Resource Adequacy Enhancements: First Revised Straw Proposal Stakeholder Meeting

July 8-9, 2019

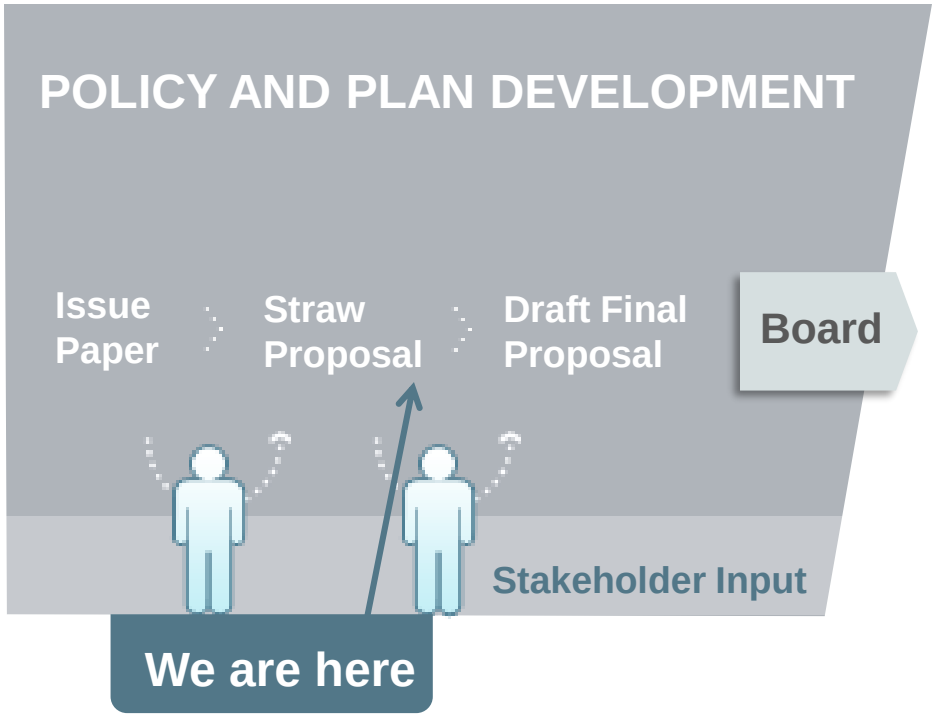
Agenda: Day 1 – July 8: Principles & Objectives, System Resource Adequacy

Time	Agenda Topic	Presenter
10:00-10:05AM	Welcome and Introduction	Kristina Osborne
10:05-10:25AM	Principles & Objectives	Chris Devon
10:25-10:40AM	Determining System RA Requirements	Chris Devon
10:40AM-12:00PM	Forced Outage Rates and RA Capacity Counting	Chris Devon
12:00-1:00PM	LUNCH	
1:00-1:45PM	System RA Showings and Sufficiency Testing	Karl Meeusen
1:45-2:30PM	Must Offer Obligation and Bid Insertion Modifications	Lauren Carr
2:30-3:15PM	Planned Outage Process Enhancements	Chris Devon
3:15-4:00PM	RA Import Provisions	Chris Devon

Agenda: Day 2 – July 9: Flexible RA, Local RA, & Backstop Capacity Procurement

Time	Agenda Topic	Presenter
9:00AM-11:30AM	Flexible Resource Adequacy	Karl Meeusen
11:30AM-12:00PM	Local Resource Adequacy	Lauren Carr
12:00-1:00PM	LUNCH	
1:00-2:30PM	Local Resource Adequacy (continued)	Lauren Carr
2:30-3:25PM	Backstop Capacity Procurement Provisions	Gabe Murtaugh
3:25-3:30PM	Next Steps	Kristina Osborne

Stakeholder Process



PRINCIPLES AND OBJECTIVES

Principle: The resource adequacy framework must reflect the evolving needs of the grid

- As fleet transitions to clean, variable, and energy-limited resources traditional resource adequacy must be revisited
- Including assessment of more than simply having sufficient capacity to meet peak demand
- RA requirements and assessments must reflect evolving needs
- RA framework must accurately evaluate and value resources that can meet CAISO's operational and reliability needs all hours of the year

Principle: RA counting rules should promote procurement of most dependable, reliable, and effective resources

- Both RA and non-RA resources should be recognized and rewarded for being dependable and effective at supporting system reliability
- Transparent information on quality of resources available to load-serving entities will improve procurement
- Allow for the most reliable, dependable and effective resources to sell their capacity

Principle: RA program should incentivize showing all RA resources

- Modifications to existing RA structure should encourage showing as much contracted RA capacity as possible and not create disincentives or barriers to showing excess RA capacity
- CAISO must balance the impact that incentives may have on an LSE's willingness to show all contracted RA capacity

Principle: LSE's RA resources must be capable of meeting load requirements all hours

- RA targets should be clear, easily understood and based on reasonably stable criteria applied uniformly across all LSEs
- Traditional accounting approaches such as current summation of NQC values in a LSE's portfolio do not equate to resource adequacy alone
  - This approach does not assure an LSE can satisfy its load requirements all hours of the year
- RA also encompasses LSEs meeting their load requirements all hours of the year, not just meeting peak demand

Objectives – RA Enhancements

- Update RA framework to assess forced outage rates for resources
  - Incorporate forced outages into procurement process upfront in planning horizon
- Conduct RA adequacy assessments based on unforced capacity of resources and RA portfolio's ability to ensure CAISO can serve load and meet reliability standards
  - Incorporating forced outages into RA assessment will help inform which resources are most effective and reliable at helping California decarbonize its grid
- Simplify existing RA provisions that are complex and interrelated to extent possible while considering impacts to resulting incentives

Objectives – RA Enhancements

- Modifications must be coordinated and remain aligned with the CPUC process and decisions
- However, solely relying on installed-capacity-based PRM as the only basis for resource adequacy is not sustainable given the transforming grid
  - Increasing reliance on more variable, less predictable, and energy limited resources may show sufficient capacity to meet traditional PRM measures, but may not have sufficient capability to meet reliability needs and load requirements in all hours
- Utilization of both installed capacity (NQC) and unforced capacity (UCAP) values in CAISO's RA processes
  - Resulting Must Offer Obligations need to be tied to RA showing NQC values to accomplish these important changes

SYSTEM RESOURCE ADEQUACY

Overview of System RA Topics

- Determining System RA requirements
- Forced Outage Rates and RA capacity counting
- System RA Showings and sufficiency testing
- Must Offer Obligation and Bid Insertion modifications
- Planned Outage Process enhancements
- RA Import provisions
- Maximum Import Capability provisions

DETERMINING SYSTEM RA REQUIREMENTS

System UCAP requirement proposed to more adequately address forced outage risks

- CAISO has observed impacts of forced outages exceeding resource margins established by existing planning reserve margin requirements during some periods
  - This is a potential reliability concern
- To better address this risk posed by forced outages CAISO is proposing to establish a system unforced capacity (UCAP) requirement to more directly account for forced outages
  - Develop a minimum system UCAP requirement that all LSEs must meet and show as RA

Recent June stress days illustrate need to improve planning to account for forced outage impacts upfront

	6/10/2019	6/11/2019 *	6/12/2019
Monthly Peak Forecast	42,728	42,728	42,728
Monthly Peak Forecast + PRM	49,100	49,100	49,100
Adjustments (Credits)	4,030	4,030	4,030
Final RA Obligation	45,070	45,070	45,070
Total RA showing	47,604	47,604	47,604
RA surplus/shortage (without Outages)	2,534	2,534	2,534
Total Outages	7,747	8,886	6,659
Planned Outages	172	432	506
Forced Outages	7,575	8,454	6,153
Operational RA MW (with Outages)	39,857	38,718	40,946
Net impact to RA with Outages	**-5,213**	**-6,352**	**-4,124**
Forced Outages as % of Final RA Obligation	**16.8%**	**18.75%**	**14.4%**

* Flex alert was issued for June 11, 2019

Proposal to developing UCAP requirement with CAISO identified needs to maintain system wide reliability

- CAISO believes system UCAP requirement must, at a minimum, meet monthly forecasted load peak plus all ancillary serves and flexible ramping needs:
  - At least 109 percent of the 1:2 peak load forecast
- However, because CAISO does not have perfect foresight, also considering an additional factor for observed year-ahead forecast error of ~2%
  - For example: additional UCAP margin is intended to help cover instances such as if the 1:2 year peak load forecast was 40,000 MW but prior observed peak was 42,000

Proposed CAISO system UCAP requirement

- CAISO believes bottom-up approach to establish a minimum system RA UCAP requirement is appropriate
- Will help ensure minimum resource adequacy requirements are achieved system-wide for all LSEs
- Multiple LRAs and potential variance in LRA PRM targets drives need for bottom up system UCAP requirement
  - Also mitigates potential for capacity leaning by LRAs and their respective LSEs
- CAISO is closely considering how to best ensure coordination of these important system RA modifications with CPUC and other LRA's RA programs

FORCED OUTAGE RATES AND RA CAPACITY COUNTING

CAISO is considering how to apply forced outage rates to capacity values

- 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 outages and eliminate need for complicated replacement capacity rules
- Applying forced outage rates to RA values is intended to provide certainty CAISO will receive adequate resources prior to month from resources that will be available

Several advantages for integrating forced outages into resource 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 forced outage rates of resources can help buyers avoid risks and make better informed decisions when making bilateral trades or when procuring replacement RA capacity

Calculating unforced capacity values

- Unforced capacity value – or UCAP of a resource incorporates the availability of a resource using a derating factor referred to as the resource's Effective Forced Outage Rate – or EFOR

UCAP = (NQC) * (1 - EFOR)

- CAISO proposes to calculate and publish monthly NQC and UCAP values for all resources each year
- EFOR and resulting UCAP values will not be impacted by CAISO approved planned outages

CAISO is also considering calculating forced outage rates seasonally

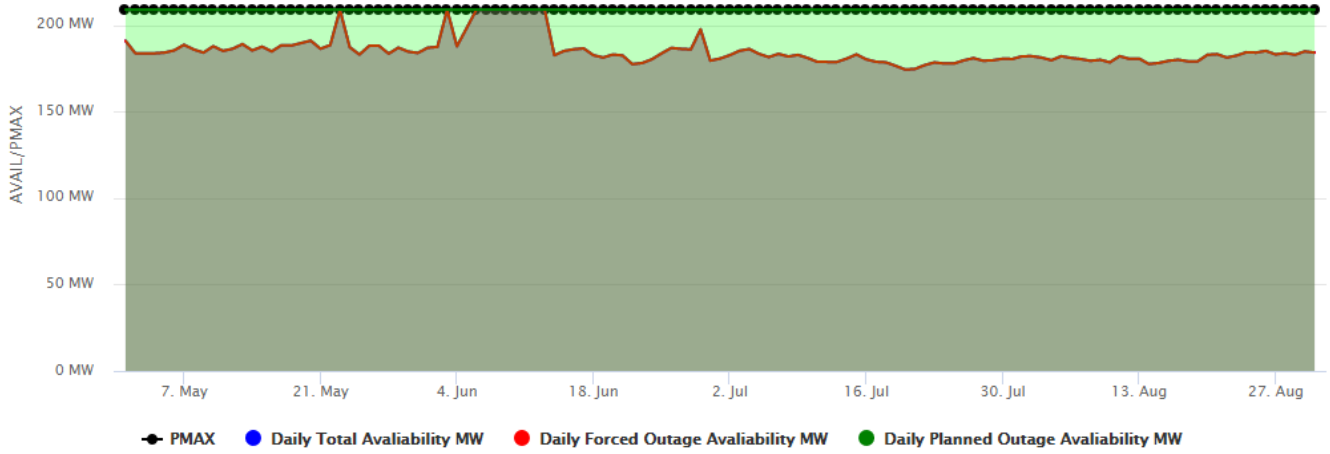
- Contemplating two seasons: summer & winter (peak, off-peak)
- Once calculated, the forced outage rate would be set for each season for the upcoming RA year
- Seasonal calculations may add some complexity, but also better reflect resources' availability during peak and off-peak seasons

Unit Outage Rate Analysis Examples

- NERC GADS data for WECC provides a WECC-wide average approximately 8% forced outage rate for all resource types providing outage data
- CAISO has not identified a feasible method for easily converting existing OMS data into accurate unit specific forced outage rates
- For illustrative purposes CAISO has provided example outage analysis to show the magnitude of outages for two resources over 2018 annual and summer periods

