Welcome to the California ISO

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Today’s agenda

- ISO Foundations
  - Roles, structure and coordination
- Functions
  - Planning, Markets, Reliability
- Participation
  - Policies & Initiatives, Stakeholder Process, ISO web tools, Training

- View copy of presentation with helpful links on our Learning Center page
- More detailed information can be found in our computer-based training courses
- There will be opportunity for written and verbal questions

See slides 53-67 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...

- Drive innovation
- Provide market transparency
- Maintain grid reliability
- Run the Market
- Support state and federal policy goals
- Provide situational awareness
- Facilitate infrastructure planning
- Coordinate the bulk electric power system
The ISO is also a Balancing Authority (BA)

The Western Interconnection is made up of 39 Balancing Authority Areas (BAAs)

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
Grid operator and market operator

<table>
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<th>A grid operator maintains reliability by:</th>
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<tr>
<td>• Balancing supply and demand</td>
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<td>• Operating transmission system within limits</td>
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<td>• Ensuring grid is secure in case of a contingency event</td>
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<td>• Orchestrating restoration in case of a system outage</td>
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<th>A market operator supports reliability by providing:</th>
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<td>• A larger operational footprint</td>
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<td>• Cost minimization to balance supply and demand</td>
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<td>• Non-discriminatory grid access to supply and demand</td>
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<td>• Price transparency reflective of system conditions</td>
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<td>• Compensation for grid services</td>
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The ISO is a Reliability Coordinator

- On November 1, 2019, the ISO became the official Reliability Coordinator of record for 41 electricity balancing authorities and transmission operators across 14 western states and northern Mexico.

- 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; and leads system restoration following major incidents.
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
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 stakeholder process allows for robust 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?

- Reliability
- Market Operations
- Infrastructure Planning
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

January

Phase 1
Develop detailed study plan

April

Phase 2
Perform sequential technical studies & publish comprehensive plan

March

Phase 3
Procurement

ISO Board for approval of transmission plan
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
A full day’s operations are covered by two markets:

**Day-ahead market**

**Real-time market**
Day-ahead markets procure resources to meet reliability needs

Assurance, a day in advance, that there are adequate resources available and deliverable in real-time
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
- Bids and schedules submitted
- DAM process begins
- Clear the market
- Publish market results

**Real-time market (RTM)**
- T-1 after 13:00
- T-75min
- Beginning at midpoint of each 5min period
- Bids/Base schedules submitted
- RTM process begins
- Clear the market
- Receive dispatches
- 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**
Ancillary services and additional capacity are procured in the ISO BAA to meet reliability requirements.

The ISO procures:

- **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

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”.

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 that 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
- Generators and imports

**DEMAND BID**

- The lower the price, the more they will buy
- 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
- Self-schedules are placed at the beginning of economic curves

**Supply self-schedules**

- Total cleared demand

Day-ahead clears supply bids against demand bids;

Real-time clears supply against ISO load forecast.

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How does the market decide which resources to commit?

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

![Diagram showing various inputs including Bids, Network model, Day-ahead Market Optimization, Outages, Forecasts, Transmission limits, Resource parameters.](ISO PUBLIC – © 2020 CAISO)
Market timelines: day-ahead, real-time and post market

**Day-ahead market (DAM)**

- **T - 7 days**
- **10:00**
- **13:00**
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**Real-time market (RTM)**

- **T-1 after 13:00**
- **T-75min**
- Beginning at midpoint of each 5min period
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  - Fifteen minute market
  - Real-time dispatch

Triggers real-time market
Real-time market processes

- **75 minutes before each trade hour**
  - **Bids and hourly base schedules submitted**
  - **15 Minute Market**
  - **5 Minute Market**
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 BAs to balance energy

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

Day-ahead market (DAM)

- Bids and schedules submitted
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Triggers real-time market

Real-time market (RTM)

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- Receive dispatches

Beginning at midpoint of each 5min period

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

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

Additional real-time award

Incremental award in the FMM

Initial day-ahead award
Meter data is collected and processed for settlements

Revenue quality meter data

Settlement quality meter data

Estimation

Validation

Editing

Settlements

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

T = Trade Date
B = Business Days
M = Months

Statements

T+3B
T+12B
T+55B

T+8B
T+48B
T+172B

Optional settlement dates for incremental changes

T+9M
T+18M
T+33M
T+36M

California ISO
FOR MORE INFORMATION…
Visit the ISO website for information and resources

www.caiso.com
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

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

http://www.caiso.com/about/Pages/News/default.aspx

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

Sign up today!
developer.caiso.com
Visit our Learning Center to find online resources and comprehensive training programs.

Visit our training calendar to sign up for training courses.

Check out our CBTs!
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<td>FERC, NERC and WECC</td>
<td><a href="http://www.ferc.com">www.ferc.com</a>, <a href="http://www.nerc.com">www.nerc.com</a>, <a href="http://www.wecc.biz">www.wecc.biz</a></td>
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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

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