Welcome to the California ISO

Today’s Presenters:
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What we will cover today

- ISO Foundations
  - Roles, Structure and Coordination

- Functions
  - Planning, Markets, Reliability

- Participation
  - Policies & Initiatives, Stakeholder Process, ISO web tools, Training
Housekeeping

- Make sure to keep yourself muted unless you have a question.
- If you have a question, you may either ask over the phone or in the chat.
- If you want to ask a question or comment, you can virtually “raise your hand” in WebEx.
Before we get started…

- View copy of presentation with helpful links on our Learning Center page
- More detailed information can be found in our computer-based training courses
- View other previously recorded training sessions

See reference section at the end of this presentation for helpful links
North American energy regions share the goal of maintaining reliability and market efficiency
The ISO is a nonprofit, public benefit corporation

Our responsibilities are to...

Maintain grid reliability

Run the Market

Coordinate the bulk electric power system

Provide situational awareness

Drives innovation

Support state and federal policy goals

Facilitate infrastructure planning

Provide market transparency
The ISO is also a Balancing Authority (BA)

The Western Interconnection is made up of nearly 40 Balancing Authority Areas (BAAs)

For more information about other BAAs, visit the WECC website

Each BA is responsible for:

- reliably planning and operating an area of the high voltage grid
- instantaneously matching generation with load inside its borders
- meeting import and export obligations
The ISO is a grid operator and market operator

**grid operator**

maintains reliability by:
- balancing supply and demand
- operating transmission system within limits
- ensuring grid is secure in case of a contingency event
- orchestrating restoration in case of a system outage

**market operator**

supports reliability by providing:
- a larger operational footprint
- cost minimization to balance supply and demand
- non-discriminatory grid access to supply and demand
- price transparency reflective of system conditions
- compensation for grid services
The ISO is a Reliability Coordinator

RC West:

- monitors the interconnected power grids in the West for compliance with federal and regional standards
- determines measures to prevent or mitigate system emergencies in day-ahead or real-time operations
- leads system restoration following major incidents

Serving over 40 balancing authorities and transmission operators
The ISO adheres to strict oversight

**FERC**
Regulated by the **Federal Energy Regulatory Commission**
- Regulates the interstate transmission of electricity, natural gas and oil

**NERC**
Compliant with the **North American Electric Reliability Corp**
- Regulates the North American grid through the adoption and enforcement of reliability standards

**WECC**
Members of the **Western Electricity Coordinating Council**
- Coordinates bulk electric system reliability in the geographic area known as the Western Interconnection
The groups you will interact with

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<tr>
<th>Department of Market Monitoring Oversight Committee</th>
<th>Western EIM Governing Body</th>
<th>Board of Governors</th>
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<tr>
<td><a href="#">Mark Robledor</a> Senior Vice President and Chief Operating Officer</td>
<td><a href="#">Elliot Mainzer</a> President &amp; Chief Executive Officer</td>
<td><a href="#">Audit Committee</a></td>
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**Khaled Abdul-Rahman Ph.D.**
- Vice President, Power Systems & Market Technology
- Power Systems Technology Development
- California Regulatory Affairs
- Power Systems Technology Operations
- IT Infrastructure, Architecture & Information Security

**Anna McKenna**
- Vice President, Market Policy and Performance
- Market Analysis and Forecasting
- Market and Infrastructure Policy

**Neil Millar**
- Vice President, Infrastructure and Operations Planning
- Infrastructure Contracts & Management
- Operations Planning
- Operations Policy and Analytics
- Reliability and Market Operations Engineering
- Transmission Infrastructure Planning

**Dede Subakti**
- Vice President, System Operations
- Grid Assets
- Grid Operations
- Operations Services, Compliance and Analysis
- Reliability Coordinator Services (RCS West)

**Enterprise Support & Campus Operations**
- Program & Application Management

**Roger Collanton**
- Vice President, General Counsel, Chief Compliance Officer, Corporate Secretary
- Audit and Advisory Services
- Communications, Public Relations and Creative & Web Services

**Stacey Crowley**
- Vice President, External and Customer Affairs
- Compliance and Corporate Affairs
- Customer Service and Stakeholder Affairs

**Ryan Seghesio**
- Vice President, Chief Financial Officer, Treasurer
- Financial Planning and Procurement
- Controller

**Jodi Zemaths**
- Vice President, Human Resources
- Corporate Training and Organizational Development

**California ISO**
ISO coordinates with state agencies

- **Air Resources Board**
  - Greenhouse gas regulations

- **Energy Commission and Legislature**
  - Renewable Portfolio Standard
  - Energy Policies (Senate & Assembly bills)

- **Water Resources Control Board**
  - Once-through cooling

- **Public Utilities Commission**
  - Resource Adequacy
  - Generation Procurement
  - Integrated Resource Plan
The robust stakeholder process allows for customer engagement with the ISO.

