EPRI OpenADR Demonstrations

OpenADR Alliance Member Meeting

Walt Johnson
Technical Executive

May 13, 2015

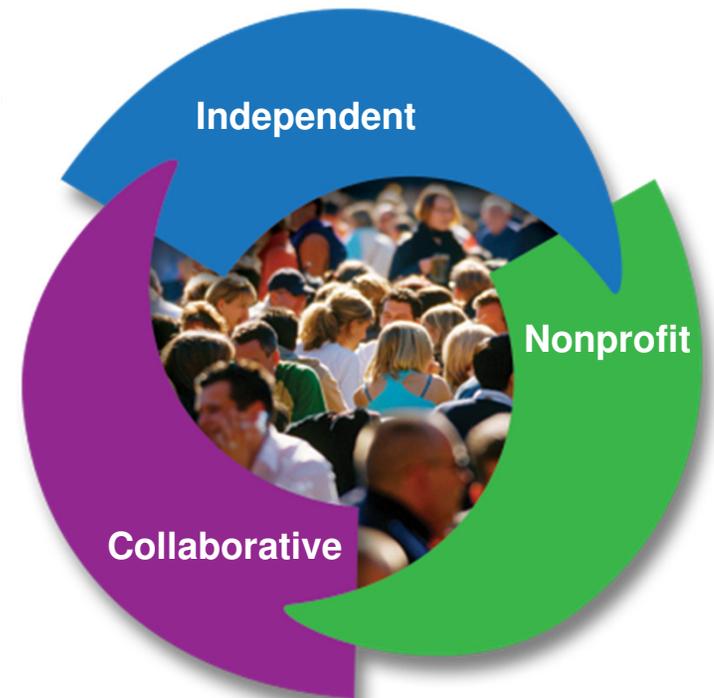# The Electric Power Research Institute

Independent

Objective, scientifically-based results address reliability, efficiency, affordability, health, safety, and the environment

