

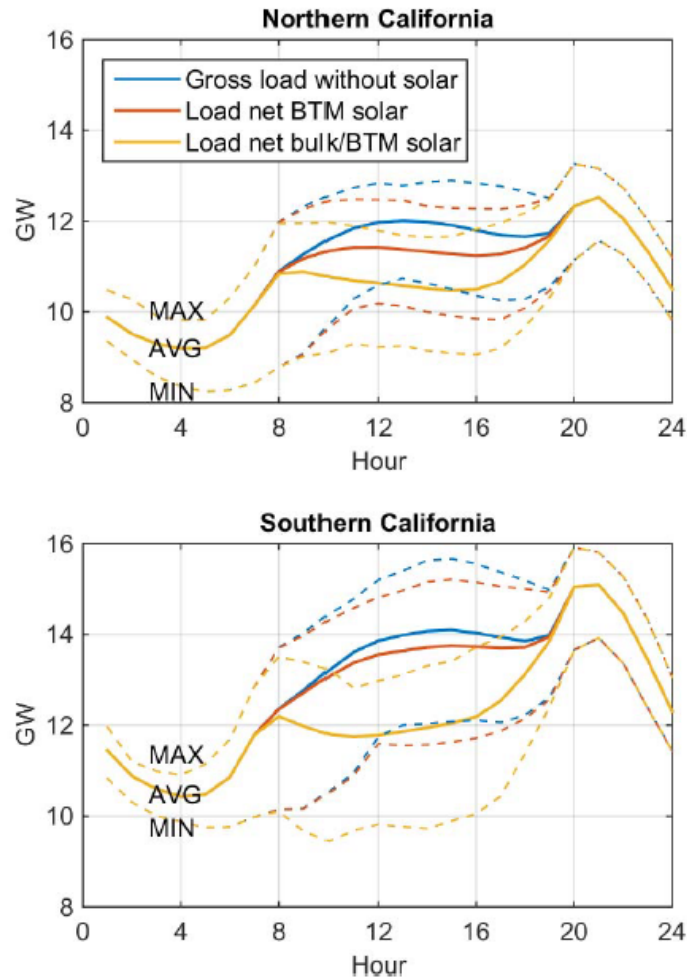
Integration of Distributed Resources

Market Design and Regulatory Impacts

CIGRE Colloquium, Philadelphia, PA

November 2, 2016

Bulk system impact of Distribution System Connected Resources

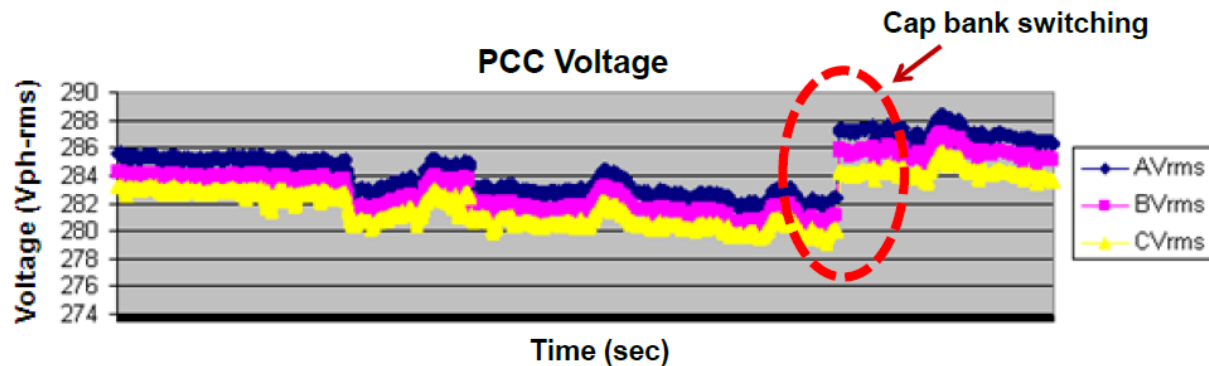


From: Impacts of Distributed Energy Generation on the State's Distribution and Transmission Grid - CPUC

Figure 7. Load and net-load curves for March 2014, showing average (solid) and maximum/minimum (dashed line) values by hour for the month.

