



Briefing on How Resource Adequacy Works in ISO's Current Balancing Authority Area

**Regional Resource Adequacy Meeting
December 16, 2015
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**Keith Johnson
Manager, Infrastructure Policy**



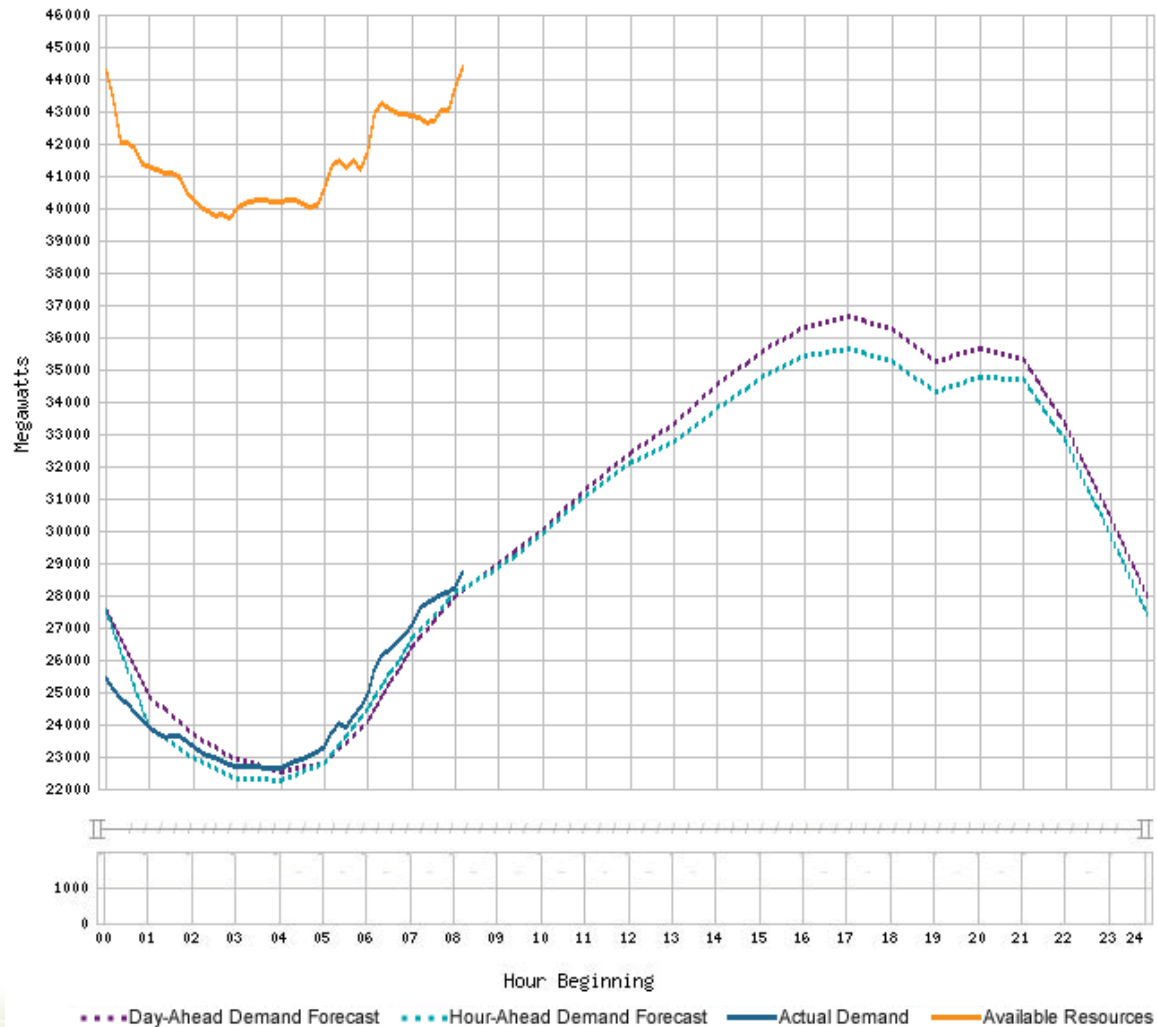
Topics to be covered during today's briefing

1. What resource adequacy is
2. ISO balancing authority area
3. How resource adequacy is achieved (the process)
4. Resource adequacy requirements
5. What is qualified capacity?
6. Resource showings and compliance
7. Bidding and scheduling requirements
8. Performance incentives
9. ISO “backstop” procurement

What is Resource Adequacy?



Resource adequacy ensures sufficient resources



Resource adequacy (“RA”) is a forward planning and procurement process.

Goal is to ensure that

- Sufficient capacity exists, has been secured through ownership or contract, and is made available to ISO markets in right places and at right times
- In order for all load to be served by responsible load serving entities (“LSE”)

Key elements include

- One-year-ahead, and one-month-ahead, forward resource showings that demonstrate that each LSE has sufficient capacity to meet its expected load plus any applicable planning reserve margin (“PRM”)

The local regulatory authority (“LRA”), LSE, supplier, and system operator have different responsibilities.

LRA

- Perform long-term resource planning and direct procurement
- Define qualified capacity (“QC”)
- Adopt RA program and require jurisdictional LSEs to procure qualified capacity

LSEs*

- Procure and/or own qualified capacity as RA capacity
- Make that RA capacity available to ISO through showings
- Bid and schedule that RA capacity consistent with applicable must-offer obligation (“MOO”)

Suppliers*

- Confirm RA capacity shown by LSE (ISO uses supplier capacity in its systems)

System Operator

- Ensure sufficient resources are available to balancing authority area (“BAA”) to provide safe and reliable operation of grid

* All business with ISO is transacted through a Scheduling Coordinator (“SC”)

Resource procurement is done through a bilateral market (or ownership where entities own resources).

1. LRAs require LSEs to procure qualified RA capacity
2. LSEs secure RA capacity (ownership or bilateral contract)
 - Megawatt (“MW”) amount of QC by each resource is posted
 - LSEs use QC information to contract with suppliers for RA capacity
 - LSEs make that capacity known to ISO as RA capacity through showings

A key feature of RA capacity is that it comes with a MOO.

- LRAs and LSEs do long-term and short-term resource planning and procurement
 - And that does not change when under an RA paradigm
- Key change when going to RA paradigm is that capacity comes to ISO as “RA capacity” and RA capacity has a MOO
 - To bid or schedule that capacity into ISO’s markets
 - Capacity needs to be of a certain type, offered in certain time periods, and from certain locations on grid

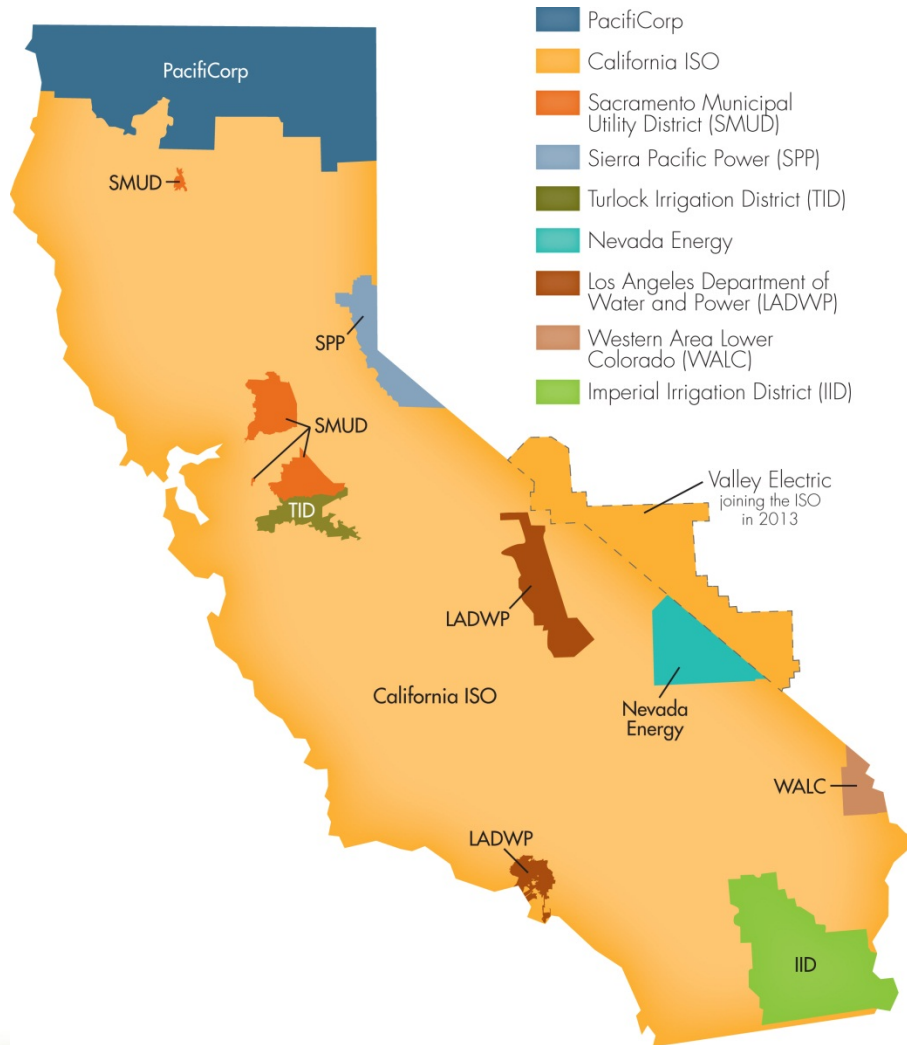
LRAs have flexibility in how they use their portfolio of resources.

