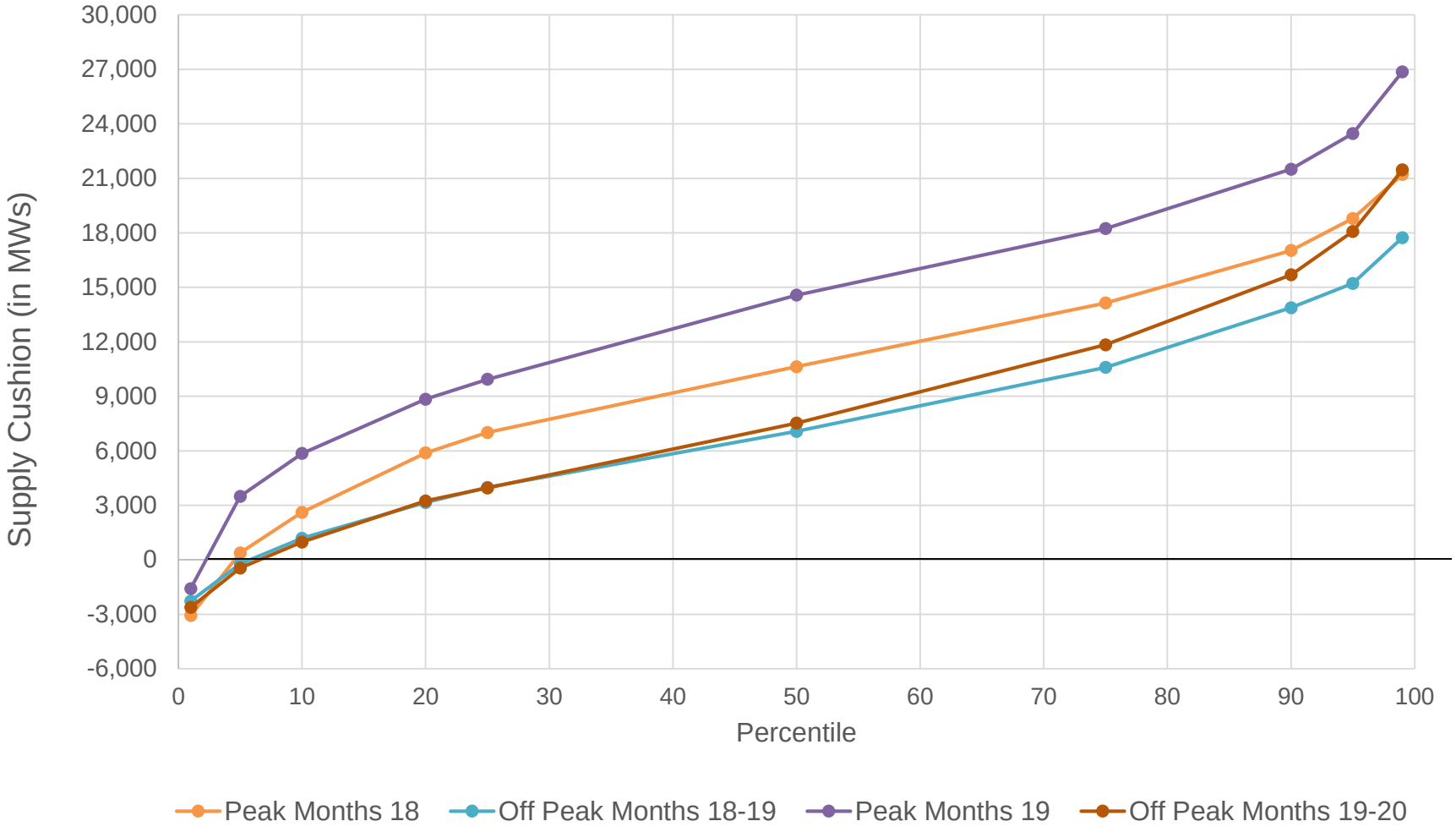
- Stakeholders reiterate importance of correctly defining supply cushion, and offered several suggestions for further refinement
- Calpine suggested looking at actual unit commitments and ramp rates to determine hours with the highest reliability risks
  - CAISO recognizes these contribute to reliability risks, but thinks that changes under DAME will improve unit commitment and sufficient ramp capabilities, and it is unlikely that this method would identify significantly different hours to assess UCAP
- SDG&E suggested counting any hour in which the supply cushion fell below the PRM*Load
  - CAISO already considered this approach, but the high variability in number of hours, and potential for no hours, increases risks for market participants and leads to outages being weighted differently across years
- Several stakeholders asked that we publish UCAP Assessment Hours ahead of time to reduce operational risks
  - CAISO can't know ahead of time which hours will be UCAP AH, but it will publish when UCAP AH were as part of its annual UCAP processes

Distribution of Supply Cushion Hours (in MWs)

Percentile	2018 Peak Months	2018-2019 Off-Peak Months	2019 Peak Months	2019-2020 Off Peak Months
1.0	-3062	-2266	-1584	-2619
5.0	380	-217	3494	-449
10.0	2619	1191	5859	977
20.0	5890	3152	8842	3243
25.0	7012	3989	9936	3960
50.0	10627	7069	14572	7526
75.0	14139	10592	18237	11840
90.0	17030	13881	21500	15688
95.0	18790	15220	23468	18076
99.0	21213	17737	26867	21467
Hours	3672	5088	3672	5111

Note: A negative value indicates there was a capacity shortfall- did not have enough Shown RA to cover Outages, Net Load, and Contingency Reserves

Distribution Curves of Supply Cushion Hours (in MWs)



Distribution of the Top 20% of Supply Cushion Hours by Operating Hour

HE	Peak Months 2018		Off Peak Months 2018-2019		Peak Months 2019		Off Peak Months 2019-2020	
	# of Obs.	% of Obs.	# of Obs.	% of Obs.	# of Obs.	% of Obs.	# of Obs.	% of Obs.
1	4	0.54	6	0.59	18	2.45	13	1.27
2	0	0.00	2	0.20	8	1.09	2	0.20
3	0	0.00	1	0.10	4	0.54	2	0.20
4	0	0.00	1	0.10	4	0.54	1	0.10
5	0	0.00	3	0.29	7	0.95	4	0.39
6	2	0.27	12	1.18	16	2.18	20	1.96
7	4	0.54	66	6.48	19	2.59	65	6.36
8	1	0.14	51	5.01	8	1.09	46	4.50
9	0	0.00	10	0.98	5	0.68	14	1.37
10	0	0.00	5	0.49	4	0.54	7	0.68
11	0	0.00	1	0.10	3	0.41	4	0.39
12	1	0.14	0	0.00	4	0.54	1	0.10
13	6	0.82	0	0.00	7	0.95	1	0.10
14	14	1.90	3	0.29	9	1.09	2	0.20
15	23	3.13	5	0.49	13	1.77	6	0.59
16	30	4.08	11	1.08	22	2.99	15	1.47
17	38	5.17	42	4.13	27	3.67	60	5.87
18	60	8.16	102	10.02	44	5.99	116	11.35
19	93	12.65	150	14.73	82	11.16	141	13.80
20	124	16.87	169	16.60	115	15.65	146	14.29
21	126	17.14	161	15.82	117	15.92	140	13.70
22	109	14.83	126	12.38	103	14.01	121	11.84
23	72	9.80	74	7.27	66	8.98	69	6.65
24	28	3.81	17	1.67	31	4.22	27	2.64
Total	735	100.0	1018	100.0	735	100.0	1022	100.0

- This table shows the distribution of the top 20% of tight supply conditions hours by operating hour.
- As expected, the majority of tight supply cushion hours are around the evening ramp/peak- HE 18-22. In Off Peak Months, we also see a spike during the morning ramp.
- However, because there are hours that fall outside these ramps, it further incentivizes resources to be available for all hours, b/c there is a chance a tight supply cushion hour could fall outside these predictable periods.
- Caputres a similar picture that a weighted 8760 analysis would
- This approach will include a majority of the possible days (averages 79.3%)

Summary of UCAP process steps

1. Determine UCAP Assessment Hours by identify which hours fall into the top 20% of tightest supply cushion hours for each season
2. Determine Hourly Unavailability Factors (HUF) for each UCAP assessment hours each season
3. Determine Seasonal Average Availability Factors (SAAF) using HUFs for each season of prior year
4. Determine Weighted Seasonal Average Availability Factors (WSAAF) using proposed weighting approach
5. Apply WSAAFs for each season of the prior 3 annual periods to determine monthly UCAP (On-peak and Off-peak) values for each resource

Proposed UCAP calculation steps

- CAISO will determine each resource's Hourly Unavailability Factor (HUF) for each of the 20% tightest supply cushion hours per season

$$\textbf{Hourly Unavailability Factor} = \frac{\textbf{Derates} + \textbf{Forced} \,\&\, \textbf{Urgent Outage Impacts}}{\textbf{NQC}}$$

- CAISO will utilize the average of Hourly Unavailability Factors (HUF) for each season for each of the past 3 years to create a Seasonal Average Availability Factor (SAAF) for each resource

$$\textbf{Seasonal Average Availaility Factor} = 1 - \frac{\sum \textbf{Hourly Unavailability Factors}}{\textbf{Number of Observed Hours}}$$

Proposed UCAP calculation steps (continued)

- CAISO also proposes a weighting method for determining a resource's UCAP values over three year period
- CAISO proposes the following percentage weights for the availability factor calculation by year from most recent to most historic: 45-35-20%
- In other words, the following percentage weights will be applied to the seasonal availability factors:
  - 45% weight for the most recent year's seasonal availability factor
  - 35% weight on the second year
  - 20% on the third year

Proposed UCAP calculation steps (continued)

- Seasonal Average Availability Factors (SAAF) will be calculated for each of the 3 prior historical years (for both on-peak and off-peak seasons)
- SAAFs will based on each Hourly Unavailability Factor (HUF) derived by assessing forced outages and derates compared to the annual NQC value for each resource
- CAISO will then apply proposed weighting to each of the five previous annual periods (for each on-peak and off-peak season) to create Weighted Seasonal Average Availability Factors (WSAAF)

$$\textbf{Weighted Seasonal Average Availability Factor} = \textbf{Annual Weighting} * \textbf{Seasonal Average Availability Factor}$$

Proposed UCAP calculation steps (continued)

- Once the Weighted Seasonal Average Availability Factors (WSAAF) are established for each season of each of prior 3 years, CAISO will sum the factors and apply them to each resource's NQC to determine the resource's seasonal UCAP ratings

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

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

Appendix files demonstrate UCAP methodology for three sample resources

- Actual Outage and derate data was collected for May 2018-April 2020 for three example thermal resources
- Outage and derates were matched to the top 20% of tightest supply cushion hours from peak and off peak season
- Year 3 was estimated as the average of Year 1 and 2
- Examples show that what impacts a resource's UCAP value is systemic outages, rather than the occasional forced outage.
  - i.e. UCAP values represent a resource's reliable capacity, rather than random variation in performance