Example Unit #1 outage rate analysis

Summer 2018

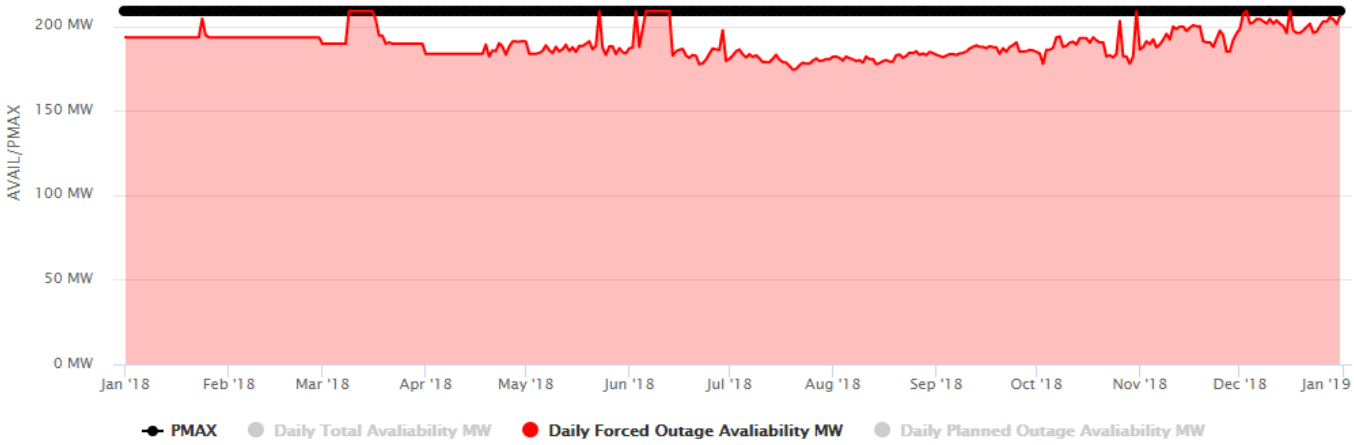


11.4% Total Outage Rate

11.4% Forced Outage Rate

0% Planned Outage Rate

Annual 2018



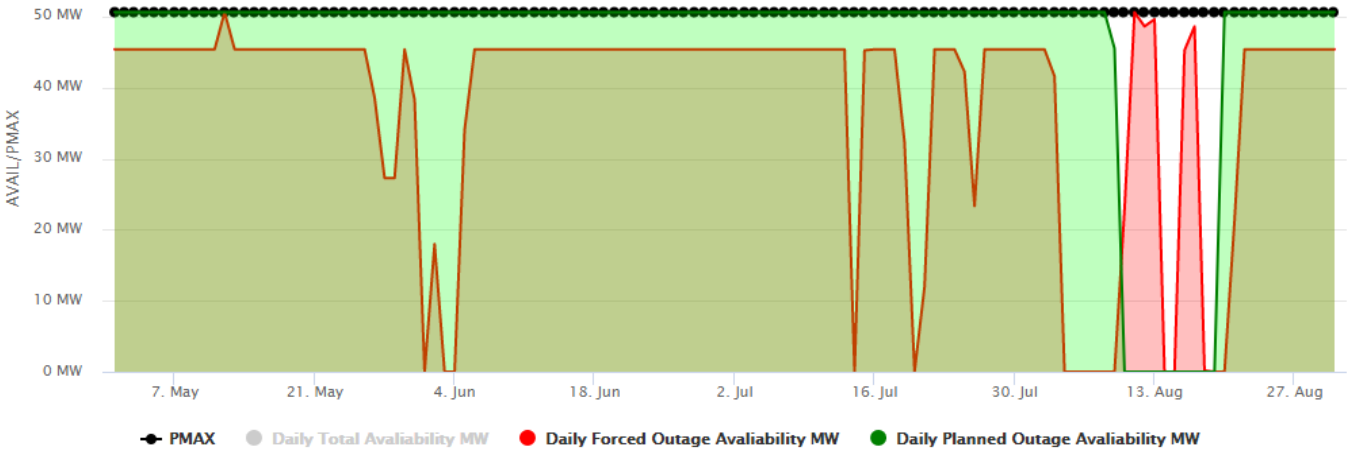
11.31% Total Outage Rate

9.17% Forced Outage Rate

2.14% Planned Outage Rate

Example Unit #2 outage rate analysis

Summer 2018

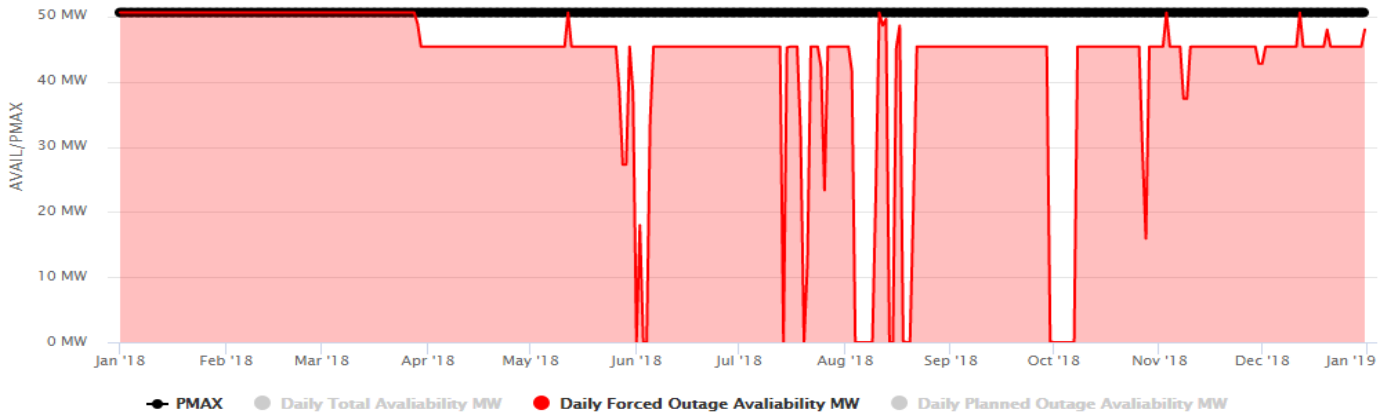


29.33% Total Outage Rate

25.06% Forced Outage Rate

8.21% Planned Outage Rate

Annual 2018



40.44% Total Outage Rate

15.06% Forced Outage Rate

26.7% Planned Outage Rate

Proposed forced outage rate assessment interval

- CAISO proposes to apply a 16-hour window between 5:00 AM and 9:00 PM for assessing resource specific forced outage rates
- Covers periods when resources are most highly in demand to meet CAISO needs and will also simplify the Availability Assessment Hours currently in use
- Using same assessment intervals allows CAISO to calculate and utilize same forced outage rate for both generic and flexible capacity

CAISO proposes to utilize three years of historic data to determine calculations for unit forced outage rates

- Each forced outage will impact a resource's seasonal forced outage rate and UCAP value for three years
- CAISO is also considering incorporating weighting method that places more weight on more recent years
- More historic periods would have less of an impact on resulting average forced outage rates
  - 50% weight for most recent annual forced outage rate,
  - 30% weight on second annual forced outage rate period, and
  - 20% weight on third annual forced outage rate period
- Resources may improve their forced outage rates by performing well over time

ELCC will establish UCAP values for wind and solar resources

- CAISO will also rely on CPUC's ELCC methodology
- Currently, CPUC only applies this methodology to wind and solar resources, but could expand that to cover variable output DR and storage technologies
- ELCC generally accounts for probability of forced outages for wind and solar resources

Removing forced outage replacement and RAAIM application to forced outage periods

- CAISO proposal will assess forced outages against forced outage rate and resulting UCAP values
- CAISO will no longer include forced outage replacement as an option for addressing forced outages
  - Change is intended to align process with proposed assessment of resource forced outage rates to provide transparency into reliability and dependability of individual resources
- CAISO will no longer have to assess resources for RAAIM during periods they have submitted a forced outage
  - Outage impact will be reflected in unit specific forced outage rate

Forced Outage Rate Data

- To determine these forced outage rates, CAISO considered two potential data sources:
  - CAISO's Outage Management System, and
  - NERC Generation Availability Data System (GADS)
- CAISO is proposing to enhance OMS to track outage rates accurately
- More universal outage reporting for GADS purposes may not always align with all potential CAISO forced outage nature of work cards
- Nature of work outage tracking will be helpful to focus on for defining type/nature of outages assessed against resource specific forced outage rates

Initial proposal for CAISO Forced Outage Rate formulation

- CAISO proposes using the standard IEEE formula as a basis for its proposed forced outage rate calculation:

$$EFOR = \frac{FOH + EFDG}{FOH + SH} \times 100\%$$

  - EFOR = Effective forced outage rate: A measure of the probability that a generating unit will not be available due to forced outages or forced deratings
  - FOH = Forced outage hours: the number of hours a unit was in an unplanned outage state
  - EFDH = Equivalent forced derated hours: the forced derated hours converted to equivalent hours
  - SH = Service hours: the number of hours a unit was in in-service state

CAISO must calculate each unit's forced outage rate using clear, well defined outage definitions

- Must specify how each outage nature of work card will be assessed against resource specific forced outage rate
- One major concept in other regions is exclusion of outages considered "Outside of Management Control" – or OMC from forced outage rate calculations
  - For example: a transmission induced outage or a force majeure event such as a wildfire or flooding event that forces a unit outage should be excluded from counting against unit forced outage rate
- CAISO proposes to incorporate a similar concept in proposed forced outage rate assessment

Forced Outage Cards – Nature of Work

Nature of Work/Opportunity Status	Lowers resource's available UCAP?
Ambient Due to Temperature	Yes
Ambient Not Due to Temperature	No
Ambient due to Fuel insufficiency	Yes
AVR/Exciter	Yes
Environmental Restrictions	Yes
Short Term Use Limit Reached	No
Annual Use Limit Reached	No
Monthly Use Limit Reached	No
Other Use Limit Reached	No
ICCP	Yes
Metering/Telemetry	Yes
New Generator Test Energy	No

Nature of Work/Opportunity Status	Lowers resource's available UCAP?
Plant Maintenance	Yes
Plant Trouble	Yes
Power System Stabilizer (PSS)	Yes
Ramp Rate	Yes
RTU/RIG	Yes
Transitional Limitation	Yes
Transmission Induced	No
Technical Limitations not in Market Model	No
Unit Supporting Startup	Yes
Unit Testing	No
Off Peak Opportunity	No
Short Notice Opportunity	No
RIMS testing	Yes
RIMS Outage	Yes

Forced outage replacement and limiting application of RAAIM to forced outages

- UCAP proposal will develop a process that relies on upfront accounting for forced outages
- CAISO continues to explore modifications to remove or limit the application of RAAIM
  - Future proposals will provide additional development of any necessary RAAIM modifications
  - CAISO believes that RAAIM will no longer need apply to forced outage periods under UCAP proposal
- Removing current allowance for forced outage replacement and will rely on UCAP and forced outage rate concepts to extent possible

Coordination of Proposed UCAP Concept with CPUC

- CAISO commits to providing the coordination necessary to align with LRA RA programs
- Addressing forced outages in planning is vital
  - Ideally LRAs would adopt similar counting rules and requirements to minimize administrative complexity
  - However, system RA requirements and PRMs based on installed capacity are not inconsistent with CAISO proposal
- CAISO will work with LRAs to align RA programs with current proposal
  - Collaborative effort includes proposing similar counting rules in future CPUC RA proceedings

UCAP requirement and counting rule will not create incompatible procurement targets for system RA

- Some stakeholders expressed concern that UCAP concept and installed capacity or NQC based PRM could create two different system RA procurement targets
- CAISO views both concepts as interrelated but not incompatible
- Proposed UCAP requirement will simply be subset (or lower bound) of LRA's established system RA PRM target
  - In other regions utilizing UCAP and PRM concepts, there are two established targets – a system PRM target and UCAP requirement that is also a subset of system PRM target
  - UCAP requirement just removes additional margin established to cover forced outages component of system PRM target

Some stakeholders expressed concerns that CAISO's proposal can result in over-procurement

- CAISO proposal for UCAP requirement recognizes forced outages are accounted for in counting method
  - Additional margin for forced outages not included in proposed system UCAP requirement
  - Proposed UCAP requirement would be lower than general installed capacity based PRM to avoid double counting of forced outages or over-procurement
  - CAISO believes LRAs can maintain an installed capacity PRM
- UCAP requirement will provide an appropriate target to guide forward procurement of resources with better forced outage rates and better reliability compared to other resources of lower reliability quality

SYSTEM RA SHOWINGS AND SUFFICIENCY TESTING

CAISO will conduct two sufficiency tests for system capacity

1. Individual deficiency test

2. Portfolio deficiency test

Designed to ensure:

- Adequate UCAP to maintain reliability for peak load, and
- Portfolio of resources work together to provide reliable operations during all hours when combined and considered together

CAISO will conduct an assessment of LSE RA showings and resource supply plans

- Ensure there is sufficient UCAP shown to meet identified reliability needs
- LSEs and resources need only submit and show NQCs
  - Once shown, CAISO will consider each resource UCAP value to conduct UCAP assessment
- Partial RA resources will receive a proportional UCAP value reflecting proportion shown for RA purposes
  - For example: A 100 MW resource with a 10 percent forced outage rate that has been shown for 50 MW of NQC will be assessed as being shown for 45 MW of UCAP RA

LSEs cannot simply procure only the unforced capacity from a resource

- Cannot buy 90 MW of NQC and UCAP from a 100 MW resource with a 10 percent forced outage rate
  - UCAP accounting method relies on the probability that some resources will be out at various times to eliminate substitution requirements
  - In CAISO's review of best practices in other ISO's such practices are not permitted

LSEs that fail to meet the UCAP requirement will be notified of the deficiency, provided an opportunity to cure, and may be subject to backstop cost allocation or UCAP deficiency charges if the deficiency is not cured

CAISO will conduct a portfolio deficiency test of only RA resources under various conditions

- Objective of a portfolio analysis is to assess if CAISO can serve load with shown RA fleet
  - CAISO will test forecasted gross, net-load peaks, and all other hours
  - CAISO will also test the ability to maintain adequate reserves and load following
- Need for this assessment is similar in concept to collective deficiency test CAISO conducts for local RA
  - CAISO must assess how the shown RA fleet works collectively to meet system needs
- Assessments conducted only on monthly RA showings
  - Only showing that provides 100 percent of the system, local, and flexible RA capacity requirements

Objective of a portfolio analysis is to assess if CAISO can serve load with shown RA fleet

- Assessment will focus on monthly showings only
  - Cannot conduct a meaningful test of annual showings

	Iteration*	Load	Wind/solar	Other Generators
Net Load Deterministic	One	Known	Known	A generator forced outage schedule determined randomly prior to the assessment
Generator Stochastic	One or several	Known	Randomly determined for each iteration with fixed installed capacity	A generator forced outage schedule determined randomly prior to each iteration
Full stochastic	Several	Random draws	Randomly determined for each iteration with fixed installed capacity	A generator forced outage schedule determined randomly prior to each iteration

* One iteration is defined a predetermined interval. This is interval can be a single day, a week, or a full month.

