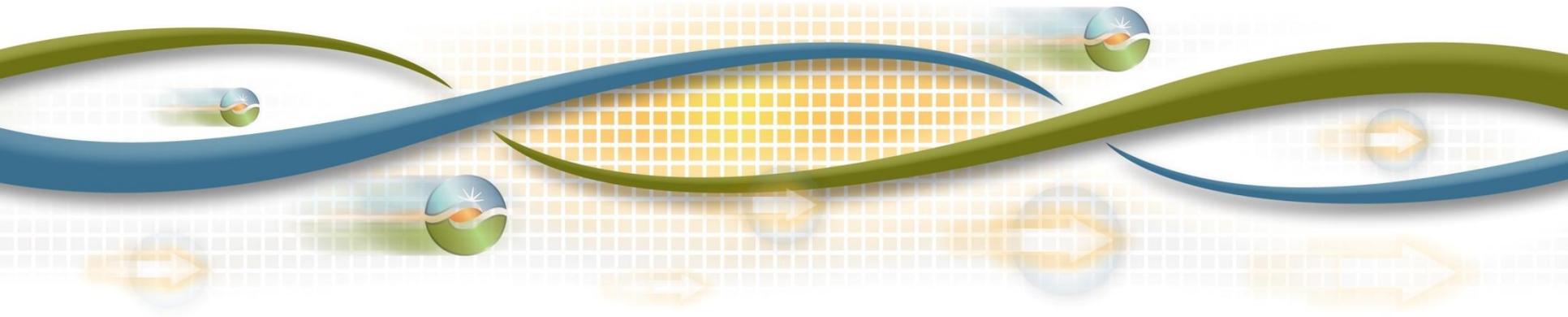




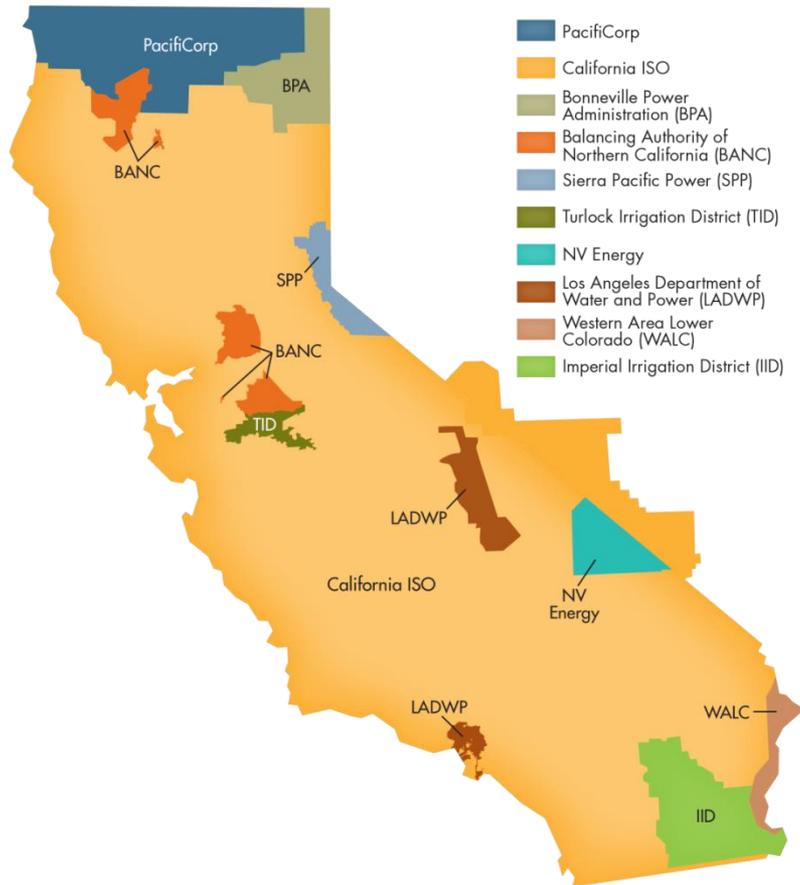
Joint Agency Workshop Microgrid Roadmap Kickoff

