California ISO

CAISO & Siemens working together

for the next generation
electric grid management

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MMS Development of Aggregated DER bids and Implementation for FERC Order 2222

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California ISO

Within its balancing authority area, the California ISO:

- Maintains reliability on the grid
- Manages the flow of energy
- Oversees the transmission planning process
- Operates the wholesale electric market

For much of the western U.S., the ISO:

- Operates the Western Energy Imbalance Market (EIM)
- Serves as Reliability Coordinator (RC West)

California's strategy for increasing renewable resource production in the state incentivizes the development of a substantial amount of DERs

- Future grid needs continues to be impacted by changing net load patterns, as illustrated in the "duck curve", DERs have the potential to operate in ways that can re-shape the curve.
- Load-serving entities (LSEs) are procuring significant amounts of their energy needs from distributed generating resources and will likely want to count the capacity of these resources towards their annual resource adequacy (RA) requirements.
- Integrating these resources into system operations through the facilitation of their participation in wholesale markets, consistent with reliable system operations, is important as their increased levels of adoption impacts the bulk power system.

CAISO is an Early Mover to Integrate DERs into wholesale market

Demand Response

- PDR
- RDRP

DERA

- NGR SOC as bid in parameter
- Energy Limit
- Batteries, Flywheel
- Price Sensitive Load

Hourly & 15 min Market

- DR participation
- PDR Load Shifting introduced

ESDER

- EOH SOC
- Default Energy Bid
- Better Operational Characteristics

Hybrid

- DER+ Storage
- ACC
- Energy, Regulation, Spinning, Non-Spinning and Flexible Ramp

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The CAISO is an early mover to integrate DERs into wholesale markets

The CAISO has participation models for a variety of services

1) Stand-alone DERs
   - 500+ new DERs (2.2 GW) since 2005
   - Same requirements as transmission-connected resources
2) Demand response (2010)
   - Distribution interconnection requirements, CAISO registration process
   - 1.7 GW in CAISO markets
   - Two major models (Proxy Demand Response and Reliability Demand Response Resource) with 7 settlement methodologies to accommodate electric vehicles, behind-the-meter solar/storage, etc.

The CAISO is an early mover to integrate DERs into wholesale markets (con't)

3) Distribution Energy Resource Aggregations (2016)
   - Allows DERs less then 1 MW in size to participate in aggregation
   - Distribution interconnection required for individual DERs
   - CAISO registration includes Utility Distribution Company and LSE 30-day review
     - Ensures DERs are not also demand response participants, in other DERAs or in conflict with their tariffs
     - Allows for distribution system identification of DER wholesale market participation and additional evaluation distribution operational impact
     - Concurrence letter from UDC is required before a DERA can enter the ISO new resource implementation process

FERC Order 2222 was largely modeled on the ISOs 2016 DER Provider filing with similar requirements identified

Model	Distributed Energy Resource Provider (DERP)
Market Participation	• Day-Ahead & Real-Time energy • Spinning & Non-Spinning reserves • Regulation Up & Down • 24x7 participation • Not subject to market power mitigation
Capacity & Aggregation Requirements	• Aggregations within same SubLAP (not including baseline DR) • Min 500 kW • Max <20 MW if across P-Nodes • DERs within the aggregation <1 MW
Metering & Telemetry	• SC metered entity submission - aggregate performance of metered DERs • Telemetry if >=10 MW, or providing A/S – aggregate response of telemetered DERs
RA Eligibility & must offer obligation	• RA eligible (no tariff rules) – Qualified Capacity methodology does not exist, requires deliverability study • MOO (no tariff rules) – CAISO standard rules may apply
Interconnection Requirements	• UDCs may prefer WDAT interconnection, but not required by CAISO/FERC • ISO new resource implementation process