CAISO must determine best platform for conducting test

- Any platform used to conduct assessment should reasonably reflect actual CAISO system
- CAISO explored three primary platforms:
  - Market Optimization based model – An offline version of CAISO market optimization software
  - IOOC tool – A tool used by CAISO's Operations Engineering group to test planned transmission and generation outages, similar to the market optimization
  - Summer Assessment Plexos model – A Plexos model used to conduct CAISO summer assessment. Models many constraints, but not all.
- Summer Assessment model is fastest, but lacks detail offered by other two

CAISO favors net load deterministic model using IOOC at this time

- Provides the best balance of time constraints, complexity, and data output
- Processing time is critical
  - CAISO must conduct this assessment and provide feedback within 10 days of receiving RA showings
- CAISO will be the first to conduct such an assessment
  - It reasonable to start with the less complicated option and learn to walk before we run
- CAISO believes IOOC will yield the most reliable results
  - IOOC models all constraints
  - Can include planned outages

CAISO will model only RA resources in this portfolio analysis

- Additional energy provided in DA or RT markets represent energy substitutes in those markets
  - Not needed in portfolio assessment to determine if RA fleet is adequate
- Must establish baseline inputs into assessment
  - CEC 1-in-2 hourly load forecast
  - CAISO will also include load following requirements
  - Wind and solar production profiles will be generated prior to running the production simulation
    - Profiles will not be considered must take capacity and actual use may be lower than the profile
  - Generator availability will be determined through Monte Carlo draw using resource forced outage rates

CAISO must establish the proper metric to determine the adequacy of the portfolio

- Each approach provides different metrics
  - Different metrics can be interpreted differently in evaluating whether the RA portfolio meets CAISO's operational needs
- CAISO explored two primary metrics:
  - Serving load and
  - Loss-of-load expectation
- CAISO proposes to use serving load
  - Initial test is largely deterministic, there is insufficient information to generate a meaningful LOLE
  - Must maintain load, AS, and load following requirements for all days and all hours
  - If any of these requirements is not met, CAISO will identify a portfolio deficiency

If any of these requirements is not met, CAISO will identify a portfolio deficiency

- If portfolio is adequate, no additional action taken
- If the portfolio is unable to serve load, CAISO will:
  - Declare a collective deficiency,
  - Provide a cure period, and
  - Conduct backstop procurement using the CPM CSP if deficiency left uncured

MUST OFFER OBLIGATION AND BID INSERTION MODIFICATIONS

Resources shown for RA will continue to have a must offer obligation under the proposed framework

- A resource's must offer obligations must be consistent with its 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
    - If that unit were only required to bid its UCAP value of 80 MW, then on average, CAISO would only receive 64 MWs of dependable capacity from that unit
- Allows CAISO to simplify forced outage substitution
  - The RA fleet effectively provides its substitute capacity upfront
  - CAISO is exploring eliminating the existing RA forced outage substitution rules and reducing reliance on RAAIM

Example: System RA Must Offer Obligations

- Assume 4 resources included on RA showings, 2 sell full NQC amount and 2 shown for partial RA (below full NQC)

Resource	NQC (MW)	Forced Outage Rate	Amount of unit's NQC included on RA Showing	UCAP Showing Calculation (NQC shown for RA * 1 – Forced Outage Rate)	Summary of RA Showing NQC and UCAP (MW)	System RA MOO (MW)
1	100	5%	100 MW NQC	100 MW NQC * (1 - 0.05) = 95 MW UCAP	100 NQC (95 UCAP)	**100**
2	100	20%	100 MW NQC	100 MW NQC * (1 - 0.2) = 80 MW UCAP	100 NQC (80 UCAP)	**100**
3	100	15%	50 MW NQC	50 MW NQC * (1 - 0.15) = 42.5 MW UCAP	50 NQC (42.5 UCAP)	**50**
4	100	10%	75 MW NQC	75 MW NQC * (1 - 0.1) = 67.5 MW UCAP	75 NQC (67.5 UCAP)	**75**
Total	400	-	325 MW NQC	285 MW UCAP	**325 MW NQC (285 UCAP)**	**325 MW MOO**

CAISO proposes a standard must offer obligation to apply to all resources unless specified under exemption

- Standard MOO: 24x7 bidding into day-ahead market for all resources, and 24x7 bidding into real-time market for all resources committed in the day-ahead or that can be committed in Short-Term Unit Commitment (STUC) horizon

Standard Must Offer Obligation		
DA MOO	**RUC MOO**	**RT MOO**
Economic bids or self-schedules for all RA capacity for all hours of the month resource is not on outage	RUC availability bid for all RA capacity for all hours of the month the resource is not on outage	Economic bids or self-schedules for any remaining RA capacity from resources scheduled in IFM or RUC. Economic Bids or Self-Schedules for all RA capacity that can be committed within the STUC horizon

CAISO will align any RA must-offer obligations with the policies and needs identified in the Day-Ahead Market Enhancements

CAISO proposes to apply bid insertion to all resources that are not use-limited, and to registered use-limited resources with an opportunity cost

- Enhances CAISO's ability to identify forced outages
  - Resources would need to submit an outage to avoid dispatch
- Provides reliability to CAISO by ensuring bids in the market
- Would not create a disincentive to show RA capacity
- Exemptions required for certain resources that fall outside the categories of non-use-limited or registered use-limited

CAISO may need to define exceptions to the 24X7 MOO and bid insertion rules for certain resource types

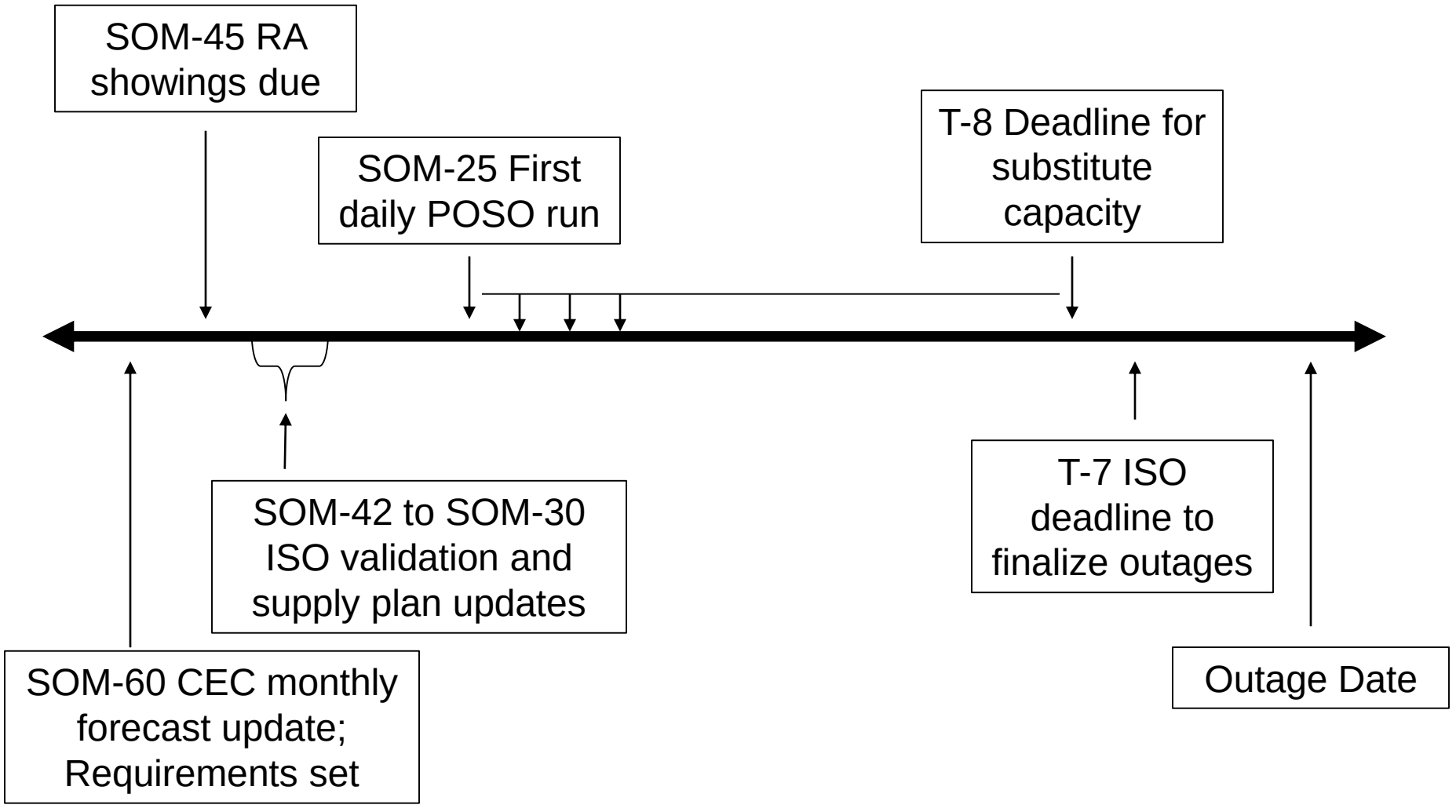
- For an initial list of proposed exemptions, see table 5 in section 5.4.1 of the Revised Straw Proposal
- Specific proposed modifications to existing exemptions:
  - NGR: Resources participating under NGR must reflect charge and discharge capabilities (currently, MOO is only on the charging portion)
  - RDRR: Bid insertion for RDRR resources in real-time only (currently, no bid insertion for RDRR in DA or RT)
  - Regulatory Must Take (RMT): For any portion of the resource that is RA and RMT, resource must provide documentation of availability and bid per documented availability. For any portion of the resource that is RA and *is not* RMT, resources must bid per the standard MOO

PLANNED OUTAGE PROCESS ENHANCEMENTS

CAISO currently uses POSO for planned outages

- RA resources currently enter planned outages into the CAISO outage system
- CIRA runs a daily POSO report with determination for a planned outage need for substitution
- Resources may submit outages between 25 and 8 days before for POSO consideration
- POSO compares the total amount of operational RA Capacity to the total system requirement
  - Requirements are established by CEC forecasts and are updated 60 days prior to the start of the month
  - Considering outages, if less capacity is available than requirements, CAISO assigns substitution obligations

Current planned outage substitution obligation timeline



Planned outage process modifications

- Stakeholder feedback 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

Proposal outlines several changes to the existing planned outage provisions

- Development of a planned outage calendar
- Requiring comparable substitute capacity
- Development of a substitute capacity bulletin board
- Revisions to CAISO planned outage substitution process

- CAISO will redesign the POSO tool to base substitution requirements on system UCAP requirement rather than NQC requirement
  - When the ISO does not have excess capacity resources will be **required** to procure sufficient UCAP substitute capacity

POSO tool

- Outages will continue be approved through the POSO tool
  - Outages and substitute capacity will be evaluated and accepted on a first-in-last-out basis
- Generators on outage will continue to be allowed to self-select substitute capacity for any outage

CAISO proposes to adopt requirements to ensure comparable resources are provided for planned outage substitution

- Only certain resources will be acceptable substitution for other resources seeking to take planned outages with replacement obligations
- Limits replacement resources qualifying for meeting POSO requirements of particular resources to be comparable with resource going on outage
- Due to transition to a fleet with greater reliance on variable and availability and use-limited resources
- Important to reflect new operational constraints in planned outage substitution obligation requirements

CAISO proposes that POSO requirements must ensure replacement resources reflect comparability

- A resource with no use or availability limitations seeking planned outage that receives a replacement obligation would be required to replace with a comparable resource that is not use or availability limited
- CAISO is focused on availability and capabilities, not technology or fuel types
- Specifically exploring requirements to provide comparability related similarities such as: location, use limitations, availability limitations, run time duration limits, and Ancillary Services certification/capabilities

Planned Outage replacement comparability

Comparability Categories	Issues Considered in CAISO Review
Location	TAC area, Local area
Use Limitations	ULR status
Availability Limitations	Availability Limitations: # of starts per day, # of consecutive days of operation, run
Ancillary Services certification/capabilities	AS categories: Spin, Non-Spin, Regulation Up/Down
Run time duration limits	Equal or greater run time duration (at Pmax or full NQC output)

Outage calendar offers visibility into shown resource adequacy compared to requirements

- Proposing to develop a calendar that shows potential availability of additional system headroom on daily basis
  - This headroom may allow resources to take planned outages without specifying substitute capacity
  - If the calendar shows no available headroom, then any RA resource requesting planned outage on those dates will be required to show substitute capacity
- Exploring providing a daily MW value for UCAP headroom in excess of the RA requirements

Example outage availability calendar

2 Headroom: 25 MW	3 Headroom: 205 MW	4 Headroom: - MW	5 Headroom: - MW	6 Headroom: - MW	7 Headroom: 350 MW	8 Headroom: 7 MW
9 Headroom: 30 MW	10 Headroom: 712 MW	11 Headroom: 145 MW	12 Headroom: 320 MW	13 Headroom: 200 MW	14 Headroom: - MW	15 Headroom: 25 MW

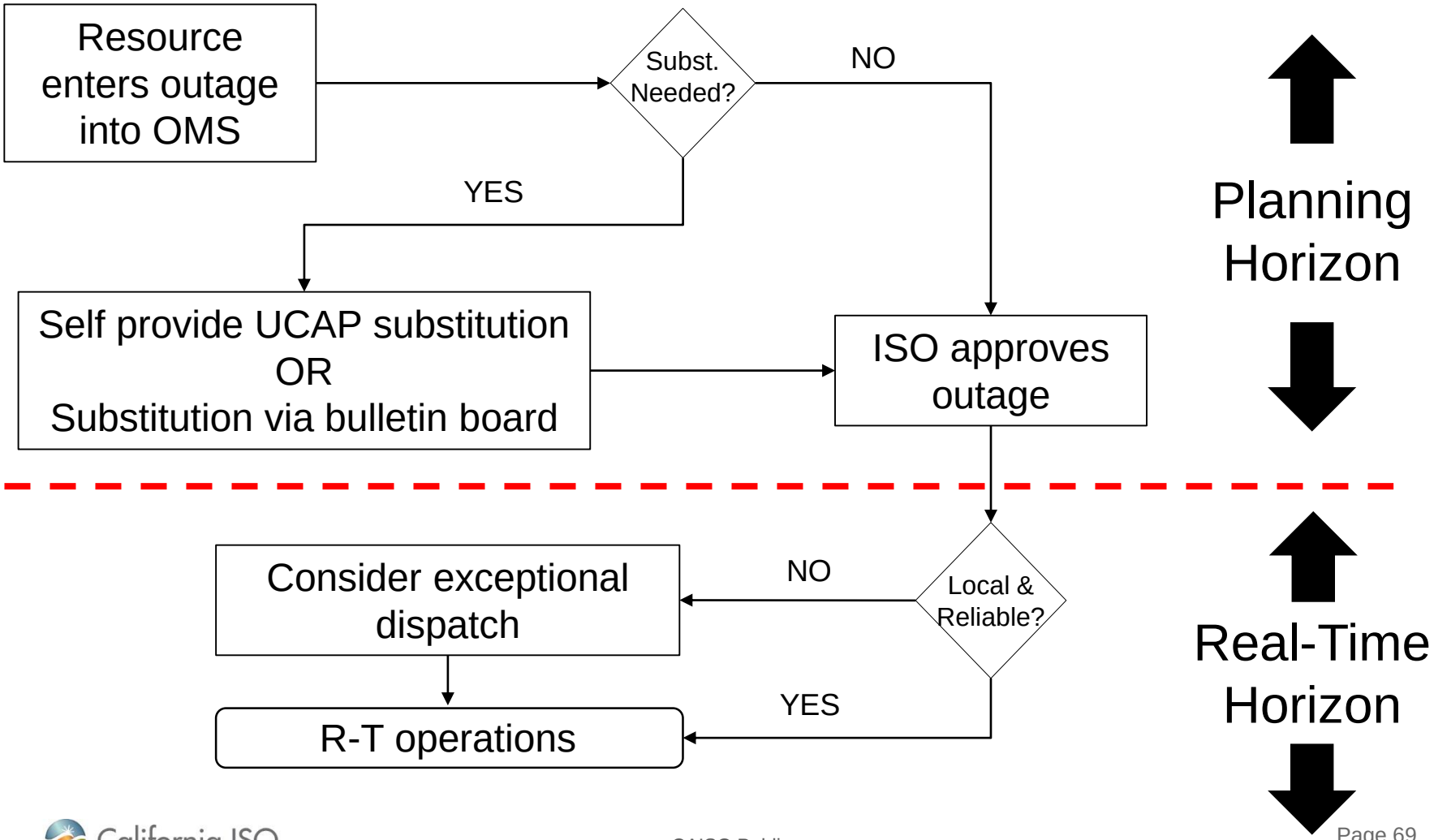
CAISO plans to offer a bulletin board to match planned outages with substitute capacity