UCAP determination example: Thermal Resource A

$$\text{UCAP} = \sum \text{Weighted Seasonal Average Availability Factors}^{\text{Season}} * \text{NQC}$$

Year	Peak Months SAAF	Annual Weight	Weighted SAAF (Summer / On-Peak)
3	0.911	20%	0.182
2	0.835	35%	0.292
1	0.931	45%	0.419
		Total = 100%	0.893
Year	**Off Peak SAAF**	**Annual Weight**	**Weighted SAAF (Winter / Off-Peak)**
3	0.986	20%	0.197
2	0.986	35%	0.345
1	0.987	45%	0.444
		Total = 100%	0.986

Sum of Weighted SAAFs (Summer)	Sum of Weighted SAAFs (Winter)	NQC	On-Peak UCAP	Off-Peak UCAP
0.893	0.986	250 MW	223.25 MW	246.5 MW

Note: SAAF based on actual outage data, (see excel files for HUF values) but NQC value modified to anonymize the resource

UCAP determination example: Thermal Resource B

$$\text{UCAP} = \sum \text{Weighted Seasonal Average Availability Factors}^{\text{Season}} * \text{NQC}$$

Year	Peak Months SAAF	Annual Weight	Weighted SAAF (Summer / On-Peak)
3	0.941	20%	0.188
2	0.990	35%	0.347
1	0.891	45%	0.401
		Total = 100%	0.936
Year	**Off Peak SAAF**	**Annual Weight**	**Weighted SAAF (Winter / Off-Peak)**
3	0.972	20%	0.194
2	0.982	35%	0.344
1	0.962	45%	0.433
		Total = 100%	0.971

Sum of Weighted SAAFs (Summer)	Sum of Weighted SAAFs (Winter)	NQC	On-Peak UCAP	Off-Peak UCAP
0.936	0.971	100 MW	93.6 MW	97.1 MW

Note: SAAF based on actual outage data, (see excel files for HUF values) but NQC value modified to anonymize the resource

UCAP determination example: Thermal Resource C

$$\text{UCAP} = \sum \text{Weighted Seasonal Average Availability Factors}^{\text{Season}} * \text{NQC}$$

Year	Peak Months SAAF	Annual Weight	Weighted SAAF (Summer / On-Peak)
3	0.947	20%	0.189
2	0.929	35%	0.325
1	0.964	45%	0.434
		Total = 100%	0.948
Year	**Off Peak SAAF**	**Annual Weight**	**Weighted SAAF (Winter / Off-Peak)**
3	0.818	20%	0.164
2	0.958	35%	0.335
1	0.678	45%	0.305
		Total = 100%	0.804

Sum of Weighted SAAFs (Summer)	Sum of Weighted SAAFs (Winter)	NQC	On-Peak UCAP	Off-Peak UCAP
0.948	0.804	50 MW	47.42 MW	40.20 MW

Note: SAAF based on actual outage data, (see excel files for HUF values) but NQC value modified to anonymize the resource

CAISO is considering two approaches to calculating UCAP for new resources*

- Option 1: Start with class average, maintain constant weights over time:
  - Year 0: 45% class avg., 35% class avg., 20% class avg.
  - Year 1: 45% year 0 performance, 35% class avg., 20% class avg.
  - Year 2: 45% year 1, 35% year 0, 20% class avg.
  - Year 3: 45% year 2, 35% year 1, 20% year 0
- Class-average data based on
  - Operating data for similarly designed resources of the same technology type
  - Availability factors observed during the 20% tightest supply cushion hours each season
- Starts with lower capacity value, but lower weights allows for time to "work the bugs out" with lower capacity value impact
- CalCCA, NRG, and PAO submitted comments in support

* May not apply to all new resources (see DR resources as an example)

CAISO is considering two approaches to calculating UCAP for new resources*

- Option 2: Start with NQC value, place heavy emphasis on actual performance in initial years:
  - Year 0: (i.e. before actual operational data): NQC
  - Year 1: 70% year 0 performance, 30% NQC
  - Year 2: 55% year 1, 35% year 0, 10% NQC
  - Year 3: 45% year 2, 35% year 1, 20 year 0
- Starts with higher capacity value, but actual performance can have significant impact early on
- CESA, EDF-Renewables, and LS Power submitted comments in support of this option

* May not apply to all new resources (see DR resources as an example)

UCAP METHODOLOGIES FOR NON-CONVENTIONAL GENERATORS

State of charge for storage resources must be considered, in addition to forced outage rates, to fully measure availability

- Optional parameters available to storage may restrict availability below full RA amount in real-time
  - End of Hour State of Charge (EOH SOC): an optional real-time market biddable parameter to achieve desired state of charge by the end of an hour
  - ESDER 4 market enhancement to preserve minimum SOCs in order to respect self-schedules in future hours
  - Resources can also elect SOCs in the master file which may limit resource availability below RA value
- UCAP calculation should consider these SOC constraints, in addition to forced outage rates, if the SOC is set such that the resource's full RA amount is not available

The CAISO proposes the following formulation for battery storage resource availability for specific hours

$$Availabiltiy = \min(ABS(Effective\ Min), Effective\ Max, \frac{Effective\ Energy}{4})$$

Where:

- Effective Min = Effective minimum that the storage resource could be dispatched to (i.e. not on outage on the charge portion)
- Effective Max = Effective maximum the resource could be dispatched to (i.e. not on outage on the discharge portion)
- Effective Energy = Total amount of energy the resource can store (i.e. energy not subject to min/max constraints during that hour)

- After this value is calculated it will be used to calculate the resource's hourly unavailability factor defined previously

These examples demonstrate outages and/or state of charge constraints (1 of 2)

If the resource is a +/- 25 MW storage resource with 100 MWh of energy storage capability:

- **Hour 1:** The resource is not on outage (+/- 25 MW) in the real-time market, and there is no constraint on the state of charge for this hour
  - Total 4-hour deliverable energy (effective availability): **25 MW**
- **Hour 2:** The resource is on outage for 5 MW (+/- 20 MW) in the real-time market, and there is no constraint on the state of charge for this hour
  - Total 4-hour deliverable energy (effective availability): **20 MW**

These examples demonstrate outages and/or state of charge constraints (1 of 2)

If the resource is a +/- 25 MW storage resource with 100 MWh of energy storage capability:

- **Hour 3:** The resource is not on outage (+/- 25 MW) in the real-time market, but imposes a minimum end of hour SOC of 25 MWh
  - Total 4-hour deliverable energy (effective availability): **18.75 MW** = (100 MWh – 25 MWh) / 4 hours
- **Hour 4:** The resource is on outage for 10 MW (+/- 15 MW) in the real-time market, and imposes a minimum end of hour SOC of 25 MWh and a maximum state of charge of 75 MWh
  - Total 4-hour deliverable energy (effective availability): **12.5 MW** = (75 MWh – 25 MWh) / 4 hours
    - Note: this value is selected because it is less than the 15 MW that is bid into the market

These examples demonstrate outages on either the charge, discharge portion, or both

Assume no constraints on the state of charge in these examples

- **Hour 5:** Bid range from -20 MW to 25 MW (5 MW outage on the charge portion)
  - Resource's effective availability is **20 MW**
- **Hour 6:** Bid range from -25 MW to 18 MW (7 MW outage on the discharge potion)
  - Resource's effective availability is **18 MW**
- **Hour 7:** Bid Range from -50 MW to 25 MW
  - Resource's effective availability is **25 MW**
- **Hour 8:** Bids Range from -50 MW to 50 MW
  - Resource's effective availability is still only **25 MW** for this hour because that is the most that could be delivered persistently for 4 hours, given 100 MWh of energy storage capacity, and equal to the resource's NQC

CAISO proposes a hydro UCAP counting methodology that generally aligns with recent CPUC decision on hydro counting

- Hydro resource output depends heavily on snowpack water availability, which can vary drastically from year to year
- CAISO proposes an alternative to the standard UCAP calculation, which would use a longer term historical-year weighted average assessment of resource availability during the 20% tightest supply cushion hours
  - Consider outages due to both water availability and mechanical outages for the previous 10 years
  - The CAISO proposes to use the historical availability during the RAAIM hours for historical years prior to calculating supply cushion

The following steps would be used to calculate UCAP for hydro resources

- Use historical bid in capacity to calculate a 50 percent exceedance and a 10 percent exceedance value
  - Weight the 50 percent value by 80 percent and the 10 percent value by 20 percent to determine the UCAP value
    - **UCAP = (.8*Median+.2*10th percentile)**
- CAISO requests stakeholder feedback on this proposed hydro UCAP methodology and if this alternative is preferred to the standard UCAP approach

For resources with QC values calculated using an ELCC methodology, CAISO will use ELCC value as the UCAP value

- CAISO will rely on an ELCC methodology when applicable
- ELCC will establish UCAP values for wind and solar resources
- Currently, the CPUC only applies this methodology to wind and solar resources, but could expand it to cover other variable energy resources such as weather sensitive or variable output DR

CAISO will use ELCC value as the UCAP value for two main reasons

1. Other ISOs equate wind and solar UCAP values with a statistical assessment of resources' output
2. ELCC already takes into account the probability of forced outages for wind and solar resources

- By using ELCC, these technologies have already had QCs reductions for expected forced outages and derates
- CAISO understands there are some shortcomings of this approach but believes this is the most appropriate option for the application of UCAP for these resource types

Resources that do not have ELCC based QC methodology but have a need for alternative UCAP determination approach

- For DR and QF resources their availability is often variable or limited to certain periods dictated by program hours or end-use customer needs
  - CAISO believes these resources should be assessed in a different manner to establish their UCAP values
- If LRAs do not adopt an ELCC based QC methodology for these variable and availability-limited resources, CAISO will apply an alternative UCAP determination

DR and QF resource: alternative performance based UCAP determination

- For DR and QF resources CAISO will evaluate resource performance relative to their dispatch instructions for periods when they received market awards
- CAISO will track each resource's historical performance over the prior 3 years and compare their market dispatches to their actual performance during those periods to establish the availability that will be applied to their UCAP value

For DR providers, the CAISO is also contemplating the need to apply this approach at an SC-level

- For DR providers, CAISO may need to apply this approach at an SC-level, rather than an individual resource level to mitigate the potential for gaming or manipulation by simply creating new DR resource IDs
- This SC-level approach is intended to avoid the potential that poorly performing DR providers receive class-average UCAP values simply by changing or creating a new resource IDs that have no historical data

DAY 2: RA Enhancements Fifth Revised Straw Proposal

July 14 - 16, 2020

Agenda – Day 1

Time	Topic	Presenter
9:00 – 9:10	Welcome and Introduction	Isabella Nicosia
9:10 – 9:30	Production simulation: Determining UCAP needs and portfolio assessment	Karl Meeusen
9:30 – 11:30	Unforced Capacity Evaluations	Bridget Sparks & Lauren Carr

