



Battery Performance Expectations

Welcome

Our presentation will begin shortly.

Today's Trainer:

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Why are we here?



To prepare resource owner/operators to effectively manage their battery resources to maintain market efficiency & grid reliability

It requires a partnership to ensure the safety and reliability of the grid!

What Will I Be Learning?



- How do my battery resources fit in the Bulk Electric System?
- What are my battery resource capabilities?
- What are my requirements for physical management of my battery resource?
- What are my communication responsibilities?
- What are the reliability consequences of not following my instructions?
- Where can I learn more?

Housekeeping



Keep yourself muted to minimize background noise



Unmute to ask verbal questions or write questions in the chat pod



Raise your hand using WebEx interactivity tools

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What's next?

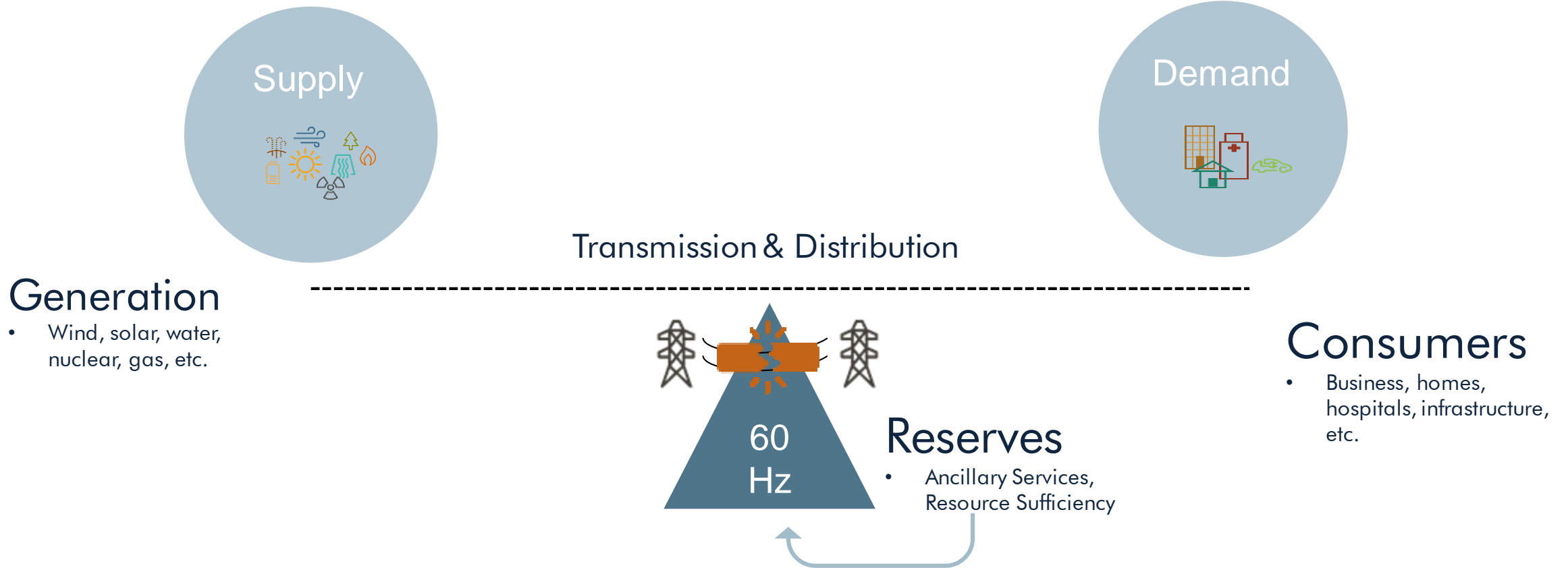
- This training is being recorded
- Recordings and presentations will be posted on the [ISO Learning Center](#) within 3 business days
- Questions gathered during this course will be collected and turned into a comprehensive Q&A guide after the conclusion of the 4 training course series
- The Storage computer based training course will be updated and republished in mid-June
- This is the second training in a series focused on efforts to create a Resource Owner/Operator training track – stay tuned!



Foundational Information

How do you fit into the overall picture?

System reliability requires a constant and instantaneous match between supply and demand



Bulk Electric System

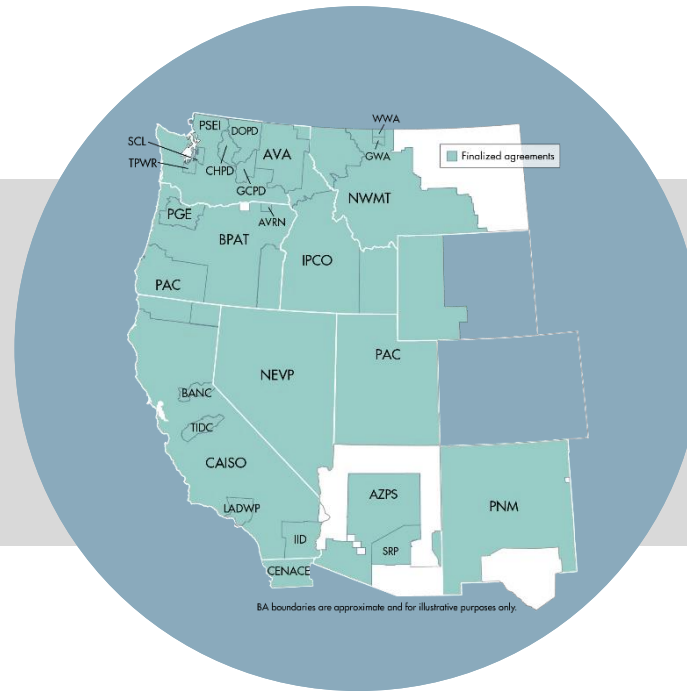


Western Electricity Coordinating Council
Transmission Map

ISO Market and Reliability Footprints



ISO BAA

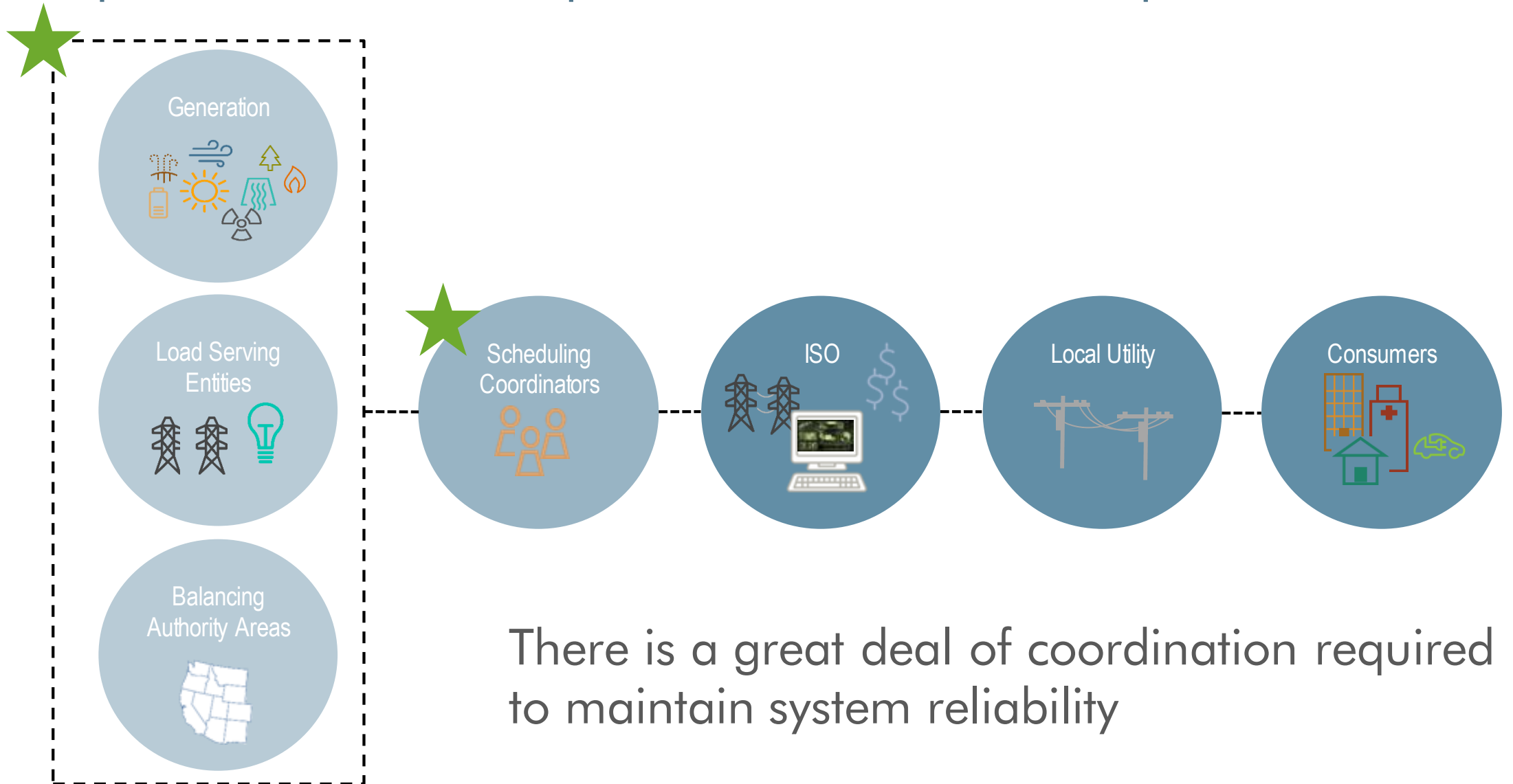


RC West



WEIM

Participation with the ISO depends on the service to be provided



There is a great deal of coordination required to maintain system reliability



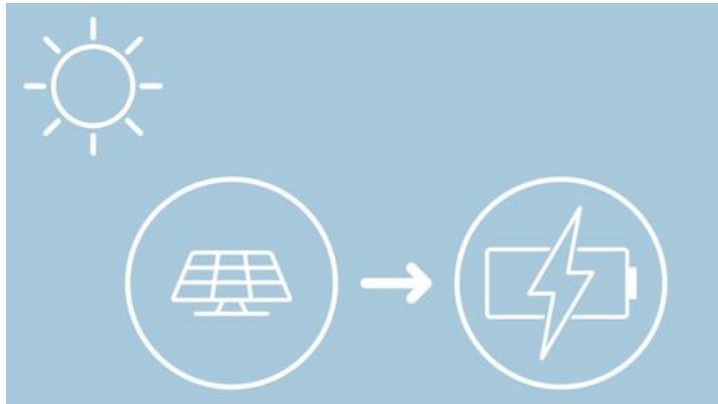
Storage

How does it work?