Hi-Pen PV Impacts on Feeder

- Voltage fluctuations beyond the permissible range
- Reverse power flow:
 - Exceeding thermal rating of feeder equipment
 - Change in settings of automatic voltage regulation devices due to shift in load center
- Feeder re-configuration
- Reduced sensitivity to faults
- Capacitor bank switching

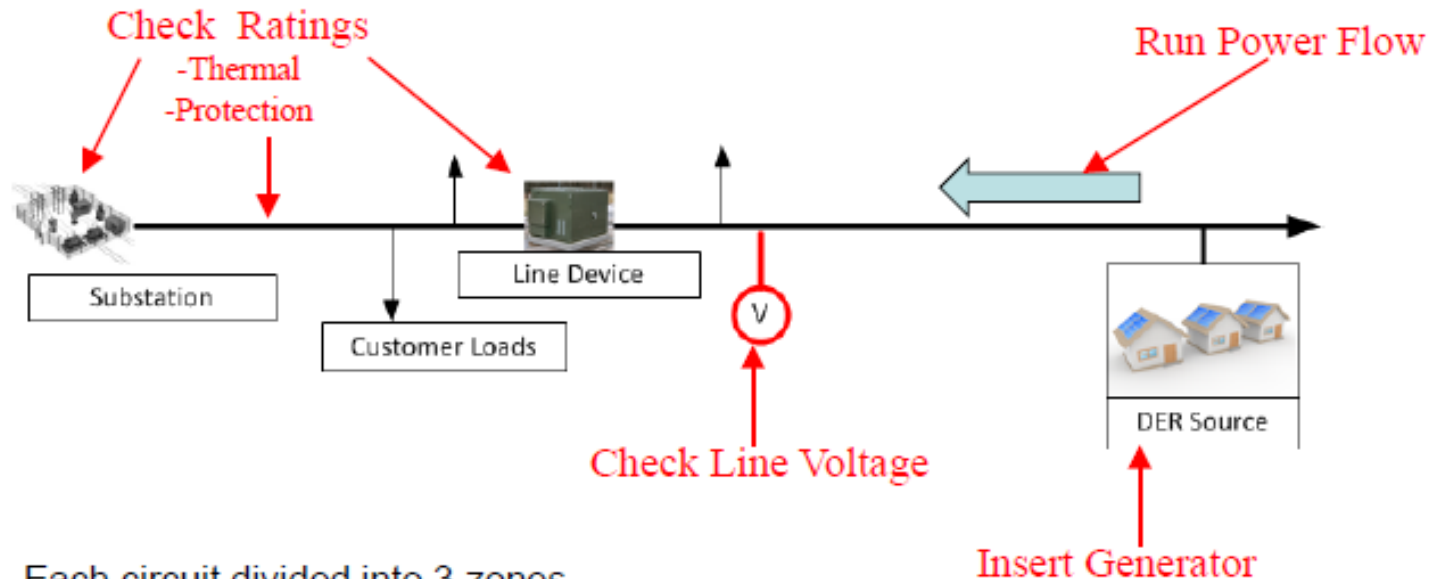


March 1-2, 2011

DOE/CPUC High Penetration Solar Forum

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Hosting Capacity or Integration Capacity Analysis



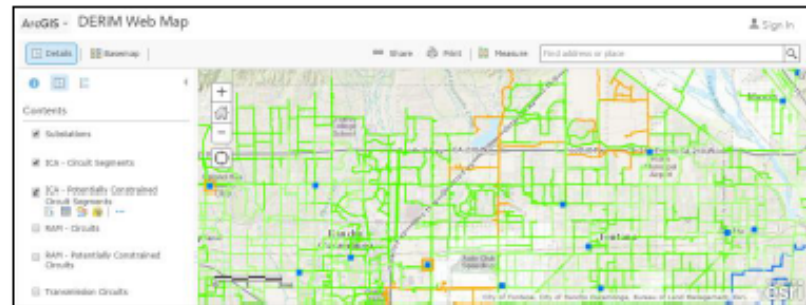
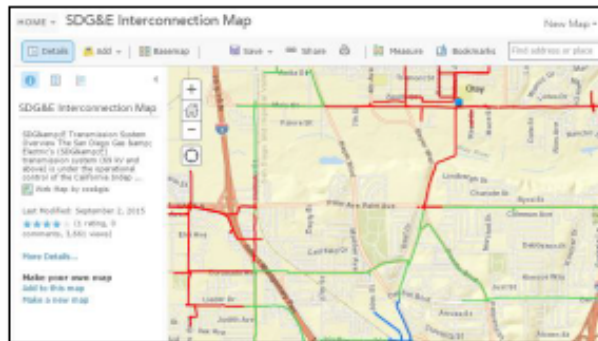
- Each circuit divided into 3 zones
- Max-sized generator placed at far end of each zone, run power flow
- Check for limit violations
 - Voltage: Is voltage above/below thresholds? Do fluctuations exceed 3%?
 - Thermal: Are equipment/conductor ratings exceeded?
 - Protection: Is fault current below interrupting ratings?
- If screens pass, move on to next zone, if fail, reduce generator size and rerun