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Agenda – Day 2

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9:10 – 9:50	Must Offer Obligations and Bid Insertion	Lauren Carr
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10:30 – 12:00	RA Imports	Karl Meeusen

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Agenda – Day 3

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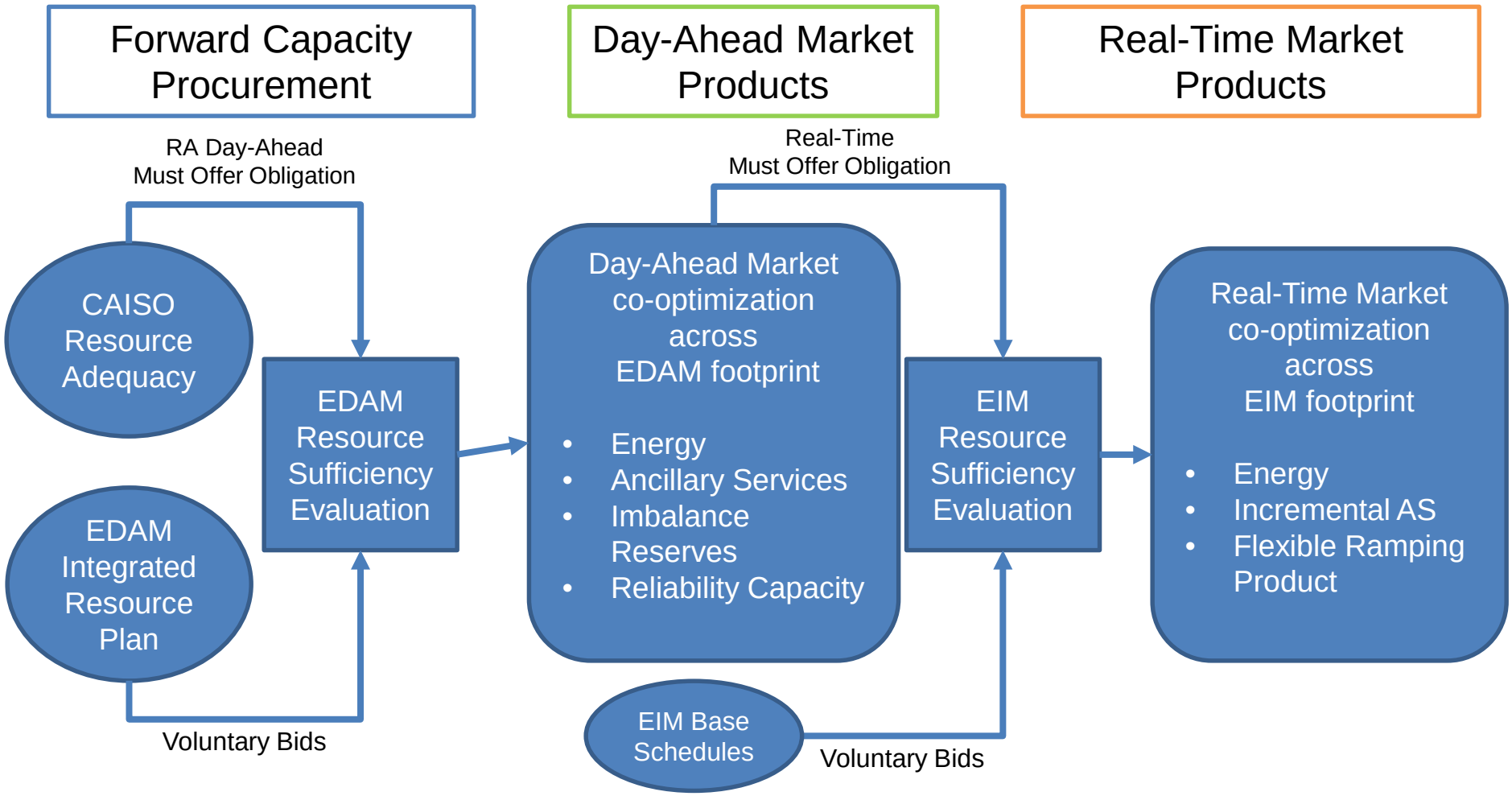
MUST OFFER OBLIGATIONS AND BID INSERTION

Overview of RA, DAME & EDAM relationship with CAISO market runs



RA resources are obligated to bid shown RA capacity into the CAISO market

- Must offer obligations (MOOs) must be set at the resource's shown NQC value
  - For example: A resource shown for 100 MW of NQC with a 20% forced outage rate (providing 80 MW of UCAP), would have a MOO to bid 100 MW of capacity into CAISO markets when not on outage
  - If a resource shows a portion of its NQC as RA the must offer obligation is set at the portion of the NQC shown as RA, not the full amount
- Allows CAISO to simplify forced outage substitution
  - By using UCAP-based RA counting and NQC-based resource bidding obligations, the RA fleet effectively provides its substitute capacity upfront
  - CAISO proposes to eliminate the existing forced outage substitution rules in favor of UCAP proposal

Resource adequacy resources will have a day-ahead must offer obligation (1 of 2)

- The CAISO proposes RA must offer obligations into the day-ahead market only, with limited exceptions
- To simplify offer obligations, the CAISO proposes a standard MOO that would apply to all RA resources, unless specified by the CAISO:
  - **Standard 24 by 7 MOO into day-ahead market:** Economic bids or self-schedules for all RA capacity for all hours of the month the resource is not on outage
    - Refers to both planned and forced outage

Resource adequacy resources will have a day-ahead must offer obligation (2 of 2)

- Products proposed in DAME will ensure sufficient commitments day-ahead to meet uncertainty that may materialize between day-ahead and real-time
- Resources awarded in the day-ahead will have a real-time must offer obligation up to their day-ahead award
- RA resources must still be available for exceptional dispatch after the conclusion of the day-ahead market whether or not they receive a day-ahead award
  - If a resource is not available for an exceptional dispatch after the day-ahead market, the resource should submit the appropriate outage card

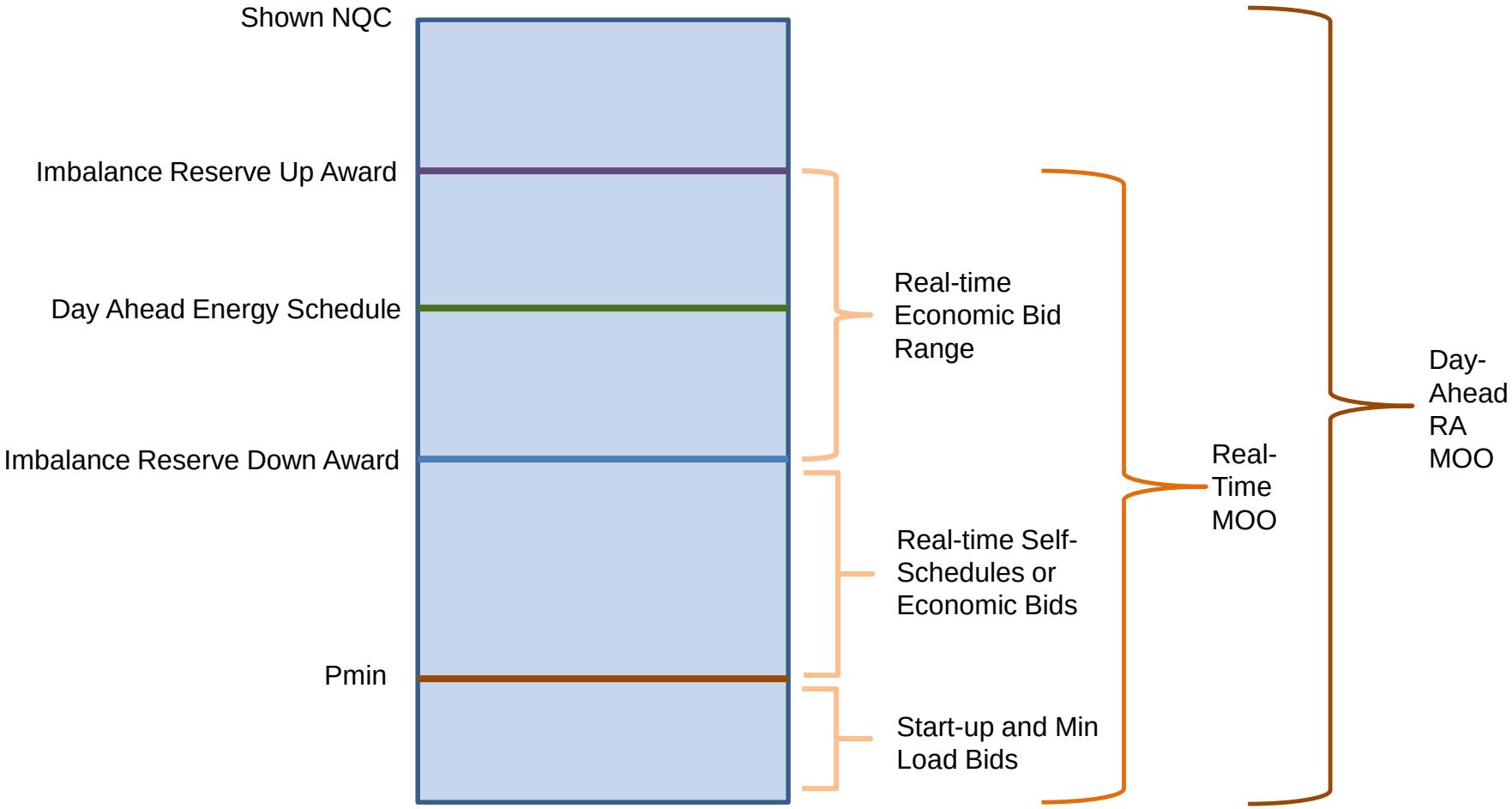
Day-ahead bidding obligations for system and local resource adequacy (1 of 2)

- Resources providing system and local resource adequacy will be required to bid or self-schedule for energy and bid or self-provide ancillary services
- Additionally, they will be required to economically bid for reliability capacity and corrective capacity for any portion not self-scheduled for energy or ancillary services
- Resources providing system and local resource adequacy only will not be required to bid for imbalance reserves
  - Resources providing flexible RA will be required to economically bid for imbalance reserves

Real-time must offer obligation overview

- Resource adequacy resources will have the same real-time must offer obligation as non-RA resources based upon day-ahead awards
  - Includes day-ahead energy schedule, ancillary services awards, reliability capacity awards, and imbalance reserve awards
  - Resources must economically bid the full range of their reliability capacity and imbalance reserve awards
- Real-time must offer obligations apply in the hourly intervals that a resource has a day-ahead schedule

Day-ahead to real-time must offer obligations



CAISO proposes the 24 by 7 day-ahead must offer obligation with bid insertion, with limited exceptions

