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DER 2.0: The Evolution of Distributed Resource Technologies and Regulators
DER 2.0: Evolution of Distributed Energy Resource Technologies and Regulations

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The growth in renewables and distributed energy resources is transforming California’s energy supply portfolio and how our grid functions.

System Peak Demand was 46,232 MW on July 27, 2016
Rapid DER deployment is spurring a democratized and decentralized system calling for enhanced coordination at the T&D interface.

- **Diverse end-use devices and diverse owners/operators affect:**
  - Load shapes, peak demand, total energy consumption
  - Energy flows, voltage variability, phase balance
  - Variability and unpredictability of net loads and grid conditions

- **CAISO “sees” DER as if located at T&D substations**
  - No ISO visibility to distribution grid conditions/impacts
  - Distribution utility is unaware of DER bids and dispatches

- **DER providing services to customers and the distribution system affects the T&D interfaces**
  - Need accurate operational forecasting and local management of DER variability to ensure end-to-end feasibility
Daily coordination, cooperation, and engagement is needed to ensure feasible energy transactions.

- DERP Update ISO/DSO on resource limitations and outages
- ISO Provide schedules to DSO to ensure feasible dispatch
- DSO provide advisory info on grid conditions to DERP to ensure feasible DER bids/schedules
The future grid may be a layered hierarchy of nested optimizing sub-systems.

- Each tier only needs to see interchange with the next tier above & below, not the details inside other tiers.
- ISO focuses on regional bulk system optimization while DSO coordinates DERs.
- Layered control structure reduces complexity, allows scalability, and increases resilience & security.

**Regional Interconnection**

- **BAA (Balancing Authority Area)**
- **CAISO (California Independent System Operator)**
- **DSO (Local Distribution Area or Community Micro-grid)**
- **Smart building**
- **Micro-grid**

*X* Point of Interchange
Thank you.

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Market & Infrastructure Policy
Food for thought as we move into a high-DER future...

- **Enabling Multi-use Applications of DER**
  - What grid services can be valued and stacked?
  - Who has primacy over the resource in what situations?
  - How to prevent double counting of capacity or resource capabilities?
  - Net energy metering interactions and impacts on multiple-use applications

- **Assessing DER Performance and Evaluation Methods**
  - Retail/wholesale metering interactions and adjustments needed.
  - Sub-metering issues, rules, and manipulation concerns/
  - Accounting for and removing the “typical use” of devices to ensure no double payments when selling specific grid services.

- **Understanding DER Modeling and Optimization Techniques**
  - Setting and managing aggregate DER resource distribution factors in network models, i.e. how much expected output from each Pnode?
  - How to account for the dynamic nature of DER when resource configurations and capabilities can vary greatly over time?
  - How to model and manage storage device state of charge constraints?
  - How to manage resource use limitations beyond 24 hour optimization horizons

- **Agreeing on the Best System Architecture Design**
  - How to properly model and forecast interactions at the T&D interface?
  - How to properly model micro-grids/Nano-grids?
  - What is the most elegant system architecture to employ in a high-DER future? A Nested architecture or ?

- **Coordinating Actions and Information at the T&D Interface**
  - How to ensure feasible dispatches from ISO to end-use customer
  - What are the essential roles and responsibilities of key players at the T&D interface?
  - What information must be exchanged and in what timeframes?

- **Addressing Station Power Rules and Regulations**
  - How to treat station power when storage device is in charging mode?
  - How to avoid double charging for station power at retail and wholesale level in behind the meter applications?
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No smoking: Toward 100% renewable

• Routinely achieving 90% renewable during mid-day
• All but 1 generator shut down on clear days for up to 6 hours

Next up: periods of 100% renewable during mid-day
No ability to take solar without significant storage

- SolarCity / Tesla 13 MW / 52 MWh
- AES 20 MW / 100 MWh
- Additional projects in the works
KIUC’s Storage Fleet

**Smoothing**
- **Frequency Control v1**
  - 4.5 MW / 3.0 MWh
  - advanced lead acid (own)

- **Frequency Control v2**
  - 6 MW / 4.6 MWh
  - lithium ion (own)

**Shifting**
- **Dispatchable Solar v1**
  - 13 MW / 52 MWh
  - lithium ion (PPA)

- **Dispatchable Solar v2**
  - 20 MW / 100 MWh
  - lithium ion (PPA-planned)

**100% RPS**
- We’re working on it...