CALIFORNIA ENERGY COMMISSION

DOE/OE INTEGRATED μGRID R&D PLAN FY 2015-2016

Workshop

Microgrid Assessment and Recommended Future RD&D Investments for the State of California

Sacramento, CA

March 6, 2015

Jim Reilly, Consultant to DOE/OE

Topics

1. Vision
2. Program Areas
3. Standards and Regulatory

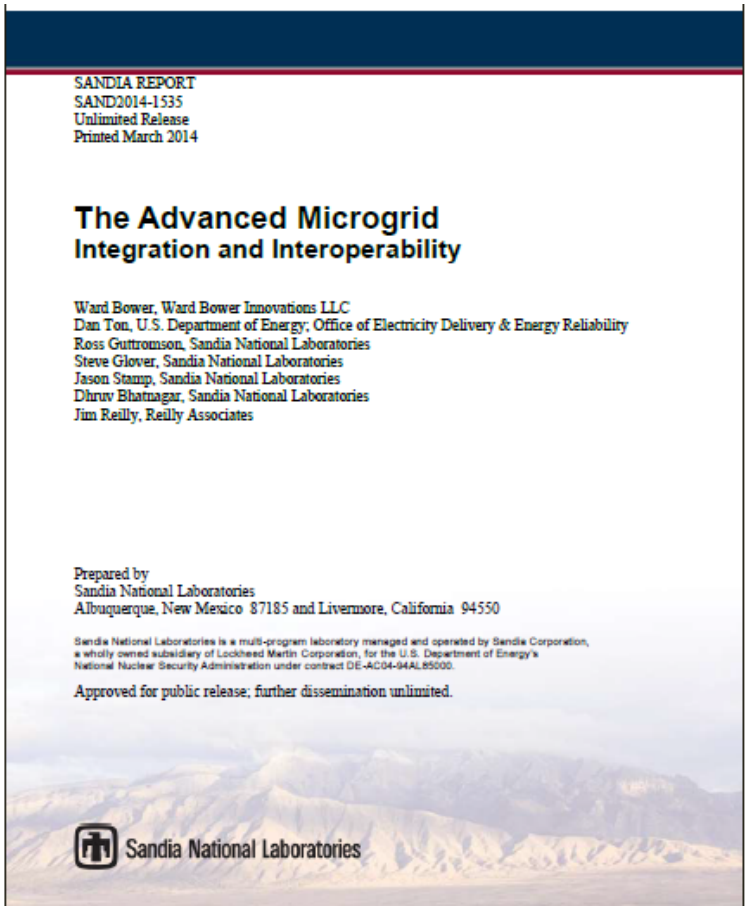
Integrated µGrid R&D Plan FY 2015-2016

Vision

The Integrated µGrid R&D Program foresees the technical requirements for advancing the microgrid to a fully integrated entity within the distribution system, interacting seamlessly with the Distribution System Operator.

The Advanced Microgrid:
DOE Supported Report SAND 2014-1525

- Objectives
- Operational modes
- System architecture
- Technical challenges
- Development impact areas
- Ownership of microgrids
- Considerations for systems
- Microgrid applications
- Standards and codes
- Microcontrollers
- Smart grid interoperability panel (SGIP)
- References



SANDIA REPORT
SAND2014-1535
Unlimited Release
Printed March 2014

The Advanced Microgrid
Integration and Interoperability

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Sandia National Laboratories

"An advanced microgrid is one that provides functions at the PCC beyond basic islanding (disconnect) and synchronization (reconnection) functions. An Advanced Microgrid interacts with the larger grid (macrogrid) cooperatively managing power flows across the PCC optimizing benefits for both the microgrid and macrogrid."

Smart Grid R&D Focus Areas

Microgrid R&D

For commercial viability, reliability, and resiliency

Continue R&D pathway to support achieving the DOE program goals (in reliability, efficiency, CO_2 reduction, and cost effectiveness) and implementing the DOE CAP strategy, leading to creating a smarter and more resilient grid and community.

Advanced Distribution Management System (ADMS)

Providing better control and visibility

Develop architectures that integrate new & existing applications across the utility enterprise to accommodate rapid and complex communications/interactions between D&T; develop operational control strategies using advanced analytics.

Resilient Electric Grid R&D

For enhanced grid resilience

Implement high-priority R&D projects identified in the resilient grid roadmap, developed in a broad stakeholder workshop in 2014 and finalized during the QER in 2015.