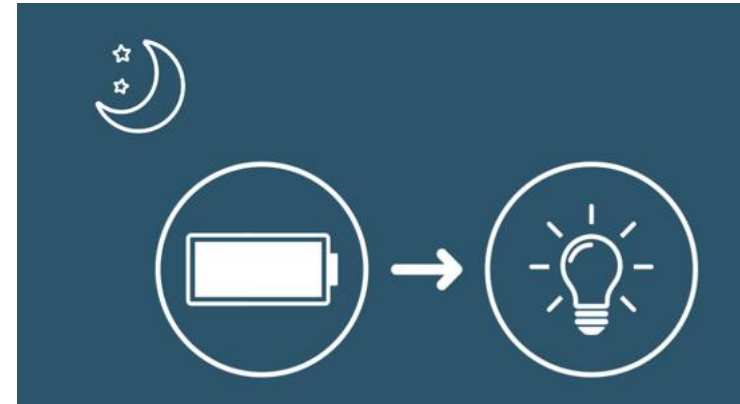
Battery Energy Storage System



Energy storage systems enhance power system flexibility and enable higher levels of renewable energy integration

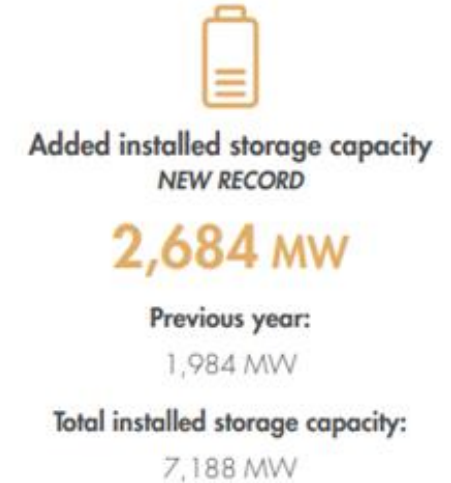
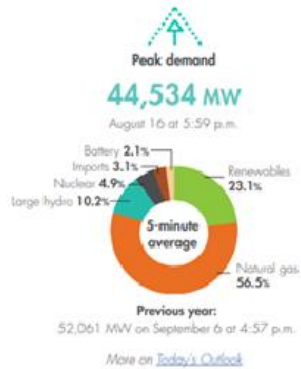


Excess solar energy may be used to charge batteries during the day when supply may be greater than demand.

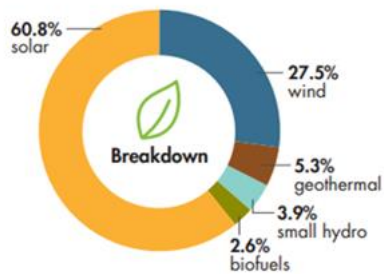


When net demand increases and solar resources can no longer generate, the batteries can discharge to meet system needs.

2023 Statistics from Today's Outlook



Installed renewable resources (as of 02/01/2024)



	Megawatts
Solar	18,517
Wind	8,358
Geothermal	1,610
Small hydro	1,180
Biofuels	778
TOTAL	30,443

[See Today's Outlook](#)

Installed battery capacity⁴
7,261 MW
As of 02/07/24; subject to change.

www.aiso.com

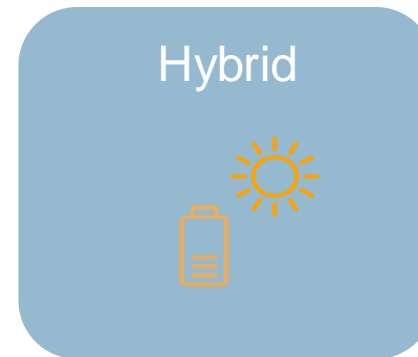
ISO's storage resource models are continuing to evolve in order to accommodate the unique operating and technical characteristics of battery resources



- Independent resources connected directly to the grid
- Individual Resource ID



- Different energy technologies at same generating facility
- Shared grid point of interconnection
- Separate Resource IDs, bids and dispatch instructions

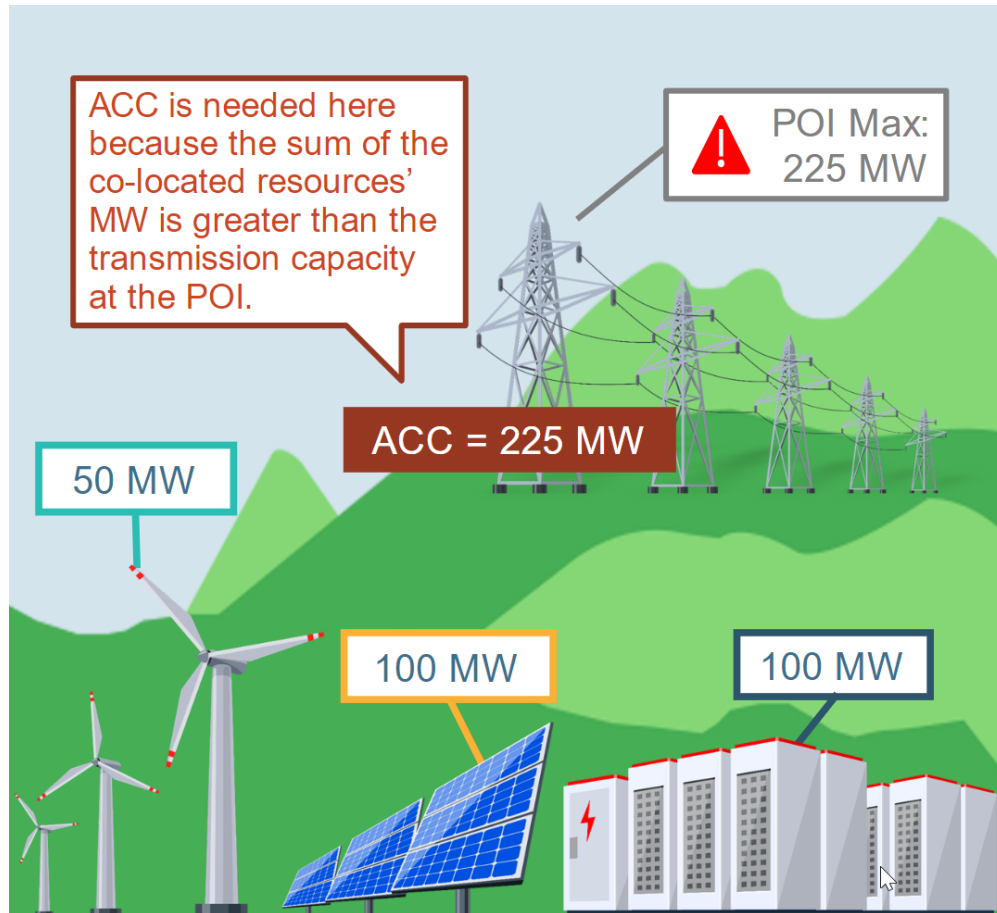


- Different energy technologies at same generating facility
- Shared grid point of interconnection
- Single Resource ID, bids and dispatch instructions
- Energy source determined by SC/Resource Operator



- Bid capacity into the ISO day-ahead regulation markets only
- Awarded for regulation up and regulation down
- Cannot bid any other services

Co-Located Resources and Aggregate Capability Constraint



Created to prevent co-located resources from exceeding the capacity limit of their shared Point of Interconnection

Enhanced CBT
mid-June 2024

Off Grid Charge Indicator

Enhanced CBT
mid-June 2024

The screenshot shows the California ISO system interface. At the top, there's a navigation bar with tabs like 'Bids', 'Trades', 'Convergence Bids', etc. Below that, a 'Bid summary' table is visible. A red arrow points from the 'TOP' button in the table's toolbar to a configuration dialog box. The dialog box has a list of checkboxes on the left and a corresponding 'Yes/No' column on the right. The 'Off grid charge indicator' checkbox is checked, and its value is 'Yes'.

Hour	Gen capacity limit	tag	Off grid charge indicator
01h	0.00		Yes
02h	0.00		Yes
03h	0.00		Yes
04h	0.00		Yes
05h	0.00		Yes
06h	0.00		Yes
07h	0.00		Yes
08h	0.00		Yes
09h	0.00		Yes
10h	0.00		Yes
11h	0.00		Yes
12h	0.00		Yes
13h	0.00		Yes

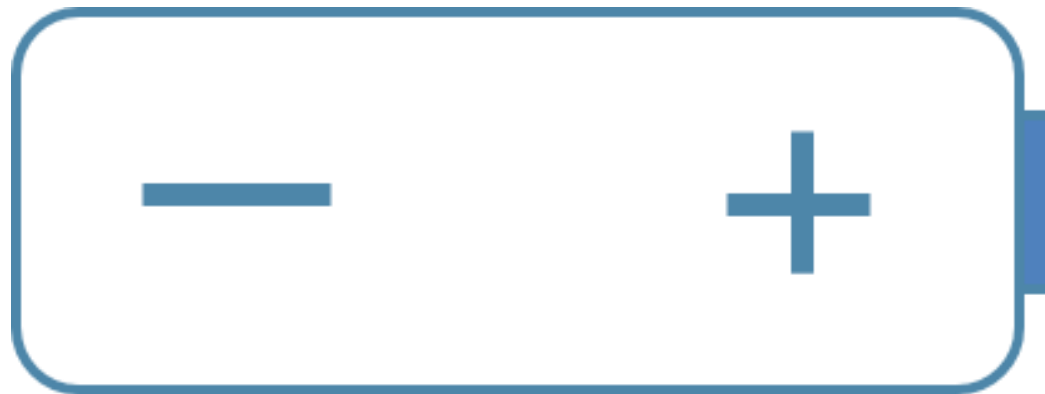
- Created by the ISO to enforce the Charging Constraint within SIBR, allowing a co-located storage resource to elect not to charge beyond the output of its associated co-located variable energy resource (VER)
- Does not change existing policy or CAISO tariff requirements on the feasibility of bids or must-offer obligation for RA capacity
- ***Completely at the SC's risk and discretion***

Tariff section 37.3.1.1

Managing State of Charge (SOC)

State of Charge (SOC) represents a battery's level of charge relative to its capacity