Making Locational variation information available

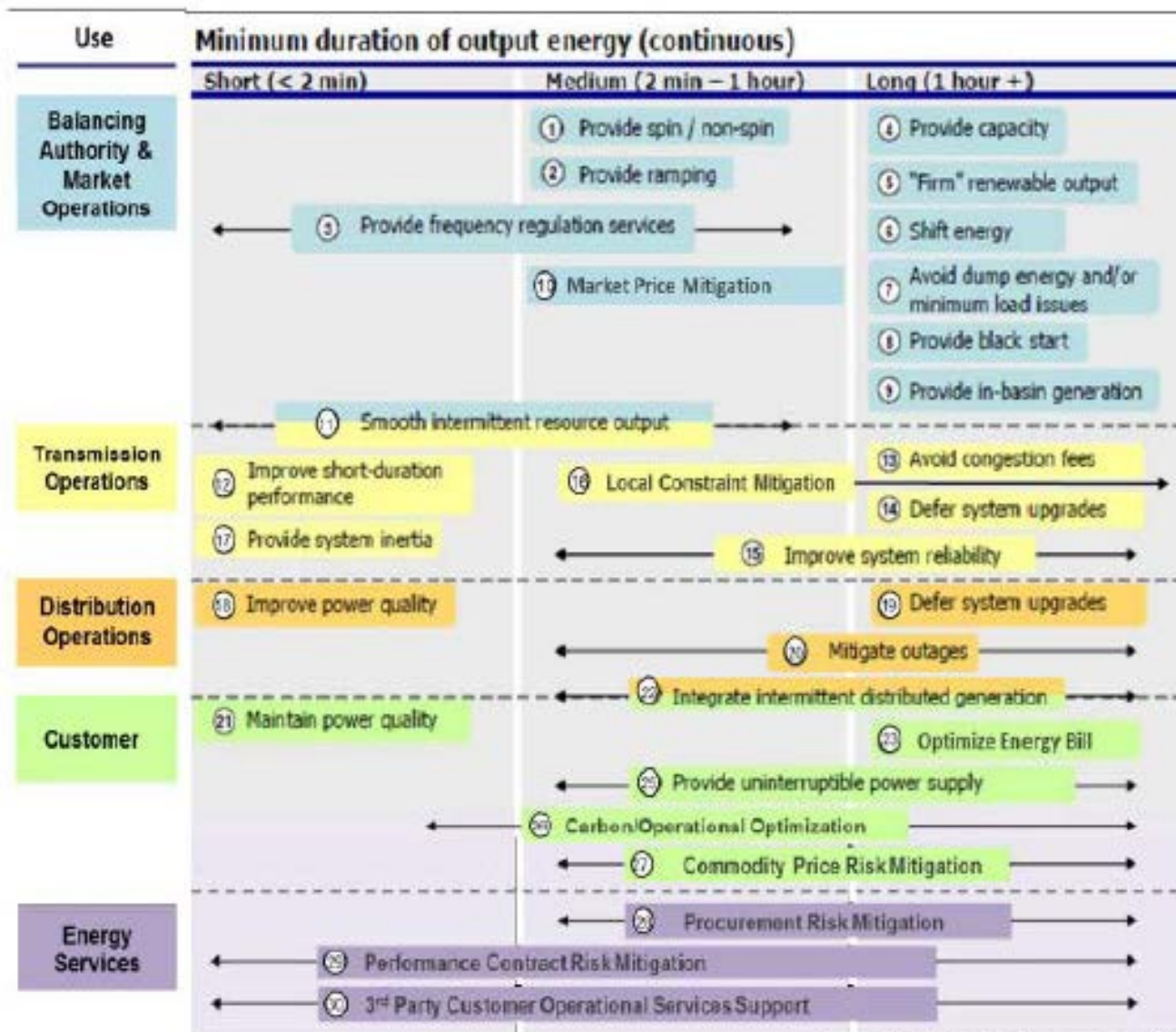


Update Process

- Batch processing and data conditioning must be performed in order to analyze up to date circuit conditions
- Desired goal of IOUs is to have maps updated monthly
- Fast growing/high penetration areas warrant most frequent updates