Market-Based Control Signals

Enabling economical and flexible stability

Develop simulation tools for the impact of transactive control, establish valuation basis for customer-delivered and grid-delivered energy services, and assess how to achieve a more distributed customer-driven grid.

Smart Grid R&D Program

Modernizes distribution grid through advanced control and distribution management and control systems and new operational paradigms (integrated microgrids and DER controls)

Supports increasing demand for renewable energy integration and grid reliability and resiliency at regional, state and local levels

FY 2014 and Prior

- Microgrids
- DER/DR/PEV Integration
- Distribution Automation

FY 2015/ FY2016

- Microgrids
- Advanced Distribution Management Systems
- Restoration Strategies
- Resilient Distribution Grid

Integrated µGrid R&D Plan FY 2015-2016

Program Areas

Design and Planning Tools

- Microgrid Design Optimization Using DER-CAM
- Technical Resource Exchange to Support Microgrid Development
- Impact Analysis of Interactive Operations of Microgrid and Distribution System

System Control and Power Flow

- Guidelines for DMS for Grid Modernization
- Grid Interactive Microgrid Controllers & Aggregated DER
- Microgrid Integrated Controls (CSEISMIC)
- Virtual Microgrid & Reference Design for Sectionalized/Islanded Feeders

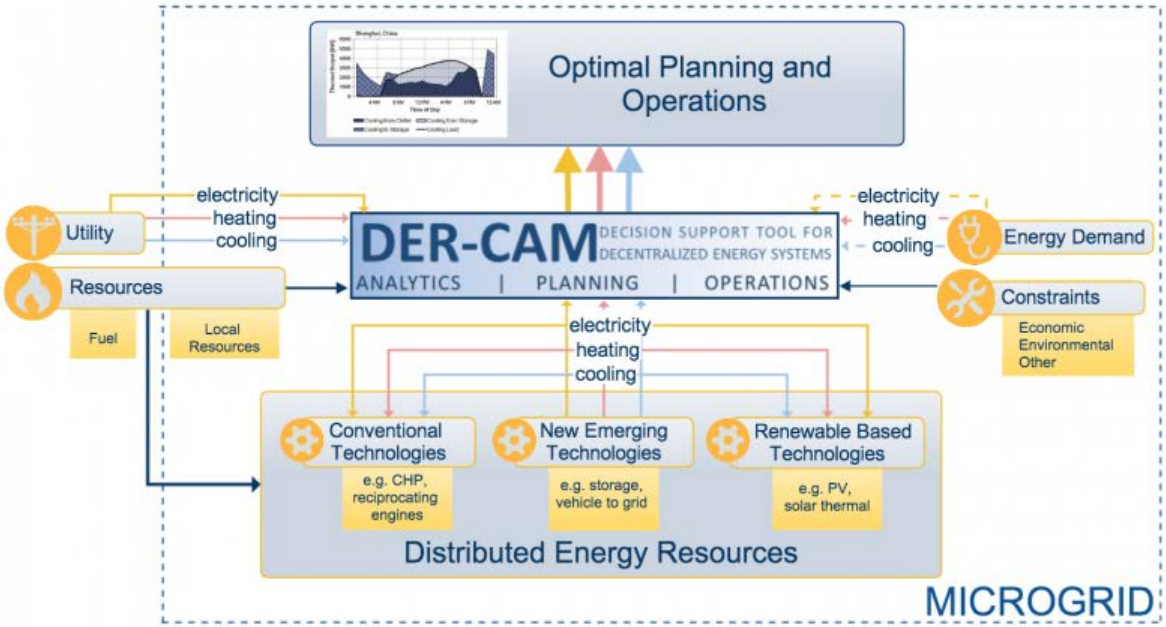
Device and Integrated Testing

- Microgrid Controller HIL Test Bed (simulation- uGrid EMS and DMS)
- Grid Self-Aware Elastic Extensible Resiliency (Grid-SEER) Platform

Standards

- IEEE p2030.7 Standard for Specification of Microgrid Controllers
- IEEE p2030.7.X Standard for Testing of Microgrid Controllers