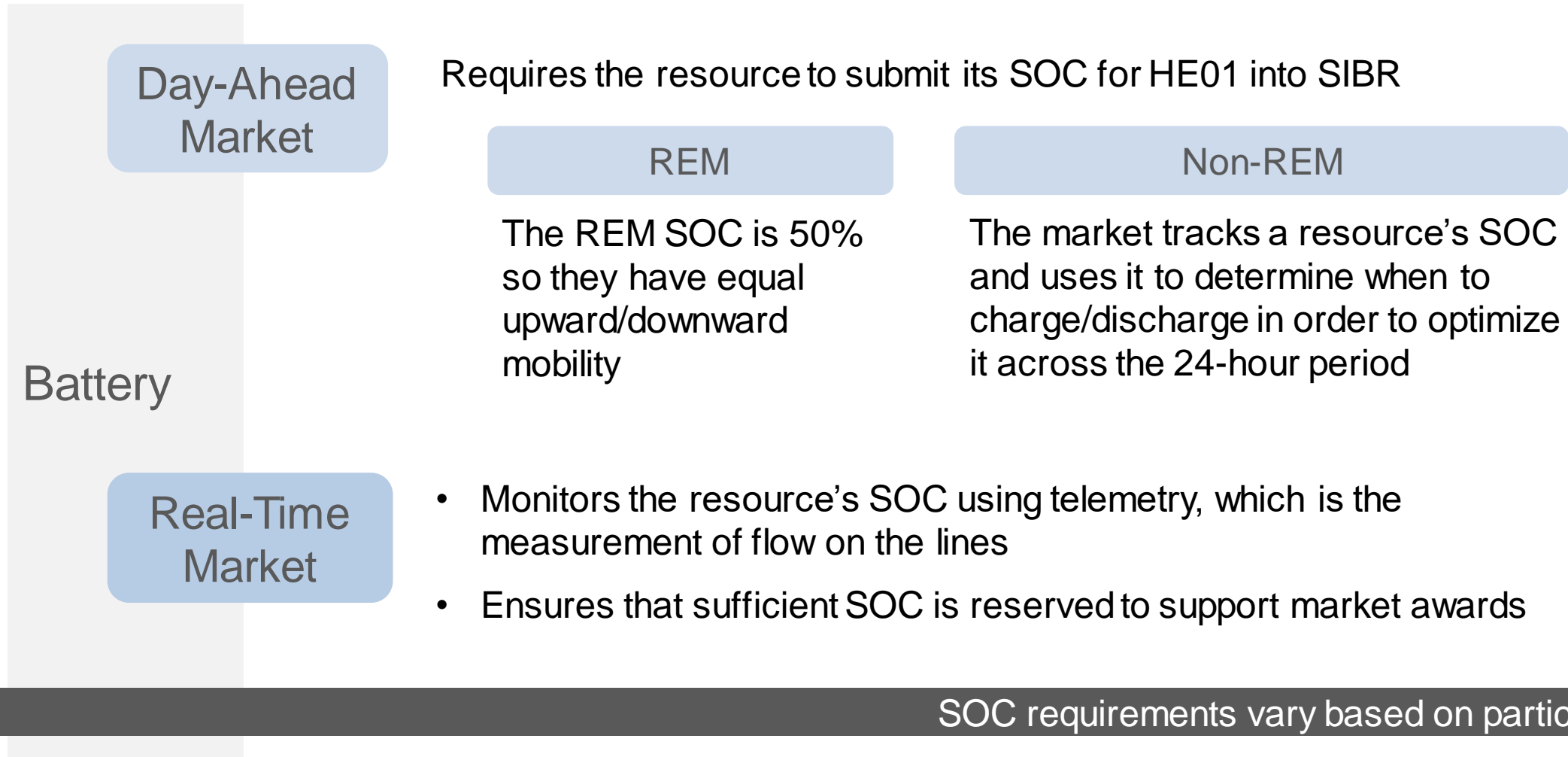
P_{min} is a negative value that is the maximum a storage resource can charge



P_{max} is a positive value that is the maximum a storage resource can discharge

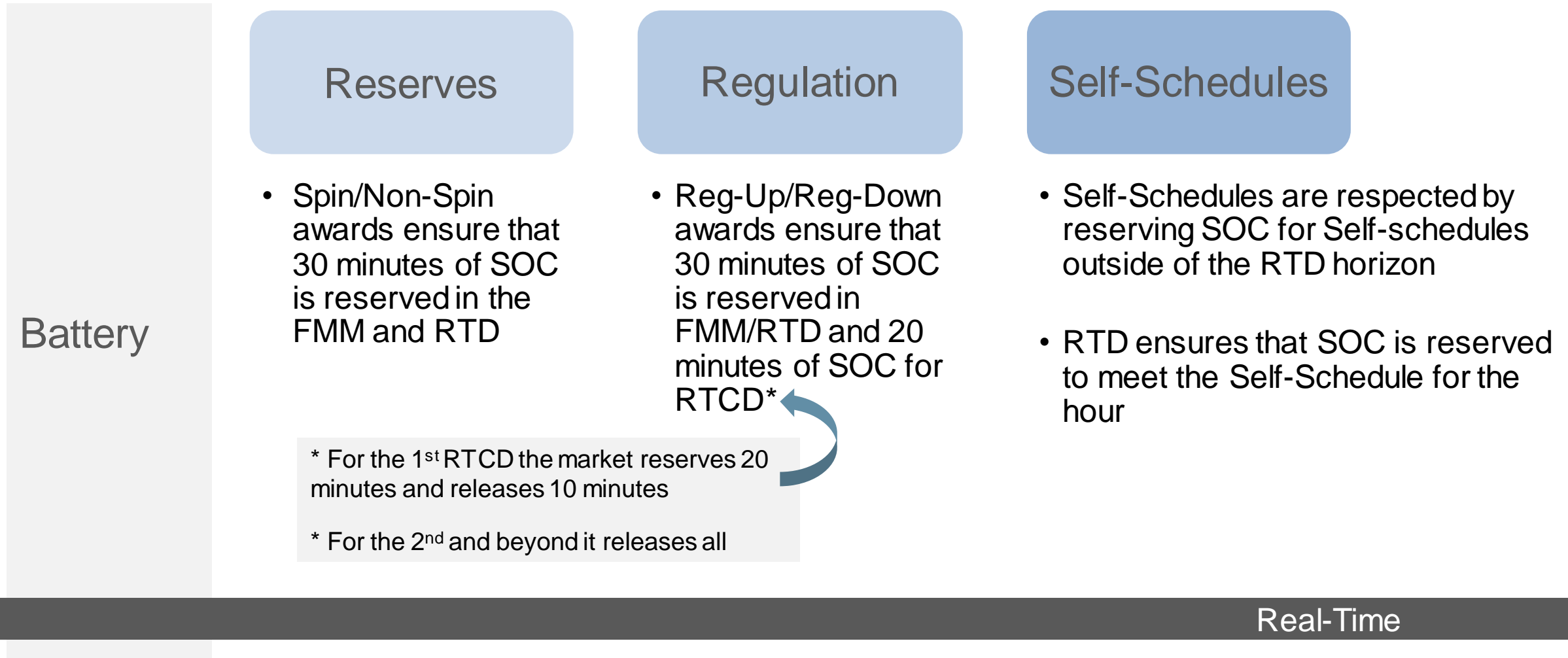
ranges from complete discharged to fully charged

Managing a resource's State of Charge (SOC)



SOC requirements vary based on participation

Managing a Resource's State of Charge (SOC)



Learning Activity



- What is a key takeaway from this section? Write it in the chat.



Management of Resources

Expected Response to Dispatch and Operating Instructions

Resource Management Priorities

1. Immediately follow Operating Instructions when issued by the ISO
2. Notify the ISO immediately if your resource is incapable of following your Dispatch Operating Target
3. Ramp linearly to follow Dispatch Operating Points mid interval to mid interval
4. Follow Dispatch Operating Targets accurately

SCs and Resource Owner/Operators must work together

Resource instructions are sent via Automated Dispatch System (ADS)

RTM Outputs

- For each **fifteen-minute interval** the market is:
 - Starting-up or shutting down resources
 - Transitioning multi-stage generators
- For each **five-minute interval** the market is:
 - Issuing real-time dispatch instructions



Automated Dispatch System (ADS)

The screenshot displays the California ISO Automated Dispatch System (ADS) interface. It features several key components:

- Batch Status and Interval Grid:** A table at the top left showing dispatch intervals. The 'Current Interval' is 23:55-00:00, and the 'Hourly DOT' is 13:12.
- Options Menu and System Messages Grid:** A panel at the top right containing system messages and configuration options.
- Resource Data Grid:** A large table in the center showing resource details for various units, including Resource ID, Config ID, DOT Type, and various performance metrics.
- Trajectory Plot for Specified Resource:** A line graph at the bottom left showing the dispatch trajectory for resource 7STDRD_1_SOLAR1, plotting DOT (Dispatch Order Total) over time.
- Instruction Details Grid for a Specified Resource:** A table at the bottom right providing detailed instructions for resource 7STDRD_1_SOLAR1, including instruction type, accept status, award MW, and start/end times.

Optimal dispatch representing a single point on the Dispatch Operating Point trajectory