- Resources available to voluntarily provide substitute capacity will be able to list resources and a specified price for use of that substitute capacity
  - CAISO bulletin board will provide daily granularity
- Generators looking for substitute capacity will have visibility into resources offering substitute capacity
  - Exploring if results can be filtered to only show substitute capacity for a particular resource suitable for substitution (per replacement comparability requirements)
- Exploring implementation so accepting capacity through this tool will automatically match resources on outage with accepted substitute capacity in CAISO systems

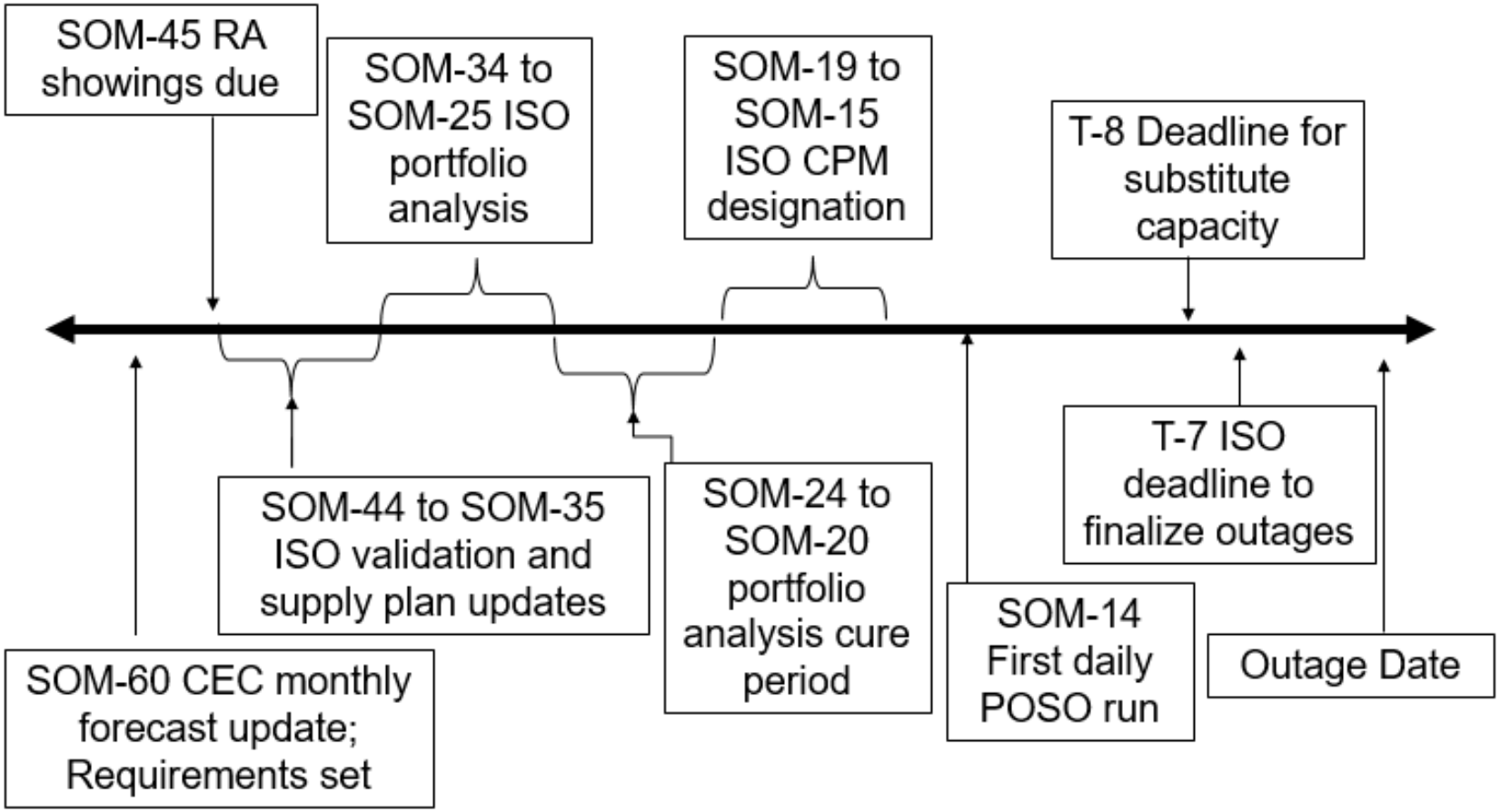
Example for outage replacement bulletin board

Resource	Use-Limited or Availability-Limited	Run-time duration limit at NQC	A/S Certified	Fuel Type	MWs (NQC / UCAP)	Offer ($/kW-Month)
A	Yes (avail-limit)	4 hours	Yes – Reg Up / Down	Battery Storage	20 NQC 18.0 UCAP	$8
B	No	None	Yes – Spin	Gas	50 NQC 44.3 UCAP	$6
C	Yes (starts per day)	24 hours	Yes – Spin	Gas	50 NQC 36.6 UCAP	$5
D	Yes (avail-limit)	2 hours	Yes – Reg Up / Down	Battery Storage	10 NQC 9.2 UCAP	$5
E	No	N/A	Yes – Spin + Reg Up	Gas	100 NQC 94.9 UCAP	$4.5
F	Yes (VER)	N/A	No	Solar	10 NQC 10 UCAP	$2
G	Yes (VER)	N/A	No	Wind	10 NQC 10 UCAP	$2
H	No	16 hours	Yes – Spin	Gas	30 NQC 17.5 UCAP	$2

New process to take a planned outage would look similar to the current process



Proposed planned outage process timeline



Ensuring reliability remains key and CAISO will retain ability to ensure planned outages do not cause issues

- CAISO will continue to enforce local constraints, and may deny outages if local reliability issues arise
  - Self-selected substitute resources (within the same local area) may reduce instances of the ISO needing to do this
- CAISO will continue to retain authority to deny an outage, even with substitute capacity, for reliability reasons
- CAISO will retain ability to procure additional capacity through backstop tools after the planned outage timeframe for reliability

RA IMPORTS PROVISIONS

Clarifying RA Import rules concerns

- RA Import provisions may cause reliability concerns
- Two main issues for Import RA rules:

1. Double counting
   - CAISO should be able to ensure resources shown as import RA are not also relied upon by native BA to serve native load or otherwise be sold to a third party or relied upon to meet capacity needs of others in addition to CAISO load – not possible to be sure today
2. Speculative supply
   - Possible speculative supply (nothing secured at time of showings) providing Import RA and using bidding strategies to avoid RT MOO or delivery obligation – evidenced by high DA bids, but not conclusive and would be of less concern if most is economic energy swapping

Objectives for RA import rules modifications

- Create more comparable treatment to internal RA resources for RA imports
  - Current provisions provide less rigorous requirements for RA imports, no RT MOO for RA imports that have no DA award
  - No emergency recall ability and no assurance that external non-resource specific RA imports will respond to CAISO operator Exceptional Dispatch
- Consider other aspects of RA Enhancements proposals for incorporating forced outage rates
  - Ensure fair and comparable treatment for RA imports and specifically non-resource specific imports as related to proposed Unforced Capacity counting and assessment modifications
- Ensure coordination with Extended EIM and DA Markets Enhancements initiatives

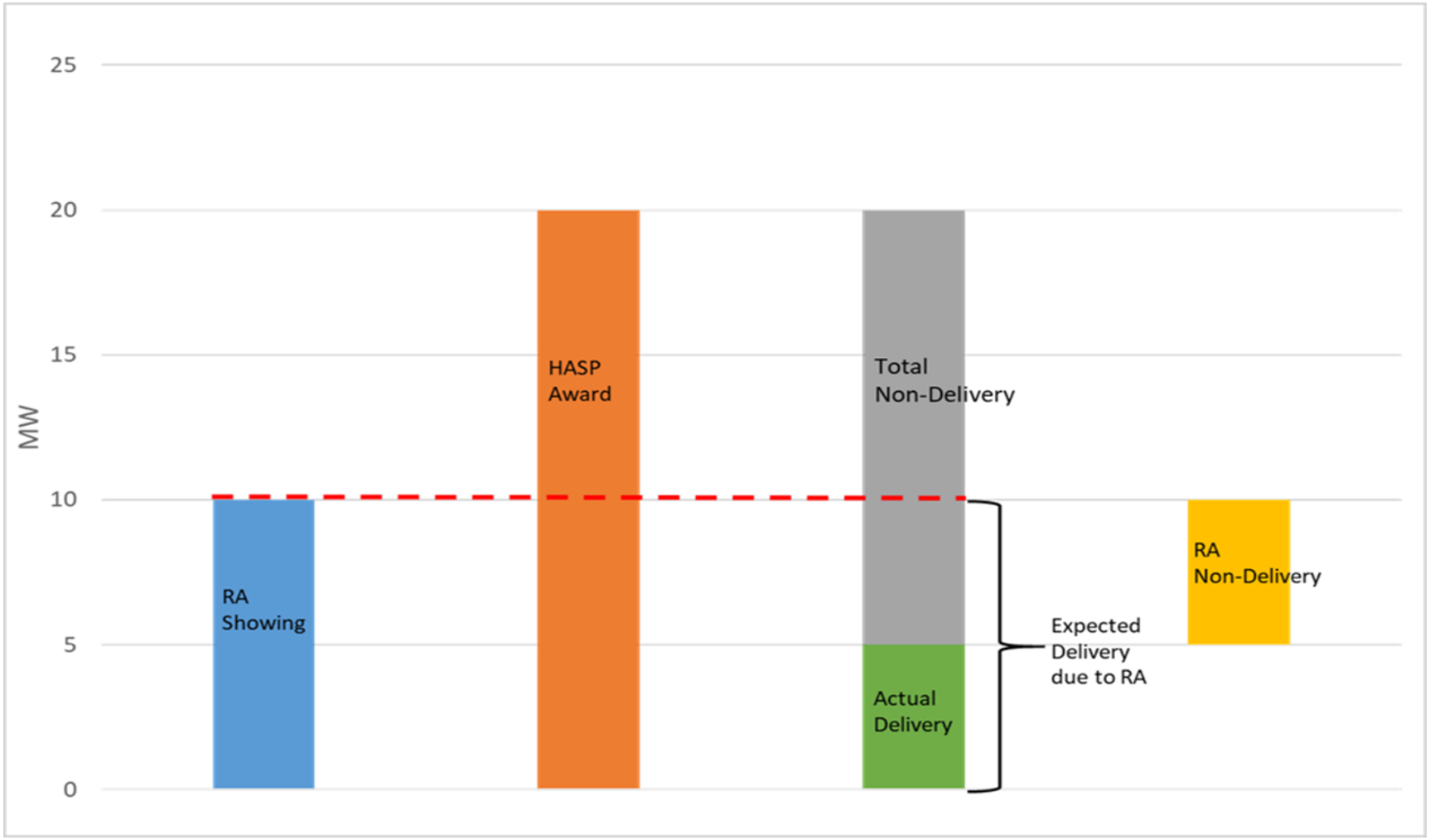
Ongoing analysis efforts updated for greater accuracy

- Analysis to determine delivery patterns and behavior for import RA resources
- CAISO has analyzed data sets for: import RA showings, HASP schedules for import RA resources, and real-time RA delivered quantity
- Identifies if Import RA resource was awarded in real-time market but failed to deliver; did not deliver because the scheduling coordinator failed to bid; or actually delivered equal or greater than the RA showing

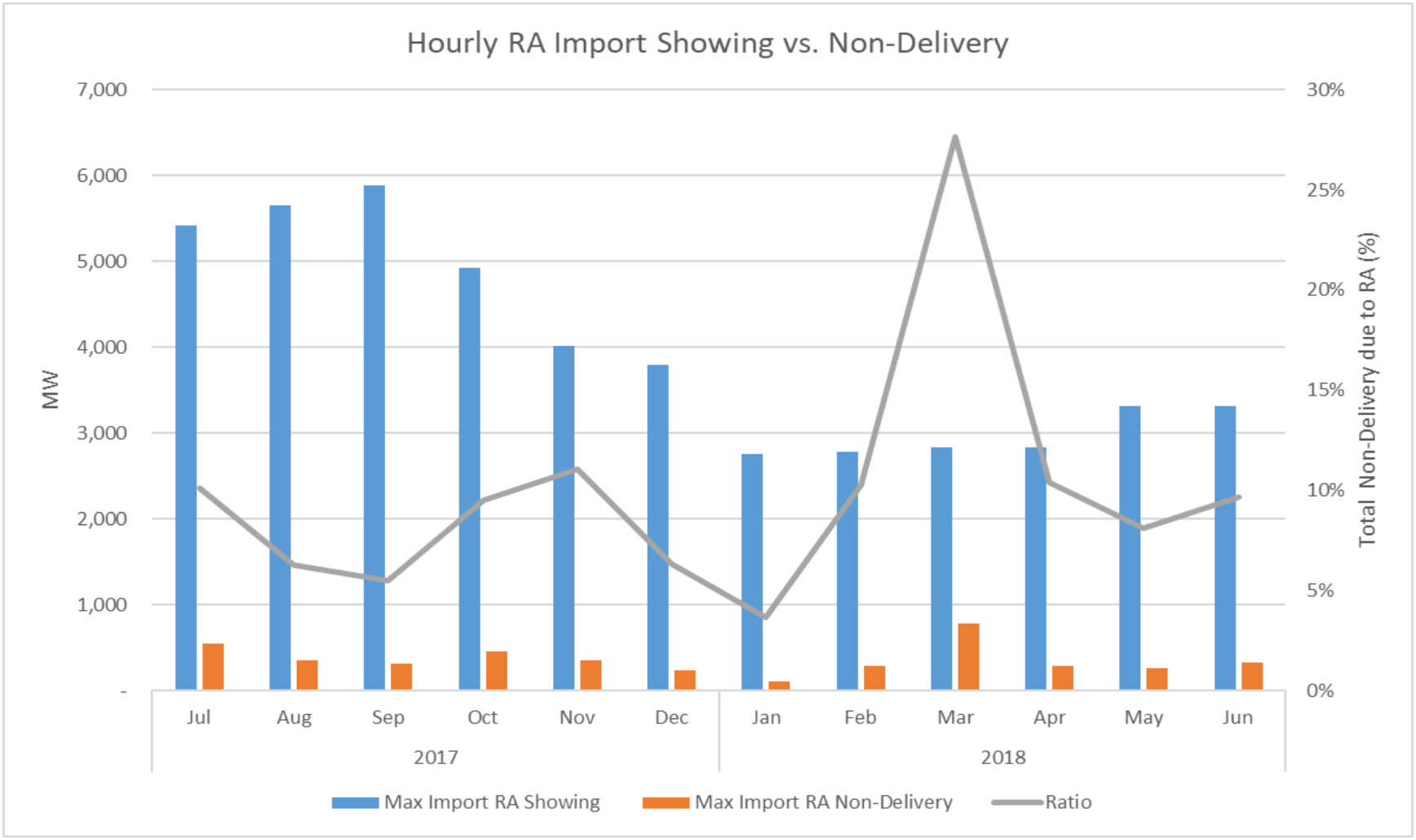
Analysis has been refined for better accuracy