Peter Klauer, Smart Grid Solutions Manager
California ISO

May 24, 2016



California Balancing Authorities



- The California ISO manages the flow of electricity for about 80 percent of California and a small portion of Nevada
- There are certain pockets of California where local public power companies manage their own transmission systems

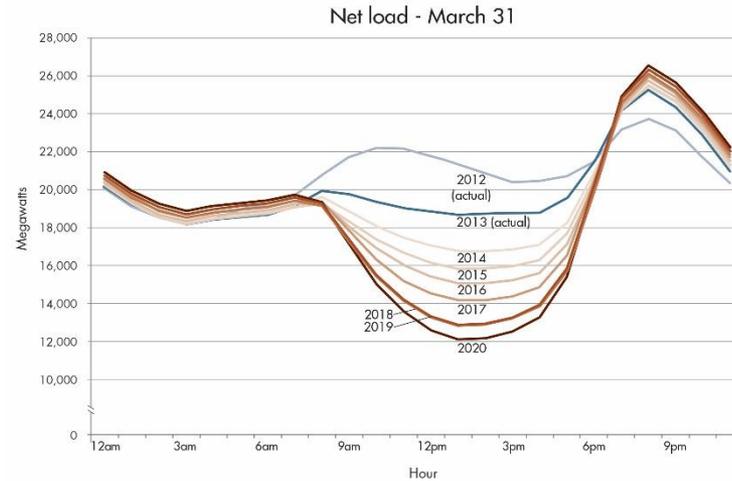
- **60,703** MW of power plant capacity (net dependable capacity)
 - **50,270** MW record peak demand (July 24, 2006)
 - **30 million** people served

California energy and environmental policies drive renewable integration and transmission needs

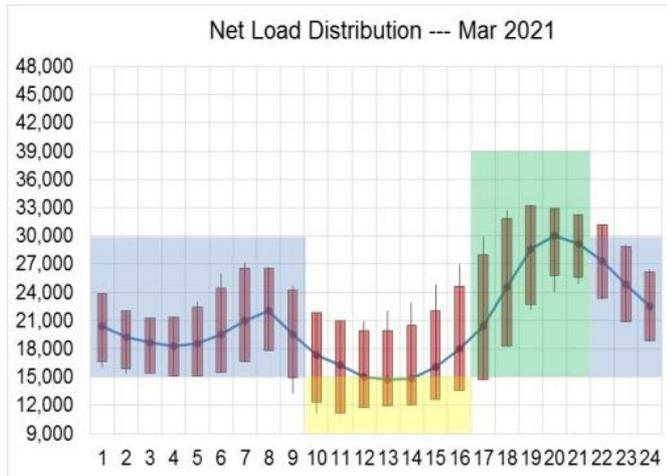
- Greenhouse gas reductions to 1990 levels by 2020
- 33% of load served by renewable generation by 2020; 50% of load served by renewable generation by 2030
- 12,000 MW of distributed generation by 2020
- Ban on use of once-through cooling in coastal power plants
- Less predictable load patterns – rooftop solar, electric vehicles, distributed storage, and microgrids