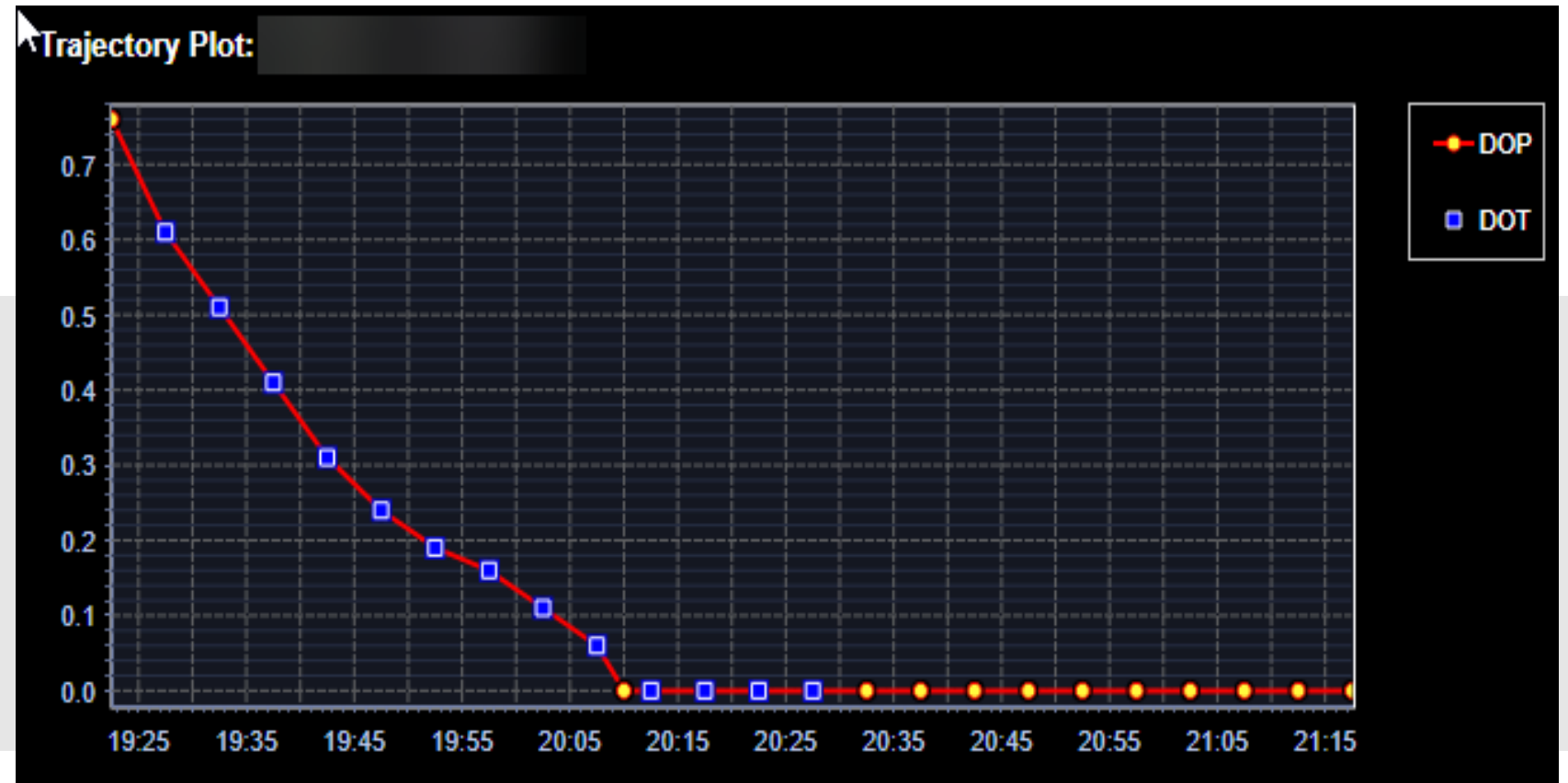
Dispatch
Operating
Target

Daily Instructions

- Received via ADS
- Resources expected to perform as instructed and, for Eligible Intermittent Resources (EIRs) only, “produce as capable” unless they receive an Operating Instruction

Optimal dispatch representing a single point on the Dispatch Operating Point trajectory

Daily Instructions



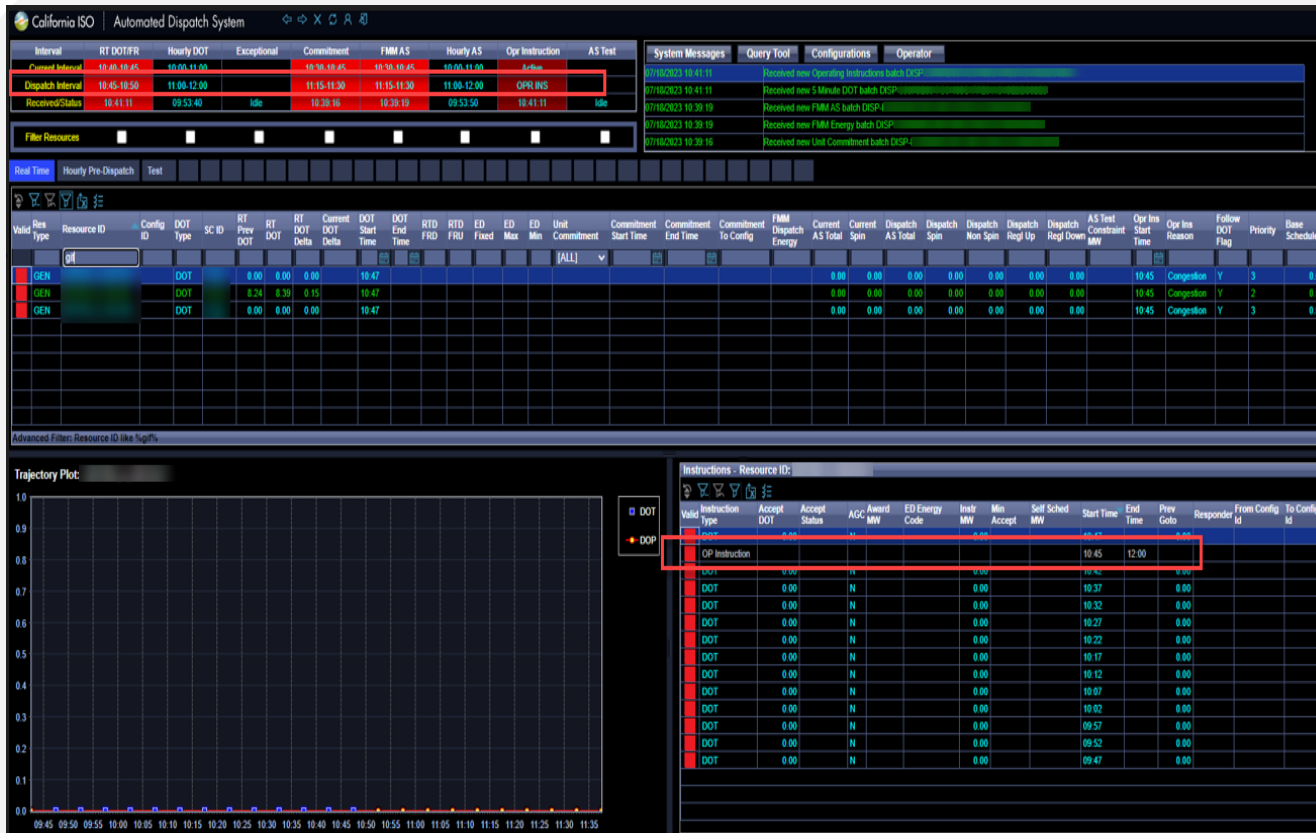
Command by Operators to preserve the state, status, output or input of a Bulk Electric System resource

Operating
Instructions

Emergency Instructions

- May be received via EMS and/or verbal communication
- May be received via ADS as a result of Operator intervention
- Required to be followed within given timelines and ramp requirements unless physically impossible

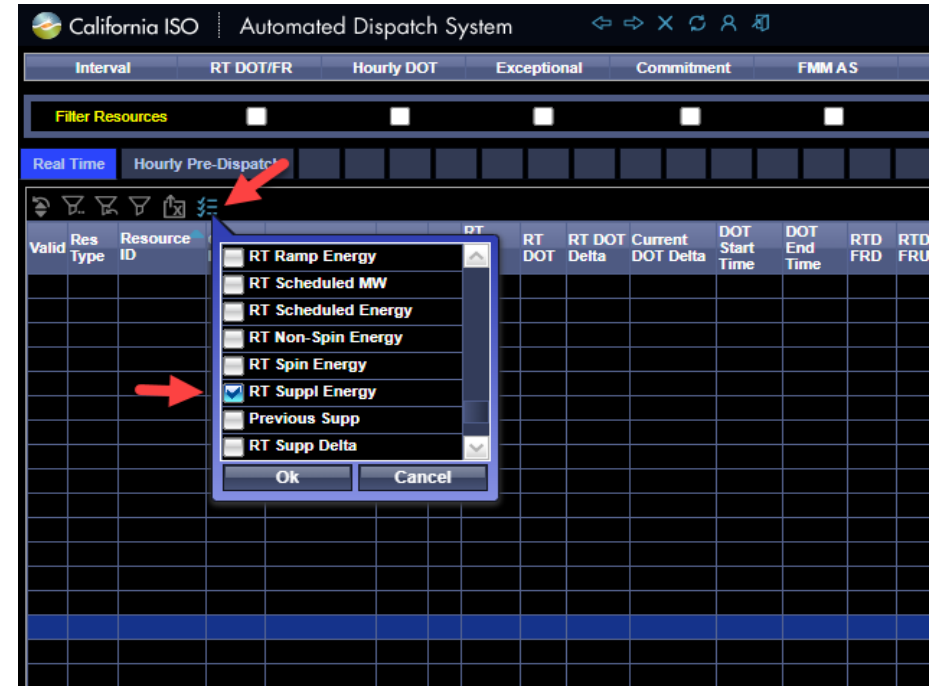
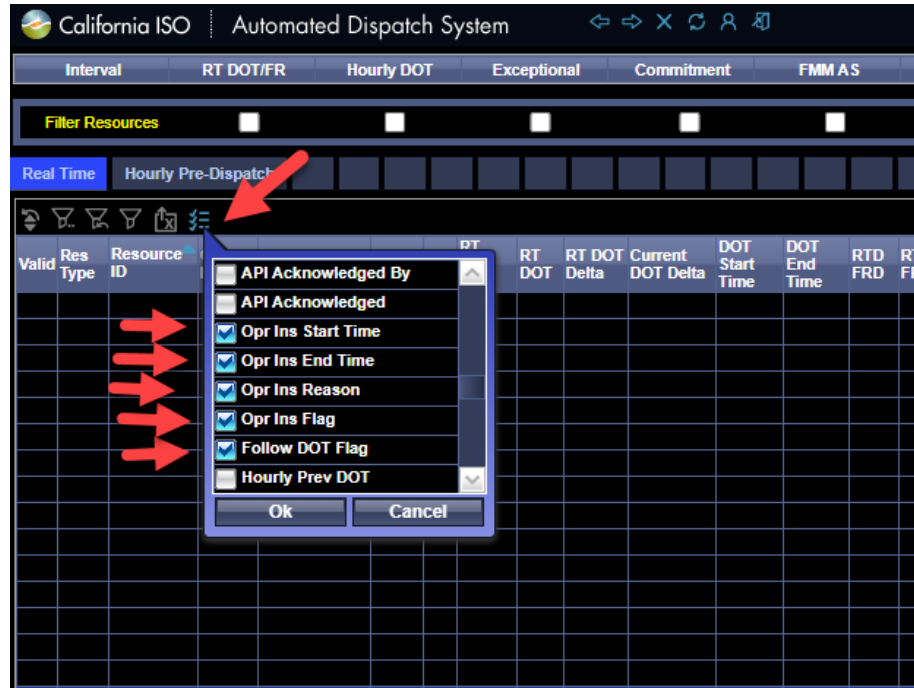
Example of Operating Instruction



- Note Field will indicate “Do not exceed DOT due to <Reason>”
- Resource obligated to comply with Operating Instruction within 10 minutes, ramping linearly with DOT.
 - The acknowledgement should be visible when the first user from the SC organization acknowledges the pop up.
- The message shall only pop up once per user per time horizon of the instruction, and will remain until acknowledged by the user.

What Are Some Steps You Can Take To Improve Visibility?