- RA is a monthly requirement, i.e. MW amount varies by month
- An LSE will have a RA MW requirement each month
- Each LSE will have a portfolio of resources
- A portion of an LSE's portfolio in any given month must be made available to ISO market (the RA requirement)
- LSE is free to use “excess” non-RA resources/capacity as it chooses after it has met its RA requirements
 - Can bid excess into ISO market
 - Can use excess as substitute capacity if its RA capacity goes out on outage
 - Can sell excess capacity to others

What is the ISO's BAA?

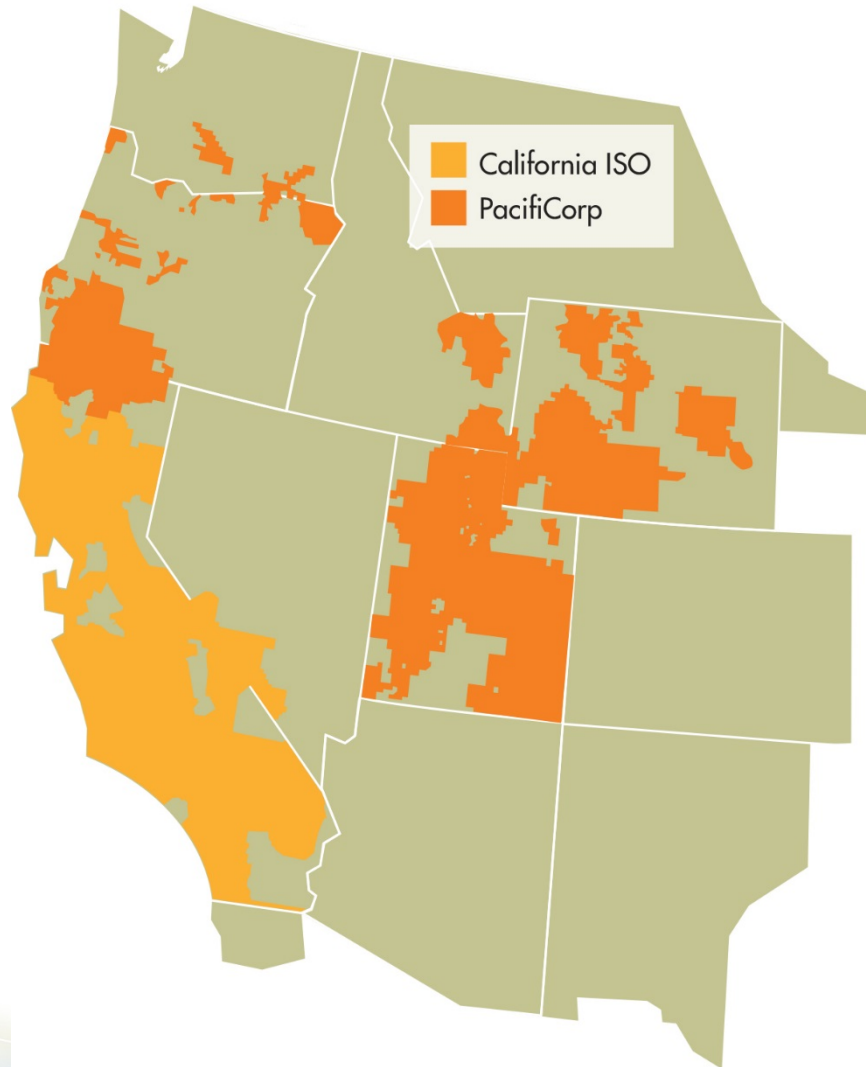


Current ISO BAA (yellow shaded area)



- **65,000 MW** of power plant capacity
- **50,270 MW** record peak demand (July 24, 2006)
- **26,000 circuit-miles** of transmission lines
- **244 million megawatts** of electricity delivered (2013)
- **\$8 billion** annual market
- **30 million** people served
- **One** of nine ISO/RTOs in North America

What an expanded BAA might look like.



How do we achieve RA?



The table below summarizes key steps in RA process and responsible party.

#	Step	Responsible Party	The Goal
1	Determine operational needs	ISO	Communicate how much is needed
2	Establish RA program	LRA	Have RA program and rules
3	Plan resources/direct procurement	LRA	Order procurement
4.	Procure resources	LSE	Resources procured
5.	Present resources to ISO	LSE/Supplier	Here is what is procured
6.	Assess resource showings	LRA/ISO	Ensure requirement procured
7.	Make resources available	Supplier	Provide capacity to RA market
8	Assess resource performance	ISO	Ensure capacity is performing
9	Run market and operate grid	ISO	Reliably operate grid

RA Requirements

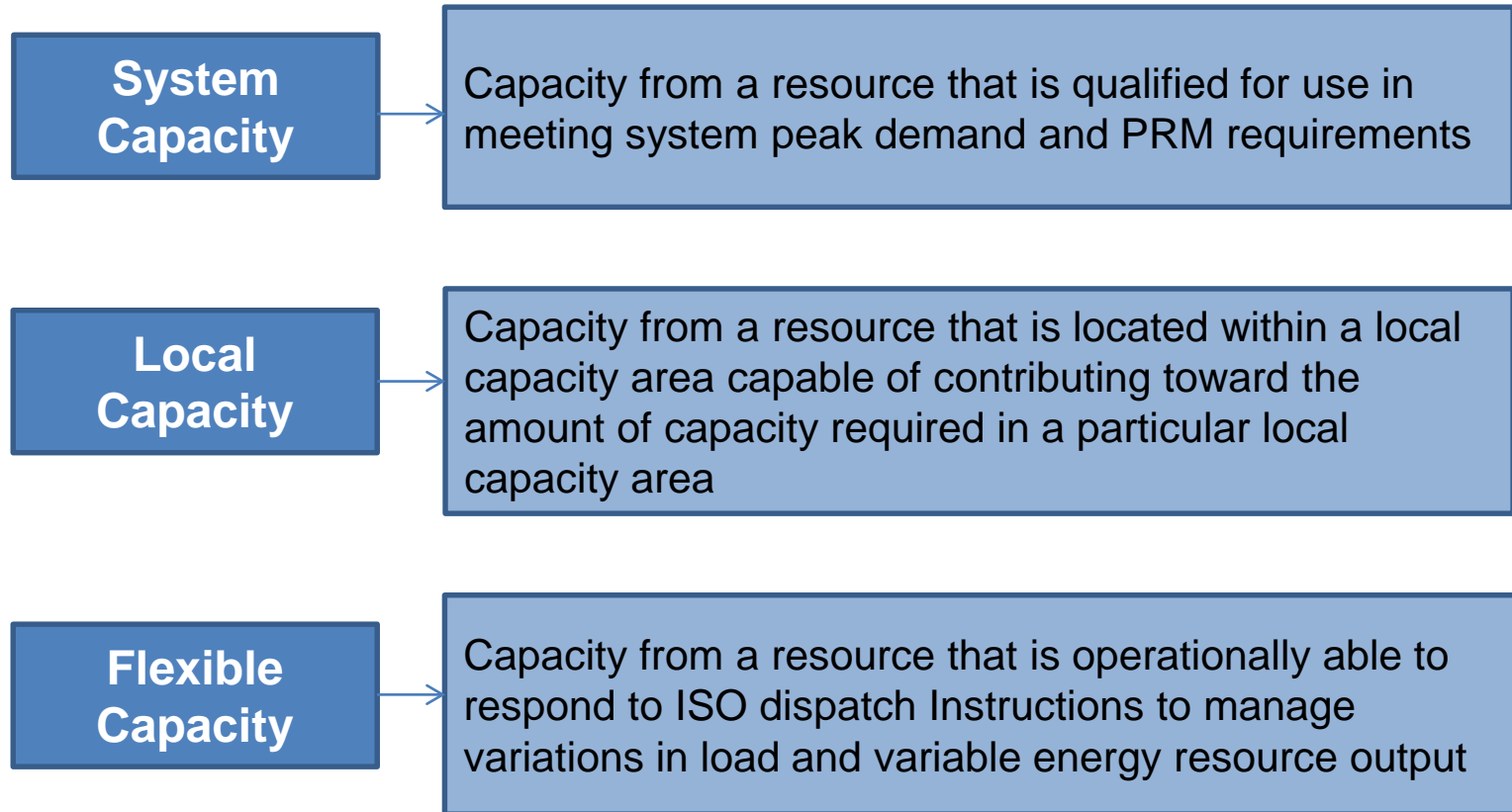
LRAs establish RA programs.