Grid Impact and Operational Challenges

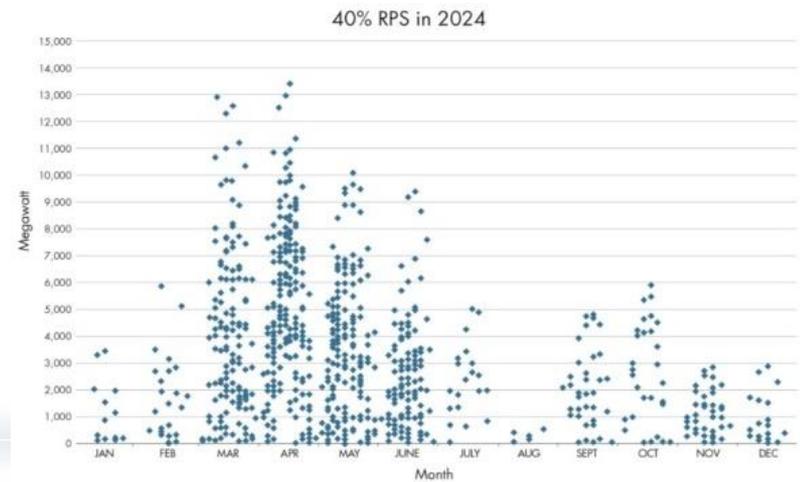
- Over supply and ramping challenges



- Time of use alignment with grid conditions



- Potential for renewable curtailment



Microgrids are comprised of localized load and generation resources which *normally operate connected to and synchronous with the traditional centralized grid* but can disconnect and function autonomously as an island within the macrogrid



Source: DOE

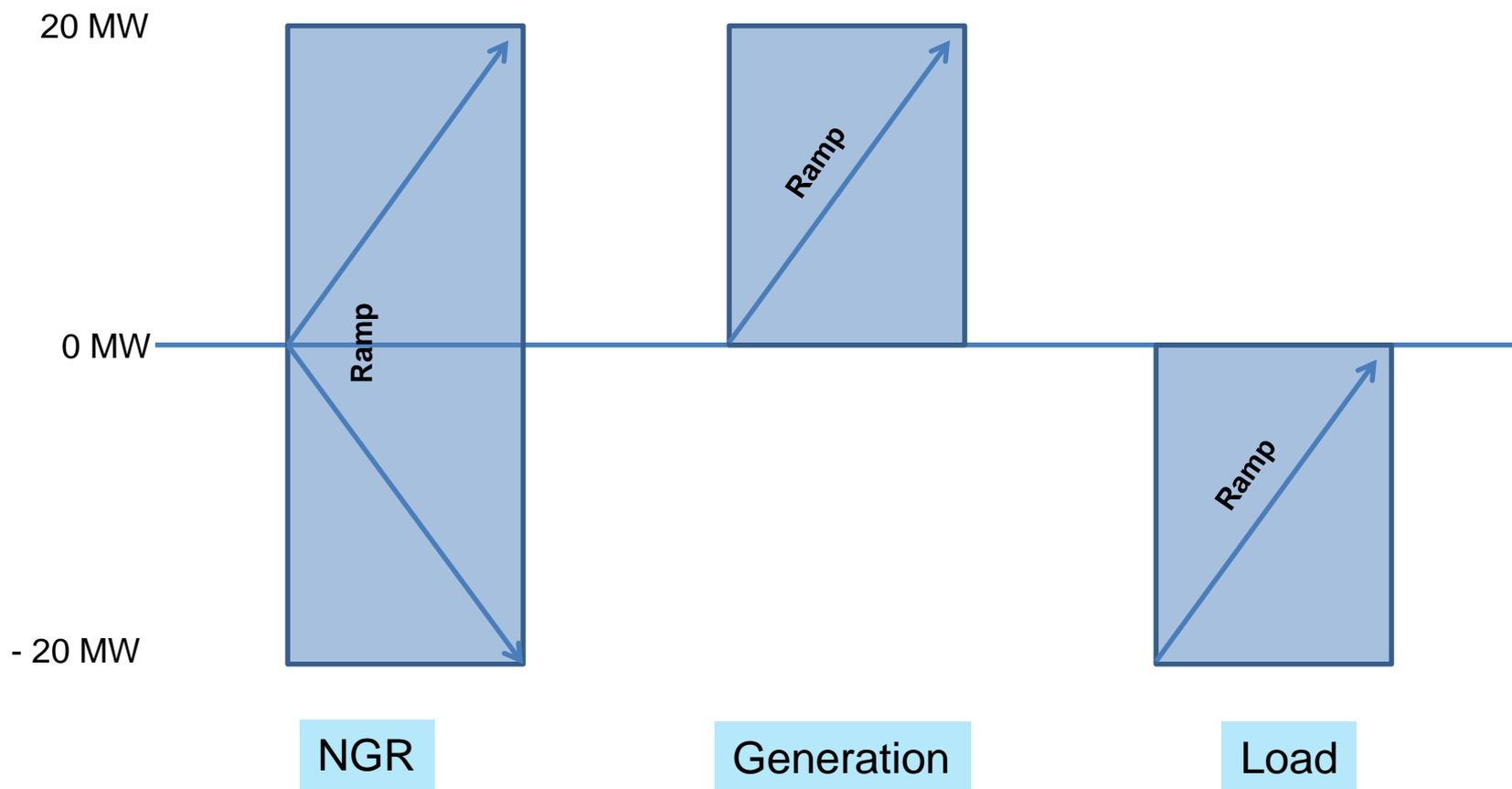
Characteristics of a participating microgrid