- CAISO defines “non-delivery” as the MWh quantity that did not meet the real-time schedule
  - Because RA imports are scheduled hourly, the non-delivery quantity is determined by comparing the HASP schedule to the RA delivery quantity
  - It is important to compare these values to the RA showing amounts
- Specifically, an RA import resource’s Resource ID is not limited to bidding only the amount of MWs that have been shown for RA
- CAISO has observed many instances when bidding and awards for RA import Resource IDs exceed amount of MWs shown for RA

Clarifying analysis of potential concerns related to RA import delivery



Observed undelivered RA import resources accounts for less than 10% of hourly RA showings on average



Proposed RA Import modifications

- CAISO proposes to require specification of the Source BA for all RA imports on RA and Supply Plans for monthly showings
- CAISO also proposes to adopt and codify provisions similar to current CPUC RA program rules and regulations for RA imports to provide firm monthly delivery under CAISO tariff to ensure similar treatment among all LSEs

Specification of RA Import Resource Balancing Area Source

- RA import resources are not required to be resource specific or to provide any greater certainty they represent supply from a specific Balancing Area
  - Only required to be shown as sourced on a specific intertie into CAISO's system
- CAISO proposes to require specification of the Source BA for all RA imports on RA and Supply Plans for monthly showings
  - With potential extension of day-ahead market to EIM entities, CAISO believes that RA import resources must specify source Balancing Area at minimum
  - Proposed modification would allow CAISO to ensure that RA imports are not double counted for EIM resource sufficiency tests

Incorporating CPUC RA program RA imports rules and regulations into CAISO tariff

- CPUC requires LSEs provide documentation that reflects unspecified imports being submitted to meet RA requirements have firm energy delivery and operating reserves behind them
  - CPUC has specified that this documentation can be contract language or an attestation from import provider that confirms RA import is supported by firm energy and operating reserves
- CAISO believes it is appropriate to incorporate similar provisions for RA imports in its tariff
  - CAISO proposes ALL LSEs must submit supporting documentation that any non-specified RA import resource being shown on annual and monthly RA and Supply plans have firm energy delivery with equivalent supporting documentation

Not pursuing some prior aspects at this time but continuing more in depth analysis

- No longer proposing real-time bidding requirements for all RA Import MWs
  - Maintain current bidding rules for RA imports and only MWs receiving day-ahead awards will be required to bid in real-time
  - Continues alignment with current CPUC rules regarding bidding obligations for non-resource specific resources
  - Impact to efficient utilization of transmission system is important
- No longer proposing requiring 24 by 7 RA Import MOO
  - Extension of bid obligations would fully preclude any sub-set of hours import contracts from qualifying to meet RA requirements
  - Considering updated analysis on RA imports this change and resulting impact of removing qualification of some import resources does not appear justified at this time

Maximum Import Capability provisions

- Each year, CAISO establishes maximum import capability (MIC) values for import paths
  - CAISO believes the calculation methodology is still working as intended without significant impact to reliability or LSEs' ability to utilize imports for RA purposes
- CAISO is not proposing to make any modifications to the calculation methodology at this time
- Once MIC values are calculated the import capability is allocated to CAISO LSEs through 13 step allocation process
- CAISO proposes modifications to allocation process

Import capability allocation process review

- After calculating total MIC, Existing Transmission Contracts (ETC) and Transmission Ownership Rights (TOR) amounts held by LSEs are protected for and removed from MIC figure
  - Determines remaining MIC available for allocation to LSEs
  - Remaining MIC referred to as Available Import Capability
- Process for allocating this MIC to LSEs is referred to as the Available Import Capability Assignment process
  - 13 step allocation process detailed in the CAISO tariff, Section 40.4.6.2.1 – further detail provided in proposal appendix

Available Import Capability Assignment process steps

	Process description
Step 1	Determine Maximum Import Capability (MIC)
	- Total ETC
	- Total ETC for non-ISO BAA Loads
Step 2	Available Import Capability
	- Total Import Capability to be shared
Step 3	Existing Contract Import Capability (ETC inside loads)
Step 4	Total Pre-RA Import Commitments & ETC
	- Remaining Import Capability after Step 4
Step 5	Allocate Remaining Import Capability by Load Share Ratio
Step 6	CAISO posts Assigned and Unassigned Capability per Steps 1-5
Step 7	CAISO notifies SCs of LSE Assignments
Step 8	Transfer [Trading] of Import Capability among LSEs or Market Participants
Step 9	Initial SC requests to ISO to Assign Remaining Import Capability by Intertie
Step 10	CAISO notifies SCs of LSE Assignments & posts unassigned Available Import Capability
Step 11	Secondary SC Request to ISO to Assign Remaining Import Capability by Intertie
Step 12	CAISO Notifies SCs of LSE Assignments & posts unassigned Available Import Capability
Step 13	SCs may submit requests for Balance of Year Unassigned Available Import Capability

CAISO received stakeholder feedback on challenges presented by Import Capability Assignment process

- Reviewing current approach to determine if any enhancements could improve use and efficiency of Available Import Capability allocated to LSEs
  - Proposing to modify process to improve fairness, efficiency, and ease of understanding and implementation
- Concerns about possibility some LSEs may not fully utilize allocated MIC on each intertie during all RA months
  - Some LSEs may not make unused MIC available for others to buy
- Smaller LSEs concerned about ability to secure enough MIC on desired interties to support RA procurement

CAISO proposes to incorporate an auction mechanism into Available Import Capability Assignment process

- Provide alternative or additional opportunities for procurement of import capability by LSEs
  - Some LSEs may need to secure more than their pro rata load ratio share of MIC on any given branch group/intertie to support a particular RA contract
- Alternative mechanism could allow for more efficient procurement of import capability by those LSEs that place a greater value on Import Capability for various reasons
- CAISO could retain all, or a portion of the remaining Available Import Capability, to be auctioned or otherwise procured by LSEs

CAISO presents an initial auction design concept for consideration and discussion purposes

- Market based mechanism for allocation of import capability could address concerns regarding fairness
- Develop an auction mechanism to sell and allocate all Remaining Import Capability to LSEs
  - Following current Step 4 after CAISO has protected for all ETCs, TORs, and Pre-RA commitments
- Proposed auction mechanism would be included in the process to replace current Steps 5 through 13

Proposed auction will provide LSEs an opportunity to procure intertie-specific import capability rights

- Following Step 4 of current process CAISO would keep all of Remaining Import Capability unassigned and make it all available through auction process
- Auction allows LSEs to bid at value they place on import capability on any specific intertie
  - LSEs can then bid for the import capability they need
  - Import capability will be allocated according to LSE bids
  - 100% of Remaining Import Capability will allocated based upon bids to buy on specific interties with each intertie becoming a specific a product
  - Auction revenues could potentially be used to reduce TAC Transmission Revenue Requirement or allocated back to LSEs on a pro rata load share basis

Other Import Capability Allocation modifications considered but not proposed at this time

- Some stakeholders suggested intertie capacity not used to support an RA contract within a respective RA procurement timeframe should be released and made available to support other import RA contracts
  - Does not work with current monthly showing process due to procurement timing constraints
- Enhance provisions for reassignment, trading, or sales of Import Capability among LSEs
  - If not pursuing auction mechanism CAISO may need to provide some alternative to current bilateral transfer process to better facilitate transfer of import capability among LSEs and improve efficient utilization of import capability, not proposing anything now

FLEXIBLE CAPACITY

CAISO seeks to close gaps by developing a flexible RA framework that captures both CAISO's operational needs and the predictability of ramping needs

- Changes to the flexible capacity product and flexible capacity needs determination should closely align with CAISO's actual operational needs for various market runs (*i.e.*, day-ahead market and fifteen-minute market)
- FRACMOO2 initiative was placed on hold, the objectives and work from that initiative have been integrated into the present initiative
  - At this time, CAISO is closing the FRACMOO stakeholder process

CAISO reviewed the drivers of flexibility need on the system

- Assessment sought to identify reasons CAISO would need to move resources from a fixed schedule
- The goal of this assessment was to more clearly identify how CAISO can access flexibility
  - Goal was not to expand the requirement definitions for flexible RA – but –
- Once flexibility needs are identified, make determination if need requires forward procurement to ensure adequate capacity is available to CAISO

There are multiple drivers of the CAISO need for flexibility

- Flexibility is required in all intervals to satisfy ISO operational needs, but not all types of flexibility are required in all hours
  - Forecasts (*i.e.*, load, VER, BTMs) improve between market runs
  - Timing granularity differs between market runs (hour, 15 min, 5 min)
  - Deviations from dispatch
  - Shaping around prescribed delivery of interties (Hourly blocks and industry ramp blocks)
  - Net-load ramps are non-linear
- Dispatch, controllability, response in required time horizon where planned to be utilized
  - Tertiary – Market flexibility needs
  - Secondary – Regulation and AGC (Impacted by tertiary)
  - Primary – Frequency Response (Impacted by secondary and tertiary)

CAISO requires several different types of flexibility, but not all need to be procured through resource adequacy

Primary – Frequency Response, RA procurement required: No

- Obligation of interconnection
- CAISO needs to ensure resources are able to and incentivized to meet their obligations, not a prescription of availability

Secondary – Regulation, RA procurement required: No

- Market product that provides sufficient incentives through the market to ensure adequacy

Tertiary – Market flexibility needs, RA procurement required: Yes

- Markets require sufficient economic bid range is provided to dispatch around load and resource variability (or inflexibility)
- CAISO should always have sufficient flexible capacity to pass ramp sufficiency tests
- Ensures flexible resources have a path to economic viability relative to inflexible resources (*i.e.*, leads to more rational retirement)

There are numerous benefits of forward procurement of flexible RA capacity

Examples of benefits from forward planning for tertiary or market flexibility needs include:

- Realization of full EIM benefits
- Predictable and economic retirement of resources
- Facilitate state environmental policy at lowest cost
- Mitigate random price spikes
- Provide for lower cost, more reliable dispatches
- Ensure CAISO can maintain reliability during highly variable weather conditions

As a result, CAISO's flexible capacity needs are to ensure numerous objectives are achieved

- Markets have sufficient economic bid range to dispatch around load and resource variability (or inflexibility), manage significant net load ramps, address uncertainty and differences in market granularity (i.e. hourly vs. fifteen minute) between market runs,
- CAISO always has sufficient flexible capacity to pass its own EIM ramp sufficiency tests
- Flexible resources have a path to economic viability relative to inflexible resources (*i.e.*, leads to more rational retirement)

CAISO observes the need for two categories of flexible capacity:

1. Predictable: known and/or reasonably forecastable ramping needs
   - Require a set of resources economically bidding into CAISO's day-ahead market to properly shape the day-ahead market
   - Allows CAISO to create a feasible market dispatch in the day-ahead market without relying on penalty parameters or exceptional dispatches
2. Unpredictable: ramping needs caused by load following and forecast error
   - CAISO must rely on real-time market dispatches to account for unpredictable ramps caused by uncertainty

A deeper pool of flexible resources improves the efficiency of CAISO dispatch and management of renewable resources