- LRAs establish RA programs that establish RA requirements application to their jurisdictional entities
- ISO defers to LRAs for certain RA requirements, but has authority to set certain requirements and “backstop” to those requirements if adequate RA capacity is not provided
- ISO tariff has default RA requirements/criteria in situations where an LRA has not adopted RA requirements
- LSEs are required to cover their share of ISO BAA peak load, local, and flexible RA capacity needs

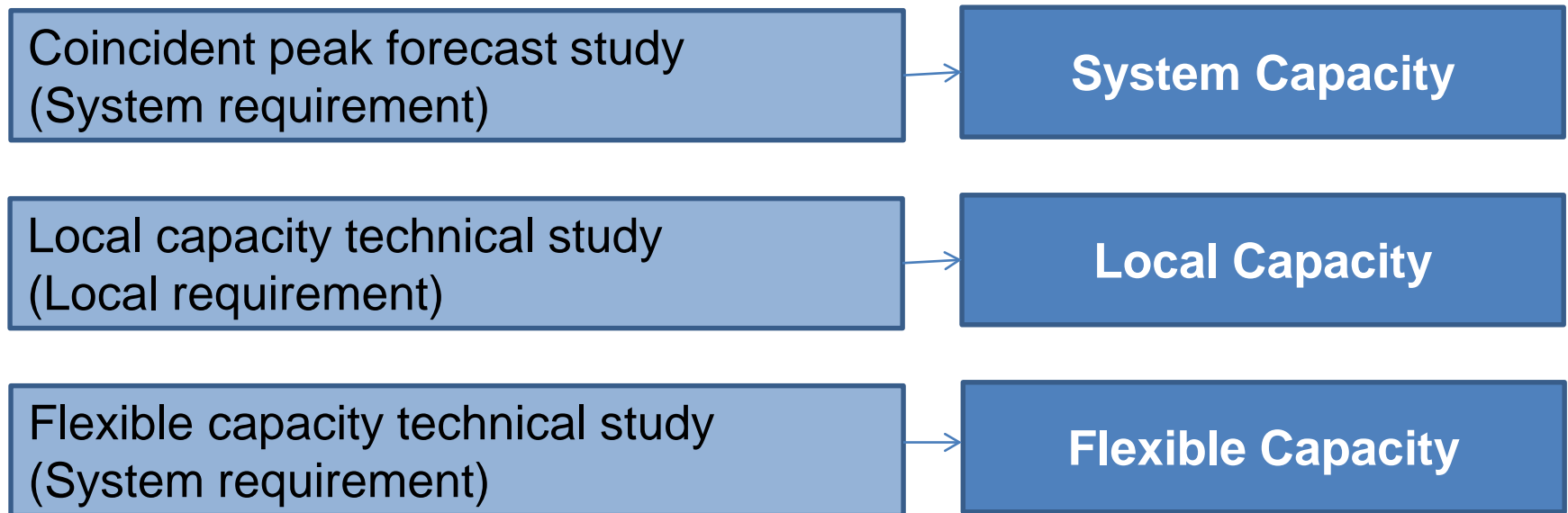
Several of the key elements of an RA program are listed below.

- PRM
- Established and standardized load forecast
- Capacity procured in advance and comprised of system, local and flexible capacity
- Rules for “counting” the MW value of resources
- Requirements to offer RA capacity into ISO market
- Procured resources must be “deliverable” to load
- Formal process to review procurement reports
- Clear *ex ante* consequences for noncompliance and poor performance

Three types of RA capacity are needed to reliably operate the grid.



Each type of RA capacity is different and is derived from a different study.



The requirements for each type of RA capacity are summarized below.

Type of Capacity	Determined	Requirement
System	Monthly	Requirement varies by month – each month must procure load forecast plus PRM ¹
Local	Annually	Same requirement for each month of year for each TAC area - LSE must procure for each TAC area in which it serves load and resource must be physically located within local areas of each TAC ²
Flexible	Annually	Requirement varies by month – LSE must procure its requirement

¹ PRM percentage can vary based on LRA's RA program.

² Local capacity can count for system capacity, but system capacity does not necessarily count for local capacity.

LSEs have options regarding how to use their portfolio of resources.

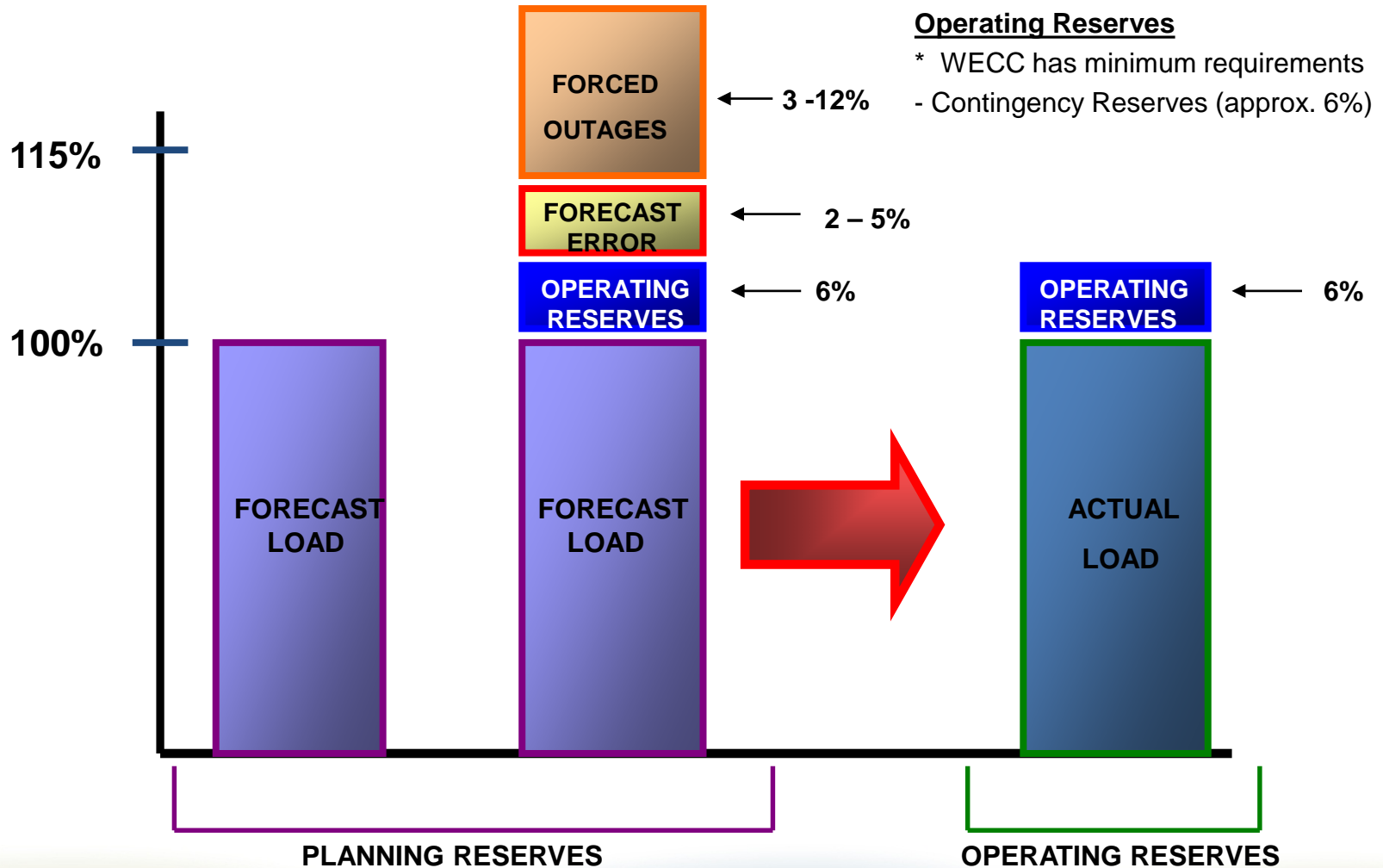
- LSEs have year-ahead and month-ahead RA procurement targets
- Some LSEs own their own resources – which means they can be both LSE and supplier
- LSEs can contract for RA capacity from other suppliers
- If a market participant’s “supplier-side” of its business has excess RA capacity
 - Can bid excess into ISO market
 - Can use excess as substitute capacity if its RA capacity goes out on outage
 - Can sell excess capacity to others

The load forecast is a key element in determining RA requirements.

- LSEs submit load forecasts
 - California Energy Commission establishes forecast including assumptions for load modifying demand response and energy efficiency
- Accuracy requirement is “1-in-2-year” for system assessment and “1-in-10-year” for local assessment
- Each LSE’s load forecast is adjusted for system coincidence by month

Coincident peak load determines total RA requirement and it is allocated to LSEs pro rata based on their load share

Illustrative Planning Reserve Margin of 15-17%



The concept of system procurement is shown in the map below.

System capacity requirement

System capacity can be procured from any resource that is physically located anywhere within ISO BAA)