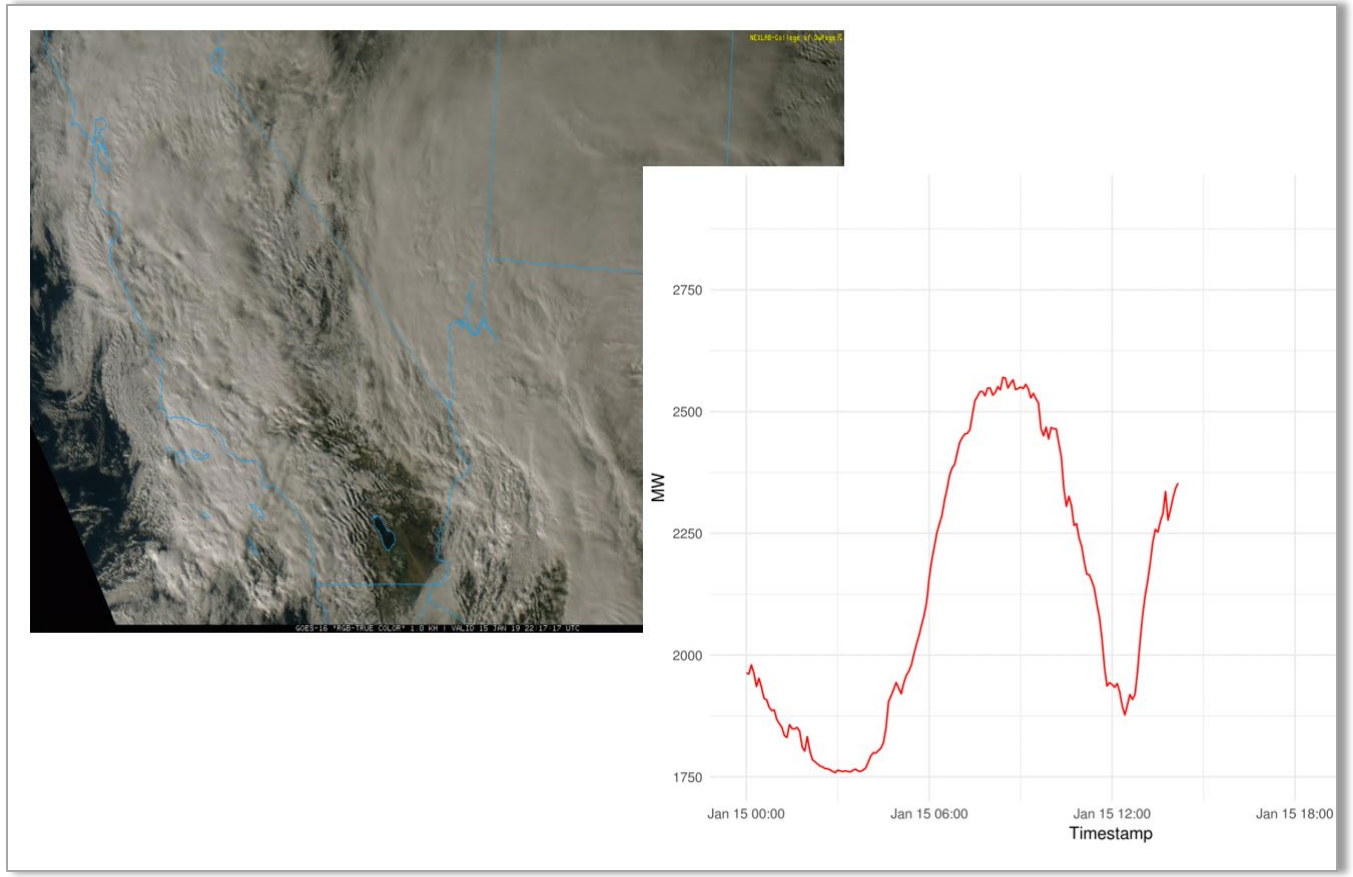
On May 18, 2023, FERC accepted the CAISOs compliance filing making the it the first ISO/RTO to fully comply with the order to enable distributed energy resource aggregations.