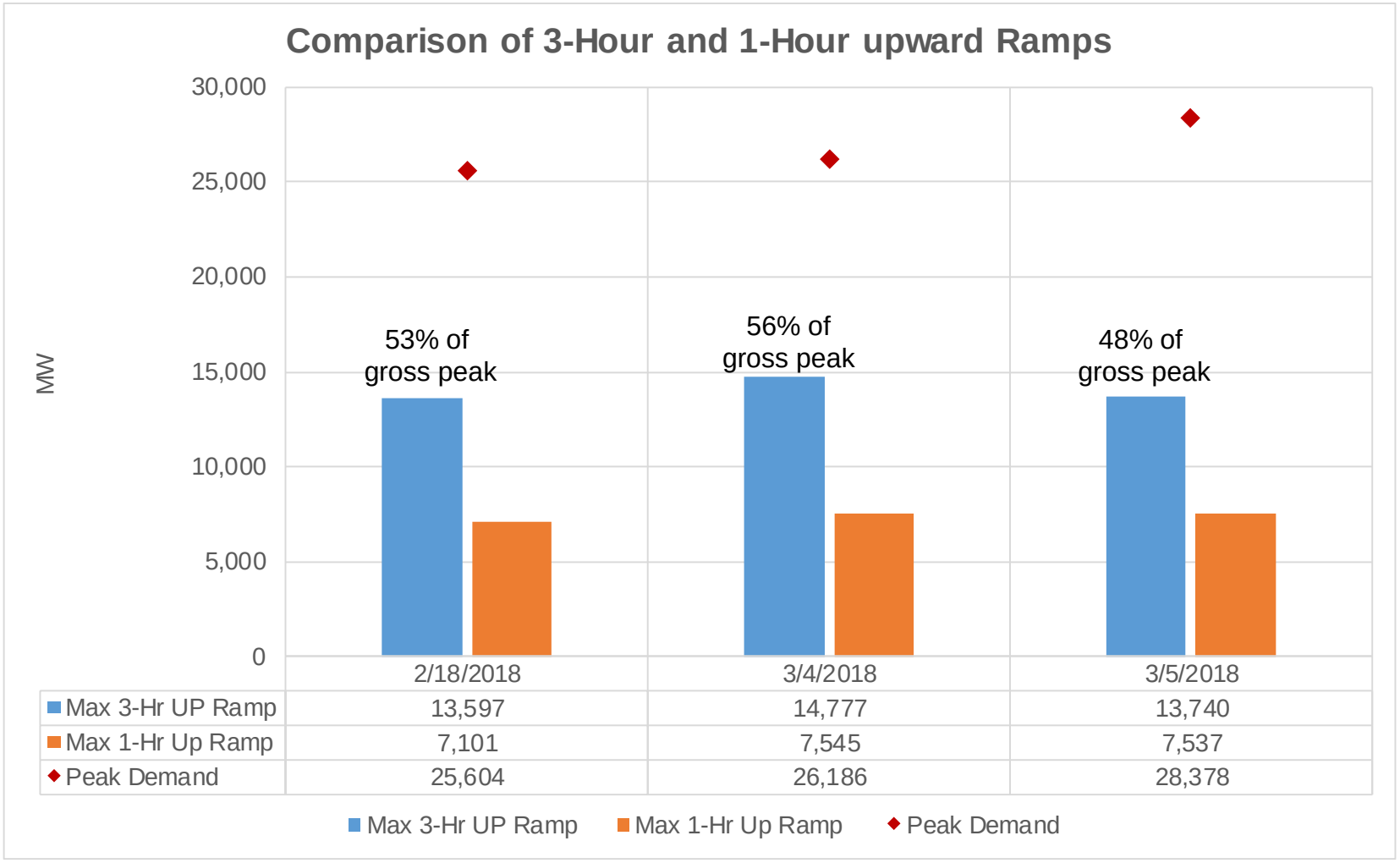
- CAISO expects net load ramps to grow and minimum net load to decrease over time
- Could lead to ramp constraints within the RA fleet and require additional exceptional dispatches
- CAISO proposes to maintain a requirement so there is sufficient bid range to cover the forecasted maximum three-hour net load ramps
  - Provide the resources needed to shape day-ahead market awards and commitments based on market solutions and should mitigate the need for exceptional dispatches

The three hour net load lamp is not a linear ramp

- A segment within the three-hour net load ramp requires a much faster ramp rate than the rest of the net load ramp
- Three-hour upward ramps are over 50 percent of daily peak demand.
- The largest one-hour net load ramps can be more than 50 percent of the three-hour net load ramp

This indicates a indicates need for faster ramping resources

3-hour upward ramps are over 50% of daily peak demand, indicating need for faster ramping resources



Load and generation are creating uncertainty between day-ahead and real-time markets

- Uncertainty after RUC, including both load following and forecast error, must be addressed by:
  - Resources previously committed in the day-ahead market, or
  - Faster starting resources available for commitment in the real-time market
- There can be significant differences between the IFM and FMM based on forecast error and time granularity
  - This is particularly true during sun rise and sun set

CAISO proposes flexible RA capacity requirements to align with the proposed imbalance reserves

- CAISO is developing market rules to procure imbalance reserves as part of its Day-Ahead Market Enhancements stakeholder initiative
  - The objective is to ensure the day-ahead market has sufficient resources awarded with upward and downward ramping capabilities to address real-time imbalances
  - Resources that receive an imbalance reserve award will have a must offer obligation in the real-time market
  - The energy bids associated with the imbalance reserve award will enable the real-time market to address uncertainties that materialize between the day-ahead market and real-time market through economic bids

Objectives of flexible RA capacity

- CAISO clearly states, quantifies, and justifies flexible capacity needs and how LSEs are able to meet them
- Resource capabilities are procured, shown and made available to the CAISO well in advance of market operations
- Market solves using economic bids, not penalty parameters
- Resources are justly compensated for the attributes they provide, ensuring adequate supply of each attribute
- Meets EIM Resource Sufficiency Tests

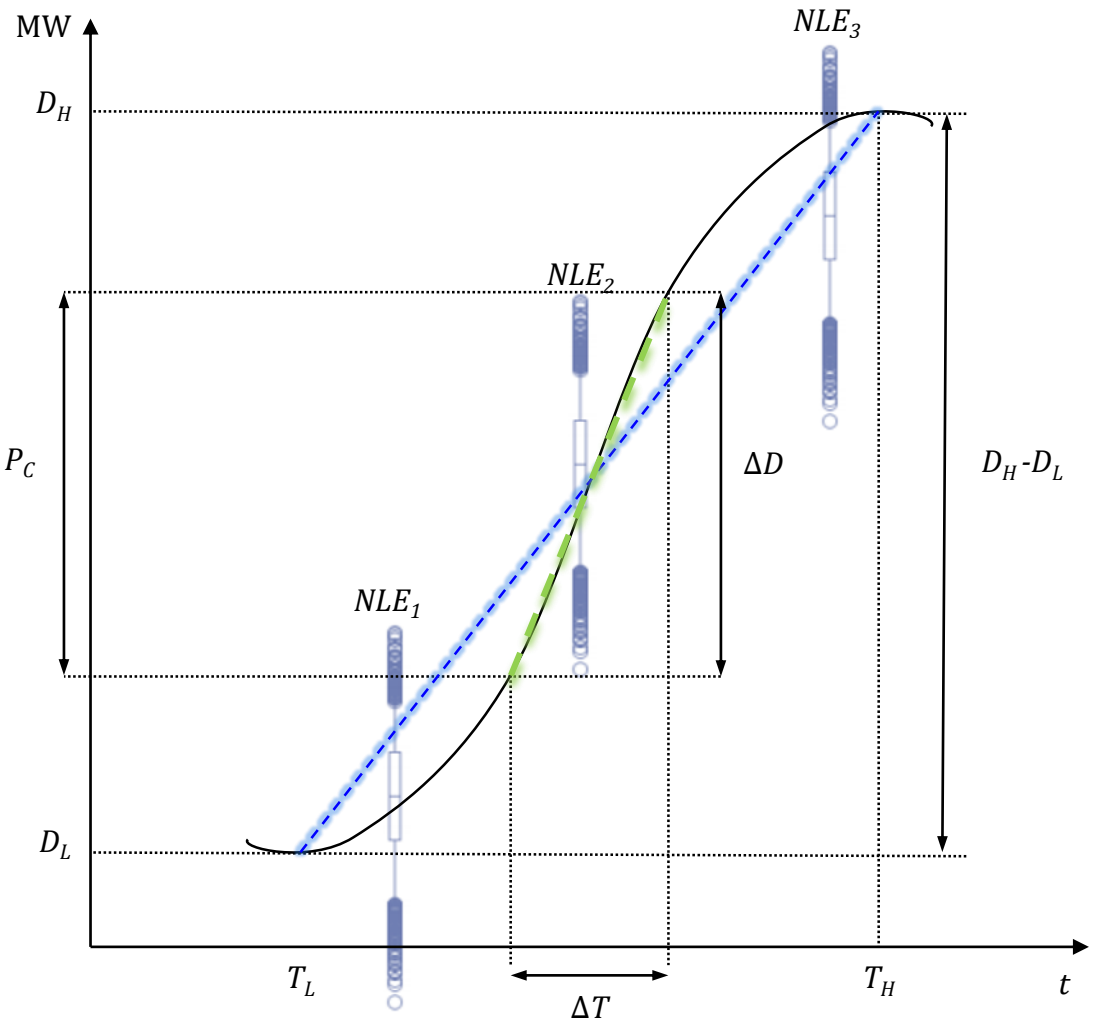
What is driving the flexible RA capacity needs and driving the MOOs for resources?

- Variability/ramping
  - Three-hour net load ramp
  - One-hour net load ramp
  - DA/RT FRP (i.e. uncertainty between market runs)
    - Ramp sufficiency tests?

- What hours are resources needed?
  - Evening net load ramp
  - 24x7 uncertainty

CAISO is exploring three flexible RA requirements: Uncertainty, Fast Ramping, and Long Ramping

- **Uncertainty Ramp:** Historic forecasted net load error between IFM and FMM
- **Fast Ramp:** Steepest section requiring highest ramp rate ($\Delta D/\Delta T$) over typically one hour
- **Long ramp:** From a low net demand (D_L) to a high net demand (D_H) over a time period ($T_H - T_L$), typically three hours



Any new flexible RA capacity requirements should meet basic criteria

- Easily procurable bilaterally
- Each requirement is clearly defined and quantified
- Resources' ability to meet each requirement is known and quantified
- Mitigates regulatory risks for procuring LSEs

CAISO will modify the existing flexible capacity requirements to simplify counting, eligibility rules, and must offer obligations to the greatest extent possible

Current flexible capacity needs assessment can be used to determine long and fast ramping flexible RA capacity needs

- Provides a tested process
- CAISO proposes to make some important changes to this study process and needs determination
  - Modify the existing 3.5 percent expected peak load portion of the flexible capacity requirement to be consistent with WECC Standard BAL-002-WECC-2a
  - Reconstruct overall available wind and solar output and include this quantity into the formulation of the net-load
    - Eliminates the concerns of double counting VERs towards meeting flexible capacity needs

Combining all off these elements yields an overall flexible capacity needs determination for long ramping

Long ramping need = Max Forecasted 3-Hour ramp (including reconstituted renewable curtailments) + ½ Max (MSSC, 6% of the monthly expected peak load) + ε

CAISO proposes to set fast ramping flexible RA capacity need based on the largest one-hour forecasted net-load ramp in each month

- CAISO is seeking stakeholder input regarding how this requirement should consider operating reserves when making needs determination.
  - Should it include an additional quantity of the fast ramping requirement to account for the overlap between flexible RA capacity or is this overlap sufficiently addressed by long-ramping procurement?

CAISO is currently exploring different options for determining requirements for uncertainty

- CAISO is proposing to use three years of historic data to determine:
  - Maximum difference between IFM and FMM forecasts, and
  - The rate of change in that difference
- CAISO will combine calculated forecast error with and expected growth in wind and solar
- CAISO will extrapolate the need for the uncertainty requirement for the upcoming RA year
- CAISO seeks stakeholder input on this approach to determining the requirements for uncertainty

For resources internal to CAISO BAA to be eligible to provide forecastable requirement the resource must meet all of the following criteria

- Either be a non-use limited resource – or – a use-limited resource with a use limitation CAISO can model in its energy market through an opportunity cost adder
- Be a dispatchable resource
- Not be a Conditionally Available Resource
- Not be a regulation energy management resource

For resources internal to CAISO BAA to be eligible to provide uncertainty flexible RA capacity, the resource must meet all of the following criteria:

- Meet the qualifications to provide the forecastable requirements
- Meet the definition of a short start resource
- Be dispatchable in at least 15 minute increments
- Must be able to reasonably control fuel source

CAISO seeks stakeholder feedback regarding the proposed eligibility rules as well as any additional criteria that should be considered

These eligibility criteria leave two primary issues unresolved

- Accounting for energy limitations
  - EFC counting rules ensure the resource is capable of producing energy for a given time period
  - Eligibility criteria do not address the ability of the resource to have available energy when needed
- Requirements for starts or ramping frequency
  - Current Base Ramping flexible RA capacity product requires two starts or two ramps per day
  - CAISO is not proposing minimum start or ramp requirements

These eligibility criteria leave two primary issues unresolved (cont.)

- Risk having resources no longer being able to meet its day-ahead commitment
  - For example, resources with one start per day receiving a day-ahead award for an evening start and then being committed in the morning of the operating day
  - A similar scenario can exist for storage resources that are not able to recharge during the day

EFC for internal resources will be calculated using resource's ability to ramp over a given time interval

- Each resource will receive three EFC values for each month
  - 15 minute
  - One hour
  - Three hour
- EFC values will only be calculated for resources that are eligible to meet the given requirement(s)

EFC for internal resources will be calculated using resource's ability to ramp over a given time interval (cont.)

- EFC calculation will no longer consider
  - Pmin/start-up time
  - Weighted average ramp rate
- EFC capped at the resource's UCAP
  - Cold start from its lowest operating limit to max output
- Pmin of the resource cannot be split
  - Pmin for a resource is either completely included or excluded from a resources EFC calculation
- Two exceptions to this rule:
  - Solar
  - Non-generator resources

NQC values in non-summer months do not reflect solar's ability to meet forecastable ramping needs

- Solar's ability to reduce net load ramps comes from willingness to *not* generate *prior* to net load ramping events
  - NQC is determined by its ability to serve load, or generate
- CAISO proposes to calculate solar resources EFC as a function of the resource's historic output
  - EFC would be calculated as a percent of their peak output for a month or season
  - Recognizes that solar production, or lack of production, is a significant contributor to net load ramps
  - CAISO believes solar EFC should be a high percentage of historic output
- CAISO seeks stakeholder feedback on determining percentage

NGR resources can help balance net load ramps by lifting the net-load by charging and providing generation output

- CAISO proposes to count NGR resources' EFC based on the resource's ability to provide generation (positive and negative) over a given interval
  - Allows NGR resources to potentially receive EFC values for full charge and discharge ranges
- CAISO is currently exploring EFC deliverability studies as part of its transmission planning process
  - CAISO will also use this process to inform the current process in determining if resources can be EFC only resources (*i.e.*, not require to have an NQC to receive an EFC))

CAISO will allow imports to provide flexible RA capacity for forecastable flexibility requirements

- Must meet the same firm energy standard applied to system capacity
- LSE must demonstrate that it has adequate MIC to use the import resource to provide flexible RA capacity
- Resource must identify the capacity's BAA of origin and the interconnection point with CAISO system
  - Must credit CAISO with any flexible RA capacity from resources based in an EIM BAA shown as flexible RA capacity
- Must be 15-minute dispatchable resources
- Imports will not be eligible to provide uncertainty requirement

CAISO will allow imports to provide EFC up to the UCAP of the resource

- Imports do not have the same defined ramp rates or minimum operating levels as internal resources
  - No Pmin and high ramp rates in Masterfile
- CAISO is not able to calculate an EFC in the same way it does for internal resources.
- LSEs and resource owners must determine how much flexible capacity they wish to procure from imports

Each LSE must demonstrate it can meet its proportionate share of each of the requirements

- CAISO will provide each LRA its jurisdictional LSEs' contribution to each requirements
  - LRAs can then determine its own allocation of each of the requirements
    - CAISO is not looking for LRAs to provide an allocation methodology, instead, the LRA should provide CAISO with each of its jurisdictional LSE's allocation
  - Load-Following, Metered Sub-System LRAs will not receive an allocation for any forecasted flexible RA capacity needs attributable to changes in load
  - If the LRA does not provide an allocation, then CAISO will allocate to each LSE based on its allocation methodology

Each LSE must demonstrate it can meet its proportionate share of each of the requirements (cont.)