DER-CAM: Decision Support Tool for Microgrids



Optimal solutions based on user criteria

- minimize economic burden
- minimize CO2 emissions

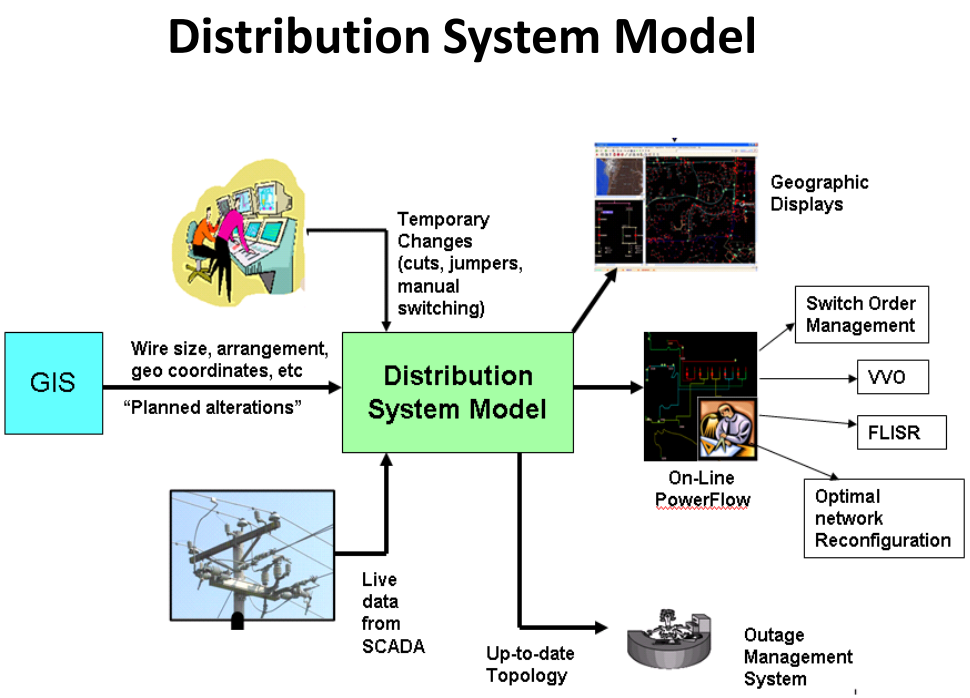
Takes into account site-specific data

- detailed loads
- tariffs
- weather data

Optimal Energy Solutions

- multiple technologies: renewables; CHP; storage; …
- multiple load management features: critical loads; load shifting; peak shaving; resiliency; …

Guidelines for Distribution Management Systems for Grid



Source: Robert Uluski, EPRI

The objective of this project is to identify the functional gaps of DMS and propose a guideline for DMS development and implementation for grid modernization.

The scope of the project is divided into tasks that address the needs for DMS, requirements for DMS for integration of microgrids and DERs, and standardization of the guidelines.

Real Time Digital Simulator (RTDS)-Based Hardware-in-Loop (HIL) Microgrid Test Bed

Flexible platform for testing, verification, and assessment of microgrid components and controllers for system operation, energy management, and protection under different operation scenarios

Purposes

- Provide standardized and independent testing
- Reduce deployment cost for new devices and solutions
- Perform research
- Investigate safety issues
- Facilitate standards development

Conduct testing of:

- Both system level and device level
- Microgrid energy management
- Microgrid control and operation (CSEISMIC testing in FY15)
- Communication
- Protection

IEEE P2030.7: Standard for the Specification of Microgrid Controllers

On June 11, 2014 the IEEE SA Board approved the PAR (IEEE P2030.7), *Standard for the Specification of Microgrid Controllers*.

