Welcome to the California ISO

Today’s Presenters:
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Presentation to begin 9:05 am PDT
Please open your chat pod

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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.

For more information visit the ISO/RTO Council website.
The ISO is a nonprofit, public benefit corporation

Our responsibilities are to…

- Maintain grid reliability
- Provide situational awareness
- Facilitate infrastructure planning
- Support state and federal policy goals
- Run the Market
- Coordinate the bulk electric power system
- Drive innovation
- 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

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

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

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

- **Department of Market Monitoring Oversight Committee**
  - Mark Roblener
    - Senior Vice President and Chief Operating Officer

- **Board of Governors**
  - Elliot Mainzer
    - President & Chief Executive Officer

- **Audit Committee**

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- **Khaled Abdul-Rahman Ph.D.**
  - Vice President, Power Systems & Market Technology
- **Anna McKenna**
  - Vice President, Market Policy and Performance
- **Neil Millar**
  - Vice President, Infrastructure and Operations Planning
- **Dee Subakti**
  - Vice President, System Operations
- **Enterprise Support & Campus Operations**
  - Program & Application Management
- **Roger Collanton**
  - Vice President, General Counsel, Chief Compliance Officer, Corporate Secretary
- **Stacey Crowley**
  - Vice President, External and Customer Affairs
- **Ryan Seghesio**
  - Vice President, Chief Financial Officer, Treasurer
- **Jodi Zemaitis**
  - Vice President, Human Resources

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- **Power Systems Technology Development**
- **California Regulatory Affairs**
- **Grid Assets**
- **Grid Operations**
- **Infrastructure Contracts & Management**
- **Operations Services, Compliance and Analysis**
- **Reliability Coordinator Services (RC West)**
- **Audit and Advisory Services**
- **Communications, Public Relations and Creative & Web Services**
- **Financial Planning and Procurement**
- **Corporate Training and Organizational Development**
- **IT Infrastructure, Architecture & Information Security**
- **Market and Infrastructure Policy**
- **Operations Planning**
- **Reliability and Market Operations Engineering**
- **Transmission Infrastructure Planning**
- **Compliance and Corporate Affairs**
- **Customer Service and Stakeholder Affairs**
- **Controller**
- **Talent and BP Operations**
- **Legal**
- **Federal Affairs**
- **Regulatory**
- **Regional Affairs**
- **Regional Integration**
- **State Affairs**

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[California ISO Logo]
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

### Day-Ahead market

- Ensures, a day in advance resources are available and deliverable in real-time
- Allow parties with bilateral agreements to schedule contracted supply/demand and offload excess supply as energy or Ancillary Services
- Secure pricing

### Real-Time market

- Hour ahead scheduling to enable import/export MWs
- Allows variable energy resources to submit energy forecasts and economic bids closer to financially-binding interval to increase bid accuracy
- Liquidates financial only bids
- Dispatches energy to meet instantaneous demand
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**
- **13:00**

1. **Bids and schedules submitted**
2. **DAM process begins**
3. **Clear the market**
4. **Publish market results**

- **Triggers real-time market**

### Real-time market (RTM)
- **T-1 after 13:00**
- **T-75min**
- **Beginning at midpoint of each 5min period**

1. **Bids/Base schedules submitted**
2. **RTM process begins**
3. **Clear the market**
4. **Receive dispatches**
5. **Post market**

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

competition among suppliers to serve the load

No competition = Market power

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

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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.

Generators and imports

Loads and exports
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

**Demand self-schedules**

- Energy: $/MWh
- MW

**Supply self-schedules**

- Energy: $/MWh
- MW

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**.

Total cleared demand
How does the market decide which resources to commit?

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**
- **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
- **Beginning at midpoint of each 5min period**: Clear the market
- **Receive dispatches**
  - Hour-ahead scheduling process
  - Fifteen minute market
  - Real-time dispatch

**Post market**
Real-Time market processes

Bids and hourly base schedules submitted

75 minutes before each trade hour

15 Minute Market

5 Minute Market

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 15 mins

STUC is looking out 4 ½ hours

Every 5 mins

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.

Diagram:
- Demand
- Supply
- Inter-Regional Interchange
- Power Generated
- Sales
- Purchases
- Load
- Losses
- Frequency
- Reserves

Decrease: 60
Increase:
Entities can participate through market products and reliability services

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

**Reliability**
- Ancillary services: Instantaneous Contingency reserve
- Residual unit commitment
- Flexible ramping product
- Reliability Coordination

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

**Day-ahead market (DAM)**
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Triggers real-time market

**Real-time market (RTM)**
- **T-1 after 13:00**
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  - Bids/Base schedules submitted
  - RTM processes begin
  - Clear the market
  - Receive dispatches
  - Post market
Let’s look at a day in the life of a participating resource.

**Market Participants take positions**

**Settlement Payments and Charges**

**Market Optimization and Reliable Operation**
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.

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

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

- Inputs from day-ahead and real-time markets and meter
- Calculations of formulas and settlement rules
- 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**

- **T** = Trade Date
- **B** = Business Days
- **M** = Months

- **Initial statement**
  - Meter data
  - Market price corrections

- **Last required statement**
  - Disputes due

- **Optional statements**
  - Disputes due

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

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

Recent News Releases

Alerts, Warnings & Emergencies

Helpful Links

Regional Energy Market

Strategic Planning

Innovation, technologies & strategies

• 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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http://www.caiso.com/market/Pages/MarketProcesses.aspx |
| 41-43   | Reliability Requirements | http://www.caiso.com/planning/Pages/ReliabilityRequirements/Default.aspx |
| 44      | Ancillary Services Congestion Revenue Rights Convergence Bidding | http://www.caiso.com/participate/Pages/MarketProducts/Default.aspx |
| 45-46   | SC Certification | http://www.caiso.com/participate/Pages/BecomeSchedulingCoordinator/Default.aspx |
http://www.caiso.com/market/Pages/MeteringTelemetry/Default.aspx  
http://www.caiso.com/Documents/ISOMarketChargeCodesMatrix.xls  
http://www.caiso.com/informed/Pages/StakeholderProcesses/Budget-GridManagementCharge.aspx |
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