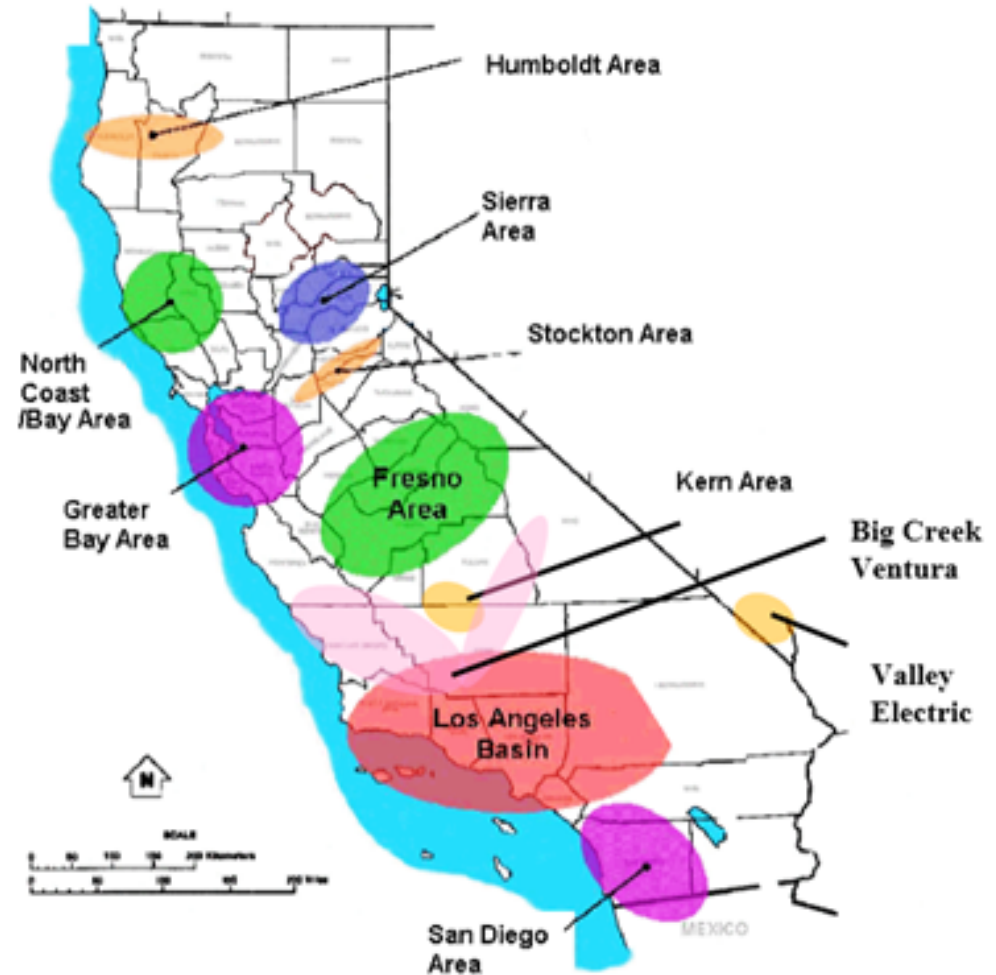
Note that imports can also count towards system capacity, subject to RA import allocation



The concept of local procurement is shown in the map below.

Local capacity requirement areas within ISO

Local capacity must be procured from resources that are physically located within the local area



The nature of the local requirement and study methodology are described below.

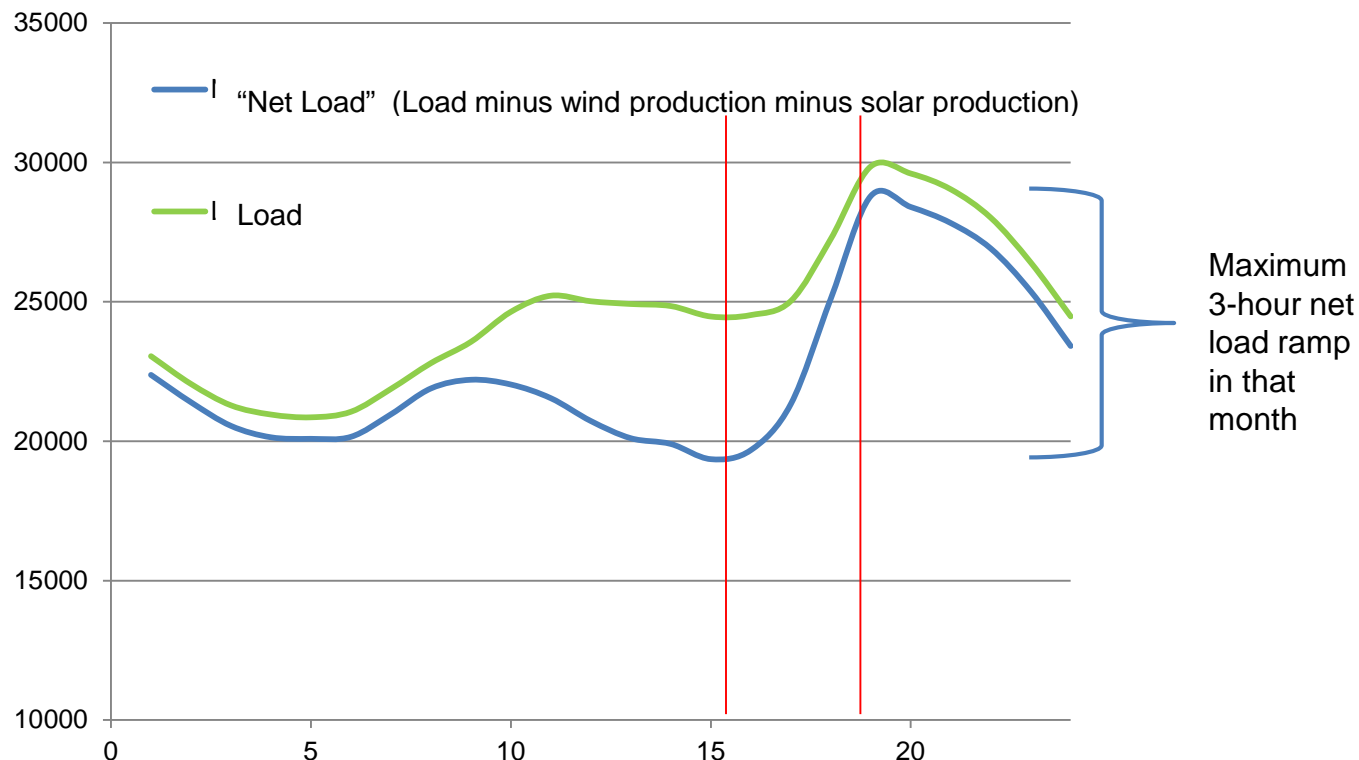
- Nature of requirement
 - Subset of system RA requirements; represents capacity that needs to be procured in specific local areas
 - Minimum resource capacity needed and available in local area to reliably operate grid
- Study methodology
 - Evaluates peak load condition in local area
 - Uses “load pocket” concept: load within local area may exceed maximum transmission capacity available to deliver resources into that area
 - Long-term studies fully integrated into annual transmission planning process; uses latest 1-in-10 year summer peak forecast for local areas

ISO has authority to establish local capacity requirements.

- Resources that can qualify
 - Any resource within the defined local area that has been verified to be “deliverable”
- ISO authority
 - ISO can determine minimum local capacity requirements on LSEs in order to maintain ISO reliability standards
 - If LSE procurement falls short of ISO’s identified needs, ISO may engage in backstop procurement to ensure reliability standards are met in local areas

ISO has authority to establish flexible capacity requirements.

ISO needs are based on largest 3-hour net load ramp for system in month

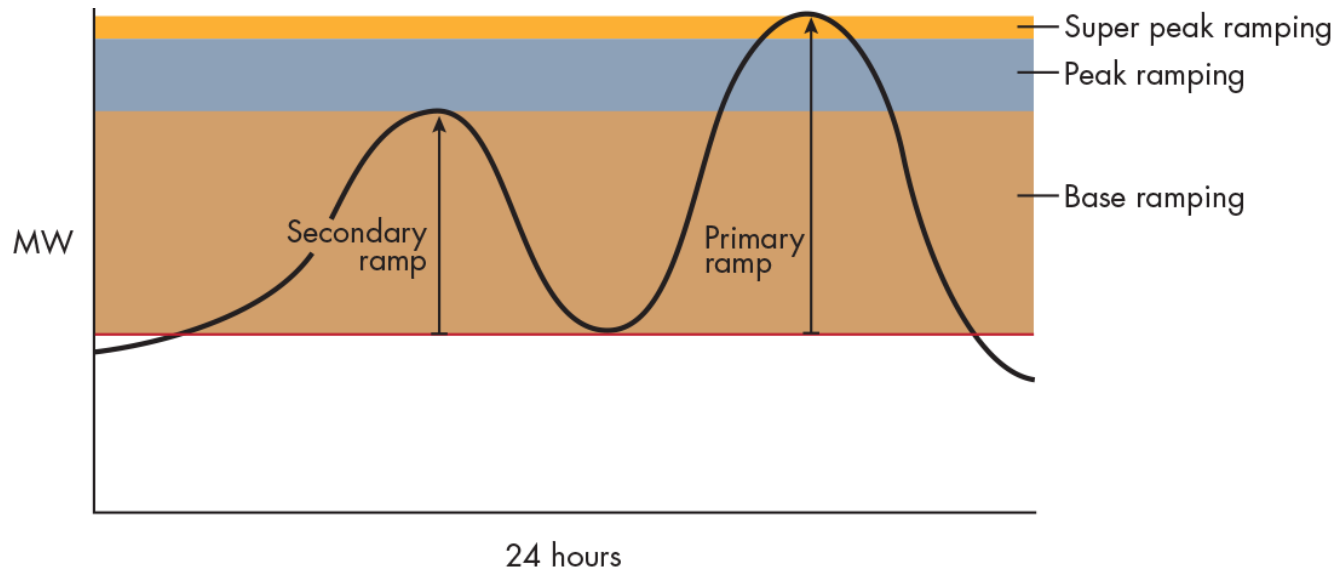


Needs are allocated to LRAs based on their LSEs' contribution to net load ramp

Flexible capacity requirements ensure the ISO can meet net load changes.

- ISO conducts study each year to determine MW of flexible capacity “need”
- LSEs must annually demonstrate sufficient capacity to cover their share of the net load changes
- Flexible resources must submit economic bids in ISO market
- ISO has authority to procure additional flexible capacity if needed to address deficiencies

Three categories enable some needs to be provided by preferred resources with limited availability.



Parameter	Category 1 (Base Ramping)	Category 2 (Peak Ramping)	Category 3 (Super-Peak Ramping)
Must-Offer Obligation	5:00 a.m. – 10:00 p.m.	5 hour block	5 hour block
Energy Requirement	Minimum 6 hours	Minimum 3 hours	Minimum 3 hours
Daily Availability	7 days/week	7 days/week	Non-holiday weekdays

* Flexibility MW value of a resource is defined by amount it can ramp in three hours.