By November 1, 2024, the CAISO will align its tariff with the final order and implement changes needed including:

- Lowering the DERA minimum capacity requirement from 500 kW to 100 kW;
- Creating a heterogeneous DERA model that can include demand response; **(biggest implementation lift)**
- Clarifying that a DERA may not receive “double” compensation (retail program + wholesale participation) for capacity, energy, or other services and requiring the distribution company to confer regarding any double-counting concerns; and
- Requiring DERAs to notify the CAISO when their information changes due to the removal, addition, or modification of a DER within the DERA.

Telemetry enhances accuracy of load forecasting to account for behind-the-meter penetration

- Example shows impact of rapidly moving demand actuals due to movement of ~725 MW of DER generation due to cloud coverage throughout the middle of the day



Situational awareness of both market participating and non-participating DERs is critical for CAISO operations

- Behind-the-meter solar has been the most impactful DER for CAISO operations thus far
- In future, DERs will be more heterogeneous, bi-directional, and driven by varying use patterns and customer needs
- Understanding the impact of DERs is critical to situation awareness and reliability
  - This will likely require access to aggregated telemetered response by technology type for both short-term (*i.e.,* within a few minutes or hours) and long-term modeling and forecasting

Why no DERA participation under current CAISO market participation provisions?

- Retail programs are more attractive
  - NEM (No capacity limit)
- Stand-alone DER resource requirements are low
  - 500 kw for generators and 100 kW for storage
- Lack of an established methodology to determine an RA capacity value for DERAs
- Complexity DERAs introduce to distribution system operations and planning

Update:
The CAISO is anticipating its first DERA to begin market participation in August 2024!

Key challenges to high DER future

- Forecasting DERs' load modifying effects on actual load consumption in the operational time-frame.
- Predicting the short-term load forecast conditions so that sufficient capacity is committed at least cost for reliable operation of the grid.
- DER impacts on long-term load forecasts that inform infrastructure planning decisions.
- Current limitations in the coordination and communication between operators of the transmission and distribution systems.
- Lack of understanding of what additional communications will be needed and availability of robust communication framework to facilitate these communications.

FERC 2222 Framework for the Aggregate DER Participation
Key Aspects

Aggregation

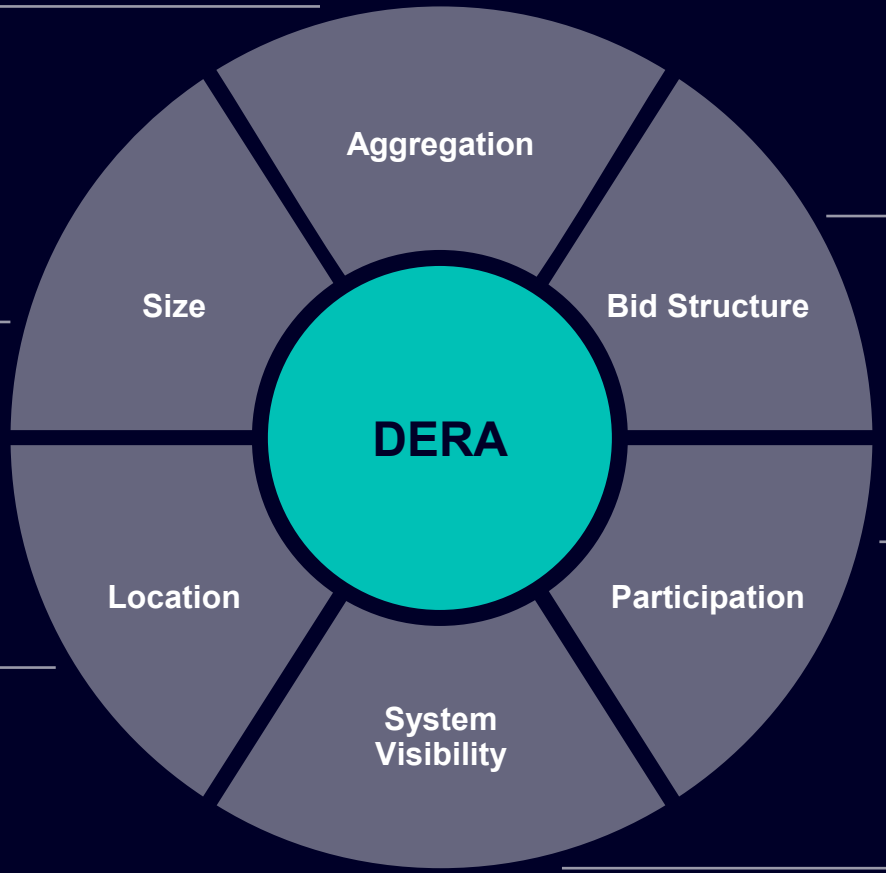
Heterogeneous – Energy & Curtailment
Includes Distribution Curtailment
Resources