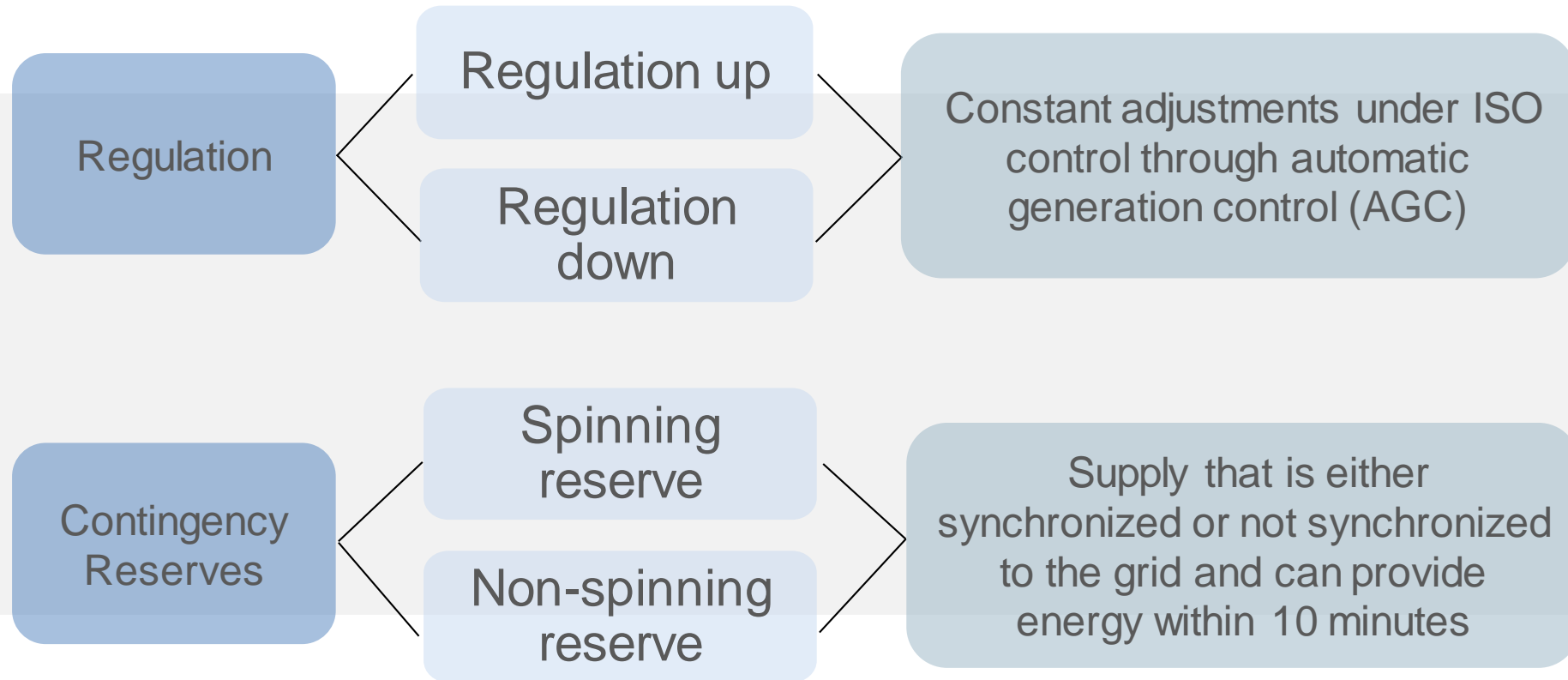
Make These 6 Columns Visible To See Flags When Resources Are Not Following DOTs



This may significantly reduce the length of time resources fail to follow their DOTs

Ancillary Services

Ancillary services ensure reliability as electricity is moved from generating sources to customers



DAM Processes Step 2

Market instructions for energy and ancillary services from ADS and AGC

Awards for Energy and A/S will operate together

Type	Awarded MW
Energy	30 MW
Regulation Up	10 MW
Regulation Down	5 MW

30 MW DOT

Provide regulation within range of 25 – 40 MW

Automated Dispatch System (ADS)

- Sends Dispatch Operating Targets (DOTs) for energy
- Sent every 5 minutes based on optimization instructions

Automatic Generation Control (AGC)

- Sends signals to manage regulation instructions
- Sent every 4 seconds based on Reg Up / Reg Down range

Expectations for Ancillary Services (A/S) Certified Resources

Performance for Reliability

In order to provide Regulation, be able to:

- ramp on and off Automatic Generation Control (AGC) to DOP in linear fashion
- stay on AGC for entire duration of A/S award and have manual controls to place on AGC
 - The ADS AGC flag is a courtesy feature for AGC notification; however, the resource must have the capability to have manual control to place on AGC
 - *Note: Do not program your controllers to rely on the ADS AGC feature alone*
- follow 4 second set points accurately
- show that regulation range reflects accurate capability
- ensure Outage Management System (OMS) reflects true capability and availability of resource
 - Resource cannot be on AGC providing Regulation with failed Telemetry
 - OMS Metering Telemetry card required with A/S fields set to 0 availability

What steps does the ISO take if you cannot perform and have not communicated your resource limitations?

Performance for Reliability

- CAISO Generation Dispatcher will create internal tickets flagging a resources inability to perform:
 - CAISO will issue the following:
 - an official letter stating importance of reliability and adhering to regulatory standards, requesting;
 - completion of training
 - detailed root cause analysis that led to inability to perform and what has been done to rectify the situation
 - potential Ancillary Service (AS) block preventing AS awards
 - potential removal from market
 - for repeat offenders; potential referral to Department of Market Monitoring (DMM)

Resolution requires submission of proof through CIDI and approval from ISO Operations Management

Learning Activity



- How could grid reliability be at risk by not following Dispatch and Operating Instructions? Write it in the chat.

Outages

What tool is used to communicate your outage?

Use OMS to Reflect Physical Limits of Resources

- The Outage Management System (OMS) is the primary method of communicating Outage related information. OMS provides an automated mechanism for parties to communicate all aspects of Outage information.
- OMS should be used for all physical limitations at the plant.
 - Early submission is highly encouraged.
 - Non-urgent outages should be scheduled based on the practices established in the Outage Management BPM.
 - Reference § 8.2 Outage Management BPM for Real-Time Outage Submissions.

Coordination & communication
ensure the safety of the grid!

What Information Is Required For Outages?

Battery Example – Additional Info Required

your SCID

Market Resource ID

Refer to Procedure 3220 Section 3.3.1 Nature of Work (NOW) Categories

Be as detailed as possible in describing the issue with your resource

Min Energy = Minimum SOC (MWh)

Load Max(Pmin) = Charging Capability

Availability(Pmax) = Discharge Capability

Regulation Up
Regulation Down
Spin/Non-Spin
Can your resource provide their awards?
If not, Enter 0 for the appropriate product.

Max Energy = Maximum SOC (MWh)

Participant Name: [dropdown]
 Outage Class: Generation [dropdown]
 Resource: [dropdown]
 Start Date/Time: 06/29/2023 11:45 [calendar]
 End Date/Time: 06/29/2023 20:00 [calendar]
 Outage Duration: 0 day(s) 8 hour(s) 15 minute(s)
 Discovery Date/Time: 06/29/2023 11:45 [calendar]
 Emerg. Return Time/Type: Duration [dropdown]
 Nature of Work: PLANT_TROUBLE [dropdown]
 BA/TOP Confirmed:
 Emergency: Operational:
 RAS/SPS Out of Service: Y N N/A
 RAS/SPS Reduced Redundancy: Y N N/A
 Protection Zone: Y N N/A
 EMS/ICCP Outage: Y N N/A
 Opportunity: [dropdown]
 Participant Outage ID: [text]
 GADS Cause Codes: [text]
 Time To Start Up: [dropdown]

Short Description: *
Test Outage

Availability Notes A/S Availability PMIN Re-Rate Ramp Re-Rate Max Energy Min Energy Load Max Load Min Use Limited RIMS

Resource:	Availability Date/Time	OOS <input type="checkbox"/>	NDC <input type="checkbox"/>	PMAX	Availability MW	Outage Curtailment	Total Curtailment	Overlapping Outages
+	06/29/2023 11:45	<input type="checkbox"/>	<input type="checkbox"/>	100.45	85.00	0.00	15.45	
	06/29/2023 20:00			100.45	85.00	0.00	15.45	

Nature of Work

your SCID

Market Resource ID

Refer to Procedure 3220 Section 3.3.1 Nature of Work (NOW) Categories

Participant Name:

Outage Class: Generation

Resource:

Start Date/Time: 06/29/2023 11:45

End Date/Time: 06/29/2023 20:00

Outage Duration: 0 day(s) 8 hour(s) 15 minute(s)

Discovery Date/Time: 06/29/2023 11:45

Emergency: Operational:

RAS/SPS Out of Service: Y N N/A

RAS/SPS Reduced Redundancy: Y N N/A

Protection Zone: Y N N/A

EHS/ICCP Outage: Y N N/A

Opportunity:

Nature of Work: **PLANT_TROUBLE**

- All Outage requests submitted to the CAISO OMS must have an associated NoW category assigned to it
- Captures relevant data for outage coordination, and increase consistency in the level of information reported
- Use of certain NoW categories will determine whether an Outage de-rate for an RA resource will be subject to Resource Adequacy Availability Incentive Mechanism (RAAIM) provisions

Refer to the Outage Management Business Practice Manual

Ramping

Ramping in Accordance with Operator Instructions

Linear Ramp Rate

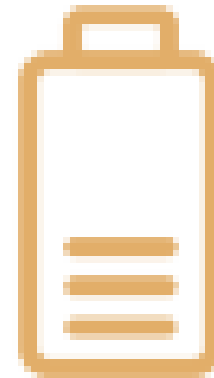
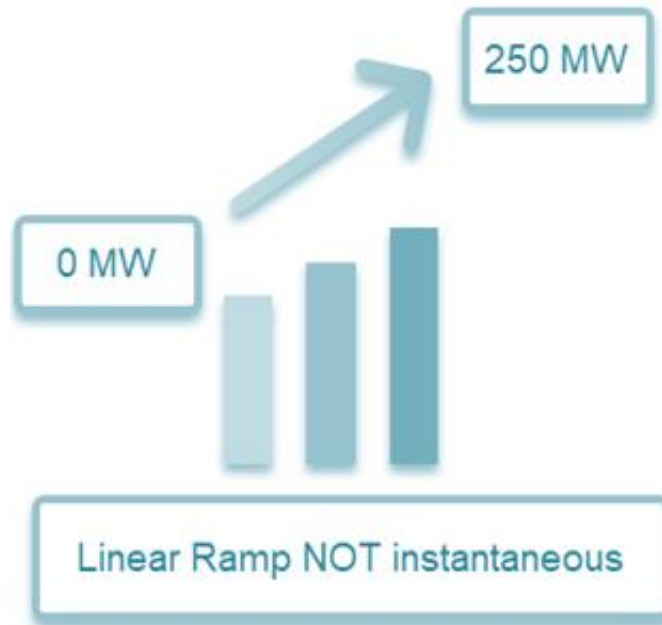
- The set point will increment linearly from starting point to target at an agreed upon ramp rate.
- Set points will increment every 4 seconds from start to finish.
 - Resource expected to respond linearly as instructions are received.
- Resource response must never “Step” above its expected ramp rate during testing or normal operations.
- Default ramp rate should be a controlled value.

