

Third Generation California Electricity Market Design

Dr. Chris Mensah-Bonsu
Senior Market Design Engineer
California ISO

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Presentation Outline

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California ISO Core Functions

- Reliably operate, as a single control area, the combined transmission grids of California's three major IOUs and other transmission owners.

- Provide non-discriminatory access to the grid for wholesale buyers and sellers of electricity.
 - Wholesale buyers
 - Load-serving entities (LSEs)
 - Large consumers
 - Wholesale sellers
 - Generators
 - Marketers

Some Motivating Factors for MRTU

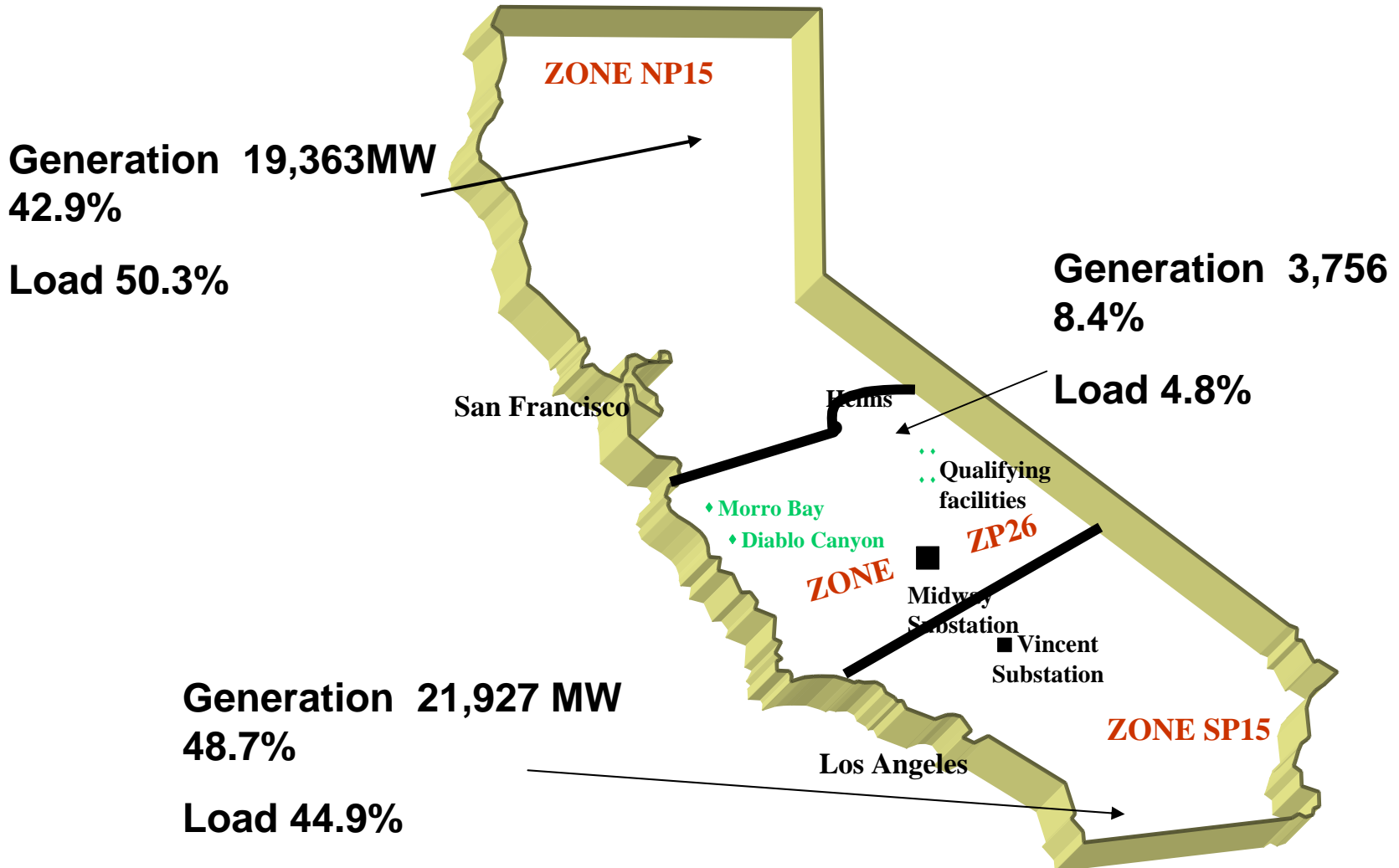
- **Need for a transparent, forward spot market**
 - Limited opportunities today for buyers and sellers to match next day needs and supplies.
 - Day-ahead hourly spot price will enhance demand response capability.
 - BUT – Creation of a forward spot market on ISO's existing zonal design would likely increase infeasible schedules.