Min & Max Size

DERA Min Size 100 KW
DER in DERA Max size 1MW
No Sizing req for Individual DER in a DERA

Location

DER & DERA in the same sub-lap



Bid Structure

Distribution Factor
Ramp Rates
Min/Max Limit
Energy Limit
Contingency Flag

Participation

DER can not in be in DERA
if already part of net metering or
other demand response

Metering & Telemetry

Telemetry at DERA level

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CAISO provides many options for DER Participation

Proxy Demand Response (PDR)
Enables 3rd parties to bid demand response to CAISO Market independent of LSE

Reliability Demand Response Resource (RDRP)
Market participation model for reliability-based load curtailment

Participating Load
Demand Response by providing a 3-part bid

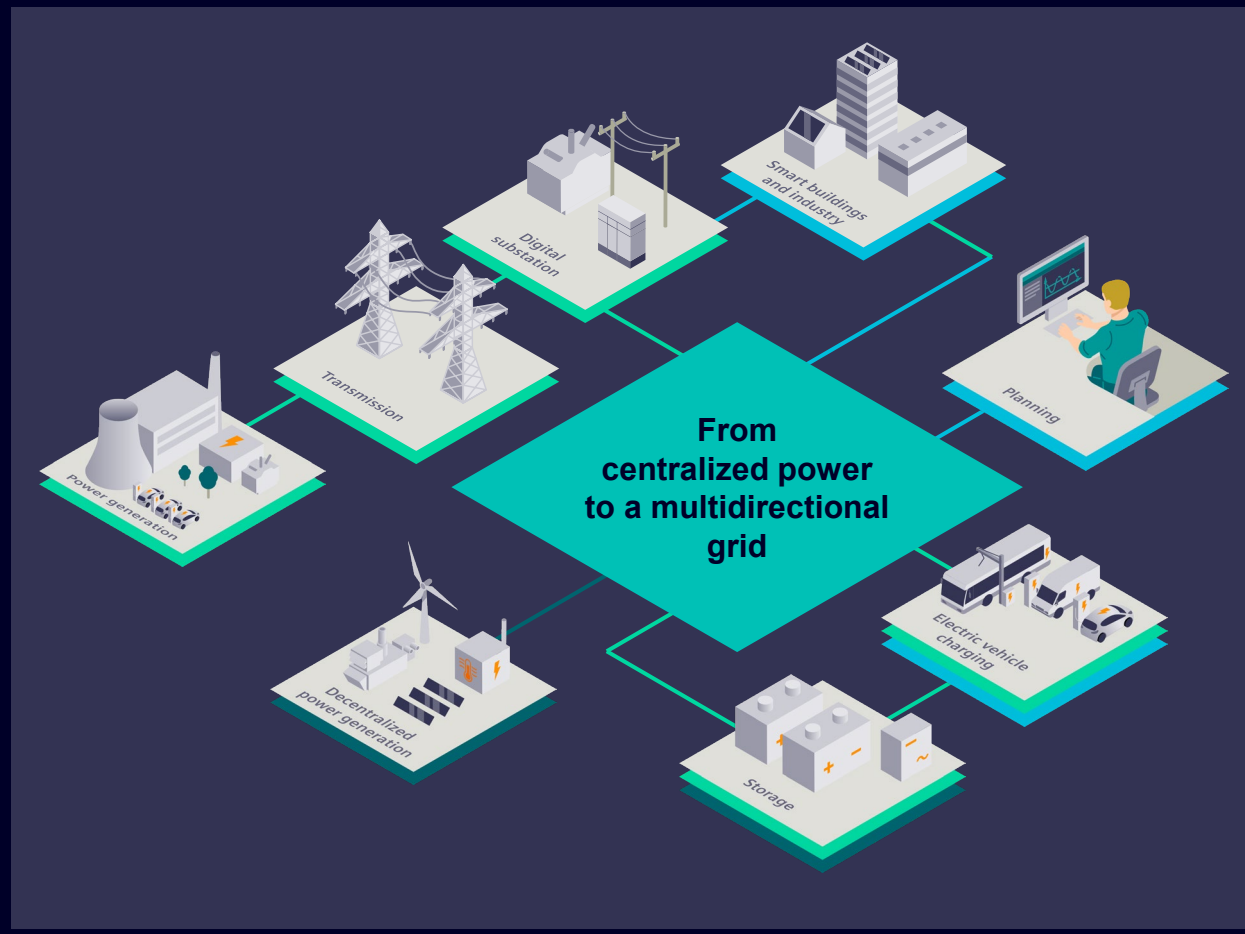
Distributed Energy Resource Provider (DERP)