What is qualified capacity?



ISO publishes two lists of capacity resources that are qualified to be procured for RA.

- **NQC List:** Published each year in July-October timeframe prior to start of the RA compliance year; resources on list are eligible to be included on year-ahead and month-ahead local and system RA showings
- **Effective Flexible Capacity List:** Published each year at same time as NQC list; contains all flexible resources that are eligible to be included on year-ahead and month-ahead flexible RA showings

LRAs determine criteria for resources to count as “qualifying capacity” for RA.

Examples of technologies

- Thermal resources
- Wind resources
- Solar resources
- Hydro resources
- Energy-limited resources
- Demand response resources
- Energy storage resources

ISO takes “qualifying capacity” values and determines “net qualifying capacity” values.

- ISO determines these values annually and creates and publishes an “NQC” list for RA compliance year
- ISO tests QC value against values listed below and an NQC is established at lower of following:
 - Calculated QC
 - Latest unit testing information
 - PMax
 - Resource deliverability (energy only, full capacity, interim deliverable, partial deliverable)

ISO performs system studies to determine the deliverability of resources.

- Study methodology considers deliverability
 - At peak load condition
 - Using “generation pocket” concept where generation in area may exceed transmission capacity available to deliver resource outside the area
- Generation deliverable MW amount is determined based on studies with deliverable imports represented
- Import deliverable MW amount determined based on average of highest recent historical usage during summer peak conditions
- Being deemed “deliverable” conveys no priority rights when resource uses ISO controlled grid

Import deliverability is assessed using the Maximum Import Capability (“MIC”) methodology.

- MIC MW amount is calculated based on amount of simultaneous energy schedules into ISO BAA during peak system load hours over last two years
- MIC on each intertie is available to LSEs for procuring RA capacity from external resources; it is not assigned directly to external resources
- MIC values for each intertie are calculated annually for a one-year term
- A 13-step process is used to allocate MIC to LSEs

Zonal constraints are also considered in counting criteria.

- “Path 26 counting constraint” accounts for limited transmission transfer capability across Path 26 in ISO BAA
- Relies on information regarding existing contracts for its implementation, similar to MIC import capability allocation process
- Constraint only applies to CPUC-jurisdictional LSEs because the requirement is not currently in ISO tariff

How do resources and capacity “count” for local capacity?

- A resource can count as local capacity as long as resource physically sits within local capacity requirement area
- NQC list shows
 - Which local capacity requirement area each resource is physically located within
 - NQC MW value for each qualified resource

The rules for counting a resource as flexible capacity are shown below.

Start-up time greater than 90 minutes

$$\text{EFC} = \text{Minimum of (NQC-Pmin) or (180 min * RRavg)}$$

Start-up time less than 90 minutes

$$\text{EFC} = \text{Minimum of (NQC) or (Pmin + (180 min - SUT) * RRavg)}$$

Where:

EFC: Effective Flexible Capacity

NQC: Net Qualifying Capacity

SUT: Start up Time

RRavg: Average Ramp Rate

Resource Showings and Compliance

Resource “showings” are required to demonstrate RA capacity.

- LSEs submit in both year-ahead and month-ahead time frames
 - RA plan showings
- Suppliers submit in both year-ahead and month-ahead time frames
 - Supply plans
- Showings provide basis for “hand-off” of resources as RA capacity to ISO

Resource showings are used to enforce RA obligations.

- RA plan year-ahead showing obligation
 - Requires some portion of RA requirements be procured year-ahead for upcoming compliance year
- RA plan month-ahead showing obligation
 - Requires 100% of RA requirements be procured month-ahead
- Supply plan month-ahead showing obligation
 - Requires supplier to confirm what supplier treats as RA capacity (should be equal to 100% of what is shown on corresponding RA plan showing)

LSES use templates that are on ISO system to prepare RA showings.

Resource Capacity Contract Number	Resource ID in CAISO Master File	RA Capacity (MW 00.00 No Rounding)	RA Capacity Effective Start Date (mm/dd/yyyy hh:mm:ss)	RA Capacity Effective End Date (mm/dd/yyyy hh:mm:ss)	Capacity Designation (D, S, or N)	Rank for Replacement Capacity (blank for D, Resource ID for S, or numeric for N)
CNTR_1	CAISO_2_RESA	100.00	11/1/2013 00:00:00	11/30/2013 23:59:59	D	
CNTR_2	CAISO_2_RESA	50.00	11/1/2013 00:00:00	11/30/2013 23:59:59	D	
CNTR_3	CAISO_2_RESBB	25.00	11/1/2013 00:00:00	11/30/2013 23:59:59	D	
CNTR_4	CAISO_2_RESCC	10.00	11/1/2013 00:00:00	11/30/2013 23:59:59	S	CAISO_2_RESBB

Templates uploaded through ISO system to ISO for review and validation

The ISO receives both RA plan showings from LSE and supply plan showings from supplier.

- LSEs provide RA plan showings
- Suppliers provide supply plan showings
- ISO compares the two and ensures that they match

LSE RA Plan

	A	B	C	D	E	F	G	H
1								
2	Monthly	Resource Capacity Contract Number	Resource ID in CAISO Master File	RA Capacity (MW 00.00 No Rounding)	RA Capacity Effective Start Date (mm/dd/yyyy hh:mm:ss)	RA Capacity Effective End Date (mm/dd/yyyy hh:mm:ss)	Capacity Designation (D, S, or N)	Rank for Replacement Capacity (blank for D, Resource ID for S, or numeric for N)
23								
24								
25								
26								
27								

Supplier Supply Plan

	A	B	C	D	E	F	G
1							
2	Monthly	Resource Capacity Contract Number	Resource ID in CAISO Master File	RA Capacity (MW 00.00 No Rounding)	RA Capacity Effective Start Date (mm/dd/yyyy hh:mm:ss)	RA Capacity Effective End Date (mm/dd/yyyy hh:mm:ss)	SCID of Load Serving Entity
3							
4							
5							
6							
7							

Year-Ahead Procurement and Demonstration of RA is shown below.

1. LRA mandates procurement of some portion of next year's RA requirement

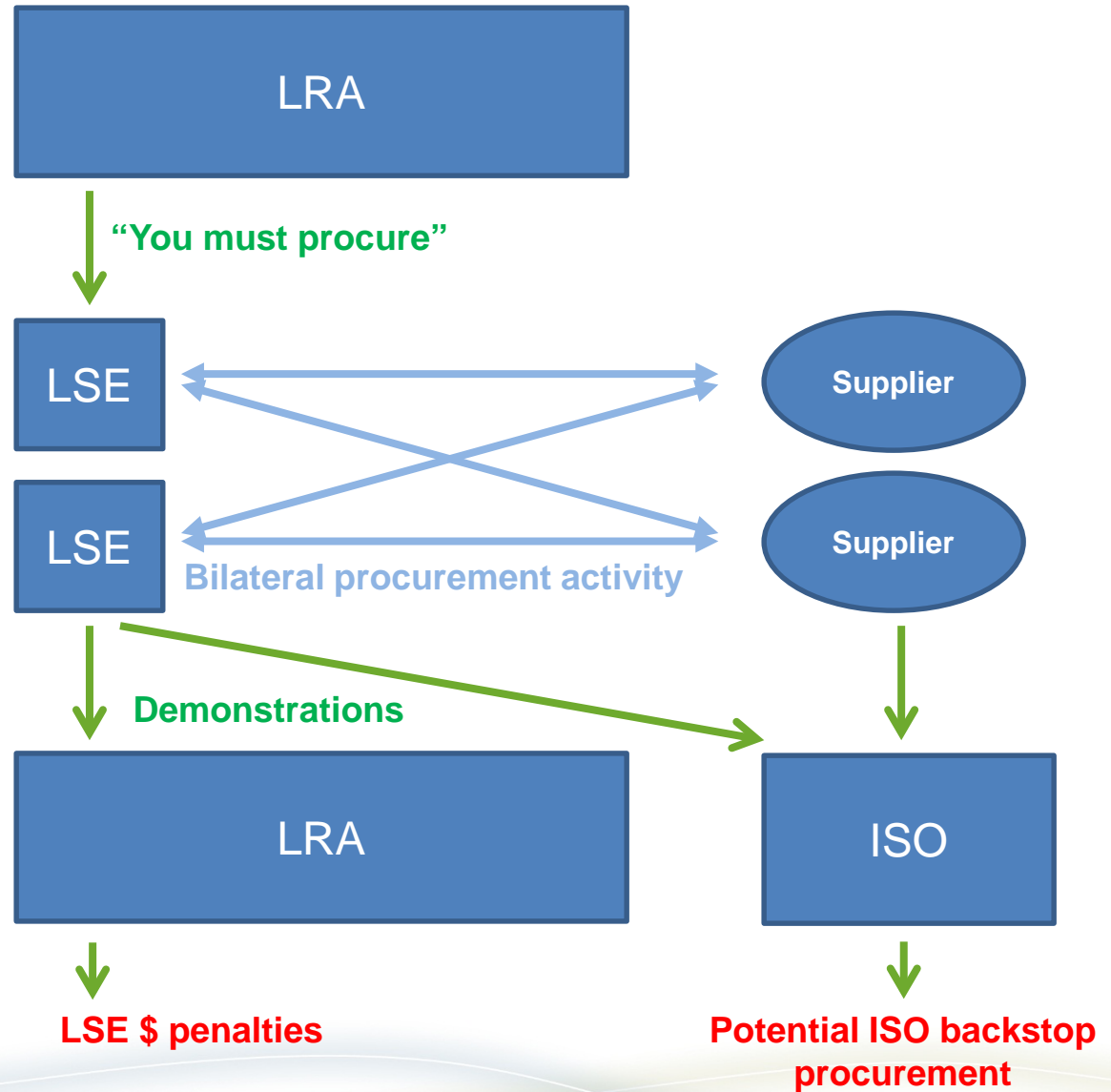
2. LSEs engage in bilateral procurement of capacity to meet this requirement

3. LSEs demonstrate procurement to LRA and ISO

4. Suppliers demonstrate RA sales to ISO

5. LRA ensures LSE compliance

6. ISO ensures suppliers corroborate LSE showings and met needs



Month-Ahead procurement and demonstration of RA is shown below.