Dr. Geza Joos, McGill, Chair

Shay Bahramirad, ComEd, Vice-Chair

Mark Buckner, ORNL, Secretary

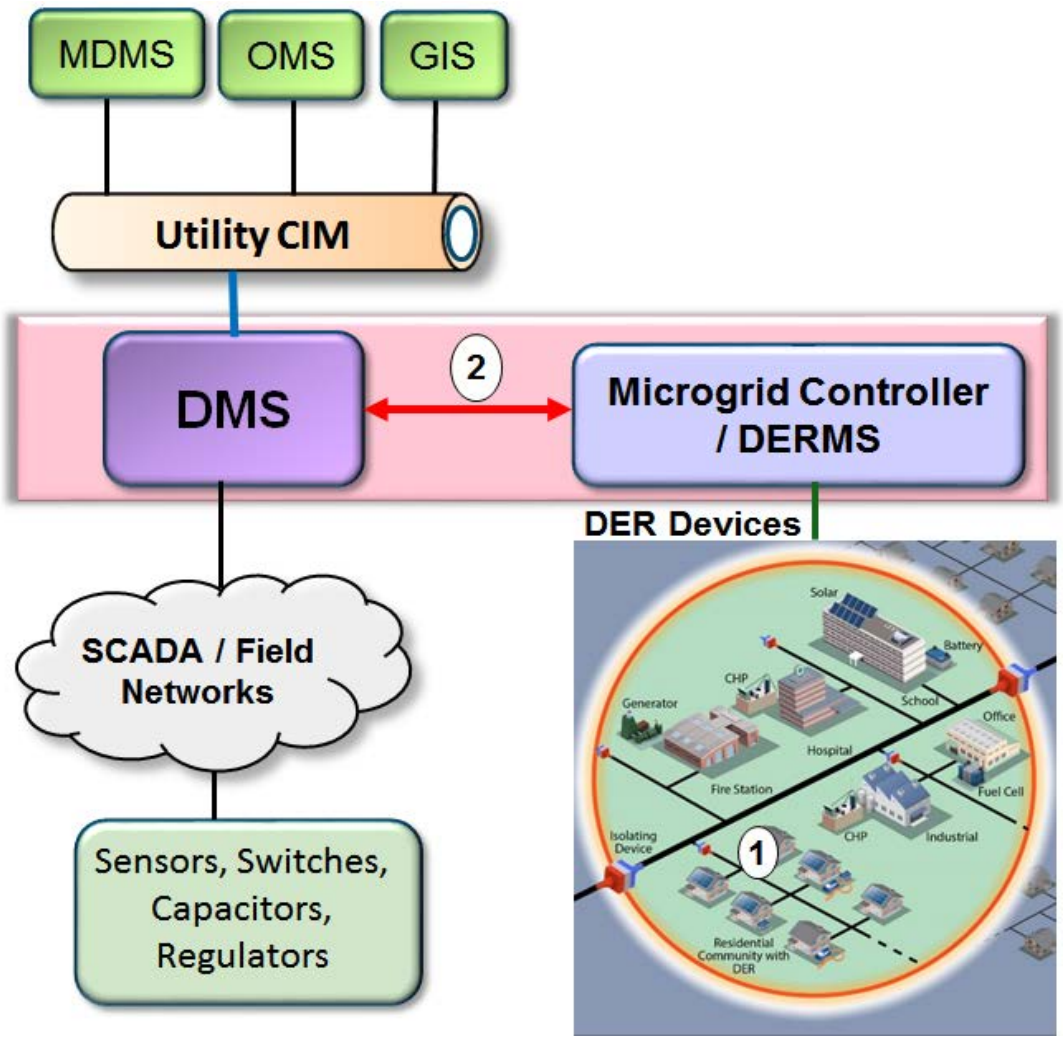
Scope: A key element of microgrid operation is the Microgrid Energy Management System. It includes the control functions that define the microgrid as system that can manage itself, and operate autonomously or grid connected, and seamlessly connect to and disconnect from the main distribution grid for the exchange of power and the supply of ancillary services. The scope of this standard is to address the technical issues and challenges associated with the proper operation of the Microgrid Energy Management System that are common to all microgrids, regardless of topology, configuration or jurisdiction, and to present the control approaches required from the distribution system operator and the microgrid operator. Testing procedures are addressed.

Industry-Led Microgrid R, D & System Design

FY 2014 FOA

- Advanced microgrid system designs (<10MW)
- Microgrid controller functionalities
- Objectives: DOE Program goals for reliability, emissions, system efficiency and resiliency
- Selections announced 8 September 2014
- $8 million for seven awards ($1.2 M per award)
- Period of performance: 2 years, including 18 months R&D and 6 months testing, data collection and analysis
- Field demonstrations of system designs (possible FOA FY 16/17)