- CAISO will allocate forecastable flexible RA capacity requirements using similar methods to those used today
  - *i.e.* assess the five largest three hour and one hour forecasted net-load ramps and determine each LRA's contribution based on changes in load wind and solar
- One change CAISO proposes is to ensure that load, wind, and solar values all come from the same intervals.
  - CAISO continues to work to assess the best metric for allocating these relative changes
  - Days with small changes in load can have high percentage of flexible RA attributed to a single LRA
  - CAISO is seeking stakeholder feedback about how to develop an appropriate weighting and allocation process

Each LSE must demonstrate it can meet its proportionate share of each of the requirements (cont.)

- CAISO is considering an allocation based on LRAs' share of peak load, and MW of wind and solar
  - Reflects that these factors, although not the only drivers, are the major drivers of uncertainty
  - CAISO is seeking stakeholder input on this option and others
- LSEs required to meet 100 percent of its flexible capacity requirements year ahead and month ahead RA showings
- CAISO will assess the showings for each showing for each requirement independently
  - Showings should be submitted in terms of EFC for each requirement CAISO will assess the long-ramp showings independent of the fast-ramp showings
  - LSEs can have a resource on one, two, or all three of its flexible RA capacity showings

Each LSE must demonstrate it can meet its proportionate share of each of the requirements (cont.)

- Once CAISO receives flexible RA capacity showings, it will do two things
  - Notify all LSEs if they have provided adequate flexible capacity in each category and notify the LSE if it was at risk of potential backstop procurement cost allocation
  - Assess the adequacy of each requirement at a system level
- If CAISO finds a deficiency in any flexible RA capacity requirement, it will assess individual showings and notify LSEs of the system deficiency
  - LSEs will be provided an opportunity to cure the deficiency
  - This cure period will align with the cure period for other RA requirements

CAISO will assess the showings for each requirement independently

- Showings should be submitted in terms of EFC for each requirement
- CAISO will assess the long-ramp showings independent of the fast-ramp, and uncertainty showings
- LSEs can have a resource on one, two, or all three of its flexible RA capacity showings

CAISO is looking to simplify the must offer obligations for flexible capacity

- Different offer obligations have created a significant amount of confusion for market participants
- UCAP values determined resource forced outage rates over a 16-hour window between 5:00 AM and 9:00 PM
  - CAISO data shows the uncertainty tends to be higher during the same 16 hour window
- Must strike a balance between
  - Multiple must offer obligations
  - Ensuring CAISO has sufficient capacity available during the intervals of need
  - Aligning flexible capacity and generic capacity rules
    - Many flexible RA resources will also provide multiple flexible RA requirements and system or local capacity

CAISO is looking to simplify the must offer obligations for flexible capacity (cont.)

- Resource must submit economic bids to the CAISO's markets from 5:00 AM to 9:00 PM for shown flexible RA
  - Real-time RA must offer obligations will align with the Day-Ahead Market Enhancements policy
- Solar and wind resources should submit economic bids for the minimum of their forecast or their shown EFC
  - Consistent with allowing solar resources to provide EFC greater than their NQC, and
  - Differs from the current practice of allowing solar resources to bid a proportionate amount of their EFC to NQC value
- NGR resources must submit economic bids to cover both the charge and discharge range of shown EFC

LOCAL RESOURCE ADEQUACY

Local capacity assessments with availability-limited resources issue definition

- Current RA program does not fully consider resources' availability limitations
- Availability-limited resources have energy limitations that could affect their ability to respond to contingency events in local areas
- RA requirements are based on meeting peak capacity needs in MWs rather than energy needs (MWhs) in all hours

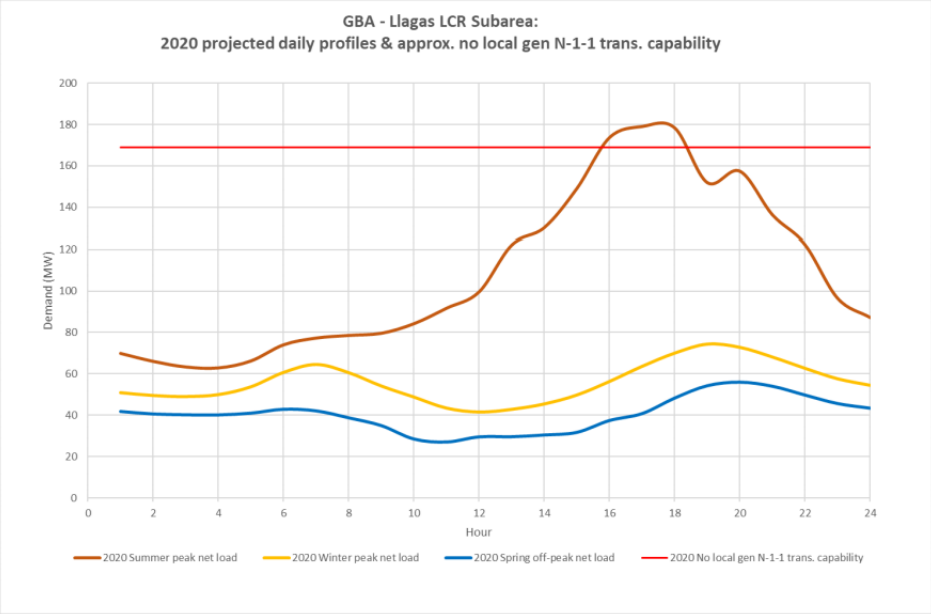
Availability-limited resource definition

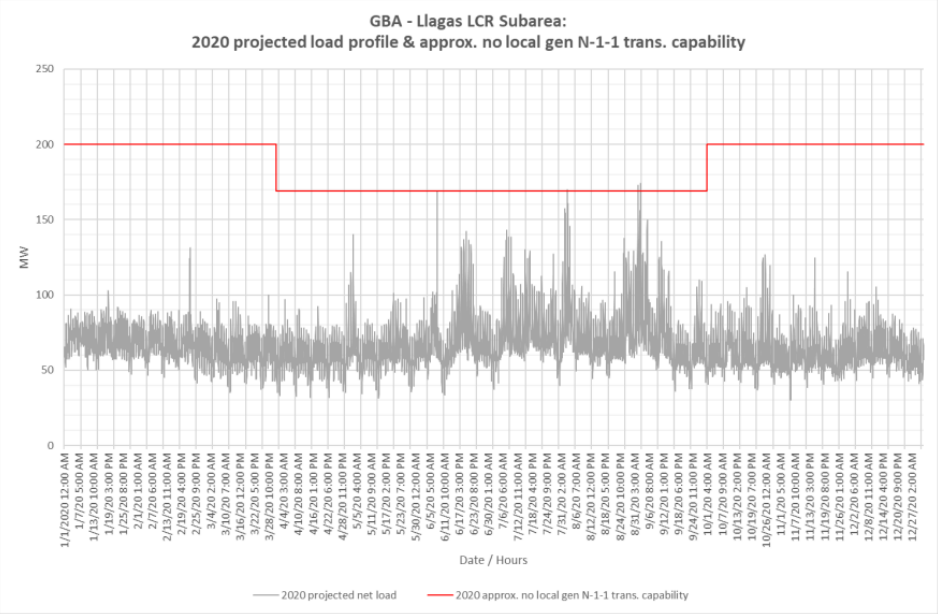
- Resources with significant dispatch limitations such as limited duration hours (*e.g.*, per year, season, month, or day) or event calls (*e.g.*, per year, season, month or consecutive days) that would limit the resources' ability to respond to a contingency event within a local capacity area
- Definition limited to resources that count towards meeting local area or sub-area resource adequacy needs
- Definition recognized by CPUC in its RA decision

CAISO believes it is important to consider availability-limitations in local capacity areas

- Currently, availability-limited resources must have a minimum of four-hour duration to qualify as RA
- Moorpark study showed the minimum duration requirement may lead to procurement that is sufficient in meeting peak capacity RA requirements but insufficient in meeting energy needs in all hours of the day
- Starting this year, CAISO has published hourly load shapes and available resource data to inform procurement aligned with energy needs in each local capacity area and sub-area

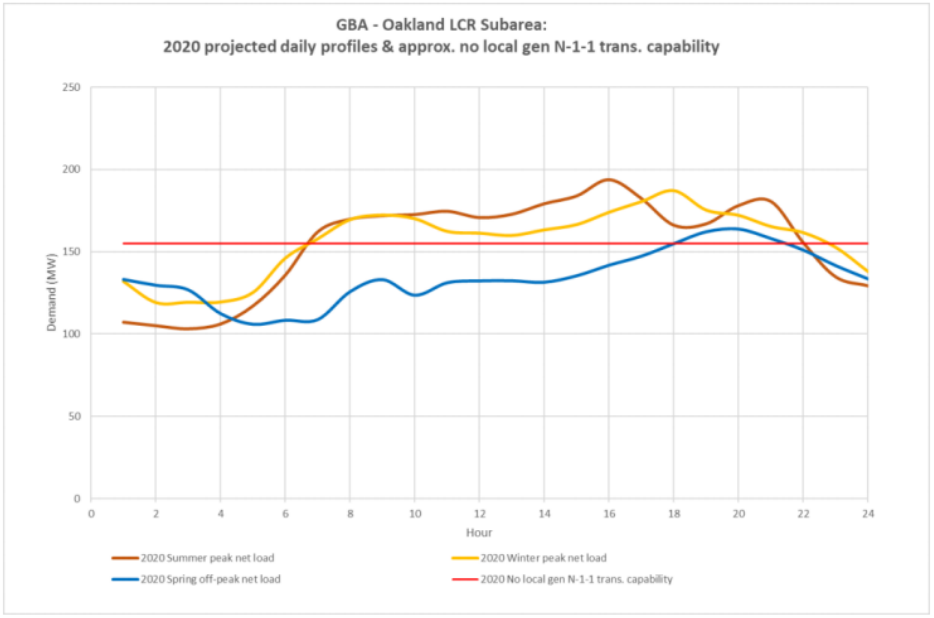
Sample Hourly Load Profiles

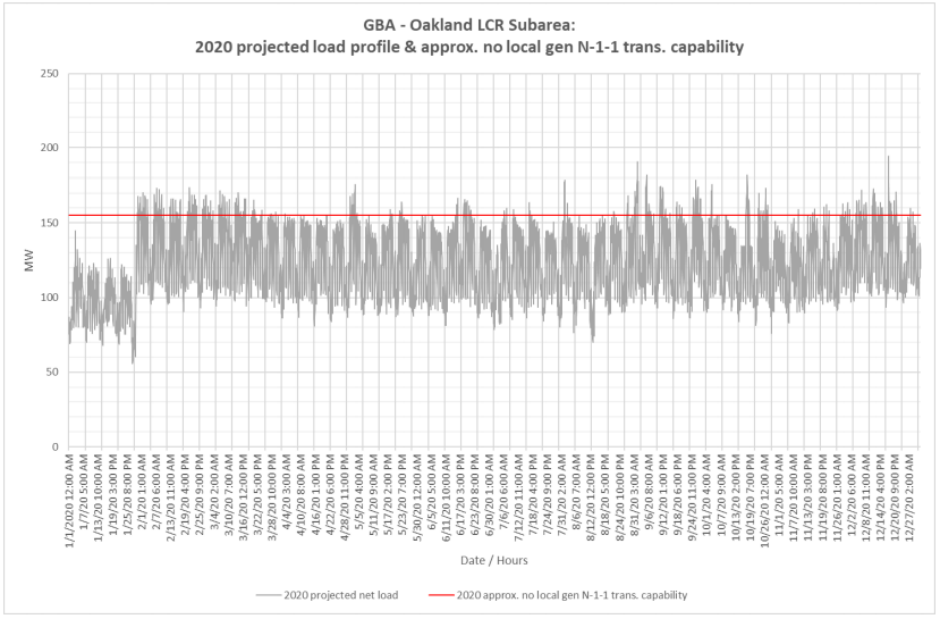




Load (MW)		Generation (MW)	NQC	At Peak
Gross Load	190	Market	246	246
AAEE	-2	MUNI	0	0
Behind the meter DG	-8	QF	0	0
Net Load	**180**	LTPP Preferred Resources	0	0
Transmission Losses	0	Existing 20-minute Demand Response	0	0
Pumps	0	Mothballed	0	0
Load + Losses + Pumps	**180**	**Total**	**246**	**246**

Sample Hourly Load Profiles





Load (MW)		Generation (MW)	NQC	At Peak
Gross Load	196	Market	165	165
AAEE	-3	MUNI	48	48
Behind the meter DG	-6	QF	0	0
Net Load	**187**	LTPP Preferred Resources	0	0
Transmission Losses	0	Existing 20-minute Demand Response	0	0
Pumps	0	Mothballed	0	0
Load + Losses + Pumps	**187**	**Total**	**213**	**213**

CAISO plans to maintain the existing LCT study process with certain additions that inform availability needs in local areas

- CAISO has incorporated hourly load shapes and available resource data into the LCT study process to inform of availability needs in local areas
  - Informs quantity of capacity in MWs and energy in MWhs needed in local capacity area
  - Informs longer term procurement and investment decisions by providing greater transparency into duration needs multiple years out
- CAISO will validate that the RA resources shown meet energy needs under the hourly load shape curve

Slow DR is an availability-limited resource not capable of responding to CAISO dispatches within 20 minutes

- Per NERC standards and CAISO tariff section 40.3.1.1(1), the CAISO must secure the system within 30 minutes of a contingency
- This allows roughly 10 minutes for CAISO operators to assess system conditions and 20 minutes for resource dispatch and response
- This required response time impacts “slow” DR resources because they cannot respond with 20 minute notification and have availability limitations that prevent frequent dispatch

To meet local RA needs, resources must either…

1. Be capable of responding quickly enough such that the CAISO can rebalance the system within 30 minutes of a contingency event, or;
2. Have sufficient availability such that the resource can be dispatched frequently on a pre-contingency basis (before a potential contingency event occurs)
   - CAISO planning studies indicate current levels of slow DR generally have sufficient availability to count for local RA
     - Excludes limited run-time duration

CAISO will develop tools to dispatch slow DR on a pre-contingency basis so it can help meet local area reliability needs

- Slow DR resources would be dispatched before a potential contingency occurs as a preventive measure
- Pre-contingency dispatch would not be cancelled if a contingency does not occur
- Pre-contingency dispatch will result in more frequent dispatch of slow DR
  - Local capacity requirements are set based on the minimum quantity of local capacity necessary to meet the LCR criteria
  - Slow DR that counts as a local capacity resource could be needed more often if other local capacity resources go on outage or retire

Example: Slow DR use as local capacity

- Local Capacity Area Characteristics:
  - Non-peak days: Load = 20 MW
  - Peak 1: Load = 28 MW, Tues 9 – Thurs 11
  - Peak 2: Load = 30 MW, Thurs 18- Sat 20
- Local Capacity Resource Characteristics:

Resource	NQC (MW)	Bid Cost ($/MW)	Availability Limitations
Resource A	10	10	N/A
Resource B	10	15	N/A
Resource C	8	20	N/A
Resource D (Slow DR)	10	50	3 consecutive days

Example: Slow DR use as local capacity (cont.)