- For a full list of proposed exemptions, see table 12 in section 4.1.4 of the Fifth Revised Straw Proposal
- Non-generator resources:
  - NGRs with a default energy bid will receive bid insertion
    - Storage DEB proposed in ESDER 4
  - NGRs must reflect charge and discharge capabilities in their day-ahead bids
  - NGRs must register under the non-REM option to provide generic RA
- Reliability demand response resources and variable resources (VERs and run of river hydro) will not have a day-ahead must offer obligation and will continue to have a real-time RA must offer obligation

PLANNED OUTAGE PROCESS ENHANCEMENTS

Previously, the CAISO put forward two new planned outage process proposals

- Option 1: Establish planned outage reserve margin for off-peak months
- Option 2: Establish a replacement marketplace conducted by the CAISO
- Stakeholder feedback is generally divided
  - Favored Option 1: SCE, Calpine, MRP, CalCCA, and Wellhead
    - Simplicity
    - Removes embedded costs to cover planned outage replacement
    - Eliminates incentive to withhold capacity from bilateral market
  - Favored Option 2: SDG&E, CPUC staff, DMM, and PAO
    - Appears to apply more direct causation to resources taking outage
    - Offered more of a market based solution

Based on the CAISO's review of other ISO/RTOs, CAISO is uniquely situated

- CAISO's planned outage options are constrained by the monthly nature of the RA program
  - Other ISOs/RTOs conduct RA procurement annually, potentially including seasonally different RA requirements
- Other ISO/RTOs can require up to two years of notice for planned outages
  - Because of much longer visibility into the RA obligations of resources, the planned outage procedures are much cleaner
  - CAISO does not know which resources will be RA resources until 45 days prior to the month
- Creates a complicated overlap between the CAISO's planned outage and RA processes

Based on the CAISO research and stakeholder feedback, the CAISO will pursue Option 1

- Only developing an additional planned outage reserve margin for the non-summer months
- Potential benefits of Option 2 are outweighed by complexity
  - Requires developing of a substitute capacity market that could be subject to market power
  - Creates additional incentives to withhold capacity from the bilateral market
  - Cost causation arguments are not as persuasive as they appear

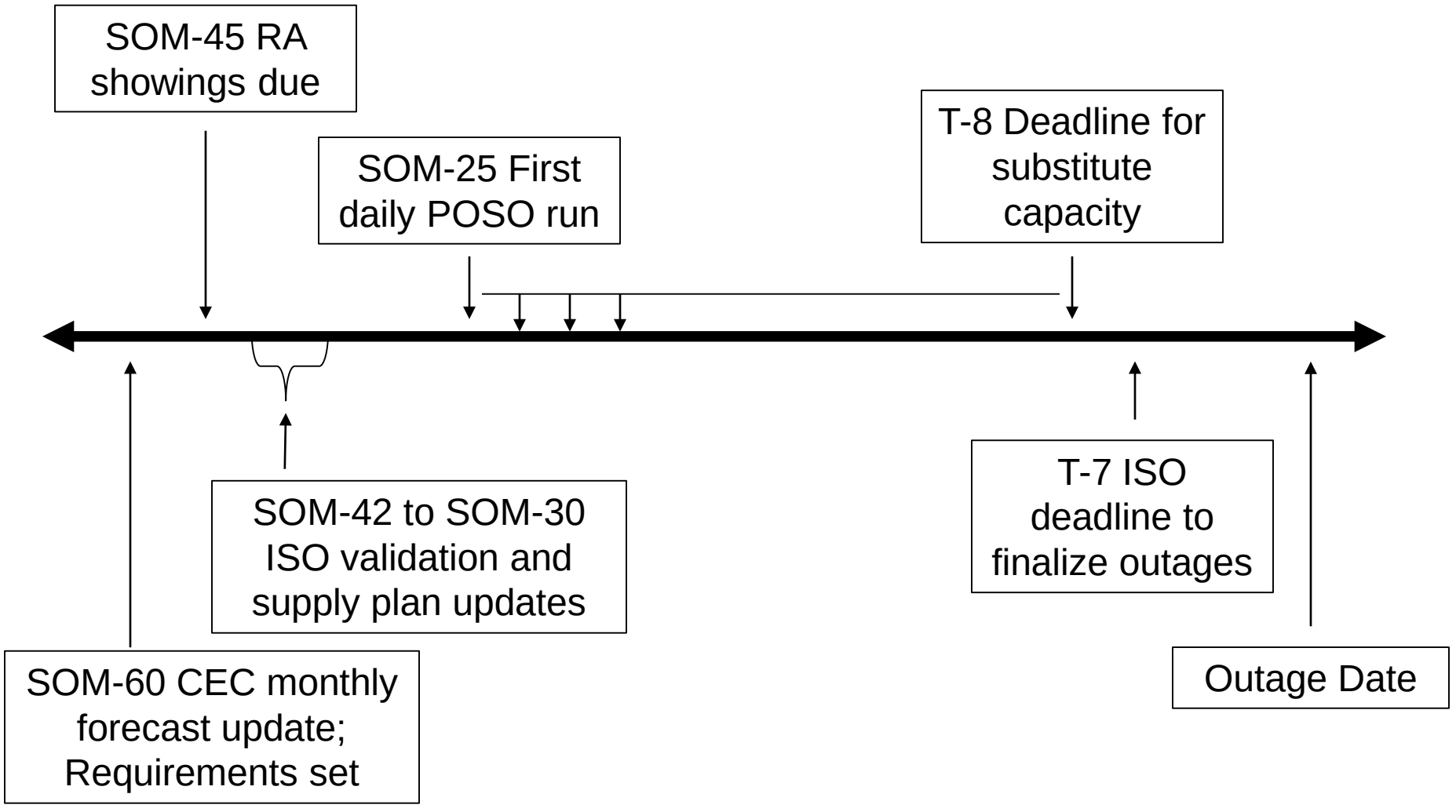
If stakeholders reject Option 1, then it will keep the existing planned outage process unchanged

- CAISO has offered numerous alternatives based on both CAISO and stakeholder proposals
- To date, stakeholders have rejected the proposals or have been highly divided in their approval or disapproval of the options offered
- Although the existing process has it challenges, the CAISO is prepared to recognize that may be the best that can be done under the current monthly RA program

Planned outage process modifications

- Stakeholders requested changes to the current planned outage system
- Most stakeholders were interested in redesigning the current framework around the following principles:
  - Encourage resource owners to enter outages early
  - Generally not cancel approved planned outages
  - Identify specific replacement requirements for a resource
  - Allow owners to self-select replacement capacity
  - Include CAISO system for procuring replacement capacity

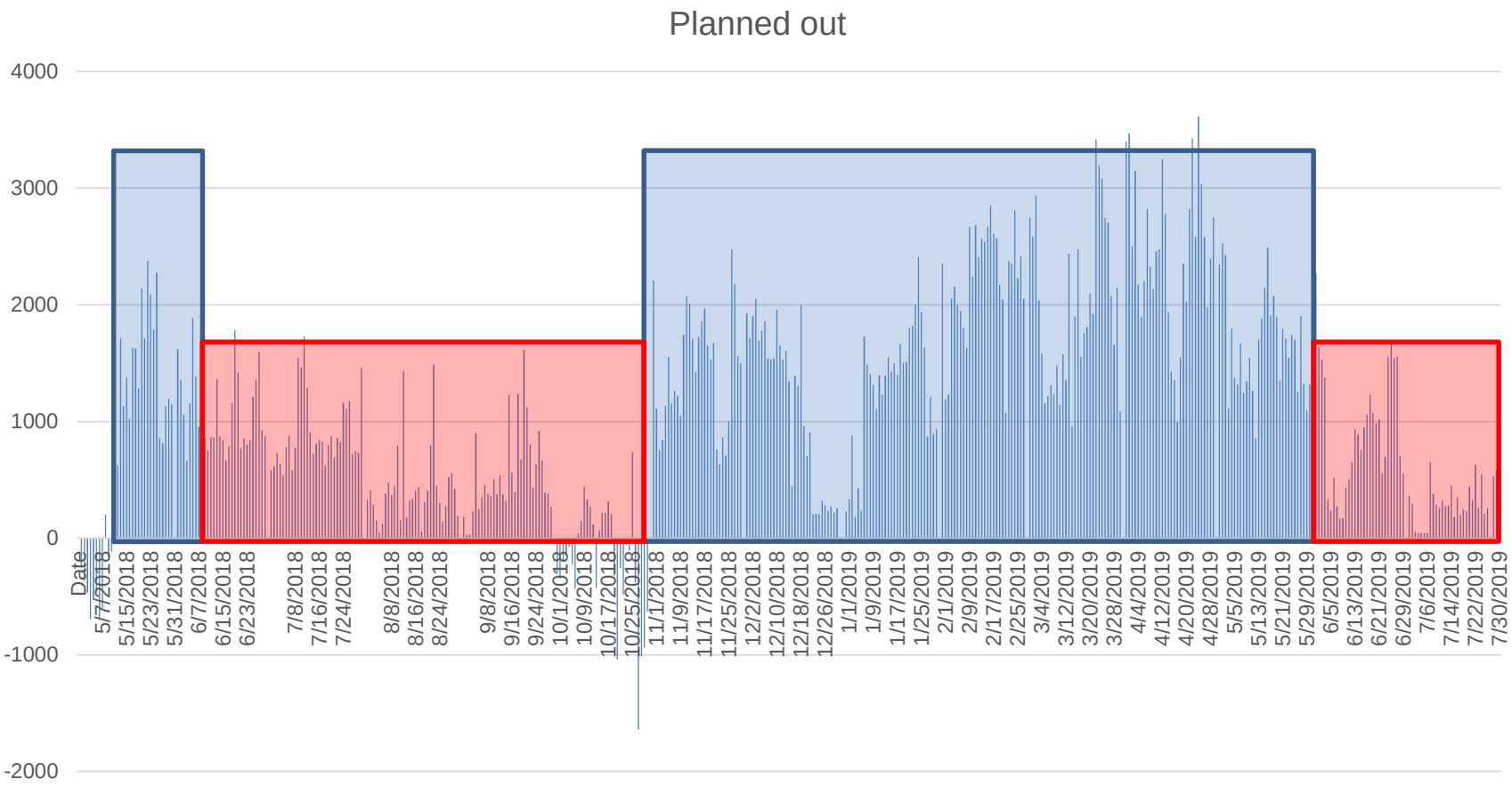
Current planned outage substitution obligation timeline



Option 1: Include planned outages procurement requirements

- CAISO would establish two new elements of the RA program
  1. CAISO would no longer allow for anything other than short-term and off-peak opportunity outages between June 1 and October 31
     - Most planned outages occur in off-peak months
  2. Establish planned outage reserve margin for off-peak months
     - Provides the greatest opportunity to procure low cost capacity
- Under this option, CAISO will also:
  - Eliminate RAAIM
  - Retain complete discretion to grant or deny all off-peak and/or short-term opportunity outages