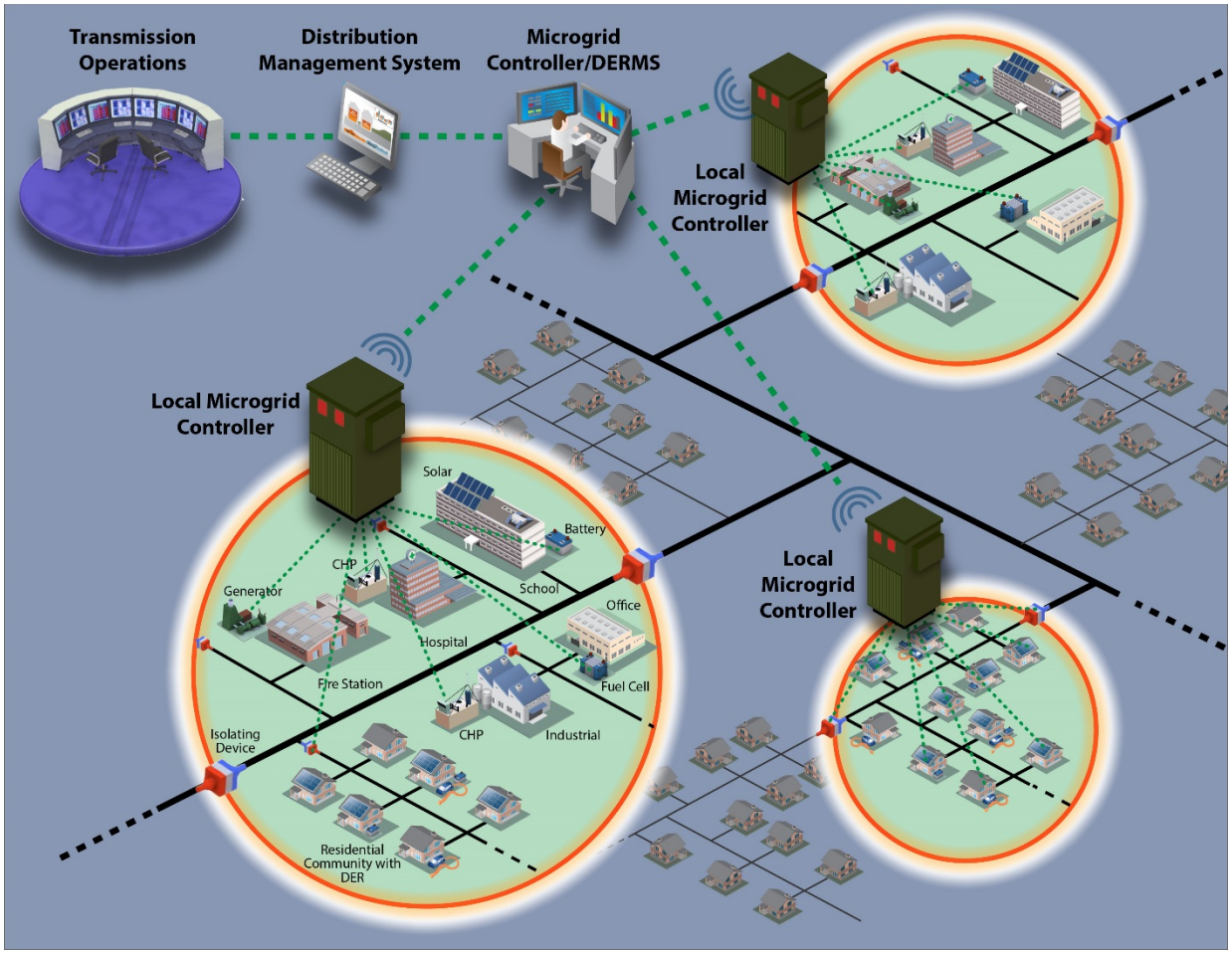
Relationship Between Microgrid Controller and DER Management System (DERMS)



There is a need to develop standardized functions for the microgrid controller and establish the relationship with the utility DMS system at the DSO level leading to technical and business processes that are both effective and replicable in many jurisdictions with increasing adoption of microgrids and DER.