- A collection of loads and DERs that meet the needs of the microgrid as well as provide services beyond the microgrid
- A portion of the Microgrid is modeled as a flexible wholesale resource
- The grid operator visibility is at the microgrid resource level
- Microgrid controllers deliver grid services based on the individual sub-resources within the microgrid.
- Microgrid exhibits reliable disconnect and reconnect procedures

Preparing the way for microgrid resources

- In 2010, the ISO began to revise its tariff to treat non-generator resources on a comparable basis with conventional generators
- In 2011, FERC approved tariff changes to facilitate non-generator resources providing ancillary services
 - Reduced the minimum rated capacity requirement
 - Reduced minimum continuous energy requirement
 - Clarified that ‘Continuous Measurement’ begins once resource reaches the awarded energy output, not at the end of 10 minute ramp requirement

In 2012, the ISO implemented non-generator resource (NGR) functionality within the wholesale markets



The ISO operates two markets

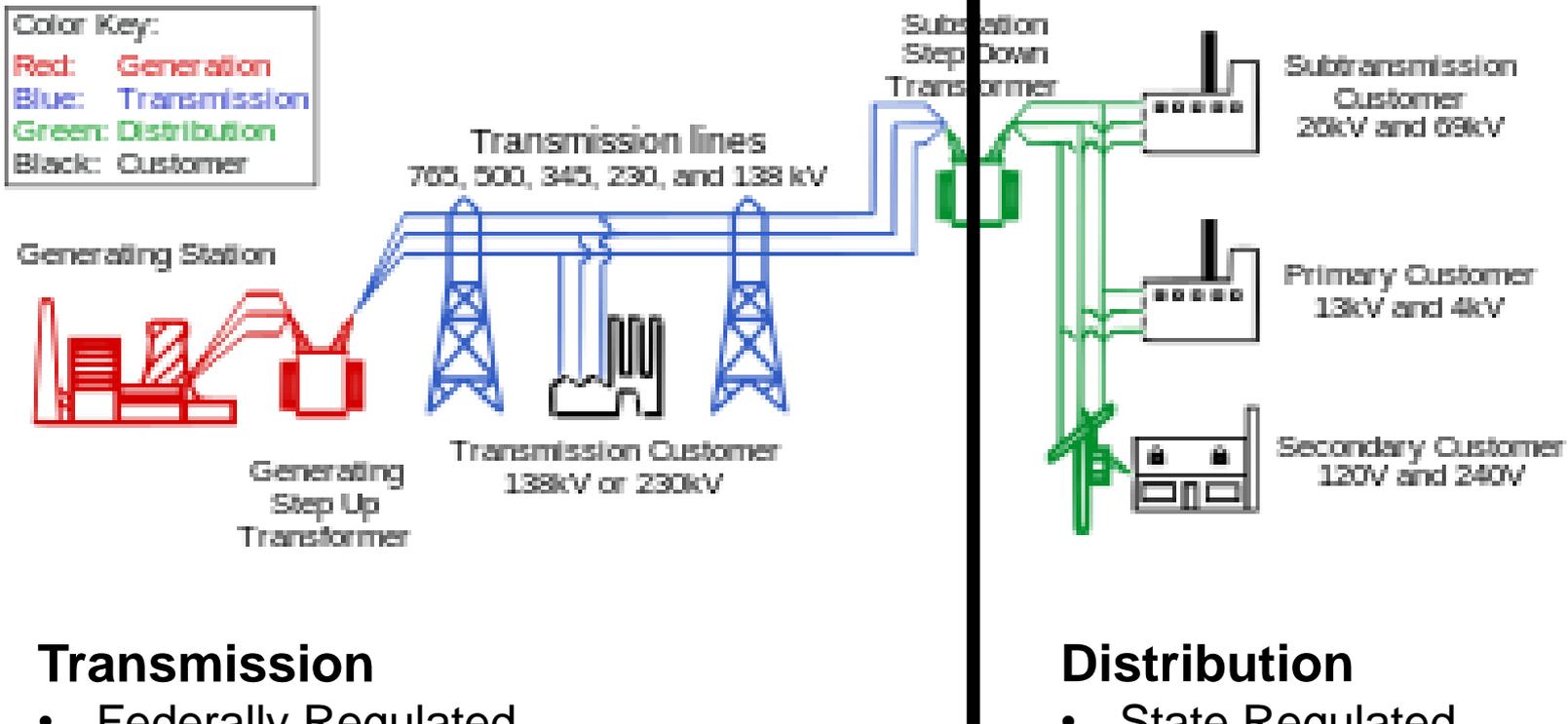
Day-ahead energy market

- Enables parties to schedule contracted supply/demand
- Enables suppliers to offload excess supply in the form of energy or ancillary services
- Enables Load Serving Entities the ability to secure pricing for load due to changes in load forecasts or for incremental changes in demand

Real-time energy market

- Fifteen-minute and five-minute market to balance supply and demand in real-time.
- Highly effective tool for managing variations in renewable energy output.
- Extends beyond California and includes five other western states.

Challenges with Distribution Energy Resources (DER) participating in wholesale transmission markets today



Transmission

- Federally Regulated
- Transmission Tariff
- Limited visibility of distribution system

Distribution

- State Regulated
- Distribution Tariff
- Limited override of dispatch

Areas for continued discussion

- Defining grid services that microgrids are able to provision
- Interconnection requirements of microgrid entities
- Load forecasting and load serving obligations
- Allocation of cost for grid reliability services (voltage/frequency)
- Visibility, control, and measurement requirements of microgrids

Three ISO Stakeholder Initiatives are underway that have direct impact on the integration of microgrid resources

- Energy Storage and Distributed Energy Resources
 - http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_AggregatedDistributedEnergyResources.aspx
- Expanding Metering and Telemetry Options
 - <http://www.caiso.com/informed/Pages/StakeholderProcesses/ExpandingMetering-TelemetryOptions.aspx>
- Frequency Response
 - <http://www.caiso.com/informed/Pages/StakeholderProcesses/FrequencyResponse.aspx>