- Update map pop up boxes with more uniform look
- Update process dependent on datasets
 - Efficiency may be gained by only updating when conditions change
- IOUs in the process of upgrading and enhancing tools to accommodate improved analyses



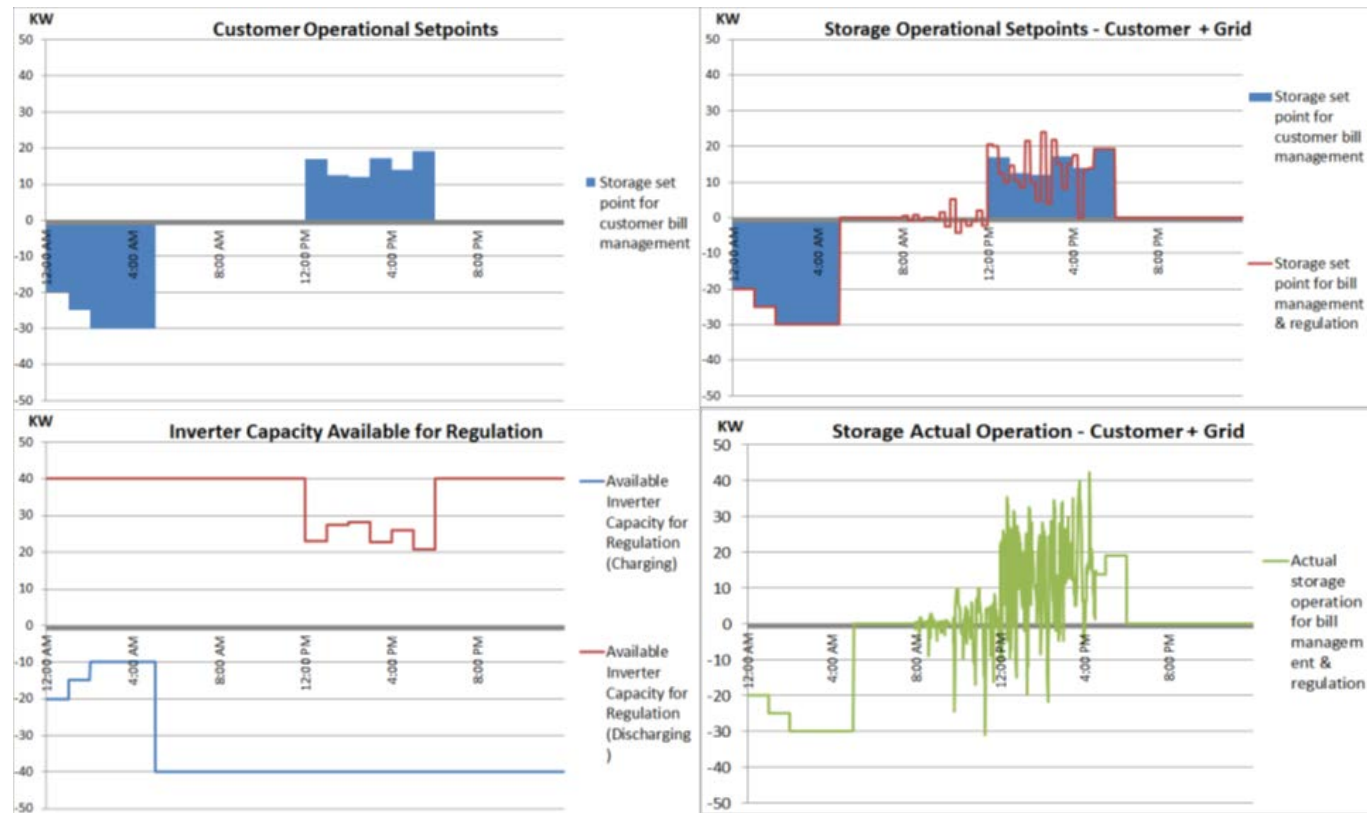
DER Value Streams – Where is the business model?