Nonprofit

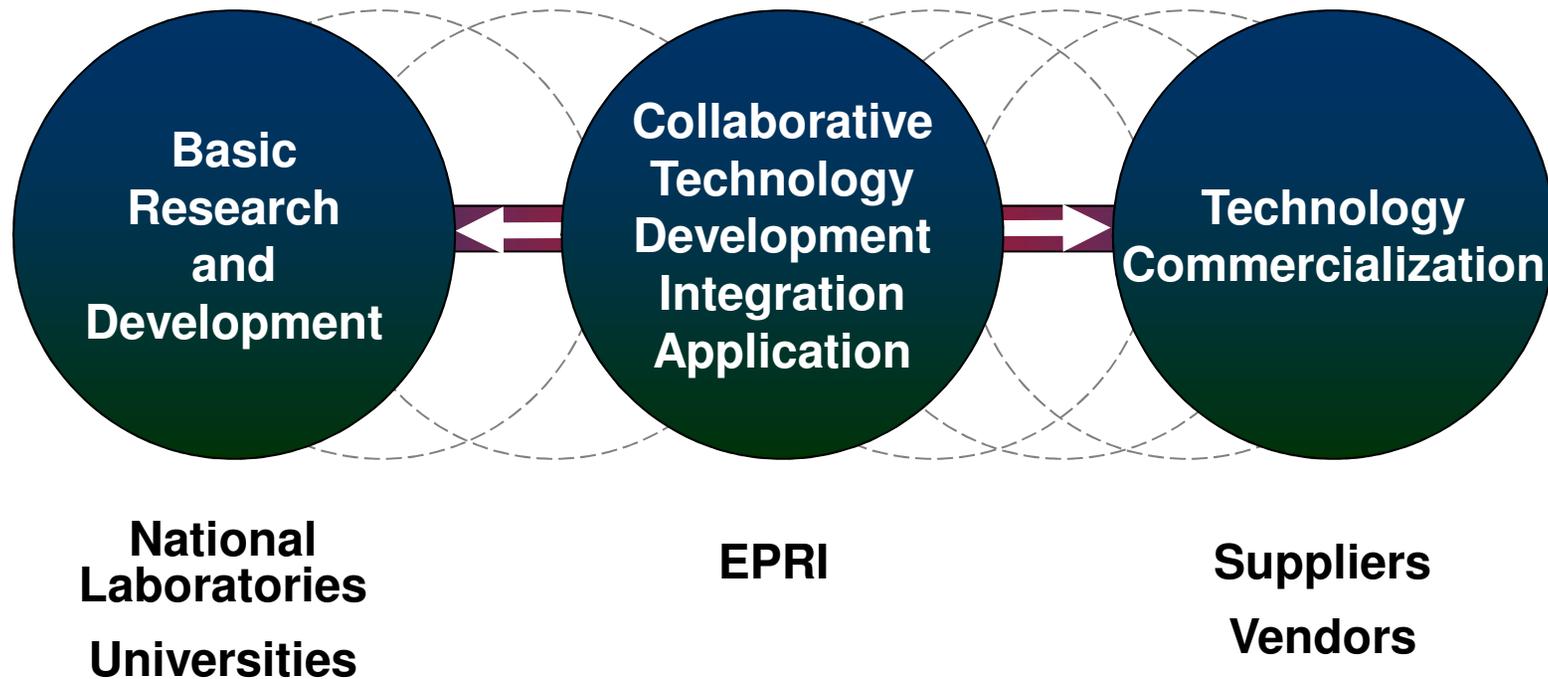Chartered to serve the public benefit

Collaborative

Brings together scientists, engineers, academic researchers, and industry experts

Together… Shaping the Future of Electricity

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Our Role…

Help Move Technologies to the Commercialization Stage…

Basic Research and Development

Collaborative Technology Development Integration Application

Technology Commercialization

National Laboratories

Universities

EPRI

Suppliers

Vendors

"Technology Accelerator!"

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OpenADR and Ancillary Services Demonstration
4-Year Project

Objectives and Scope
- Advance standards for DR-provided ancillary services ("fast DR") through utility demonstrations
- Address Research Questions
  - Quality of Service, Reliability, Security, Privacy, Scalability, etc.
- Develop utility DR technology roadmaps

Value
- Increase adoption and innovation of products
- Understand utility migration strategies
- Characterize load classes for ancillary services

Advance Standards for Automated DR and Ancillary Services

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Auto DR Demo Participants

Companies
American Electric Power (AEP)
California Independent System Operator (CAISO)
Électricité de France (EDF)
Electricity Supply Board (ESB)
Kansas City Power & Light (KCP&L)
New York Independent System Operator (NYISO)
San Diego Gas & Electric (SDG&E)
Southern Company
Tokyo Electric Power Company (TEPCO)

New Member!

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Demonstrations

- Project Demos
  - CAISO
    - Controlling Loads in a Highly-Efficient Modern Building
  - Southern
    - Controlling Loads in a Fleet of Legacy Buildings
  - ESB Networks
    - Pre-Approval of Planned DR Dispatches for Wind Integration
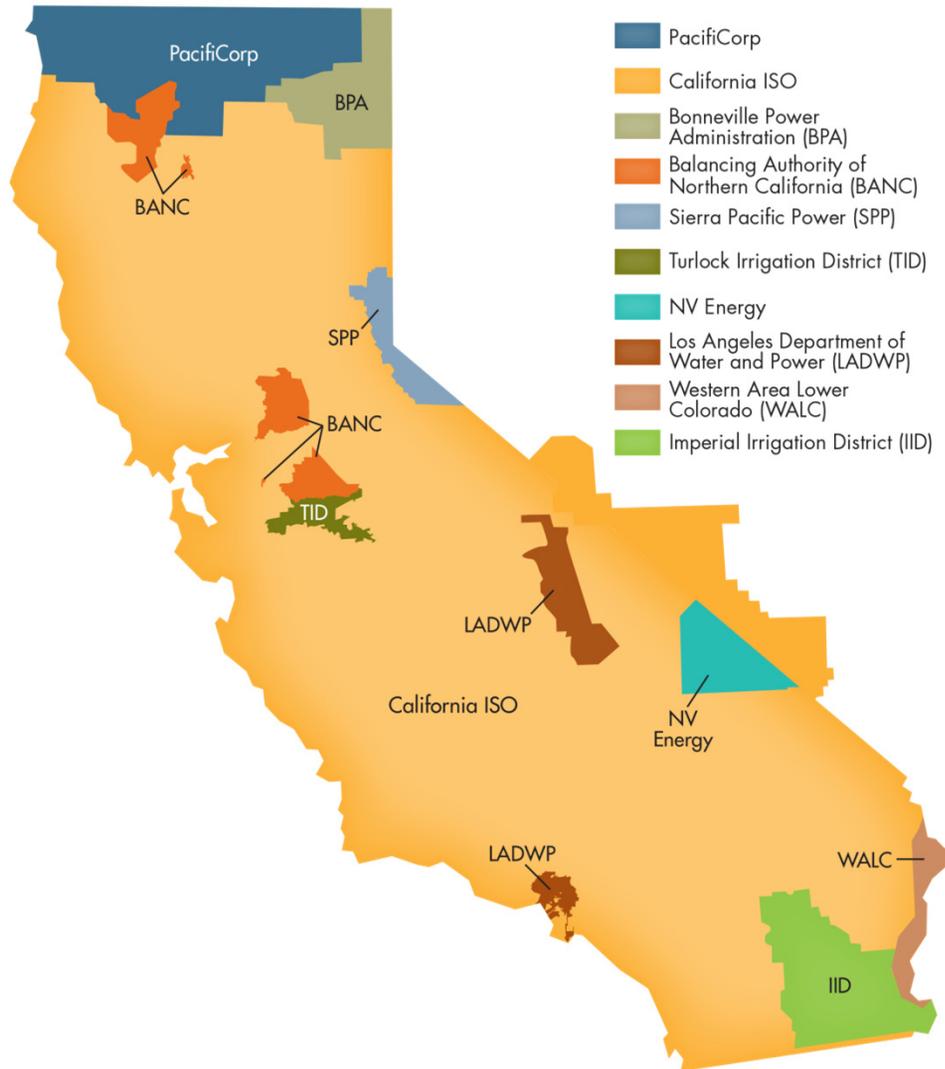- CEA-2045 Project Demos