Option 1: Include planned outages procurement requirements



Under Option 1, the UCAP capacity requirement would increase during the non-summer months

- Creates a well-defined planned outage reserve margin
- No substitute capacity is allowed or required for an outage
- CAISO's proposed capacity outage calendar would track all planned outages for each day until RA showings are made for a given month
  - Once RA showings are made, the CAISO will track how much additional capacity can take a planned outage under the planned outage reserve margin
- CAISO will review outage requests when submitted

Planned outage reserve margin should balance LSE costs and provide reasonable opportunities for resources to undertake needed maintenance

- The CAISO is not proposing a specific reserve margin
  - Not possible to declare a fixed number based on historic data
- If the planned outage reserve margin is zero, CAISO could deny or cancel all RA planned outages
  - Has the down side of potentially leading some resources to be unable to sell RA for a whole month
- If the planned outage reserve margin be set at 10,000 MW, CAISO would approve most RA planned outages
  - Would come at significant rate-payer expense
- Planned outage reserve margin can vary across months
  - i.e. 5,000 MW in January, 3,000 MW in March, zero in May

Outage requests submitted prior to RA showings will be approved or denied based on reliability assessment

- CAISO will not wait for RA showings to make this determination
- CAISO will no longer issue POSO notifications at T-22 days prior to the month for outages requested by T-25

When RA showings are made, the CAISO will subtract all planned outages on RA showings from the planned outage reserve margin for each day in the RA month

- If approved planned outages for RA resources exceeds the planned outage reserve margin
  - Then CAISO will not allow additional planned outages that day
- Approved planned outages are less than the planned outage reserve margin
  - Then CAISO will allow for additional planned outages on a given day for up to the remaining difference
  - Once planned outage requests reach the remaining planned outage reserve margin, CAISO will automatically reject all additional planned outage requests
- All planned outages are subject to reliability assessment and may be denied for potential adverse reliability impacts
  - Even if additional planned outage reserve margin remains

Examples of how CAISO will assess planned outages with a planned outage reserve margin

Timing of submission	Outage Calendar requests	Remaining planned outage reserve margin	Approved or rejected
Request made January 1 for outage on June 1	0 MW	NA	Rejected
60 days prior to month	2,500 MW	NA	Based on reliability assessment
60 days prior to month	3,500 MW	NA	Based on reliability assessment
20 days prior to outage date	2,000 MW	1,000	Based on reliability assessment
20 days prior to outage date	2,800 MW	200	Rejected
1 day prior to requested outage	3,000 MW	0	At the discretion of the CAISO

Pros and cons of Option 1

- Any outage approved by the CAISO will not impact the resource's UCAP calculation
  - All rejected planned outages, if taken, may count against the resource in its UCAP calculation
    - Regardless of the timing of the outage request or the ultimate RA status of a resource
- Eliminates all planned outage substitution
  - Removing any incentive for LSEs to withhold capacity from the market to provide substitute capacity
- Would appear to require higher overall procurement since substitution capacity is procured up front
  - Focuses on off-peak months to minimize the potential for increased capacity prices to LSEs

Although this option would require higher overall procurement, there are potential benefits to load

- Eliminates all planned outage substitution in all months
  - Removes the incentive for LSEs to withhold capacity from the market to provide substitute capacity and
  - No need for resources to include a risk premium in capacity contracts to cover any potential costs of replacement capacity
- Capacity supply in the bilateral market should increase and hidden costs should decrease
  - Benefits can be captured in both peak and off-peak months
- Focus on off-peak months minimizes potential for higher capacity prices to LSEs from higher requirements

There were numerous complex policy issues that needed to be resolved Option 2

- CAISO would have to build a complex and costly capacity clearing mechanism
- Benefits are unclear and potential downsides significant
  - Potential replacement costs
  - Market power concerns
- Stakeholders offered little in the way of how these issues would be resolved
  - Participation optional or mandatory
  - How to resolve potentially withholding capacity from the market to supplement another outage for the same SC
  - Setting daily price caps or monthly earnings caps

Cost causation arguments in support of a secondary substitute capacity break down

- All costs are ultimately passed onto to load
  - A specific generator may pay a price for substitute capacity, that resource will build that cost into its overall RA cost, which is then passed on to rate-payers
- Secondary market creates incentives for LSE to withhold some capacity to mitigate replacement cost risk
  - In these instances, the resource taking the planned outage is faced with one of two options 1) withhold capacity from the RA market to mitigate price risk or 2) risk looking for substitute capacity in a scarce market

CAISO is concerned that Option 2 can lead to planned outage costs becoming disincentives to resources doing maintenance

- Running a daily replacement capacity market will require a daily price cap, a monthly earning cap, or both
- Will prove costly and potentially result in resources forgoing maintenance
  - This risk is mitigated by the potential impacts to a resources UCAP
- These risks can be avoided entirely by establishing a planned outage reserve margin and eliminating planned outage substitution requirements

RA IMPORTS

CAISO's RA import objectives

- Modify RA import provisions to ensure RA imports are backed by physical and verifiable capacity, are not speculative, are not committed elsewhere
- Treat RA imports comparable to internal-CAISO RA resources, recognizing the CAISO competes for supply across a broad and diverse west-wide market
- Coordinate import provisions with modifications proposed through CAISO's EIM and DAME initiatives
- Create requirements that track and reasonably assimilate the resource-specific showings and verification provisions of other ISOs and RTOs

RA Import concerns are clear given current rules

CAISO has two primary concerns with current RA import rules:

1. Possibility for double counting RA import capacity
   - CAISO must be able to ensure resources shown as RA imports are not also relied upon by another BA to serve their native load, sold to a third party, or relied upon to meet the capacity needs of another entity besides the CAISO
2. Supply commitment is purely speculative and unsecured
   - Speculative RA import supply occurs when RA imports shown on RA supply plans have no physical resource backing securing the showing and no firm service delivery obligation commitment

RA imports are a growing share of California's RA capacity

- RA imports were used to meet system RA requirements during the peak summer hours an average of around:
  - 2017: 3,600 MW (about 7%)
  - 2018: 4,000 MW (about 8%)
  - 2019: 4,700 (about 10%)
- Current RA provisions require internal RA to be resource specific yet RA imports can still be non-resource specific and qualify as RA capacity
  - This fact portends a growing reliability risk to California as RA imports serve a greater share of California's RA energy needs

Brief review of key CPUC Track 1 decision elements: *(Decision D.20-06-028)*

- A resource-specific import contract shall count towards meeting RA requirements provided that it is either pseudo-tied or dynamically scheduled into the CAISO
- A non-resource-specific import shall count towards RA requirements provided that the contract is an energy contract with no economic curtailment provisions;
  - Must self-schedule or bid in between -$150/MWh and $0/MWh into the CAISO DA and RT markets at least during the Availability Assessment Hours consistent with the Maximum Cumulative Capacity buckets.
  - The energy must be delivered to the LSE in accordance with the governing contract
- For both resource-specific and non-resource specific RA import contracts, the resource must be paired with an import allocation right

Reliance on non-resource specific system resource RA contracts increases California's reliability risk

- RA import eligibility is a relatively low bar- shown on RA supply plans and has a MIC allocation
  - No resource specificity; no firm transmission service
- Allowing non-specified import RA contracts that don't represent real physical capacity at the time of RA showings means suppliers can source energy after making their RA commitments
  - Not mitigated by having an energy contract with the LSE
  - Still allow deliveries on non-firm transmission, which is subject to curtailment and recall
- Exposes system reliability to the whims and availability of whatever residual supply remains in the short-term bilateral markets across the west

Reliance on non-resource specific system resource RA contracts increases California's reliability risk (cont'd)

- A self-schedule or ≤$0 MWh bidding requirement during the AAH does not mitigate the CAISO's speculative supply or double counting concerns
  - Leaves transmission service and a suppliers ability to actually deliver RA import energy unaddressed
- Because of tightening supply in the West and in California specifically, the CAISO is increasingly concerned about the dependability and reliability of current RA import under existing RA rules

CAISO's proposal balances the need for reliable and dependable RA imports against the fact that California competes for supply in a west-wide market

Four primary elements:

1. **Source specification**: RA import capacity must be sourced from verifiable sources
2. **Dedicated service**: RA import capacity must be dedicated solely to serving CAISO reliability needs
3. **Delivery assurance**: RA import capacity must be dependable and deliverable on firm transmission
4. **Offer obligation**: RA Imports must abide by must offer obligations like all other RA resources

Source specification: RA imports must be verifiable and resource specific

- Eligible resource-specific RA types include:
  1. Non-dynamic resource-specific system resources
  2. Dynamic resource-specific system resources
  3. Pseudo-ties
- Non-dynamic resource specific system resources includes:
  - a single resource
  - a specified portfolio of resources within a single BAA
  - BAA's pool of resources
- Non-resource specific system resources will no longer qualify as RA import capacity
  - Eligible and encouraged to provide economy energy

Dedicated service: RA import capacity must be dedicated solely to serving CAISO reliability needs

- CAISO will require an attestation that the RA capacity is not sold or otherwise committed to any other entity and is not being used in connection with any other capacity or RA construct in the applicable RA compliance month
- The CAISO will develop the specific wording of the attestation requirements in the tariff development process
  - The CAISO will model the attestation similar to provisions in other ISO/RTO tariffs and business practice manuals

Delivery assurance: RA import capacity must be dependable and deliverable on firm transmission

Preference- require firm transmission service source to sink

- Firm service on all lines of interest to CAISO BAA
- Demonstrated month-ahead at time of showing
- RA imports have the same curtailment priority afforded to the BAA's native load

Alternative- allow firm transmission service on last line of interest (last leg) to CAISO BAA

- *e.g.* Firm transmission service on BPA's southern interties to COB and NOB but allow non-firm service on upstream network
- Allow minimum day-ahead e-Tagging requirement demonstrating firm transmission service on last line of interest
- Prudent to secure firm transmission service on all paths in advance

Delivery assurance: (cont'd)

- Under Alternative approach:
  - If only requiring firm transmission on last line of interest:
    - What other mechanisms might be needed to ensure delivery of RA import if upstream non-firm service is curtailed or recalled?
  - CAISO would monitor and consider imposing firm transmission service on all lines of interest, source to sink, if curtailments are occurring
- Provisions to ensure RA import cannot be recalled or curtailed to meet a source or intervening BAA's own needs

Offer obligation: RA Imports must abide by must offer obligations like all other RA resources

- All RA imports have a day-ahead must offer obligation
- Interim MOO provision:
  - Period between RA import implementation and DAME implementation- likely RA compliance year 2022
    - Require a real-time MOO requirement for interim period
- Once DAME implemented, DAME tariff provisions will redefine all real-time must-offer obligations for RA resources
- See proposal for details on the interim and post-DAME must offer obligations by RA import resource type