courtesy: EPRI

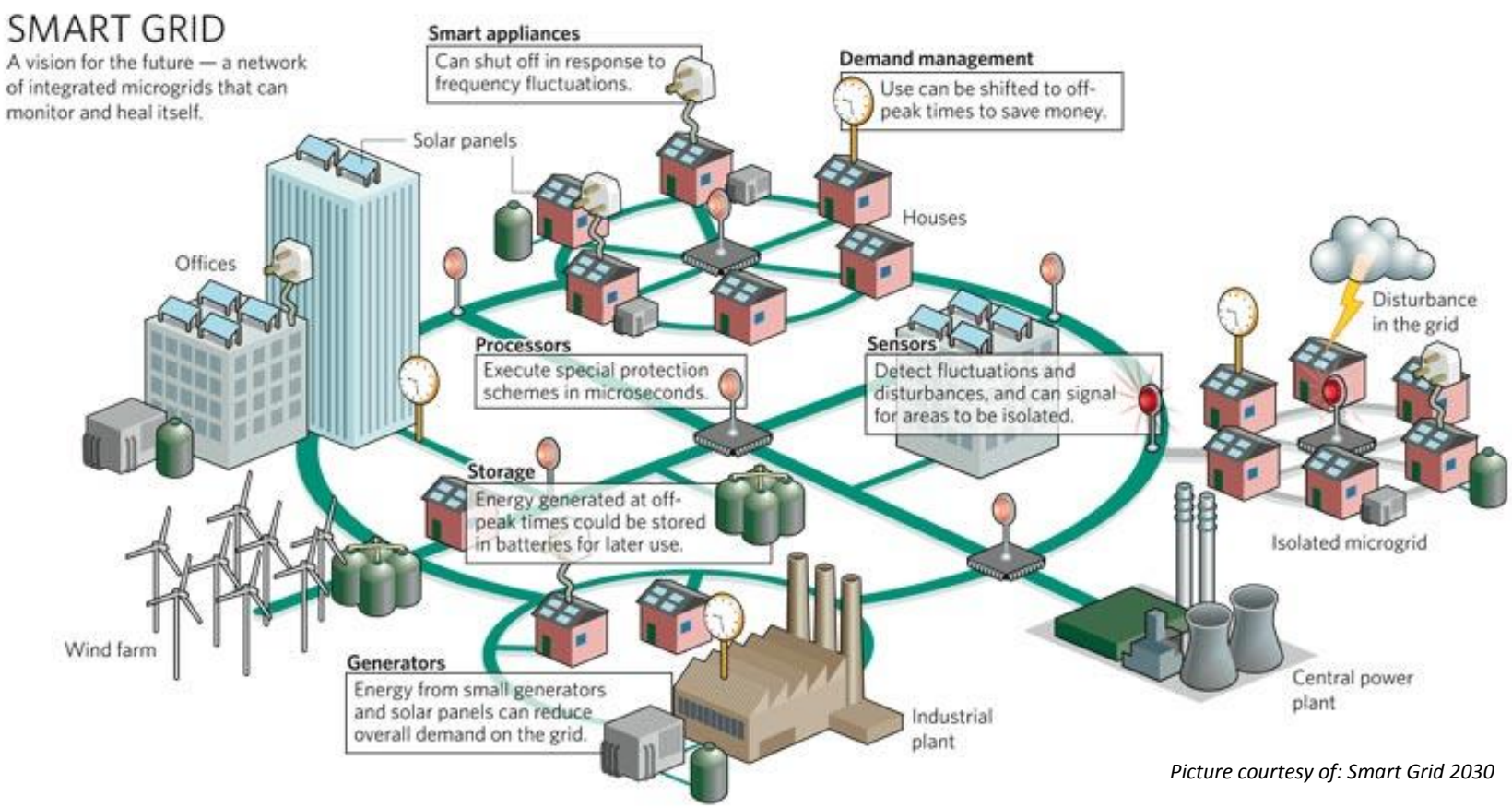
Integrated Energy Management Systems



Source: EPRI

Cyber-physical Systems and Smart Grid

R&D for Advanced Distribution Management Systems and the Integration of Microgrids and Distributed Energy Resources into the Power Delivery System