Non-Generator Resources
Limited Energy Storage Resources (LESR)
- REM – Awarded Reg Up/Down
- NREM – Energy & AS including Regulation

Dispatchable Demand Response (DDR)

Energy Storage & Distributed Energy Resources (ESDER)

Hybrid Resources



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CAISO Participation Model are Technology neutral and Focus on Resource Capability

Generator

- Aggregated
- Stand Alone
- Connected to Distribution Grid

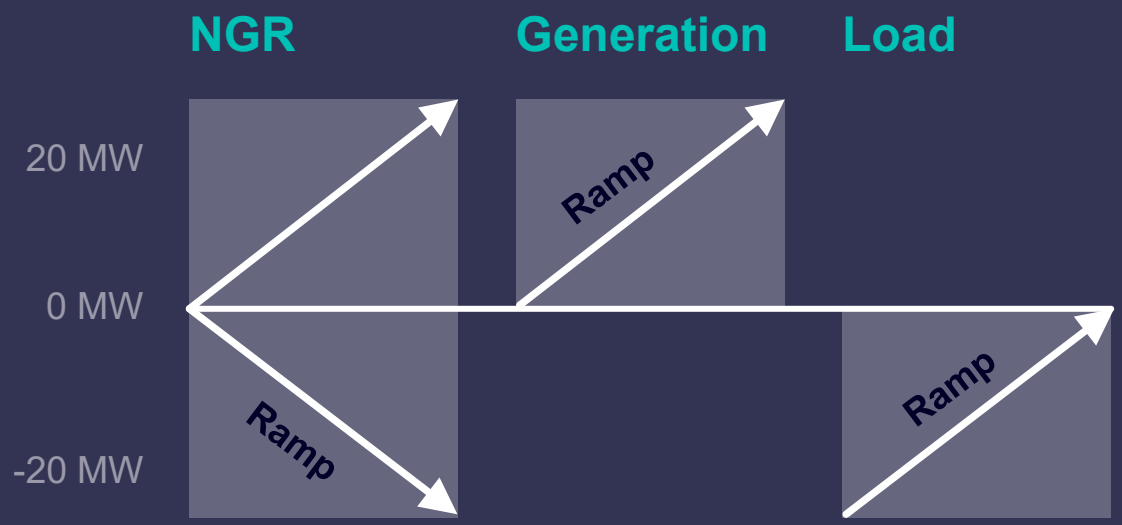
Reduces Load

- Traditional Load Drop
- Various Demand Response Programs
- Storage Backed Demand Response

Reduces Load and Generation

- Storage Resources
- Aggregation of DER

Models



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Energy Storage & Distributed Energy Resources

Key Functionalities

Parameter that better reflects Operational Characteristics

- Limit on activation and set number of hours for dispatch
- Max Daily Run Time Constraints
- Curtailment size limited to 1 MW

Optional End of Hour SOC for Storage Resources

- EOH bid parameter – SOC Max , SOC Min
- Must respect AS awards and Physical Min/Max charge constraints
- AS is protected if conflict with EOH SOC parameter