- **Systems and Software Problems**
 - Legacy systems now have over 350 patches, need to be updated to ensure reliable, timely running of ISO scheduling procedures and markets, and publication of final schedules.

Objectives and Scope of MRTU

- Fully align market incentives and energy schedules with the physical operation of the grid.
- Develop a secure operating plan for the next day with financial incentives to perform.
- Manage all constrained networks in an optimal and transparent fashion in both the day ahead and real time markets.
- Replace aging, inflexible technology with state-of-the-art scalable technology.
- Provide transparent price signals to support forward contracting and future infrastructure investment.

Present Zonal Configuration of ISO Grid



Brief Background of the MRTU Program

- Represents a major overhaul of the original and legacy market design implementation since 1998.
- Seeks to correct problems incurred with the original design
 - Real-time zonal pricing (lack of granularity)
 - No CAISO day-ahead market (PX market ceased 2001)
 - No unit economic commitment capability
 - Infeasible day-ahead, hour-ahead schedules.
- MRTU provides needed enhancements
 - Two settlement system
 - Locational Marginal Pricing (LMP)
 - Optimized unit commitment
 - Congestion Revenue Rights for hedging congestion and more.

A Secure Operating Plan for the Next Day

- Optimized bid-based unit commitment tool secures sufficient energy and ancillary services to insure feasible and secure operating plan for the next day, at least cost.
- Minimizes need for out-of-market costs and reduces likelihood of high in-day congestion management costs.
- Residual Unit Commitment (RUC) pass secures additional capacity consistent with CAISO forecast when load is under-scheduled in the day ahead by LSEs. (Load scheduling becomes a business decision.)

Manage All Network Congestion in Day Ahead Scheduling and Real Time Dispatch

- Full Network Model (FNM) driven by a State Estimator allows for complete modeling and pricing of all monitored contingencies, with enhanced accuracy.
- Load pays aggregated price, while generators are paid the nodal price. Price differentials reveal transmission bottlenecks.
- Flexible in-day commitment tools for short-start resources enhance operating flexibility and can reduce in-day CM costs.

Replace Aging, Inflexible Technology with State-of-the-Art Scalable Technology

- Day-ahead and Real-time markets on common platform and Full Network Model.
- New settlement system and bid entry/management systems improve customer experience while reducing operation and maintenance costs.
- Numerous upgrades and replacements of back-office support systems further improve efficiency.

Transparent Price Signals to Support Forward Contracting and Investment

- Robust & certain price signals from the day-ahead commitment process support forward contracting.
 - Price transparency for large and small participants.
 - Support third party establishment of standard futures contracts (via Trading Hubs).
- Transmission hedges (CRRs) for LMP congestion charges are renewable by native load on an annual basis supporting multi-year contracting.
- Locational prices signal most valuable locations for generation & transmission investment.