1. LRA mandates procurement of all of next month's RA requirement

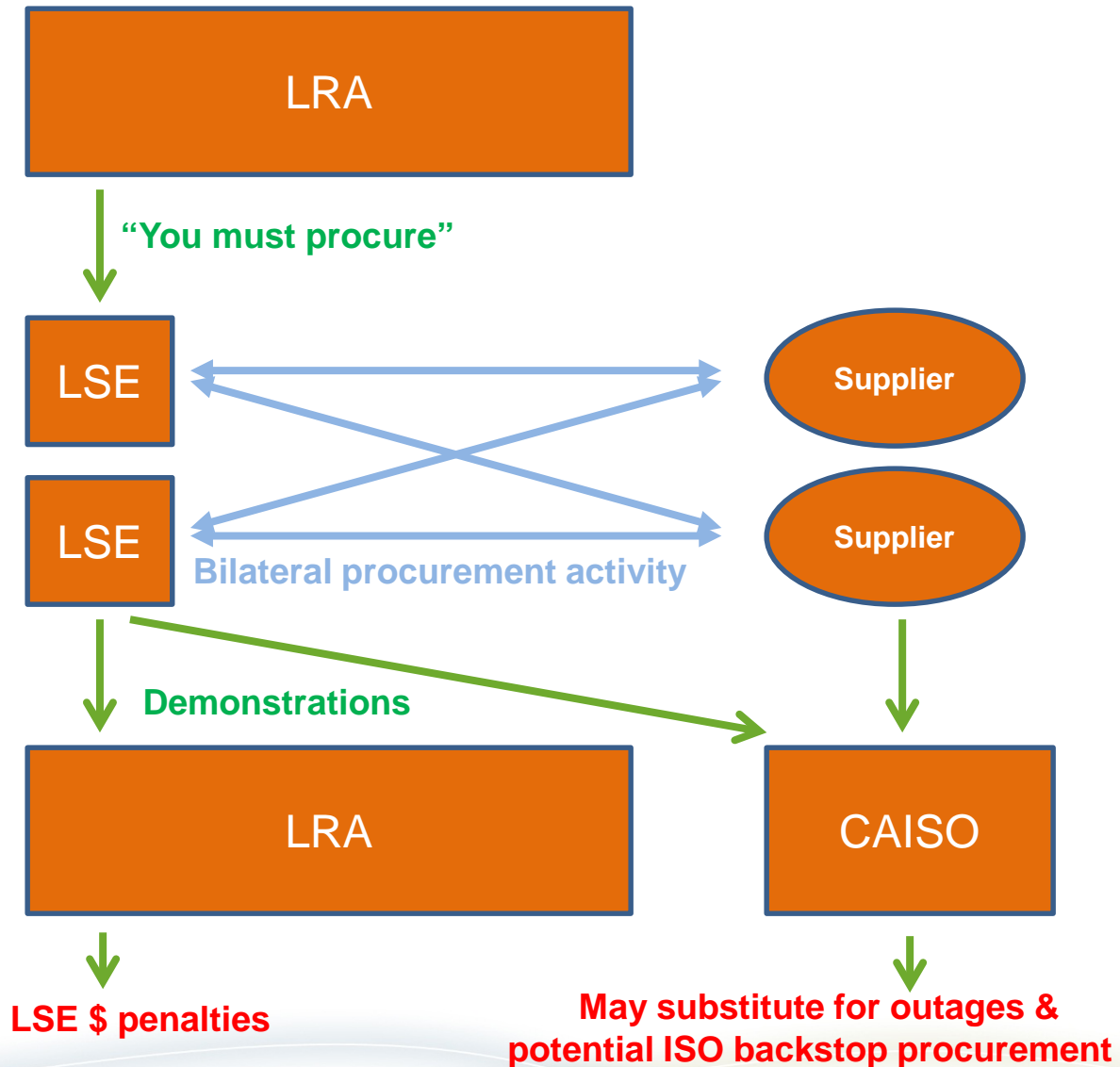
2. LSEs engage in bilateral procurement of capacity to meet this requirement.

3. LSEs demonstrate procurement to LRA and ISO

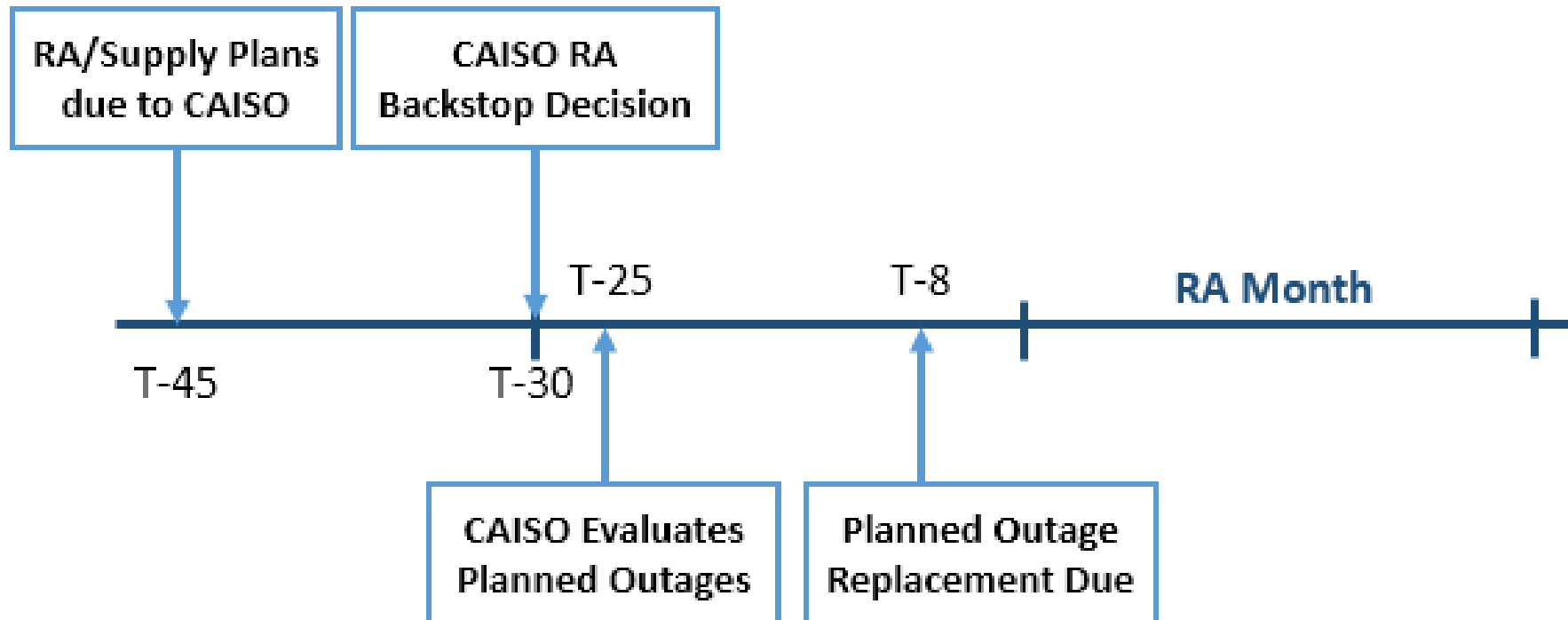
4. Suppliers demonstrate RA sales to ISO

5. LRA ensures LSE compliance

6. ISO ensures suppliers corroborate LSE showings and met needs



The current timeline for month-ahead RA showings is shown below.



Note: The ISO will be making a FERC filing in about February 2016 to change the timeline effective January 1, 2017. This new timeline was developed in Reliability Services Phase 1 stakeholder initiative and approved by ISO Board of Governors in March 2015.

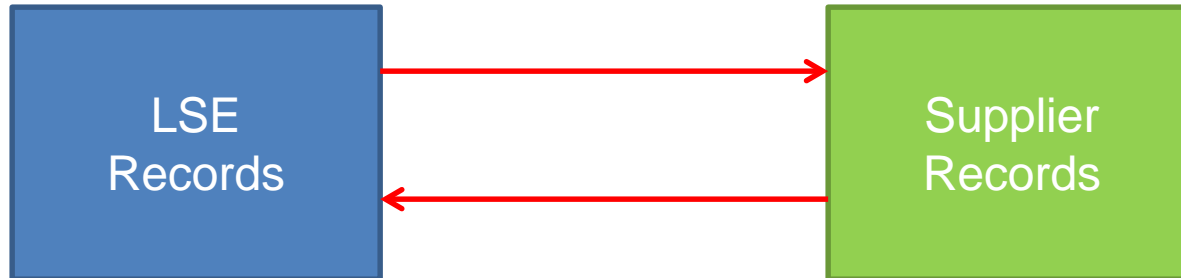
The ISO assesses RA showings.