Stakeholder input is essential to ISO planning processes and for the success of new initiatives from policy development to implementation.
Rules, guidelines and instructions define market and reliability processes

Reliability and safety requirements

Federal and Regulatory Standards

Rules and stakeholder guides

ISO Tariff and Business Practice Manuals

Step-by-step instructions

Operating Procedures
What are the ISO’s primary functions?

CAISO is registered with NERC as a Balancing Authority, Transmission Operator, Transmission Service Provider, Planning Coordinator, Market Operator, and Reliability Coordinator.
What is our focus?

Planning
Coordinating and consolidating transmission needs of the ISO BAA
Transmission planning is a comprehensive evaluation that requires coordination.

Identification of regional grid reliability requirements and projects that bring economic benefits to consumers.
Annual Transmission Planning Process

Phase 1
Develop detailed study plan

Phase 2
Perform sequential technical studies & publish comprehensive plan

Phase 3
Procurement

ISO Board for approval of transmission plan

January
April
March
Generation interconnection coordination brings new resources to the grid

A structured process to help resources interconnect to the grid
Interconnection process map

- Submit a request to interconnect
- Participate in an interconnection study
- Complete interconnection agreements
- Follow new resource implementation process
- Begin participating in the market

Adhering to the deadlines is key!
What is our focus?

**Markets**
Acting as a marketplace for wholesale power
Adequate resources for a full day’s operations are procured, confirmed and optimized by two markets to ensure reliability

<table>
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<th>Day-ahead market</th>
<th>Real-time market</th>
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<td>• Ensures, a day in advance resources are available and deliverable in real-time</td>
<td>• Hour ahead scheduling to enable import/export MWs</td>
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<tr>
<td>• Allow parties with bilateral agreements to schedule contracted supply/demand and offload excess supply as energy or Ancillary Services</td>
<td>• Allows variable energy resources to submit energy forecasts and economic bids closer to financially-binding interval to increase bid accuracy</td>
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<td>• Secure pricing</td>
<td>• Liquidates financial only bids</td>
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<td>• Dispatches energy to meet instantaneous demand</td>
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Physical energy is the electricity needed to meet the needs of the balancing authority area.

Energy supply:
- Bilateral contracts
- Utility-owned generation
- ISO markets

Energy demand:
- Load forecast

Procured outside of the ISO markets, but submitted to the ISO through bidding and scheduling.

Allow us to know how much energy will be needed in real-time to meet load requirements.
Market timelines: day-ahead, real-time and post market

**Day-ahead market (DAM)**
- **T - 7 days**
- **10:00**
  - Bids and schedules submitted
  - DAM process begins
  - Clear the market
- **13:00**
  - Publish market results

**Real-time market (RTM)**
- **T-1 after 13:00**
- **T-75min**
  - Bids/Base schedules submitted
  - RTM process begins
  - Clear the market
- **Beginning at midpoint of each 5min period**
  - Receive dispatches

- **Post market**
  - Hour-ahead scheduling process
  - Fifteen minute market
  - Real-time dispatch

Triggers real-time market
The day-ahead market determines the amount of energy that will be purchased for each hour.
The market also procures capacity (ancillary services) to meet reliability requirements

- **Regulating Reserves**
  - Regulation up
  - Regulation down

- **Contingency Reserves**
  - Spinning reserve
  - Non-spinning reserve

- **Constant adjustments under ISO control through automatic generation control (AGC)**
- **Supply that is either synchronized or not synchronized to the grid and can provide energy within 10 minutes**
The ISO procures ancillary services and additional capacity for the ISO BAA in day-ahead to meet reliability requirements.

- **Regulating reserves**
  - based on procurement targets set by ISO to meet WECC standards

- **Contingency reserves**
  - based on procurement targets set by WECC

- **Residual Unit Commitment**
  - to meet the ISO system-wide and regional forecasts
Residual unit commitment is used to meet the ISO’s energy forecast.
Residual unit commitment

A method of ensuring reliability of the grid
Capacity procurement from additional day-ahead supply for real-time
Selects from resource adequacy and other capacity bids
Awarded resources must submit an energy bid in the real-time markets
Market Power Mitigation

Each hour the ISO tests all the bids for market power. If a supplier potentially has market power, their bid will be “mitigated”.