Transmission delivery requirements for RA imports in other ISOs/RTOs

ISO-NE

- Must document that neighboring and intervening control areas will afford import capacity the same curtailment priority as native load
- ISONE can request any and all information sufficient to show the ability of the generator to deliver capacity
- Imports must describe in detail how its capacity/energy will be delivered to the ISONE border

NYISO

- Must demonstrate that the UCAP is deliverable to the New York Control Area
- External control area will afford the same curtailment priority that they afford their own Control Area Native Load Customers

Transmission delivery requirements for RA imports in other ISOs/RTOs (cont'd)

MISO

- Must demonstrate firm transmission service from the external resource to the MISO border
- External BAA qualification options to ensure energy schedules from external resources are interrupted in a manner that is transparent and supports reliability

PJM

- Imposes requirements based on how the external resource participates in the capacity market
  - can be as rigorous as a pseudo-tie arrangement or that the resource has firm transmission service to the PJM border

SPP

- Requires firm service from external resource to load
- Must be available comparable to power delivered to native load

Firm transmission service provides the best assurance energy schedules will reach the CAISO BAA

- Under the Pro Forma OATT:
  - Firm transmission service will always have a reservation priority over non-firm transmission service and all long-term firm transmission service will have equal reservation priority with native load customers and network customers.
  - Short-term firm transmission service has first right of refusal over long-term transmission service with conditions to match long-term firm transmission terms
  - Non-firm transmission service is subordinate to firm transmission service and is subject to curtailment and interruption

Non-firm transmission can put the delivery of RA imports in jeopardy

- Non-firm transmission service can be interrupted or curtailed for:
  1. A request for firm transmission service
  2. A request for non-firm transmission service of greater duration
  3. A request for non-firm transmission service of equal duration with a higher price
  4. Transmission service for network customers from non-designated resources, or
  5. Transmission service for firm transmission service during conditional curtailment periods
- Non-firm provides no assurance of delivery, especially in periods when the west is tight on supply
- Neither resource specificity nor an energy contract resolves the potential for non-delivery if non-firm

Offering an alternative approach of requiring firm transmission service only on last leg is warranted

- Attempts to balance the CAISO's need for reliable, dependable and affordable RA imports, with the need for efficient and liquid markets recognizing California competes for energy and transmission across the west
- If alternative approach is pursued, CAISO will closely monitor to ensure non-firm point-to-point transmission service is not curtailed or harms energy delivery
  - CAISO considering non-compliance penalties or UCAP hit if schedule is delivered as "non-firm" on last line of interest
  - CAISO considering UCAP hit if RA import is curtailed or undelivered

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ADDITIONAL DISCUSSION ON MODIFYING REAL-TIME MUST OFFER OBLIGATION

TRANSITIONING TO UCAP PARADIGM

The CAISO is exploring two primary options for integrating unforced capacity outages into the RA program

- Option 1: A two step de-rate process to resource QCs that includes resource availability
  - Step 1: Conduct resource deliverability assessment and adjust QC for deliverability, creating Deliverable QC (DQC) for the resource (i.e. today's NQC will become DQC)
  - Step 2: Apply non-availability factor to DQC, resulting in NQC for the resource
- Pros:
  - Capacity value will still be expressed in terms of NQC, addressing stakeholder concerns about existing contracts
- Cons:
  - May create more confusion than it solves by using the same term to mean two different things over time
  - Requires significant revisions to numerous sections of the CAISO tariff to clarify bidding requirements (for example, MOOs would now be in terms of DQC)

The CAISO is exploring two primary options for integrating unforced capacity outages into the RA program

- Option 2: De-rate NQC for forced outages to calculate UCAP
  - Apply non-availability factor to current NQC definition, resulting in UCAP value
- Pros:
  - Removes ambiguity from duel meaning of the term NQC over time
  - Clarifications of to exists RA contracts would be jointly needed, not favoring one side over the other
- Cons:
  - May require reworking existing contacts

Stakeholder Comments

- The CAISO received mixed feedback, with slightly more response to Option 2
- Option 1 was supported by CalCCA, CESA, EDF-R, LS Power, and SCE
- Option 2 was supported by Calpine, CDWR, NRG, Powerex, Six Cities, SDG&E, Wellhead
- The CAISO is leaning more towards Option 2, but would like additional stakeholder comments

The CAISO proposes a clean transition to UCAP accounting and requirements by the 2023 RA year

- Transitional accounting protocols will only add complexity and costs while potentially degrading reliability
- The CAISO proposes
  - 2022 RA year – Binding RA requirements established in terms of today's NQC values, but shadow test both UCAP RA requirements and showings
  - 2023 RA year – UCAP requirements and showings become binding for the 2023 RA year

Stakeholder Comments

- CalCCA expressed support for this timeline
- SDG&E argued that because the Central Procurement Entity (CPE) was instructed by the CPUC to begin in 2023 RA year, transitioning to UCAP at the same time could add additional complexities to this the CPE transition, and requests we delay the transition to UCAP
- SMUD also did not support transitioning to 2023 RA year because many LSEs have contracts through 2023, and suggest we begin the transition to UCAP in 2024 to be more consistent with CPUC rules.
- The CAISO seeks additional feedback on timing of UCAP transition

UCAP FOR LOCAL

CAISO outlined a proposal to apply UCAP calculations for local capacity counting

- CAISO continues to prefer local RA procurement be done with NQC values
- Numerous parties supported the CAISO's proposal to apply a conversion factor after the local capacity studies have been completed
  - SDG&E objects to the use of UCAP for local
  - PG&E and SCE asks for additional example to clarify how the CAISO would apply the various options for UCAP in local areas

The CAISO will continue running the local capacity studies exactly as is done today using NQC

- CAISO will publish the local capacity requirements in terms of NQC
- The CAISO will provide a translation table from NQC local requirements to UCAP local requirements
  - Translations will be done by TAC
- For each TAC, the total local UCAP requirement will be defined as follows:
- $$\boldsymbol{Total\ TAC\ UCAP\ responsibility} =$$

$$\left(\sum \boldsymbol{of\ TAC\ wide\ NQC\ requirements}\right) \times \left[\frac{\sum\ \boldsymbol{of\ TAC\ wide\ UCAP\ values}}{\sum\ \boldsymbol{of\ TAC\ wide\ NQC\ values}}\right]$$

NQC and UCAP *values* used in the conversion factor are given by all available values in the previous year's NQC/UCAP list for resources already in-service

- Using the NQC and UCAP values from the current year is both an infeasible and undesirable result
  - The LCR studies run from December-May
  - The annual NQC deliverability study is done in June-July
  - NQC list is currently completed August/September
- LCT study and UCAP translation needs to be final by May 30 – 120 days before the showings get here
  - CPUC requires draft LCR study April 1 and final by May 1
- Avoids complications derived from including estimated NQC and estimated UCAP values for new resources

The CAISO will calculate LSEs' local load-share ratio responsibility in terms of UCAP at the TAC level

- LRAs will be given their share UCAP to allocate to their LSEs
  - The LRA may allocate these responsibilities using its preferred methodology
  - If the LRA does not allocate their entire responsibility to their jurisdictional LSEs the CAISO will allocate the difference
- LSEs' individual compliance in meeting their given local allocation is calculated in UCAP
  - An LSE will be determined to be individually adequate if its shown UCAP is equal or greater than its allocated share

CAISO will convert UCAP values back into NQC values and run its compliance studies of all RA showings with local technical criteria and requirements

- In addition to deficiencies caused by effectiveness factors that exist today, the CAISO must also ensure there are adequate MWs in a given area
  - For example, the CAISO may receive adequate UCAP to meet individual obligations, but not enough MW to serve peak load in a local capacity area
- Deficiencies will be defined as either
  - Insufficient MW of NQC to meet the LCR
  - Insufficiently effective capacity

The CAISO will notify LSEs of any deficiencies and provide them an opportunity to cure

- If still short, the CAISO may purchase capacity from remaining non-RA resources through its CPM authority cure the deficiency
- The cost will be allocated
    1. Pro rata to each LSESC based on the ratio of its LCR Deficiency to the sum of the deficiency of LCR deficiency within a TAC Area, then
    2. If anything else is required the cost allocation will be based on the SCs proportionate share of Load in such TAC Area(s)

The CAISO may assess a number of variables to determine which resources to offer CPM designations to cure deficiencies

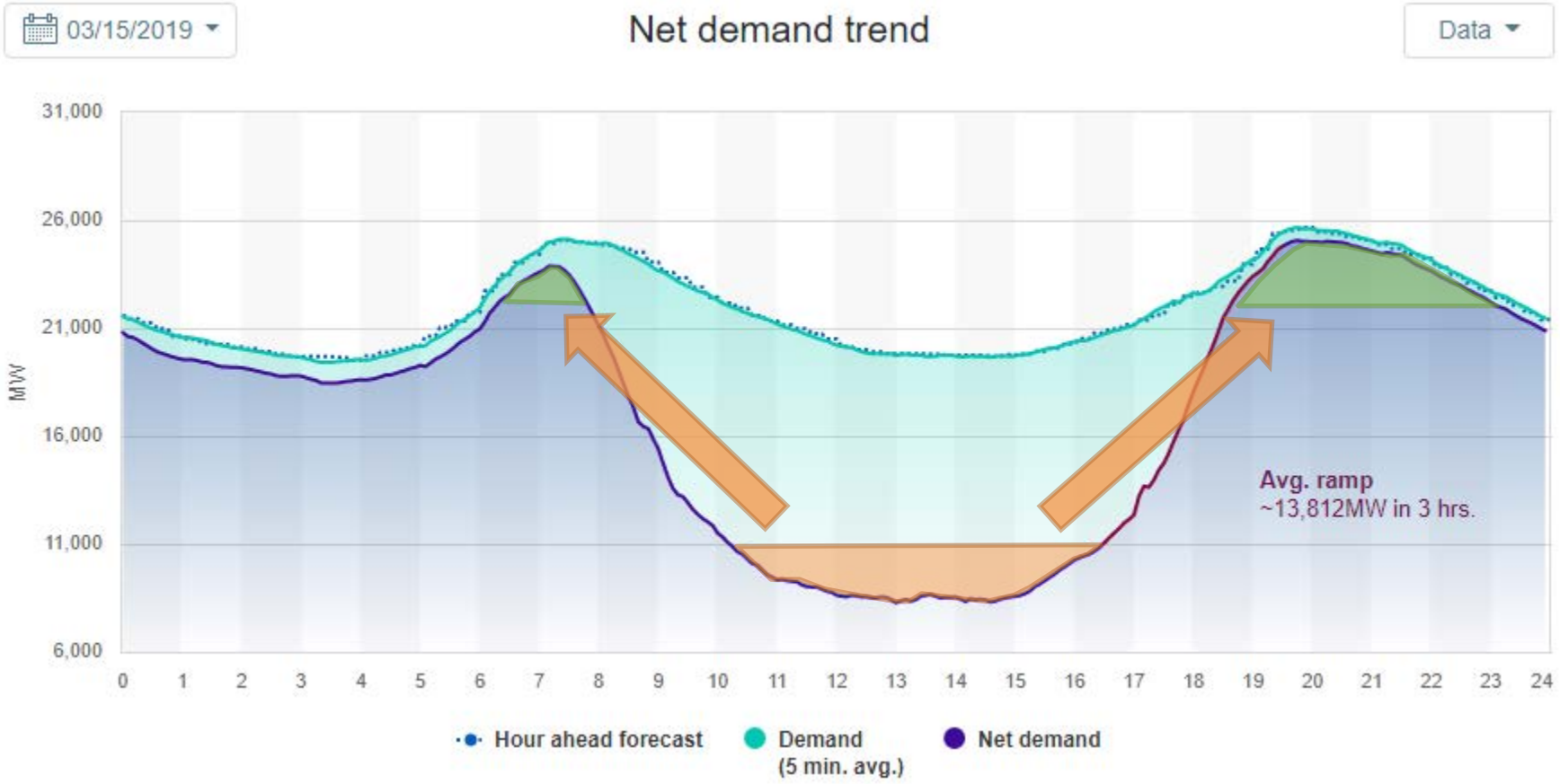
- Variables include, but are not limited to
  - Cost
  - Effectiveness, and
  - Reliability
- The CPM cost will be divided to the LSEs per the different varieties of CPM
- The LSEs that receive cost allocation for the CPM will get a capacity credit commensurate with their CPM cost ratio allocation
  - The amount of the credit is based on the quantity of UCAP purchased, not the NQC value