Default Energy Bid Cost for Storage Resources

- Energy Procurement Cost
- Marginal Cost due to Cycling
- Opportunity Cost

Streamlined Market Participation Agreement

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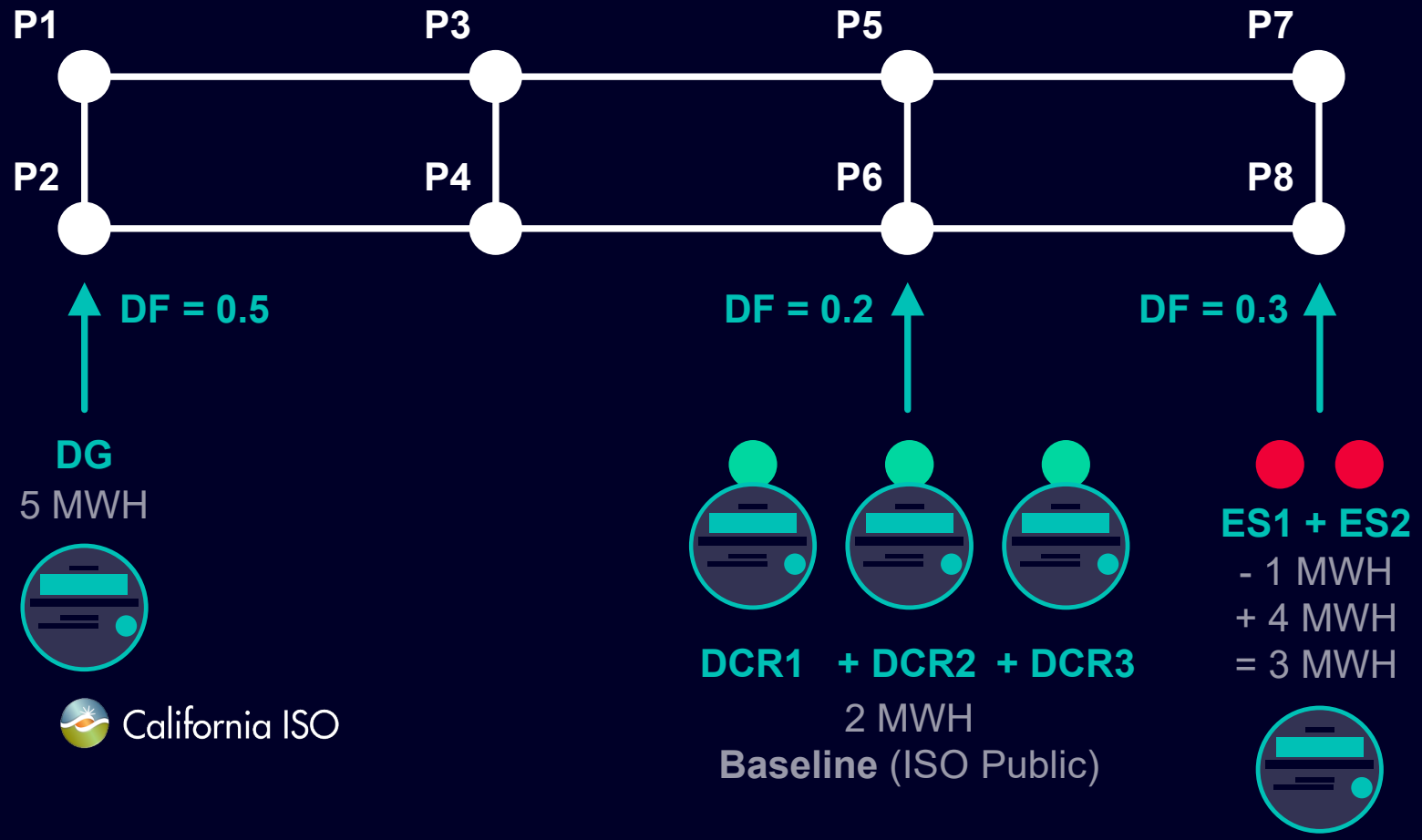
CAISO Proposal of Heterogeneous DERA (HDERA)