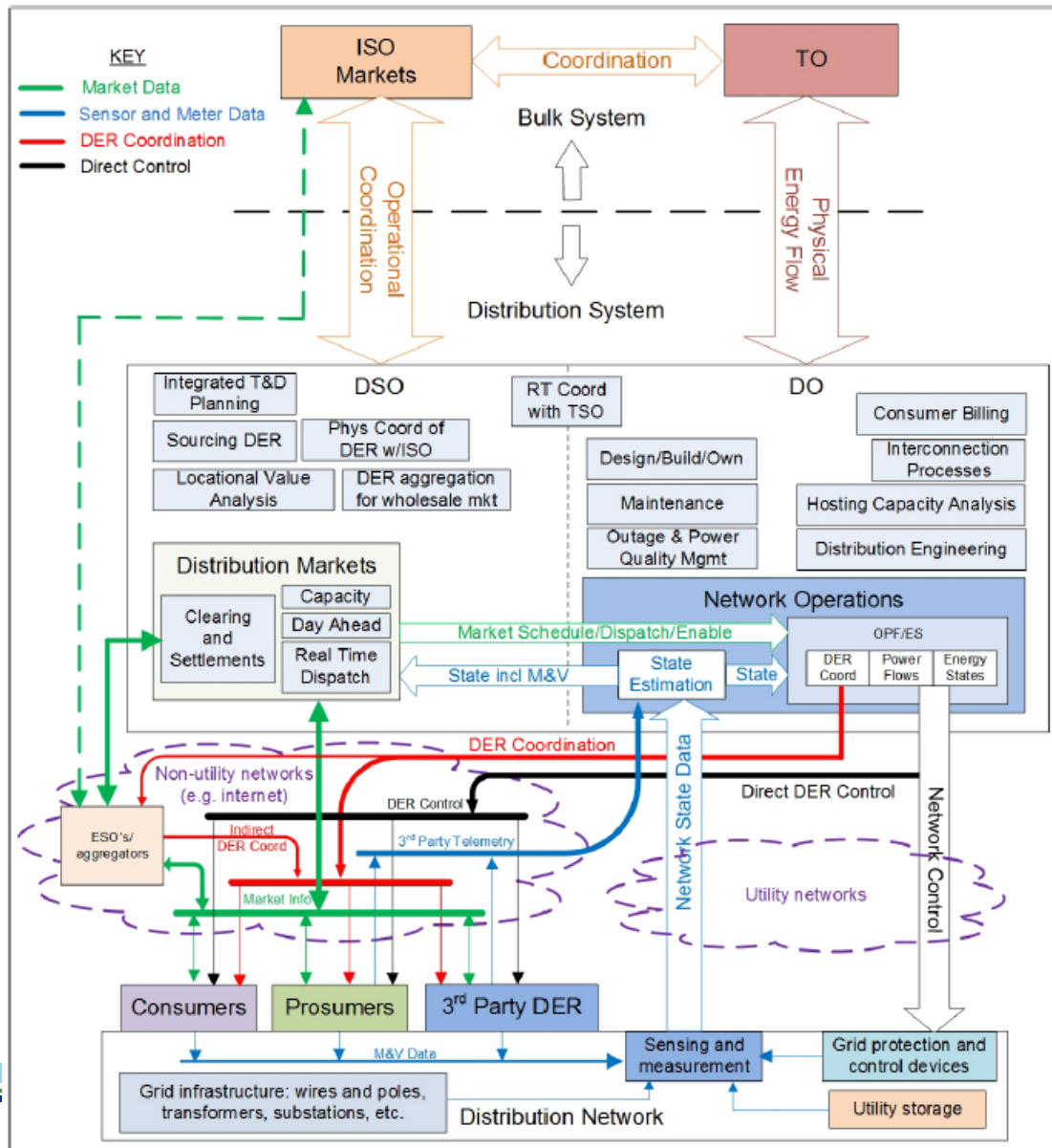
Source: SCE, Adapted by Newport Consulting

Recognizing Value for both the Bulk System and the Customer: Aggregator Bill management + Frequency Regulation

- As opportunities arise for aggregated storage to participate in grid and market support applications, aggregator control layers will require further layers of validation
- Example application: Bill management + Frequency Regulation
- Aggregator assesses opportunity costs of available storage capacity based on forecasts of customer requirements
- Integrated forecasting and optimization problem
- Grid services secondary to primary customer requirements



NR REV DSPP – Centralized “Mini-ISO” for Dispatch of DER Services Realizes Distribution System Value Streams



Source: PNNL



CPUC Rulemaking 14-08-013

Distribution Resource Planning

On August 14, 2014, the Commission issued **Rulemaking (R.) 14-08-013** to establish policies, procedures, and rules to guide California investor-owned electric utilities (IOUs) in developing their Distribution Resources Plan (DRP), required to be filed by July 1, 2015.