X No competition = Market power

✓ Competition among suppliers to serve the load
Grid operators need a plan for operating the next day to ensure reliability

- The California ISO uses its **day-ahead market** to create a reliability plan. As a result, resources are committed to provide:
  - Supply to meet the demand that cleared in the market
  - Supply to meet the ISO demand forecast
  - Ancillary services to meet the reliability requirements
ECONOMIC BIDS AND SELF SCHEDULES
Energy bids provide an economic signal indicating a participant’s willingness to supply or purchase energy.

**SUPPLY BID**

The higher the price, the more they will supply.

**DEMAND BID**

The lower the price, the more they will buy.
Self schedules are also known as “price takers”

**SUPPLY SELF SCHEDULE**

Informs the ISO that the SC is willing to run its generator regardless of the price

**DEMAND SELF SCHEDULE**

Informs the ISO that the SCS is willing to buy a certain quantity of supply, regardless of the price, to serve its load
Economic bids and self schedules

Day-ahead clears supply bids against demand bids;
Real-time clears supply against ISO load forecast.

Self-schedules are placed at the beginning of economic curves.

Day-ahead clears supply bids against demand bids;
Real-time clears supply against ISO load forecast.

Self-schedules are placed at the beginning of economic curves.
How does the market decide which resources to commit?

**Bids**

- $20
- $20
- $20
- $20
- $20

**Other cost considerations:**
- Start-up cost (one time)
- Minimum load cost (hourly)
- Energy bid curve above minimum load ($/MWh)
Other inputs of the **day-ahead** market

- Bids
- Network model
- Day-ahead Market Optimization
- Transmission limits
- Resource parameters
- Forecasts
- Outages
Market timelines: day-ahead, real-time and post market

**Day-ahead market (DAM)**

- T - 7 days
- 10:00: DAM process begins
- 13:00: Clear the market
- Publish market results

**Real-time market (RTM)**

- T - 1 after 13:00: Bids/Base schedules submitted
- T - 75min: RTM process begins
- Clear the market
- Receive dispatches

- Post market

- Triggers real-time market

- **Key Points**
  - Hour-ahead scheduling process
  - Fifteen minute market
  - Real-time dispatch
Real-time market processes

Bids and hourly base schedules submitted

15 Minute Market

5 Minute Market

75 minutes before each trade hour

The market is forward looking, evaluating market conditions for multiple time horizons (intervals) and producing the most accurate data to aid in market optimization and decision making for System Operators to maintain a reliable bulk electric system.
Real-time market hourly processes

Submit schedules 75 minutes before each hour

**As needed**
* Determined by System Operators based on system conditions

**Hourly**
* Hour-ahead scheduling process (HASP) is embedded in RTUC as the first of the 4 runs

**Every 5 mins**

**Every 15 mins**
* STUC is looking out 4 1/2 hours

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Market Power Mitigation (MPM)
Short Term Unit Commitment (STUC)
Real-time Unit Commitment (RTUC)
Real-time Pre-Dispatch (RTPD)
Fifteen Minute Market (FMM)
Real-time Economic Dispatch (RTED)
Real-time Dispatch (RTD)
Real-time Contingency Dispatch (RTCD)
Contingency – EIM Only
Real-time Manual Dispatch (RTMD)
Exceptional Dispatch (ED) – EIM Only
What is our focus?

**Reliability**
Balancing generation and load to meet energy needs in the ISO BAA
System Operations supports grid reliability

Control room personnel

- Highly skilled, cross-trained System Operators with specific responsibilities

Two separate control centers

- Redundant energy management, market software, and hardware systems
- Diversified, secure communications networks
System reliability requires a constant and instantaneous match between supply and demand.
Entities can participate through market products and reliability services

**Energy**
- Physical supply and demand ✅
- Virtual supply and demand ✗

**Financial**
- Congestion Revenue Rights ✅
- Inter-SC trades ✅

**Reliability**
- Ancillary services: Instantaneous Contingency reserve ✅
- Residual unit commitment ✗
- Flexible ramping product ✅
- Reliability Coordination ✅
Participation with the ISO depends on the service to be provided.
SC certification process requirements

- Training
- Financial
- Testing
- Policies
The Western EIM is a real-time only market
Energy Imbalance Market key points

In a non-EIM environment:
Each BA balances loads and resources within its borders

In an EIM:
The market dispatches resources across BAAs to balance energy

Entities are still responsible for running their own BAAs
Market process timelines: post market

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**Triggers real-time market**

**Post market**
Let’s look at a day in the life of a participating resource

Market Participants take positions

Market Optimization and Reliable Operation

Settlement Payments and Charges
Settlements are broken down by applicable markets

Example of 1 hour interval

- Additional real-time award
- Incremental award in the FMM
- Initial day-ahead award/Base schedules
Meter data is collected and processed for settlements

Revenue quality meter data

Settlement Quality Meter Data (SQMD) is used for billable quantities to represent the energy generated or consumed during a settlement interval.