Market Operations Business Practice Manual Section 7.2.3.6, Trajectory Data

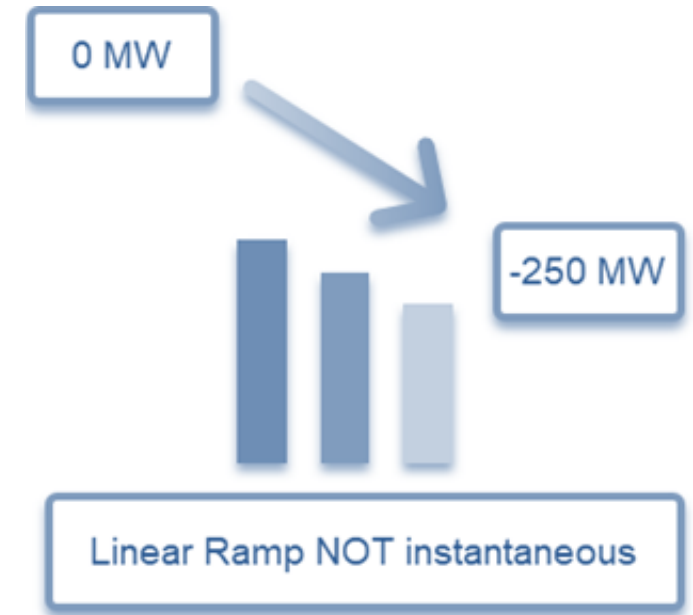
Linear Ramping

Example: 250 MW Battery
Pmax: 250 MW
Pmin: -250 MW

Discharge (+)



Charge (-)



Responding to Frequency Changes

Definitions

Primary Frequency Response (PFR)

- the first stage of frequency control and is the response of generator governors and loads to arrest locally detected changes in frequency

Droop (FERC Order 842)

- the variation in real power (MW) output due to variations in system frequency and is typically expressed as a percentage (e.g., 5% droop)
- reflects the amount of frequency change from nominal (e.g., 5% of 60 Hz is 3 Hz) necessary to cause the main prime mover control mechanism of a generating facility to move from fully closed to fully open

Deadband (FERC Order 842)

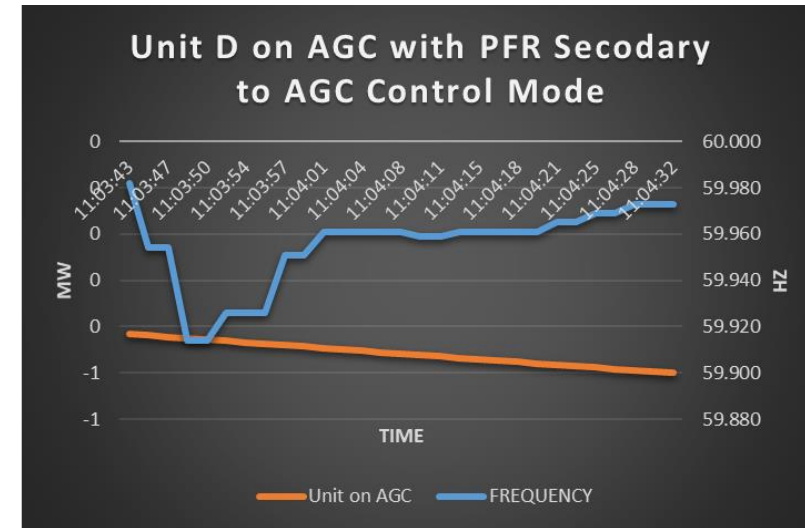
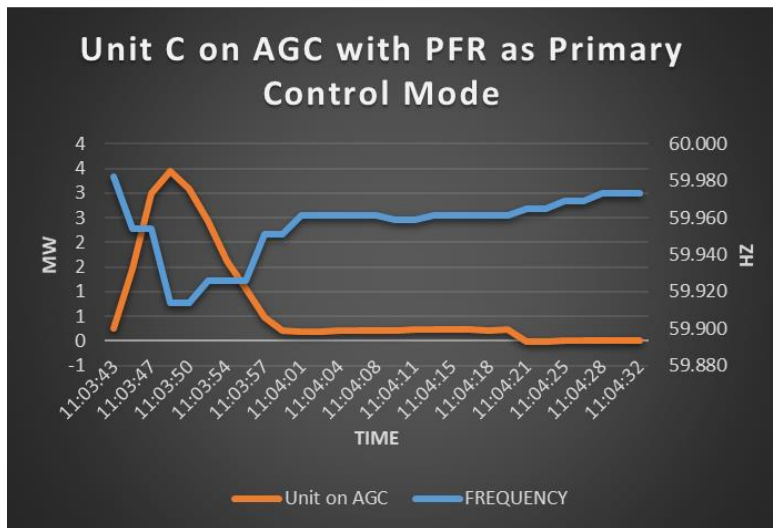
- represents a minimum frequency deviation (e.g., ± 0.036 Hz) from nominal system frequency (i.e., 60 Hz in North America) that must be exceeded in order for the generating facility to provide primary frequency response

Overview of Primary Frequency Response

- Primary Frequency Response (PFR) is an Essential Reliability Service
 - First line of defense against a frequency event – critical for system stability
 - FERC mandated PFR for generators (Order 842 – Pro forma LGIA)
 - Necessary for BAL-003 (PFR) and BAL-001 (power balancing) compliance
- MW Response of a Resource is a function of
 - Droop setting
 - Available stored energy
 - Available headroom
 - Physical or manually set restriction on the resource
 - Control mode of the resource

PFR Needs to be the Primary Control Mode

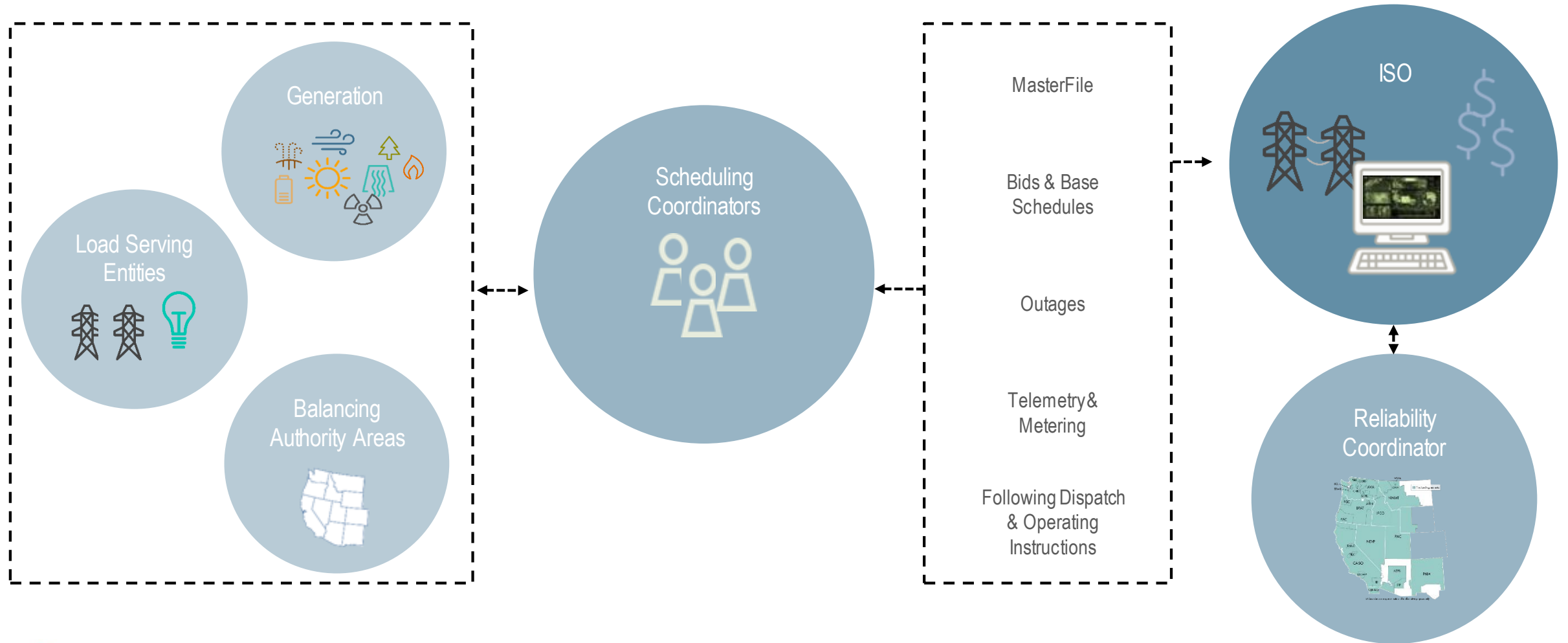
- Most Battery storage facilities have AGC as the primary control mode
- PFR must be the **primary control mode and be additive** to other control modes



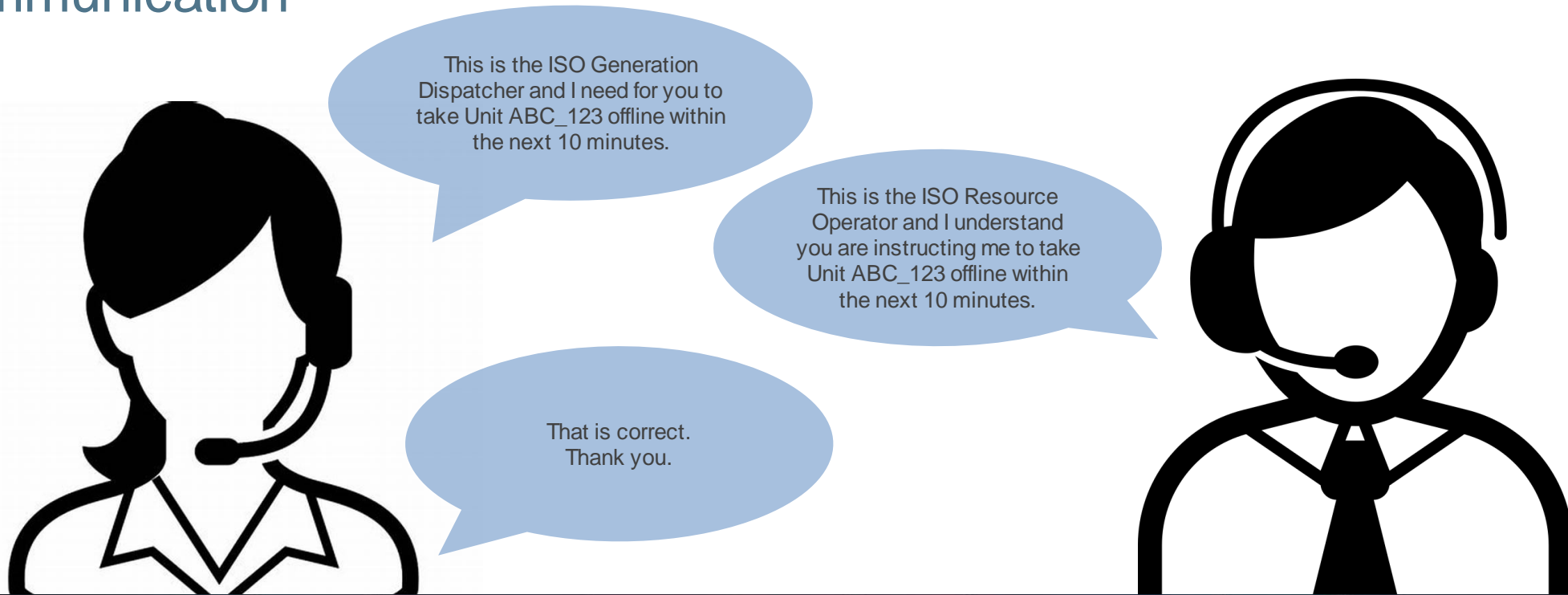
Two Similarly Sized Battery Storage Units on AGC at the Time of Frequency Event