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1 Res A: 10 Res B: 10	2 Res A: 10 Res B: 10	3 Res A: 10 Res B: 10	4 Res A: 10 Res B: 10	5 Res A: 10 Res B: 10	6 Res A: 10 Res B: 10	7 Res A: 10 Res B: 10
8 Res A: 10 Res B: 10	9 Res A: 10 Res B: 10 Res C: 8	10 Res A: 10 Res B: 10 Res C: 8	11 Res A: 10 Res B: 10 Res C: 8	12 Res A: 10 Res B: 10	13 Res A: 10 Res B: 10	14 Res A: 10 Res B: 10
15 Res A: 10 Res B: 10	16 Res A: 10 Res B: 10	17 Res A: 10 Res B: 10	18 Res A: 10 Res B: 10 Res C: 8 **Res D: 2**	19 Res A: 10 Res B: 10 Res C: 8 **Res D: 2**	20 Res A: 10 Res B: 10 Res C: 8 **Res D: 2**	21 Res A: 10 Res B: 10
22 Res A: 10 Res B: 10	23 Res A: 10 Res B: 10	24 Res A: 10 Res B: 10	25 Res A: 10 Res B: 10	26 Res A: 10 Res B: 10	27 Res A: 10 Res B: 10	28 Res A: 10 Res B: 10
29 Res A: 10 Res B: 10	30 Res A: 10 Res B: 10					

Costs

Non-peak: (10MW*$10) +(10MW*$15) = **$350**

Peak 1: (10MW*$10) +(10MW*$15) +(8MW*$20) = **$510**

Peak 2: (10MW*$10) +(10MW*$15) +(8MW*$20) +(2MW*50$) = **$610**

Example: Slow DR use as local capacity (cont.)

- Local Capacity Area Characteristics:
  - Non-peak days: Load = 20 MW
  - Peak 1: Load = 28 MW, Tues 9 – Thurs 11
  - Peak 2: Load = 30 MW, Thurs 18- Sat 20
- Local Capacity Resource Characteristics:

Resource	NQC (MW)	Bid Cost ($/MW)	Availability Limitations
Resource A	10	10	N/A
Resource B	10	15	N/A
~~Resource C~~	~~8~~	~~20~~	~~N/A~~
Resource D	10	50	3 consecutive days

Example: Slow DR use as local capacity (cont.)

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1 Res A: 10 Res B: 10	2 Res A: 10 Res B: 10	3 Res A: 10 Res B: 10	4 Res A: 10 Res B: 10	5 Res A: 10 Res B: 10	6 Res A: 10 Res B: 10	7 Res A: 10 Res B: 10
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29 Res A: 10 Res B: 10	30 Res A: 10 Res B: 10					

Costs

Non-peak: (10MW*$10) +(10MW*$15) = **$350**

Peak 1: (10MW*$10) +(10MW*$15) +(8MW*$50) = **$750**

Peak 2: (10MW*$10) +(10MW*$15) +(10MW*$50) = **$850**

Local resources that wish to infer on potential number of calls can use the hourly load shapes in the local studies

- Local studies assume 100% availability of all resources and transmission (other than limiting contingency)
- Local studies publish daily and yearly load profiles, the LCR requirement, and the amount of total physical resources in the local area
- CAISO cannot provide specific estimates because future dispatch depends on many factors that are difficult to determine including; local area load profiles and import capability, resources available in local area at a given time, individual local area load profiles, actual contingency events, etc.

Post-day-ahead approach

- **DAM:** Existing process, no change
  - CAISO will continue to run Minimum Online Commitment (MOC)
  - MOC eligible resources = Long start resources
  - MOC requirement = load – import capability – short start capacity
- **Post-DAM:** if MOC is not sufficient to commit enough resources to meet local need, ED slow DR
  - Create day-ahead dispatch for DR (RT does not undo/modify)
  - Post-DA ED eligible resources = Slow DR
  - Post-DA ED requirement = MOC insufficiency
- Slow DR response time must align with the day-ahead market timing

Real-time market based approaches

- ESDER 3 bidding options provide lead time slow DR requires in the real-time:
  - Hourly block: 52.5 minute notice
  - 15-minute block: 22.5 minute notice
  - Transition post-DA approach to allow for dispatch in the real-time market time horizon
- When CME constraints are enforced, the market will dispatch slow DR for energy when economic over reserving corrective capacity on another resource

Local RA eligibility

- Slow PDR must be dispatchable in real-time market time horizons once ESDER bidding options are implemented
- Slow RDRR will not count for local RA
  - RDRR cannot be dispatched prior to CAISO declaring a transmission emergency
  - CAISO cannot plan the system assuming the CAISO would need to declare a transmission emergency to meet our local requirements

BACKSTOP CAPACITY PROCUREMENT PROVISIONS

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 proposes additional CPM authority and a mechanism to prevent leaning

- System UCAP test
  - System UCAP deficiencies would trigger CPM procurement, with cost allocation to deficient LSEs
  - Similar to CPM today, tests are performed on annual and monthly resource adequacy showings
- Portfolio deficiency CPM
  - Procure deficiencies identified in the ISO portfolio analysis, when procured resources cannot meet system energy and reliability needs
  - Costs will be allocated on a load ratio share basis

CAISO proposes additional CPM authority and a mechanism to prevent leaning

- Local availability limited deficiency test (extension of collective)
  - Load shapes determined in local capacity technical studies may reveal deficiencies
- UCAP deficiency tool
  - LSEs that show below requirements would be charged a penalty price
    - The price will be set at the soft offer cap for CPM
  - Penalties distributed to LSEs that show above requirements
  - The capacity incentive mechanism would work in tandem with the system UCAP test

Example of system UCAP CPM designation

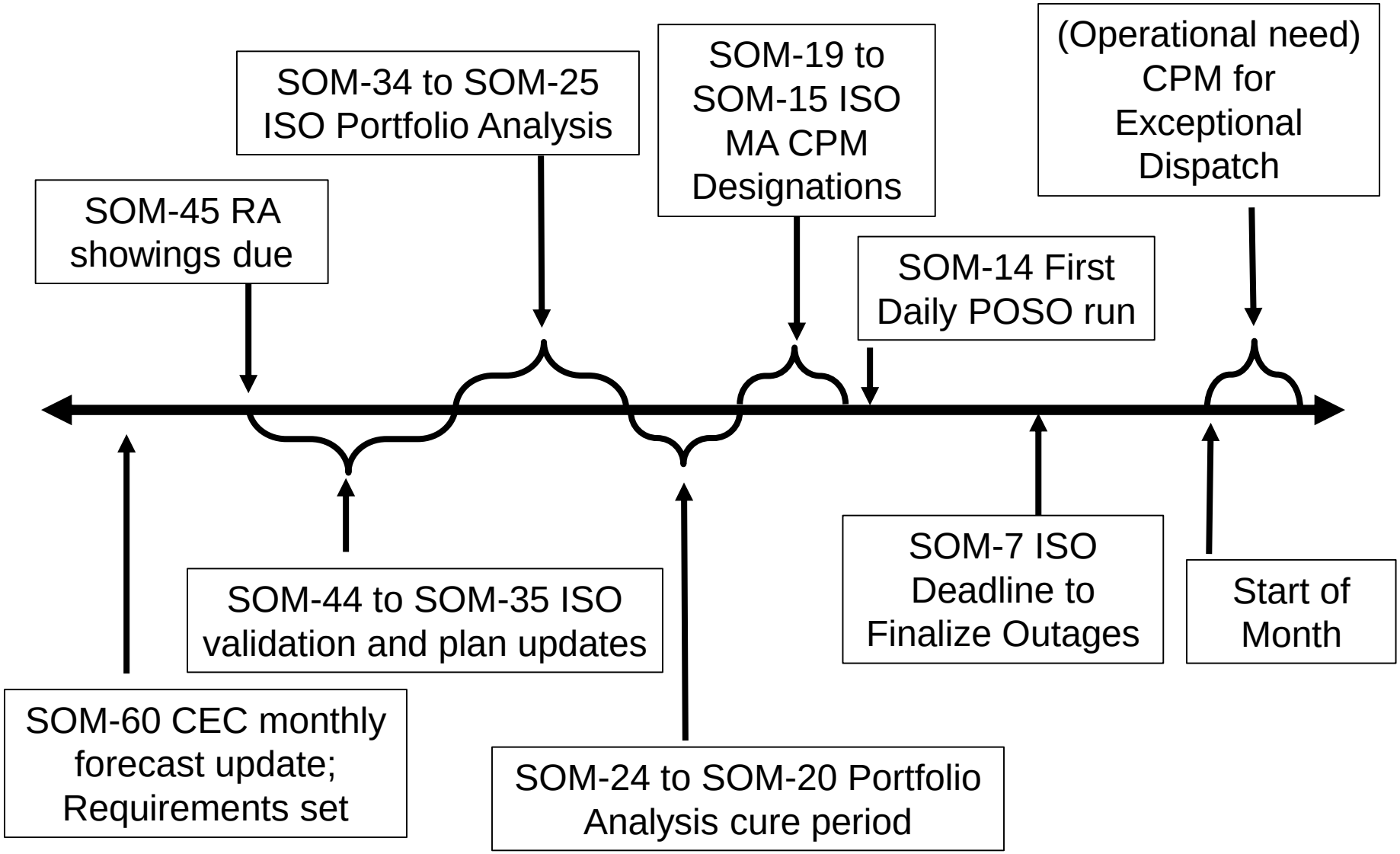
LSE	Req.	Shown	Shortage	Cost Allocation
1	100 MW	125 MW	-	
2	100 MW	80 MW	20 MW	20/45
3	100 MW	75 MW	25 MW	25/45
TOTAL	**300 MW**	**280 MW**	**45 MW**	

- System UCAP CPM designations would work similar to existing “collective deficiency” designations
  - Cost assessed and allocated by deficiency share
  - A period to cure deficiencies will be offered to deficient LSEs
  - ISO will procure 20 MW with a CPM designation
- Consistent with this proposal, this CPM authority will only apply to system – not local – deficiencies

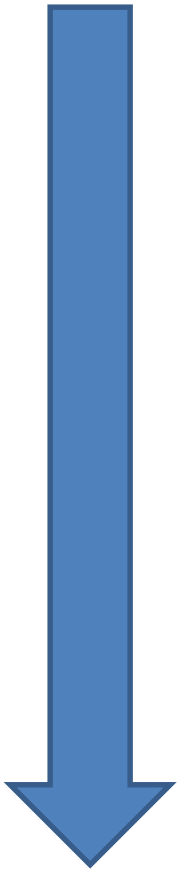
Expand CPM authority to procure for deficiencies identified in the system portfolio assessment

- It is essential that CAISO has resources available to reliably operate the grid
  - May not align with UCAP analysis
- CAISO may make backstop designations to ensure that we can meet aggregate energy needs for the system
  - This analysis will not focus only on peak needs
- Details of portfolio analysis proposal continue to be discussed
- CAISO will continue to publish study information behind CPM designations made as a result of this authority

Timeline for CPM backstop procurement



System CPM costs will be allocated first for shortfalls in portfolio procurement then UCAP and finally NQC



- Procurement necessary to backstop for UCAP deficiencies, allocated to entities with deficiencies
  - Credit will be given for attributes of resources procured, allocated on same basis
- Procurement for “traditional” system NQC shortages, with same cost allocation
- Local deficiencies will be cured and allocated to deficient entities (similar to allocation today)
  - Including Local “load shape” deficiencies are allocated locally
- Any additional procurement necessary as a result of the portfolio analysis will be made and allocated on a load ratio share basis

UCAP deficiency tool will incentivize LSEs to procure UCAP at least up to and beyond requirements

- Backstop authority is used to ensure that enough UCAP is procured to meet system needs
- The UCAP deficiency tool will incentivize LSEs to show as much capacity as possible, to receive payments
  - Disincentivizes LSEs from ‘free riding’ on neighbors
- Tool will prevent leaning between LSEs, by charging deficient LSEs the soft offer cap for the CPM
- Tool helps reduces possibility backstop procurement
- Process would be self funded and settled in the month-ahead and year-ahead time frame when RA showings and backstop procurement is complete

Examples of UCAP deficiency tool

- Example 1: No system deficiency, but LSE 3 leans for 10 MW

LSE	Req.	Shown	Shortage	Cost Allocation
1	100 MW	110 MW	-	$25,240
2	100 MW	115 MW	-	$37,860
3	100 MW	90 MW	10 MW	-$63,100

- Example 2: 25 MW system deficiency, with no resources ‘over-showing’

LSE	Req.	Shown	Shortage	Cost Allocation
1	100 MW	100 MW	-	-
2	100 MW	80 MW	20 MW	-
3	100 MW	95 MW	5 MW	-

Examples of UCAP deficiency tool

- Example 3: System deficiency of 20 MW, which is cured through CPM, and LSE 1 and 2 leaning on LSE 3

LSE	Req.	Shown	Shortage	Backstop	Cost Allocation
1	100 MW	90 MW	10 MW	8 MW	-2 MW * $6.31
2	100 MW	85 MW	15 MW	12 MW	-3 MW * $6.31
3	100 MW	105 MW	-		5 MW * $6.31

NEXT STEPS

Next steps

- Stakeholder written comments due July 24, 2019
  - Submit to initiativecomments@caiso.com
  - Comments template available at http://www.caiso.com/informed/Pages/StakeholderProcesses/ResourceAdequacyEnhancements.aspx
- Second Revised Straw Proposal posting September 2019