HDERA must consist of at least one curtailment and one energy injection resources

Settlement for HDERA will be based on net service provided to CAISO

* Net Service = Sum(Energy Provided, Demand Curtailment)



Ref: CAISO BRS FERC2222

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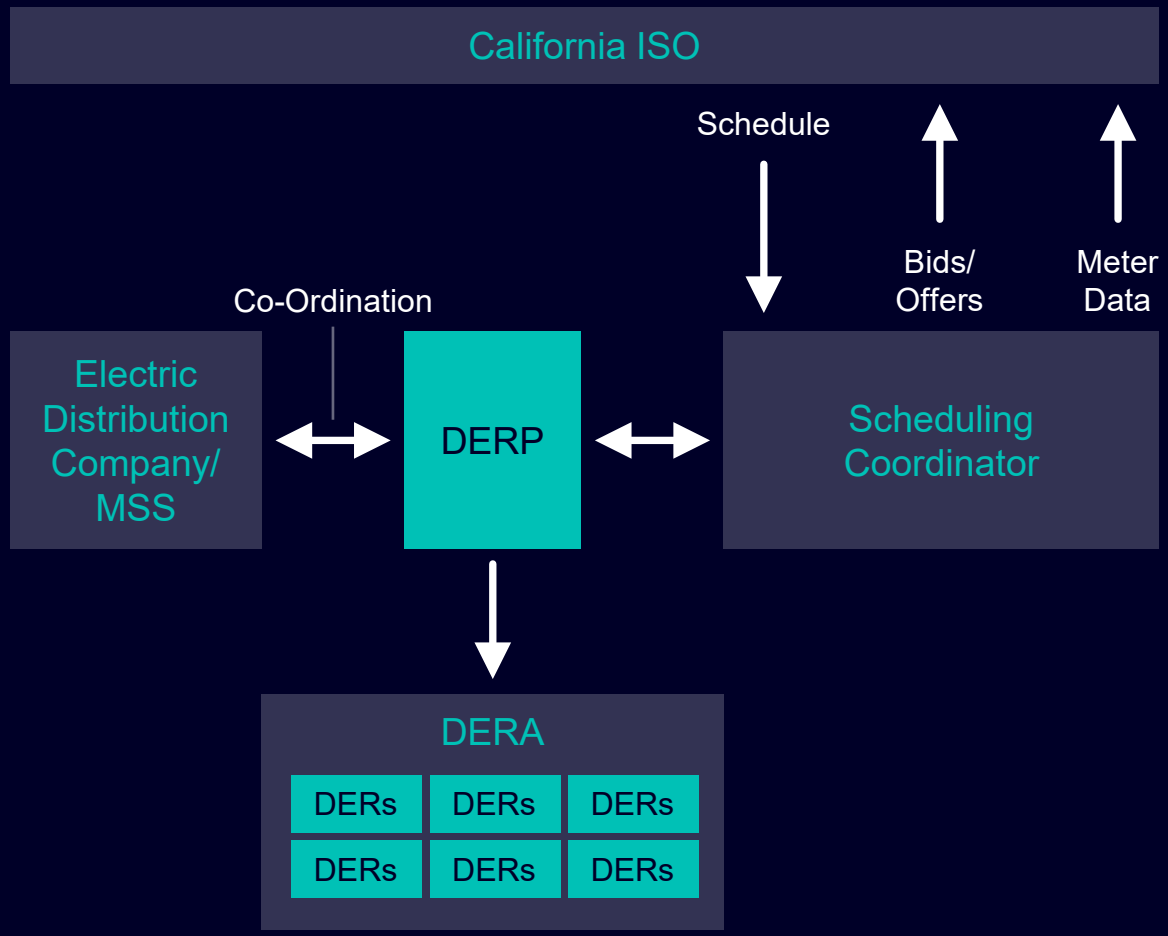
CAISO DERP Participation Model
Metering & Telemetry



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Questions and Answers

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