OPERATIONALIZING STORAGE

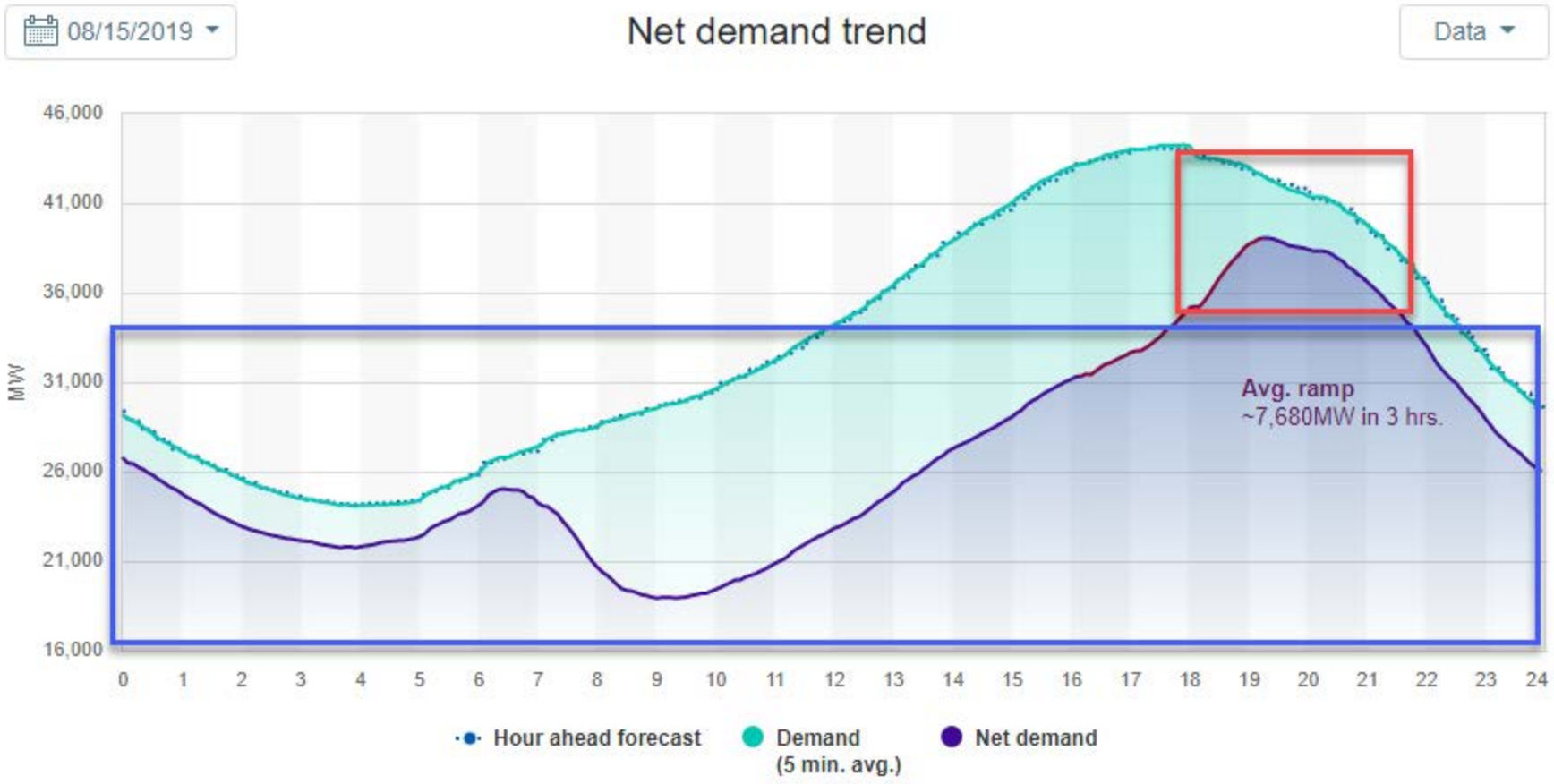
Battery storage may become a rapidly growing segment of California's resource mix

- The CPUC authorized new resource procurement for 3,300 MW of resource adequacy capacity
- Retirement over next few years include older steam resources and Diablo Canyon nuclear facility in 2024
- Today there are about 200 MW of storage online, but the ISO may be dispatching thousands of MW shortly
- Much of the new procurement may come in the form of battery storage and hybrid (solar + storage) resources
- These resources bring new integration challenges
- The Minimum charge requirement (MCR) will work with other RA tools to ensure storage is charged

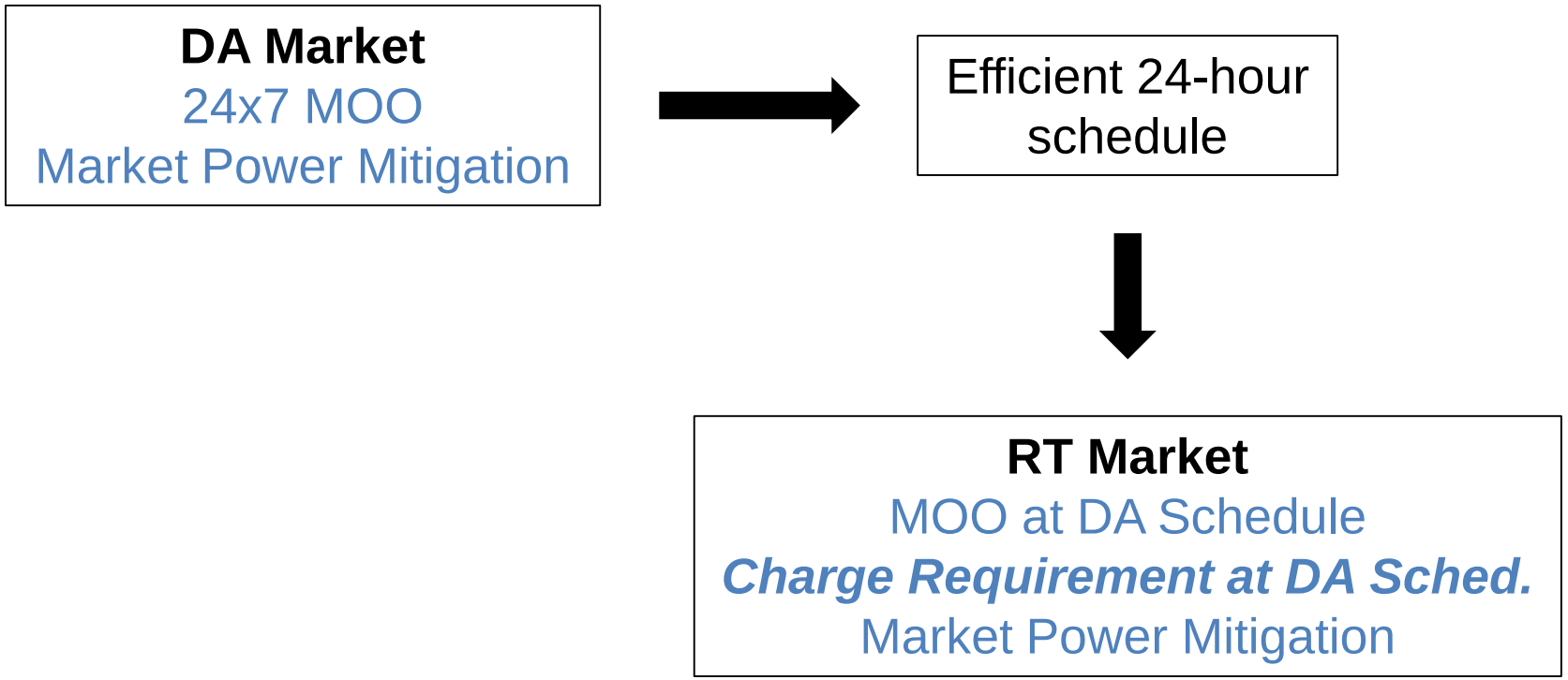
Planning for storage resources assumes ‘arbitrage’ of day-ahead energy prices from batteries



In the future storage will be critical for meeting load on days with the highest ***net load*** peak



The ISO is implementing a number of tools across three initiatives to ensure grid reliability with storage integration in real-time market



Propose to implement a minimum charge requirement (MCR) for all resource adequacy storage resources

- The state of charge is currently maintained for storage resources on the system
- Resources that are shown for RA will have dispatch constrained by a minimum charge requirement
  - Will not bind in hours after day-ahead discharge schedule
  - Will not bind in excess of aggregate day-ahead discharge schedule
  - Will not bind if there is no day-ahead discharge schedule
- The constraint ensures that the day-ahead discharge schedule can be met for the resource
- Is enforced as a minimum state of charge, that the real-time market will not dispatch the resource below

The same hypothetical resource is charged partially in the morning and discharged in the evening

Hour	9	10	11	12	...	17	18	19	20	21	22	23	24
Load	190 MW	190	190	200	...	300	330	335	345	350	340	280	210
DA Bid ↓	$30/MWh	$30	$30	$30		$30	$30	$30	$30	$30	$30	$30	$30
DA Bid ↑	$60/MWh	$60	$60	$60		$60	$60	$60	$60	$60	$60	$60	$60
DA Price	$50/MWh	$50	$25	$50		$60	$60	$60	$70	$70	$60	$60	$60
DA Sched	0	0	-50	0		0	0	0	30	50	0	0	0
DA SOC	30 MWh	30	80	80		80	80	80	50	0	0	0	0