Communication

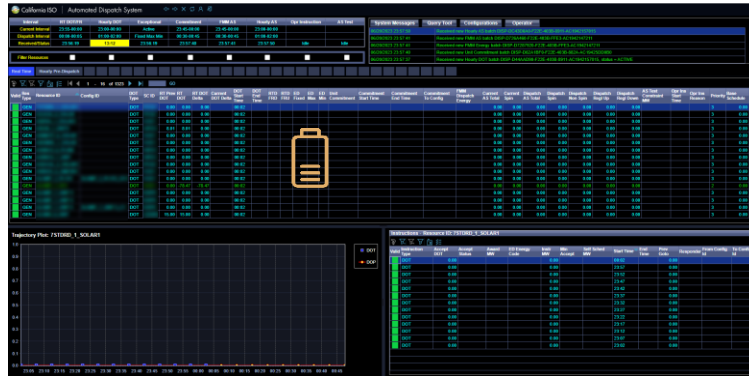
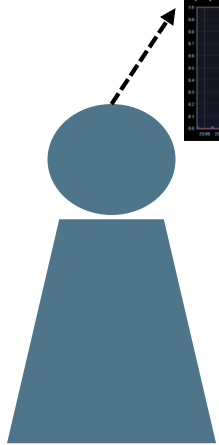
A great deal of coordination and appropriate communication is required to maintain reliability



Responding to verbal operating instructions requires three-part communication



Maintain situational awareness of how your resource may impact the system



Compliance

Possible Implications of Non-Response

Settlements

Economic
Consequences

Regulatory

Contractual
Consequences

Enforcement

Report or referral to
FERC,
NERC/WECC
CAISO DMM

Learning Activity



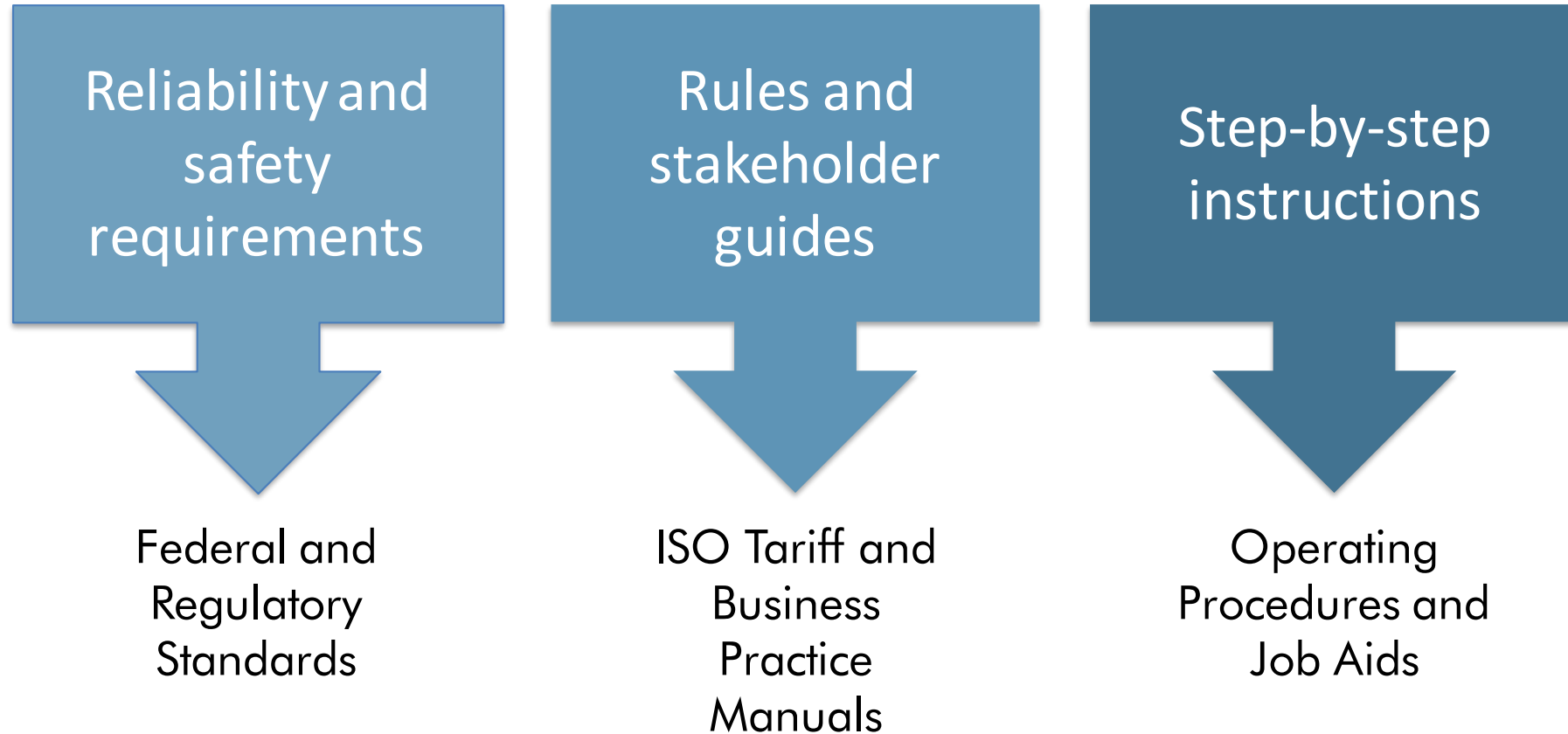
- What is a key takeaway from this section? Write it in the chat.



Reference

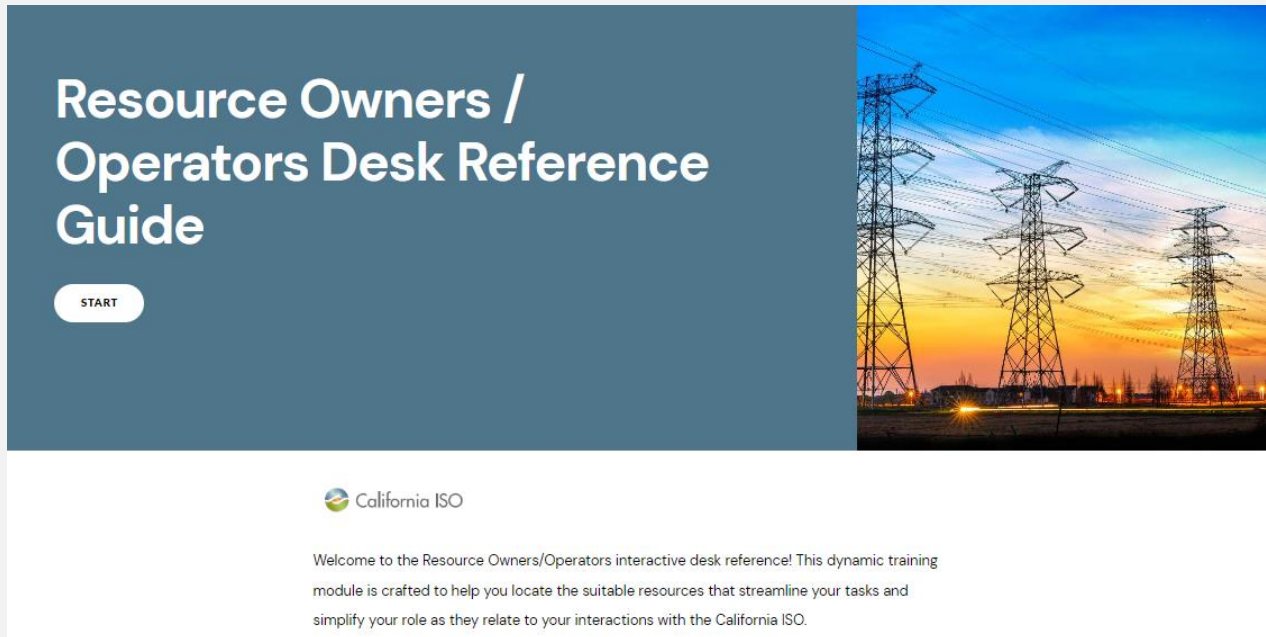
Where can you learn more?

Rules, guidelines and instructions define market and reliability processes



www.caiso.com

New reference guide to help Resource Owner/Operators find important information



Resource Owners / Operators Desk Reference Guide

START

California ISO

Welcome to the Resource Owners/Operators interactive desk reference! This dynamic training module is crafted to help you locate the suitable resources that streamline your tasks and simplify your role as they relate to your interactions with the California ISO.

Includes helpful links such as:

- Training Resources
- Knowledge Articles
- Policies & Procedures
- New Resource Implementation Documents

Available on the ISO Learning Center under the Market and Operations Learning Track

[California ISO - Learning center \(caiso.com\)](https://caiso.com)

New Resource Implementation (NRI) Webpage

California ISO

ABOUT US PARTICIPATE STAY INFORMED PLANNING MARKET & OPERATIONS RULES ISO EN ESPAÑOL

Search...

You are here

Transmission-level resource interconnection (using ISO procedures) ISO interconnection request ISO interconnection study ISO interconnection agreement ISO new resource implementation Sync date Trial operations COD date

Distribution-level resource interconnection (using utility procedures) Utility interconnection request Utility interconnection study Utility interconnection agreement

In parallel (outside of ISO/utility procedures) Permitting, engineering, procurement, construction

About Us
Participate
Resource Interconnection Guide
Become a Scheduling Coordinator
Scheduling Coordinator Ongoing Obligations
Energy Imbalance Market
Generation
Generator interconnection application process
New resource implementation process
Demand Response and Load
Distributed Energy Resource Provider
Dynamic Transfers
Storage
Metered Subsystem
Transmission
Utility Distribution Company
Metering and Telemetry
Market Products
Application Access
Learning Center
Stay Informed
Planning

New Resource Implementation process and requirements

This webpage contains the guidelines, deliverables and activities needed during the final days of interconnection projects to successfully complete resource implementation to the ISO grid.