Settlement quality meter data

Settlements

Meter data must be correct for accurate settlements.
The settlement cycle processes market activity to produce payments and charges

1. Inputs from day-ahead and real-time markets and meter
2. Calculations of formulas and settlement rules
3. Publishing of settlement statements, invoices and payment advices
Timelines are critical to settling the market efficiently

Invoices & payment advices

Every Wednesday
Invoices and Payment Advices for trading dates Mon thru Sun

Every Tuesday
Payments due by 10am and disbursements made by 2pm

Settlement Timeline

Optional statements

T = Trade Date
B = Business Days
M = Months

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FOR MORE INFORMATION…
Visit the [www.caiso.com](http://www.caiso.com) for information and resources

- **Resource Tabs**
- **Latest Reports**
- **Today’s Outlook**
- **Calendar**
- **Related Websites**

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Find helpful EIM resources on the Western EIM website

https://www.westerneim.com
Find more information about RC West under the Stay Informed tab on the ISO website

Questions?
For more information on RC West services, email us at: RCWest@caiso.com

http://www.caiso.com/informed/Pages/RCWest/Default.aspx
After the presentation, check out these links to hear from an Operator and a Market Operator about a “day in the life” from our Control Room.

California ISO Day in The Life - Grid Operations
https://www.youtube.com/watch?v=LG9cu1ahq-M

California ISO Day in The Life - Market Operations
https://youtu.be/439RVXaP4SM
Open Access Same-time Information System (OASIS) provides public access to a variety of transmission system data

http://oasis.caiso.com/mrioasis/logon.do
Today’s Outlook provides users with a broad view of supply and demand conditions impacting the ISO.

http://www.caiso.com/TodaysOutlook/Pages/default.aspx
Business Practice Manuals (BPMs) provide detailed rules, procedures and examples

- Market participants are encouraged to participate in our Proposed Revision Request (PRR) process

- Visit the ISO calendar to find monthly meeting dates to discuss PRRs

[Diagram of Proposed Revision Request process]

Sign up for the Daily Briefing to get a once-a-day summary email of what is happening at the ISO

http://www.caiso.com/dailybriefing/Pages/default.aspx
Check out our news webpage to find up-to-date information

Energy Matters Newsletter

Regional Energy Market

Recent News Releases

Strategic Planning

Alerts, Warnings & Emergencies

Innovation, technologies & strategies

Helpful Links

- Media Hotline: 888-516-NEWS (6397)
- Email: ISOMedia@caiso.com

http://www.caiso.com/about/Pages/News/default.aspx
ISO has created a dedicated developer site to enhance customer service

- Comprehensive website for IT developers
  - consolidates the technical documentation needed to access non-public ISO systems

Follow this page to keep track of browsers supported for ISO applications:
https://developerint.oa.caiso.com/pages/supported-browsers.aspx
Visit our Learning Center to find online resources and comprehensive training programs

http://www.caiso.com/participate/Pages/LearningCenter/default.aspx

Visit our training calendar to sign up for training courses

Check out our CBTs!
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Find helpful links to the Transmission Planning Process and Generator Interconnection Process below

**Transmission Planning Process**
Business Practice Manual for Transmission Planning Process

Transmission planning page

**Generator Interconnection Process**
Business Practice Manual for Generator Interconnection Deliverability and Allocation Procedures

ISO generator interconnection web pages

Resource Interconnection Fair presentations
http://www.caiso.com/informed/Pages/MeetingsEvents/PublicForums/Default.aspx

Questions: IRInfo@caiso.com
We’d like to hear from you

For more detailed information on anything presented, please visit our website at: www.caiso.com

Questions or suggestions for future trainings? Email us at: CustomerReadiness@caiso.com

For general ISO and energy questions, please submit questions to the ISO Contact Us page at http://www.caiso.com/Pages/ContactUs.aspx