In the real-time the resource charges to meet the increasing minimum charge requirements

Hour	9	10	11	12	...	17	18	19	20	21	22	23	24
Load	190 MW	190	190	20	...	300	330	335	345	350	340	280	210
DA Bid ↓	$30/MWh	$30	$30	$30		$30	$30	$30	$30	$30	$30	$30	$30
DA Bid ↑	$60/MWh	$60	$60	$60		$60	$60	$60	$60	$60	$60	$60	$60
DA Price	$50/MWh	$50	$25	$50		$60	$60	$60	$70	$70	$60	$60	$60
DA Sched	0	0	-50	0		0	0	0	30	50	0	0	0
DA SOC	30 MWh	30	80	80		80	80	80	50	0	0	0	0
RT Bid ↓	$25/MWh	$25	$25	$25		$25	$25	$25	$25	$25	$25	$25	$25
RT Bid ↑	$70/MWh	$70	$70	$70		$70	$70	$70	$70	$70	$70	$70	$70
RT Price	$60/MWh	$25	$60	$60		$60	$200	$60	$60	$60	$60	$60	$60
RT Sched	0 MW	-30	-20	0		0	0	0	0	0	0	0	0
RT SOC	30 MW	60	80	80		80	80	80	80	80	80	80	80
Min Chrg	30 MW	30	80	80		80	80	80	50	0	0	0	0

- HE 10: Resource is scheduled to charge economically above MCR
- HE 11: Resource is required to charge because of requirement
- HE 18: Resource is unable to respond to price spike b/c of MCR

Additional considerations for the minimum charge requirement and storage resources

- All minimum charge requirements will be determined on a 5-minute basis to match the real-time market
  - Additional examples may be provided in future proposal versions
- Storage resources may bid into the real-time market in a way to charge above their minimum requirements
- Storage that does not receive dispatch awards in the day-ahead market will not be subject to the MCR
  - Bidding at high prices in the DA market, may result in schedules only on the highest need days and thus relatively small MCR requirements
  - On days with no DA discharge, there will be no MCR enforced
- MCR is only applicable to storage resources that qualify for resource adequacy capacity
  - Non-RA storage will not have dispatch impacted by the MCR

The ISO considered alternative solutions to potential reliability concerns from storage resource integration

1. Require day-ahead schedules to be completely self-scheduled into the real-time market

2. Extend real-time market to look 16+ hours ahead

3. Increase real-time prices to increase financial incentives for availability in the real-time market

4. Use a tool similar to exceptional dispatch to only dispatch storage resources when essential

BACKSTOP CAPACITY PROCUREMENT

CAISO currently has authority to backstop for CPM for a number of scenarios

Existing CAISO CPM authority

1. System annual/monthly deficiency
2. Local annual/monthly deficiency
3. Local collective deficiency
4. Cumulative flexible annual/monthly deficiency
5. Significant event
6. Exceptional dispatch
7. Risk of retirement*

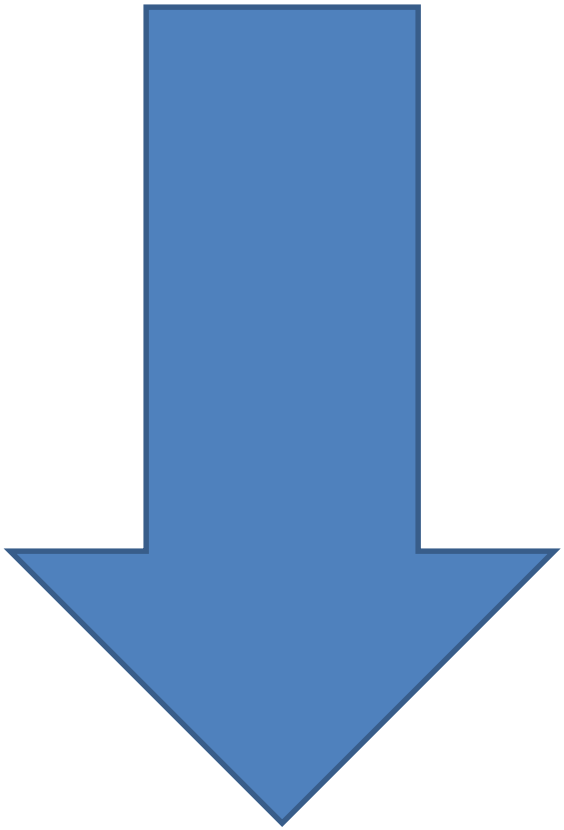
* Authority moving to RMR in the RMR-CPM enhancements initiative

CAISO seeks, and stakeholders support, additional CPM authority for the following scenarios

1. System UCAP deficiencies
    - CAISO would not backstop if a single LSE was deficient, but rather if there is an overall deficiency based on all RA showings
    - Will apply in the year-ahead and month-ahead timeframes
2. Failed portfolio analysis
3. Local area or Sub-area fails to meet energy sufficiency test

- Will continue to notify and allow entities to first cure the identified deficiency before the CAISO makes a backstop designation
- Stakeholder comments were generally supportive of these extensions in CPM authority

CPM Designation Order



- System UCAP deficiencies
- System NQC deficiencies
- Local individual deficiencies
- Local collective deficiencies
- Portfolio analysis deficiencies

UCAP Deficiency Tool

- The CAISO will not backstop if there are no collective system UCAP deficiencies, but a single LSE may still be deficient, and could therefore lean on other LSEs to fulfill their procurement requirements
- To disincentives leaning, the CAISO is continuing to prose a UCAP Deficiency Tool that will penalize LSEs that show below their requirement at the soft over cap, $6.31/kW per month, and distribute this penalty payments to all other LSEs in proportion to their over shown amount
- The CAISO will not procure CPM and impose a UCAP deficiency charge for the same MW of deficiency

Stakeholder feedback

- The main objection to this proposal is that stakeholders feel that the UCAP Deficiency Tool may further distort the bilateral market, and may lead entities to withhold additional capacity in order to receive a UCAP deficiency charge payment
- CAISO disagrees with this assessment, and believes that the UCAP Deficiency Tool will actually incentivize trades between LSEs b/c it would be more economically rational to transact with each other than withhold capacity in the off chance they may receive a UCAP deficiency charge payment
- Additionally, by getting rid of RAAIM and substitution rules, entities should have less incentive to withhold capacity to self insure, and will be more likely to want to sell off excess capacity in the future
- We provide examples to further demonstrate this point

Example 1: UCAP Deficiency Tool, no Backstop

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	Penalty	Payment
1	100	110			$25,240
2	100	115			$37,860
3	100	90	10	$63,100	
TOTAL	300	315	10	$63,100	$63,100

- LSE 1 and 3 would have benefitted more from contracting with one another. Even if they had contracted for at least half of the soft over cap 10 MW*$3.16, LSE 1 would have earned $31,600, which is $6,360 more than they would have earned from UCAP Deficiency tool payment, and LSE 3 could have saved $31,500. This demonstrates that this tool would not incentives withholding of excess capacity, because LSE 1 could profit more from selling to LSE 3 than taking the risk that they would receive the UCAP Deficiency Payment.

Example 2: UCAP Deficiency Tool, with Aggregate Shortfall

LSE	Req. (MW)	Shown (MW)	Shortage (MW)		Penalty	Payment
1	100	90	10		$12,620	
2	100	85	15		$18,930	
3	100	105				$31,550
TOTAL	300	280	25		$31,550	$31,550

- In this case, the two LSEs that are short are assessed a charge for the capacity matching the UCAP deficiency. However, the charge is limited because a maximum payment of $6.31/kW-month is reached for the payment recipient.
- Because LSE 1 is 10 MW of the 25 MW of total shortage it is assessed a charged of $6.31/kW * 5 MW * (10 MW / 25 MW) = $12,620 and LSE 2 is assessed a charge of $6.31/kW * 5 MW * (15 MW / 25 MW) = $18,930.
- Because LSE 3 is the only entity showing above the requirements, all of the collected charges are allocated back to that LSE, in this case the total amount allocated is $31,550 or $6.31/kW * 5 MW.

Example 3: UCAP Deficiency Tool, no Award Recipients

LSE	Req. (MW)	Shown (MW)	Shortage (MW)		Penalty	Payment
1	100	100				
2	100	80	20			
3	100	95	5			
TOTAL	300	275	25		$0	$0

- In this scenario, the aggregate amount of UCAP shown is below the aggregate amount of UCAP required for the UCAP requirements.
- In this case, CAISO could potentially procure backstop capacity to cure the system UCAP deficiency.
- Irrespective of any CPM designation, CAISO will not charge any market participants for the shortfall, as there is no entity to allocate those charges.

Example 4: UCAP Deficiency Tool, with Backstop

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	CPM Alloc (MW)	Adj Short (MW)	Penalty	Payment
1	100	90	10	8	2	$12,620	
2	100	85	15	12	3	$18,930	
3	100	105					$31,550
TOTAL	300	280	25	20	5	$31,550	$31,550

↓

BACKSTOP: 20 MW

- In this scenario, LSE 1 is again short 10 MW and LSE 2 is short 15 MW. Additionally, because LSE 3 only procures five MW above its requirement, there is a shortage between the aggregate amount of UCAP shown and the aggregate requirement.
- This shortfall triggers a CAISO CPM designation, for the 20 MW deficiency. CAISO then allocates eight MW of the CPM procurement to LSE 1 and 12 MW to LSE 2.
- The shortfall persists even with the adjustment for the CPM allocation, and the shortfall equals five MW or exactly the capacity that that LSE 1 showed above its requirement.
- Therefore, the remaining shortfall, inclusive of the CPM allocation, is two MW for LSEs 1 and three MW for LSE 2, which is then subject to the UCAP deficiency tool penalty.
- Penalties assessed are for $12,620 for LSE 1 and $18,930 for LSE 2. The $31,550 of the collected revenues are then credited to LSE 3.

NEXT STEPS

RA Enhancements Policy Development Schedule

Date	Milestone
July 7	Fifth revised straw proposal
July 14-16	Stakeholder meeting on fifth revised straw proposal
July 30	Stakeholder comments on fifth revised straw proposal due
Oct 12	Draft final proposal
Oct 19-20	Stakeholder meeting on draft final proposal
Nov 3	Stakeholder comments on draft final proposal
Aug 2020 - Q1 2021	Draft BRS and Tariff
Q1 2021	Final proposal
Q1 2021	Present proposal to CAISO Board

* Dates are tentative and subject to change

Comments

- Stakeholders should submit comments on the RA Enhancements fifth revised straw proposal to initiativecomments@caiso.com by July 30, 2020

- Submit comments using the template provided on the CAISO's initiative webpage located here: http://www.caiso.com/StakeholderProcesses/Resource-adequacy-enhancements