Grid evolution for high penetrations of DER

Industry Level

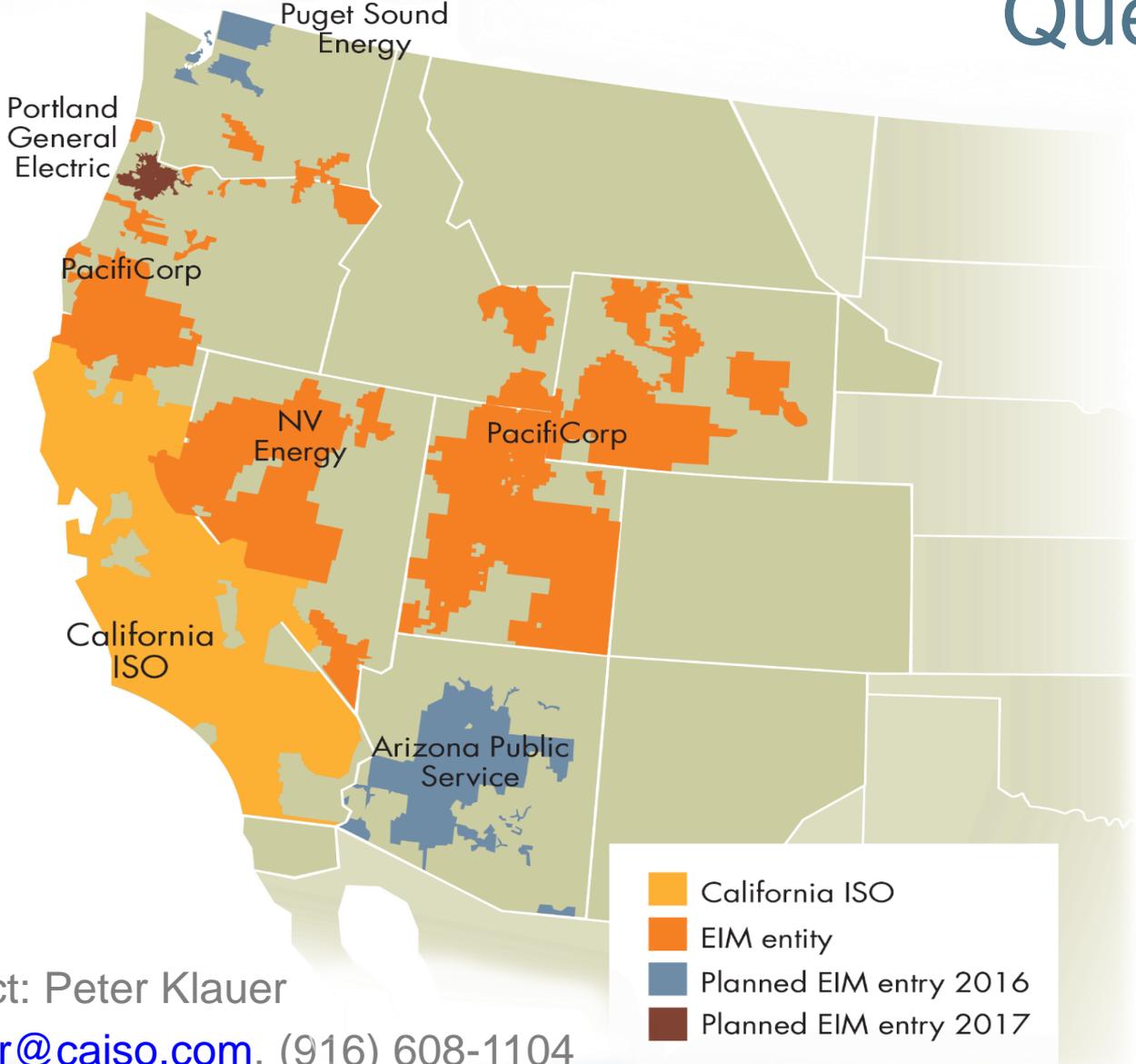
More than Smart (MTS): <http://morethansmart.org/>

- MTS is a 501(c)(3) nonprofit organization that brings industry, advocacy and government experts together to develop solutions for integrating more distributed generation resources gradually into state electricity distribution grids.

Regulatory Level

- Distribution Resource Plan (DRP) and Integrated Resource Planning Framework(IRP) CPUC Proceedings
- ISO Board direction to work closely with IOU's and other stakeholders to discuss an information framework that considers high levels of DERs

Questions?



Contact: Peter Klauer
pklauer@caiso.com, (916) 608-1104