- Each month, the ISO determines
 - If LSEs have met their overall system requirement
 - If LSEs have met their local requirement in each local area it serves load
 - If LSEs have met their flexible requirement
- Opportunity for LSEs to cure for deficiencies
- ISO may procure additional capacity through its backstop procurement authority if deficiencies still exist

Why does the ISO need supply plans?

- Without a supply plan, LSE will not get credit toward meeting its RA requirements
- Supply plan confirms that SC is committed to scheduling and/or bidding the RA capacity that has been reported to ISO
- Supply plan establishes formal business commitment between ISO and RA resources by confirming status of resource as RA resource

What is cross validation?



ISO matches LSE records to supplier records

Error-free capacity becomes committed as RA capacity

Once “designated” capacity records on RA and supply plans pass individual validation and cross validation, resources and associated capacity are established as RA capacity for duration indicated in RA and supply plan

Bidding and Scheduling Requirements

RA resources have specific bidding and scheduling requirements.

- Resources participating in ISO markets under an RA contract will have RA MOO to ISO
- System and local RA have explicit 24 hour must-offer requirements
- RA capacity that is RA capacity for even a single hour in a day is considered RA capacity for that entire day
- In addition to having a MOO, RA resources are
 - Ineligible to receive backstop capacity procurement payments for any RA capacity
 - Ineligible to receive RUC payments for any RA capacity (must bid in ISO market at \$0)

There are different requirements for system, local, and flexible RA resources.

System and Local RA Requirement

- Resource must economically bid or self-schedule to fulfill its RA obligation

Flexible RA Requirement

- Resource must economically bid to fulfill its RA obligation

Flexible capacity must offer obligation for Category 1, base ramping.

Economic Bid – MOO	<ul style="list-style-type: none">• 5:00 am – 10:00 pm
Energy Requirement	<ul style="list-style-type: none">• Minimum 6 hours at Effective Flexible Capacity (EFC)
Daily Availability	<ul style="list-style-type: none">• 7 days/week
Minimum quantity of capacity allowed	<ul style="list-style-type: none">• Set monthly based on largest secondary net load ramp
Daily start-up capability	<ul style="list-style-type: none">• Minimum of 2 starts per day or the # of starts allowed by operational limits as determined by min up and down time
Other limitations	<ul style="list-style-type: none">• No limitations that translate to less than the daily requirements
Examples of types of resources	<ul style="list-style-type: none">• Conventional gas fired resources, wind, hydro, storage with long discharge capabilities

Flexible capacity must offer obligation for Category 2, peak ramping.

Economic Bid – MOO	<ul style="list-style-type: none">• 5 hour block (determined seasonally)
Energy Requirement	<ul style="list-style-type: none">• Minimum 3 hours at EFC
Daily Availability	<ul style="list-style-type: none">• 7 days/week
Maximum quantity of capacity allowed	<ul style="list-style-type: none">• Set based on the difference between 100% of the requirement and category 1
Daily start-up capability	<ul style="list-style-type: none">• At least 1 start per day
Other limitations	<ul style="list-style-type: none">• No limitations that translate to less than the daily requirements
Examples of types of resources	<ul style="list-style-type: none">• Use-limited conventional gas fired generation, solar, conventional gas fired peaking resources

Flexible capacity must offer obligation for Category 3, super-peak ramping.

Economic Bid – MOO	<ul style="list-style-type: none">• 5 hour block (determined seasonally)
Energy Requirement	<ul style="list-style-type: none">• Minimum 3 hours at EFC
Daily Availability	<ul style="list-style-type: none">• Non-holiday weekdays
Maximum quantity of capacity allowed	<ul style="list-style-type: none">• Maximum of 5% per month of the total requirement per month
Daily start-up capability	<ul style="list-style-type: none">• At least 1 start per day
Other limitations	<ul style="list-style-type: none">• Must be capable of responding to at least 5 dispatches per month
Examples of types of resources	<ul style="list-style-type: none">• Short discharge battery resource providing regulation and demand response resources

Use-limited resources (“ULR”) have unique must offer requirements.

- A ULR is defined as resource that has physical or regulatory limitations that constrain its ability to operate
- A resource that has contractual limitations based on economics is not considered a ULR
- ULR status is conveyed by ISO after resource applies for this status
- An RA resource that is a ULR has a MOO, specifically to bid into ISO market as available

SCs are required to report outages of capacity to ISO.

- ISO may require replacement of RA capacity out on planned outage if ISO determines that reserve margin is insufficient
- RA resource may elect to provide substitute capacity for a forced outage if resource is concerned that such outage may result in resource performance incentives mechanism penalty charges

Resource Performance Incentives

RA capacity must be made available to the ISO.

Availability and the MOO

- System capacity – Must self-schedule or economically bid into market 24/7
- Local capacity – Must self-schedule or economically bid into market 24/7
- Flexible capacity – Must economically bid into market during assessment hours

The assessment hours vary by type of RA capacity.

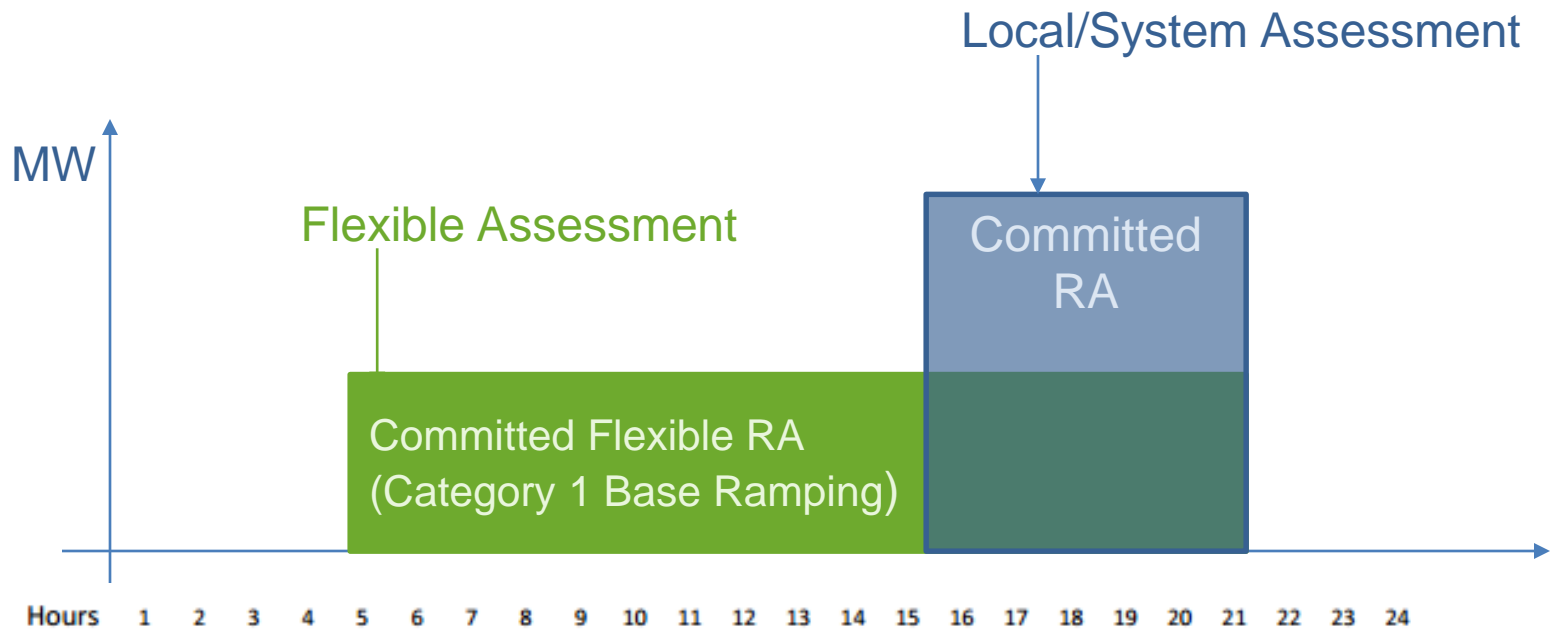
Resource performance (i.e., bidding or scheduling) is measured with respect to capacity type

- System resources must be available during peak hours
- Local resources must be available during peak hours
- Flexible resources must be available and economically bidding into market for up to 17 hours per day

For all three types of RA capacity

- Outages reduce availability
- Certain outage types will exempt a resource from being assessed a performance incentive
- ISO provides ability to provide “substitute” capacity to mitigate outage impact on availability

An example of the performance assessment period is shown below.



Note: There are three categories of flexible RA capacity, each with different must-offer requirements. The example above shows the assessment hours that apply for Category 1 Base Ramping flexible RA capacity.