This Rulemaking also intends to evaluate the IOUs existing and future electric distribution infrastructure and planning procedures with respect to incorporating Distributed Energy Resources (DERs) into the planning and operations of their electric distribution systems.

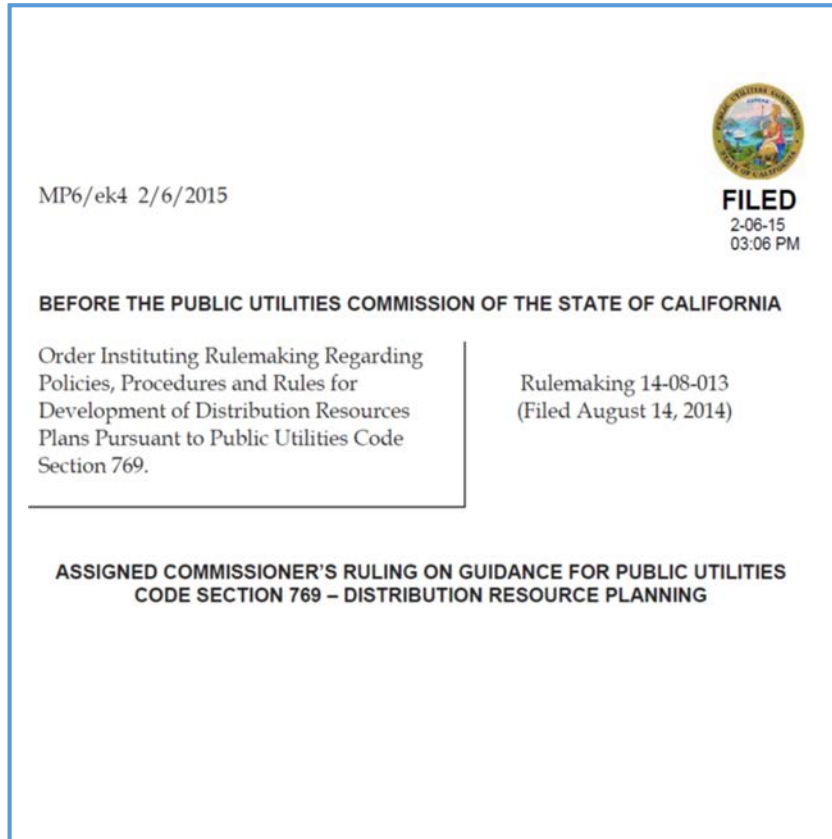
Source: CPUC

DER and Microgrid integration are the focus of guidance for distribution resource plans (DRP)

Year 1 after DRP: Demonstration project where the **Utility shall serve as a distribution system operator of a microgrid:**

- DERs serve a significant portion of customer load and reliability services
- operations of multiple DERs **managed by a dedicated control system**
- demonstrate and define necessary **operational functionalities**
- employ third-party and Utility-owned DER

CPUC Rulemaking 14-08-013 Assigned Commissioner's Ruling Envisioned Microgrids



From the Assigned Commissioner's Guidance Ruling for the DRPs issued February 6, 2015

Phase 1 (2 years, 2016-2017)

- Evaluate capacity of the distribution system to support DER under the current load forecasting scenarios.

Phase 2a (2 years, 2018-2019)

- Determine impacts on the distribution system at the substation or feeder level.
- Identify both optimal locations and combinations of DERs that can provide services in those locations.

Phase 2b (Ongoing, 2018 and Beyond)

- Stakeholder-driven development of DER procurement policy and mechanisms for the IOUs.
- Procurement policy will be competitively neutral and will **accommodate development of non-utility-owned distribution systems such as islandable microgrids** and parallel direct current and thermal distribution systems.

Source: CPUC

Thank You!

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