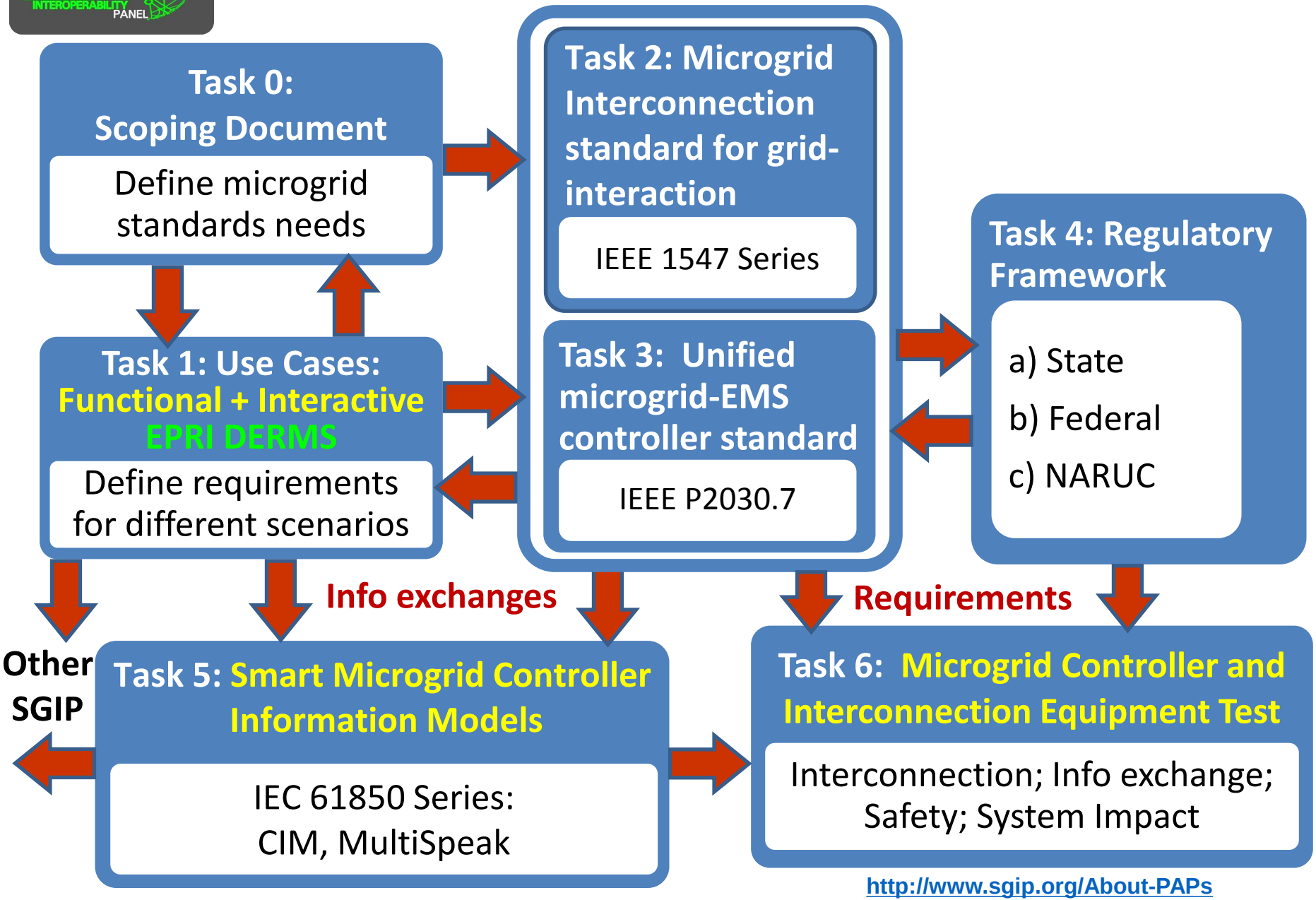
Picture courtesy of: Smart Grid 2030

Dissemination of Results

- ❖Reports on Distribution Service Platform for REV
- ❖Technical Transfer of DER-CAM microgrid model to national laboratories, EPRI, major integrators (including workshops)
- ❖Guidelines on Distribution Management Systems (Argonne National Laboratory report)
- ❖Demonstration projects
- ❖IEEE Standards Association working groups
- ❖NIST/SGIP PAP-24 Microgrid Operational Interfaces

Standards and Regulatory

PAP 24: Microgrid Operational Interfaces



http://www.sgip.org/About-PAPs

Microgrid Regulatory Issues

California Public Utilities Commission

Microgrids: A Regulatory Perspective

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April 14, 2014

DISCLAIMER

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CPUC Rulemaking for Public Utility Code Section 769 – Distribution Resource Planning

February 6, 2015

MP6/ek4 2/6/2015

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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.	Rulemaking 14-08-013 (Filed August 14, 2014)

ASSIGNED COMMISSIONER'S RULING ON GUIDANCE FOR PUBLIC UTILITIES CODE SECTION 769 – 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.

http://www.cpuc.ca.gov/PUC/energy/drp/

Microgrids in guidance for DRPs:

Year 1 after DRP: Demonstration project where the **Utility would 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

Phase 2b (Ongoing, 2018 and Beyond):

- 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.

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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.