Major Design Elements

- **Day Ahead Integrated Forward Market (IFM)**
 - Integrated congestion management, energy market, local market power mitigation (LMPM), reliability requirements dispatch, ancillary services procurement, unit commitment
- **Locational Marginal Pricing (LMP)**
 - Congestion management using accurate detailed model of the transmission grid (Full Network Model) => "nodal pricing"
 - Nodal Prices reflect congestion and marginal transmission losses
- **Congestion Revenue Rights (CRRs)**
 - Source-to-sink, to enable parties to hedge congestion cost risks
- **Residual Unit Commitment (RUC)**
 - Day Ahead reliability backstop to meet real-time load forecast
- **Real-Time Energy Market (RTM)**
 - Includes an Hour Ahead Scheduling Process that allows for changes to inter-tie schedules without creating a complete third settlement market
- **Market Power Mitigation (MPM)-Both System and Local**
 - Damage control bid cap in addition to LMPM
- **Short Term Unit Commitment (STUC)**
 - Commits units with start up time requirements under 5 hours

Some Other Design Details

- **Load Aggregation**
 - Three IOU-based aggregation zones (PG&E, SCE, SDG&E) for all non-ETC load scheduling & settlement

- **Scheduling Priorities & Self Scheduling**
 - "Self Schedules" = submitted preferred schedule quantities (supply and demand) with no prices
 - IFM gives higher priority to self schedules in clearing energy market and managing congestion
 - No "balanced schedule" requirement for individual SCs (except when submitting ETC & wheel-through schedules)

- **Congestion Revenue Rights (CRRs)**
 - Financial Rights Only - No Physical Scheduling Priority
 - Annual release of 4 seasonal CRRs, plus monthly true-up.

Key Business Support Elements

- **Scheduling Infrastructure Business Rules (SIBR)**
 - Integrated market interface with bid/offer processing rules
- **Settlements and Market Clearing (SaMC)**
 - Entirely new settlement system
 - Charge types can be configured in house
- **Post Transaction Repository (PTR)**
 - Data repository for internal and external reporting
- **Portal**
 - Provides central, secure access to MRTU applications
- **Market Quality Systems (MQS)**
 - Off-line market engine for post-market accounting, calculations, and data corrections
- **Other Legacy System Upgrades**

Summary

- New market design resolves current operational problems while providing robust price signals to support forward contracting and infrastructure investment.
- MRTU combined with future transmission enhancements will further reduce CAISO out-of-market costs.
- MRTU brings CAISO markets in alignment with best practices through new scalable technology which will allow for future flexibility and expansion.

Brief Presenter Biography

- Dr. Chris Mensah-Bonsu is a Senior Market Design Engineer with the Market Development and Program Management group of the California Independent System Operator (CAISO). He serves as a technical advisor and leads key Market Redesign and Technology Upgrade (MRTU) projects at the CAISO. Chris is also the Lead Subject Matter Expert on the Full Network Model (FNM) that forms the core of the Locational Marginal Pricing (LMP)-based California Electricity Markets.
- Dr. Chris Mensah-Bonsu joined CAISO in 2000. He is actively involved in the FNM implementation and Stakeholder processes, market design, integration, testing and production implementation efforts, as well as operational support and coordination of CAISO market applications and protocols to ensure efficient electricity markets, system reliability and Federal Energy Regulatory Commission (FERC) compliance. Dr. Mensah-Bonsu has represented CAISO as an invited guest speaker at both national and international workshops, conferences and meetings relating to electric power industry restructuring and its emerging markets.
- Dr. Mensah-Bonsu holds the Master of Science and Ph.D. degrees in Electrical Engineering from Cleveland State University, Cleveland, Ohio, and Arizona State University, Tempe, Arizona respectively. Chris has co-authored a number of peer-reviewed technical journal papers, and he is also a reviewer of IEEE Journal papers. Dr. Mensah-Bonsu is a Fellow of the Preparing Future Faculty Program, Senior IEEE Member, an active member and chair of the Prize Paper Award Committee (PPAC) of the IEEE System Economics Subcommittee.