Getting started

- Determine how to start a project at the ISO.**
Using the resource list below, determine how you will submit your project request to the ISO.

Resource project types to be created through NRI:	Use:
- Distributed Energy Resource (DERP) - SCME WEIM onboarding - SCME WEIM updates - Existing resources converting from ISOME to SCME	➔ New Resource Implementation Quick Start Guide ➔ Project Details Form
- Review New Resource Implementation Guide**
Follow the guide to ensure a smooth transition from build to bid in the ISO markets.
- Review New Resource Implementation Checklist**
The checklist provides requirements based on project type.
- Review Resource Owners/Operators Desk Reference Guide**
Use this Interactive desk reference guide that provides links to training, knowledge articles, process documents, checklist, etc. regarding effective interactions with your SCs and the ISO.

If you have questions, please submit them either through the CIDI application or using the [Contact Us](#) form. If you have a project code, please include it (i.e. 19GEN1234) in the Subject field in CIDI. If submitting your question(s) through [Contact Us](#), please select "Other" from the subject drop down and include the project code, if you have one, in the Comment field.

All other project types to be created through RIMS:

Use:
➔ RIMS Quick Start Guide
➔ RIMS Project Details Form
➔ Create RIMS Project

Provides guidance & ways to connect to help you through get your resource connected to the grid

[California ISO - New Resource Implementation \(caiso.com\)](https://www.caiso.com)

Resource Operations Readiness Training

Training Goal: to prepare customers in advance of summer to meet ISO expectations for successful resource management, especially during tight conditions.

These courses build on concepts shared during the May 1st Resource Interconnection Fair.



Resource Performance Expectations
May 7th

- Dispatch/Operating instruction response
- Hybrid resource management
- Outage cards completion
- Flex Alerts/EEA response



Battery Performance Expectations
May 15th

- Resource capabilities
- Correct Nature of Work
- Off-Grid Charging Indicator
- Physical management requirements

Managing Inertie Transactions
May 16th

- Wheel-through concepts
- Export priority
- Tagging expectations
- Flex Alert/EEA

WEIM Resource Performance Expectations
May 22nd

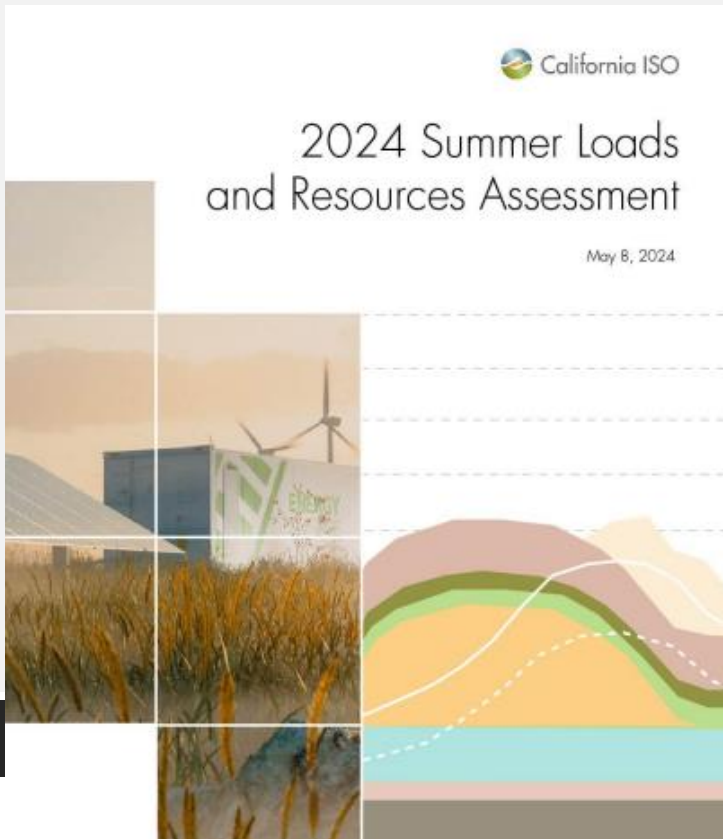
- Assistance Energy Transfer
- Demand Response process for WEIM

Register today at: <https://caiso.regfox.com/resource-operations-readiness-training-series>

Contact CustomerReadiness@caiso.com with questions.

Share this information with your staff!

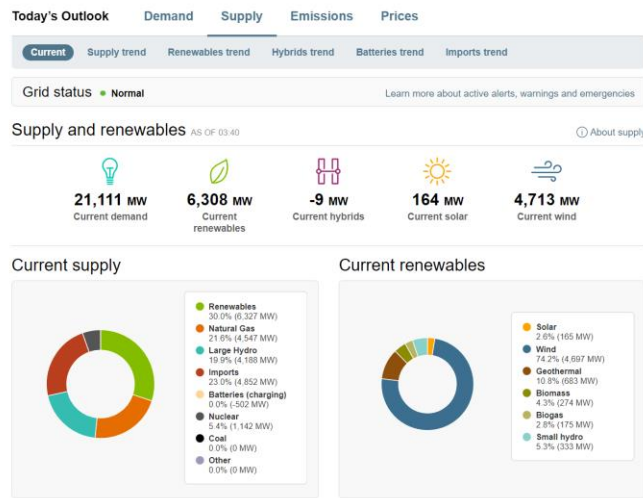
Annual Summer Loads and Resources Assessment helps prepare for summer system operations to maintain grid reliability



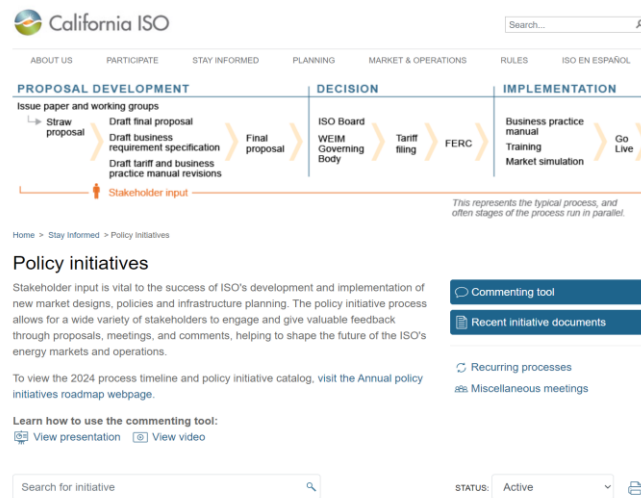
- evaluates expected 2024 summer supply and demand conditions for the California Independent System Operator (ISO) balancing authority area (BAA)
- indicates continued improvement in resource availability for the upcoming summer driven by accelerated resource development

Available on the Reports and Bulletins webpage on www.caiso.com

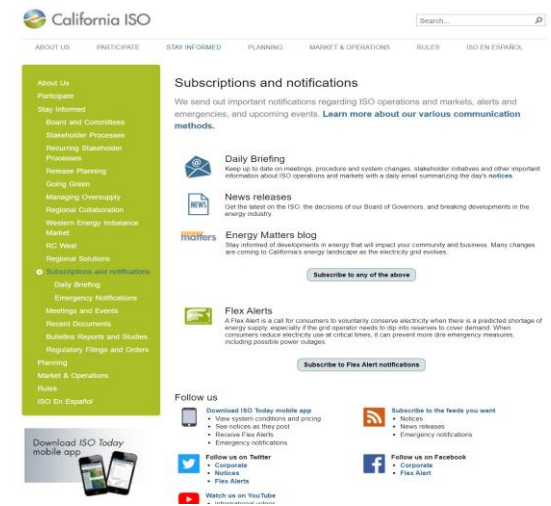
Stay Informed



Today's Outlook



Policy Initiatives



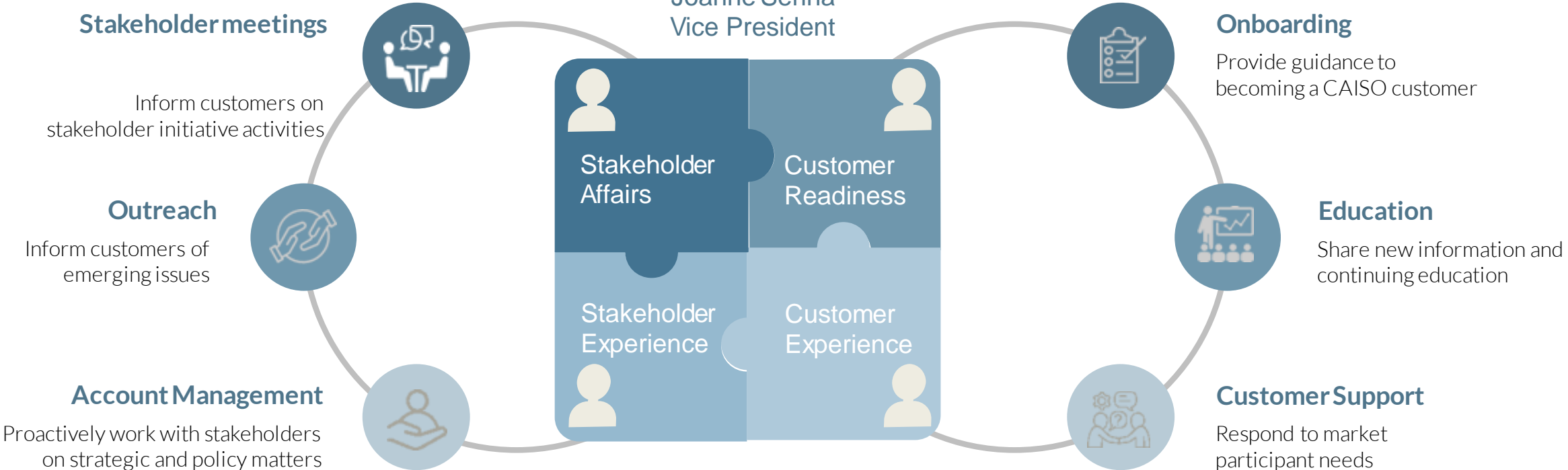
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Stakeholder Engagement & Customer Experience



Joanne Serina
Vice President





Wrap Up

Summary, Q&A

To Recap: It Takes All Of Us To Maintain Safety and Reliability of the Grid!

- Know the intricacies of your battery resource and its impact on the bulk electric system
- Communicate between SC and Resource Operator to ensure adequate control of resources 24X7
- Inform the ISO of any resource changes or physical limitations
- Actively monitor your resources
- Respond to Operating Instructions within required time parameters, consistent with Tariff requirements

Share information with your colleagues!



Thank you for your participation!

For more detailed information on anything presented, please visit our website at: www.caiso.com or send an email to: CustomerReadiness@caiso.com.

For resource specific questions or concerns, please submit a CIDI ticket.