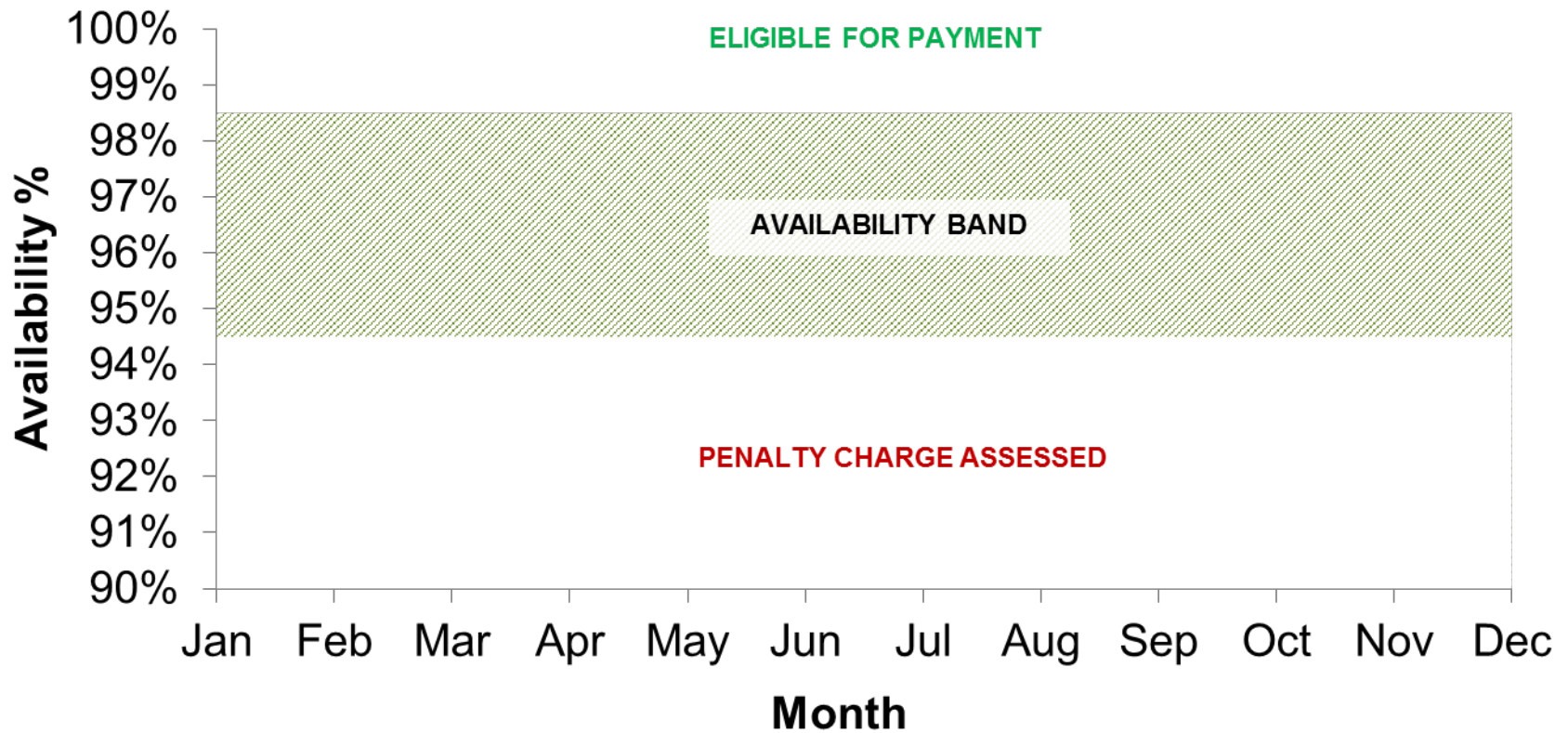
The RA Availability Incentive Mechanism (“RAAIM”) incentivizes RA capacity to perform.

- Incentivizes SCs to provide substitute capacity in event a resource becomes unavailable for long period of time due to long forced outage
- Creates incentive structure where resources are rewarded more for availability in months when ISO sees less availability
 - Penalizes resources that have monthly average availability less than acceptable reliability percentage
 - Rewards resources that have monthly average availability higher than acceptable reliability percentage

The key features of RAAIM are listed below.

- Assesses availability by comparing bids to applicable MOO to determine resource-specific availability percentage
- Compares resource-specific percentage against standard percentage range to determine MWs to charge or receive payment
- Penalizes low performers at a \$3.79/kW-month penalty price and pays high performers a pro-rata share of penalty pool of funds up to three times incentive price (will reassess price in 2019)
- Certain technologies are exempt, including wind, solar and combined heat and power resources

The RAAIM availability metric is shown below.



The RAAIM assessment process is summarized below.

1. Determine hourly target MWs a resource was supposed to have offered into energy market
2. Assess bids hourly to determine total available MW
3. Compute resource-specific monthly percentage by dividing total hourly available MW by total hourly target MW
4. Compare percentage against availability threshold
5. Assess penalty charge and payments
 - If within threshold - do nothing
 - If above threshold - determine MW value for payment
 - If below threshold - determine MW value for charge

ISO Backstop Capacity Procurement Authority

ISO has authority to procure “backstop” capacity to meet reliability needs.

- ISO may use backstop authority in three situations
 - Resolve RA capacity deficiencies in year-ahead and month-ahead timeframes
 - Supplement RA procurement by LSEs to address reliability needs caused by significant events, or when ISO exceptionally dispatches a non-RA resource
 - Designate capacity from resources needed to meet needs in next RA year that have indicated they will shut down due to it being uneconomic for them to remain in service

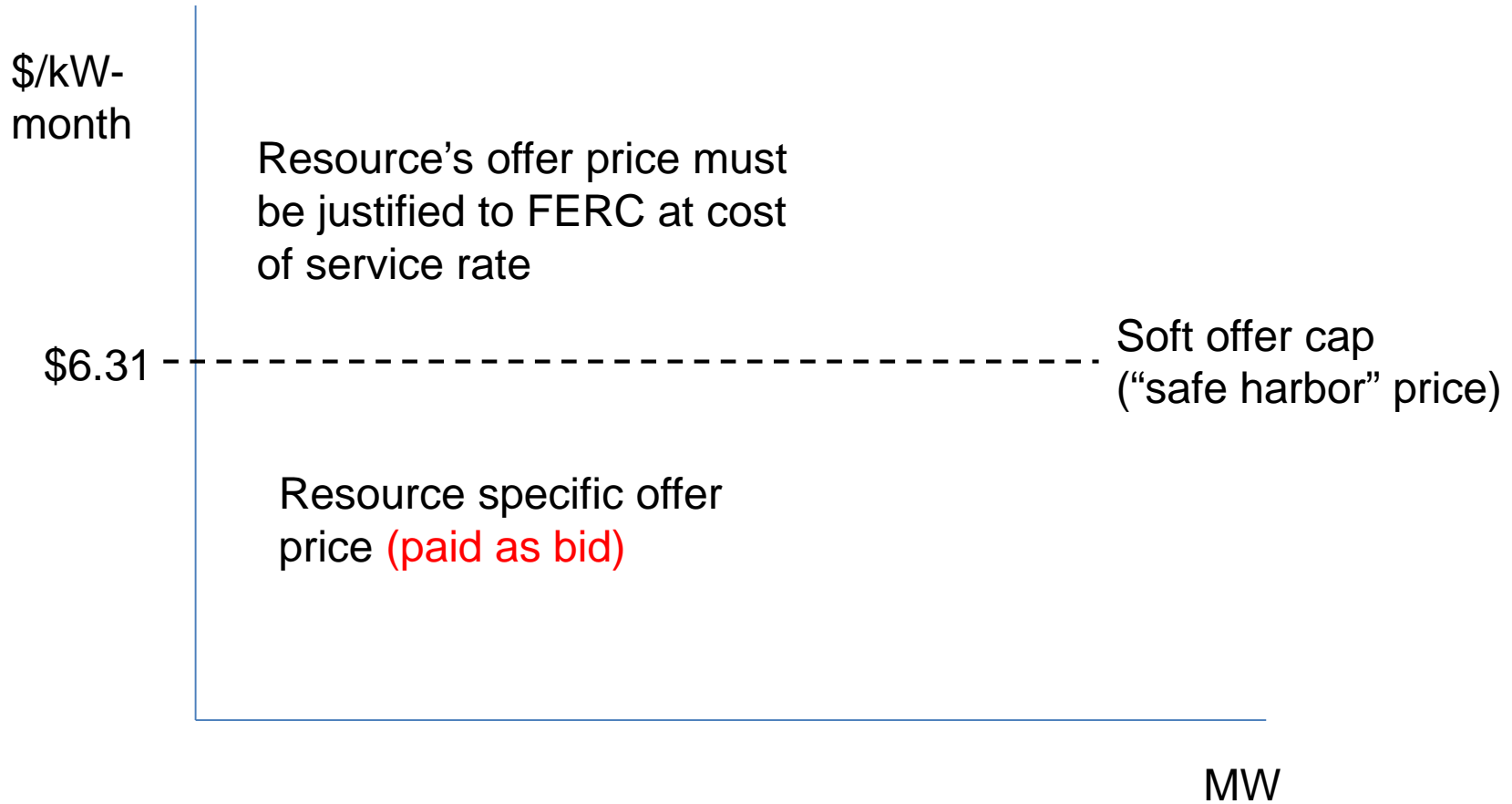
ISO backstop procurement can occur in different time periods, depending on need.

- A decision to backstop could occur
 - Year-ahead
 - About 30 days prior to RA operational month (“T-30”)
 - Within the operational month

Suppliers can offer local, system and flexible capacity into competitive solicitation process.

- Solicits offers annually, monthly and daily
- Runs when ISO determines there is need for backstop capacity
- Pays designated capacity its resource-specific offer price
- Addresses market power concerns through soft offer cap where any accepted offer prices above cap are subject to cost justification to FERC
- Soft offer cap is updated at least every four years
- All resource types may participate in solicitation, including preferred resources and imports

Soft offer cap



Follow-up questions

- Chris Devon at cdevon@caiso.com