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Two OpenADR-Related 2014 Technology Transfer Awards

- "International Application of EPRI OpenADR 2.0 Open Source Server and Client Software"
    - Électricité de France
    - Tokyo Electric Power Company

- "Smart Charging Platform with Direct and Aggregated Demand Response Capabilities"
    - CenterPoint Energy
    - DTE Energy, Inc.
    - Duke Energy
    - Sacramento Municipal Utility District
    - Saker Systems. LLC
    - Sempra Energy/SDG&E
    - Southern California Edison
    - Tri-State G&T Association, Inc.

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California ISO OpenADR Demo

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California ISO (CAISO) by the Numbers

Legend:
- PacifiCorp
- California ISO
- Bonneville Power Administration (BPA)
- Balancing Authority of Northern California (BANC)
- Sierra Pacific Power (SPP)
- Turlock Irrigation District (TID)
- NV Energy
- Los Angeles Department of Water and Power (LADWP)
- Western Area Lower Colorado (WALC)
- Imperial Irrigation District (IID)

- **60,703** MW of power plant capacity (net dependable capacity)

- **50,270** MW record peak demand (July 24, 2006)

- **27,589** market transactions per day

- **26,024** circuit-miles of transmission lines

- **30 million** people served

- **246 million** megawatt-hours of electricity delivered annually

September 2013

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CAISO Headquarters Awarded LEED Platinum Certification for Energy Efficiency and Sustainability

Doubled the amount of space for the organization while decreasing energy usage >50%

Energy savings	
Facility	**Electricity usage**
Previous leased space	65 kWh/sq. ft.
New headquarters	27 kWh/sq. ft.
Reduction	**52%**

Energy consumption is 33% better than CA energy code requirements

ISO PUBLIC

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CAISO Demonstration

Research Questions

- Could OpenADR be used to support an existing "fast DR" wholesale demand response program (Proxy Demand Resource – PDR)?

- What building loads should be targeted?

- How should the targeted loads be operated to optimize shed potential?

- Could an OpenADR 2.0 VEN be integrated with the building management system?
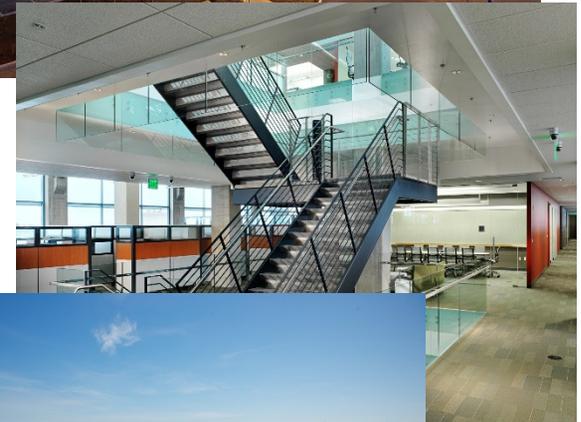
CAISO Demo Update

- Modified building control system to accept OpenADR events as a participant in SMUD's Voluntary Load Reduction Program
  - Completed integrating the existing building automation system with a new GRIDlink OpenADR module
  - Installed additional lighting controls to shed exterior lighting banks and reduce central lighting
  - Installed controls for temperature increases
- Successfully completed OpenADR testing with SMUD
  - Received technology incentive rebate for participation
  - No events called during remaining program summer window
  - Plan to extend participation in program into summer 2015
- Total cost of retrofits and OpenADR module higher than anticipated
- Still would like to simulate ISO dispatch by creating an OpenADR 2.0b event (via EPRI)
  - Working to determine compatibility with GRIDlink server for this use

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Southern Company OpenADR Demo

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Southern Company Business Units

Four retail operating companies serve 120,000 square miles in four states

- Alabama Power
- Georgia Power
- Mississippi Power
- Gulf Power

Other Business Units:

- Southern Power
- Southern Nuclear
- SouthernLINC
- Southern Company Services

Service Territory

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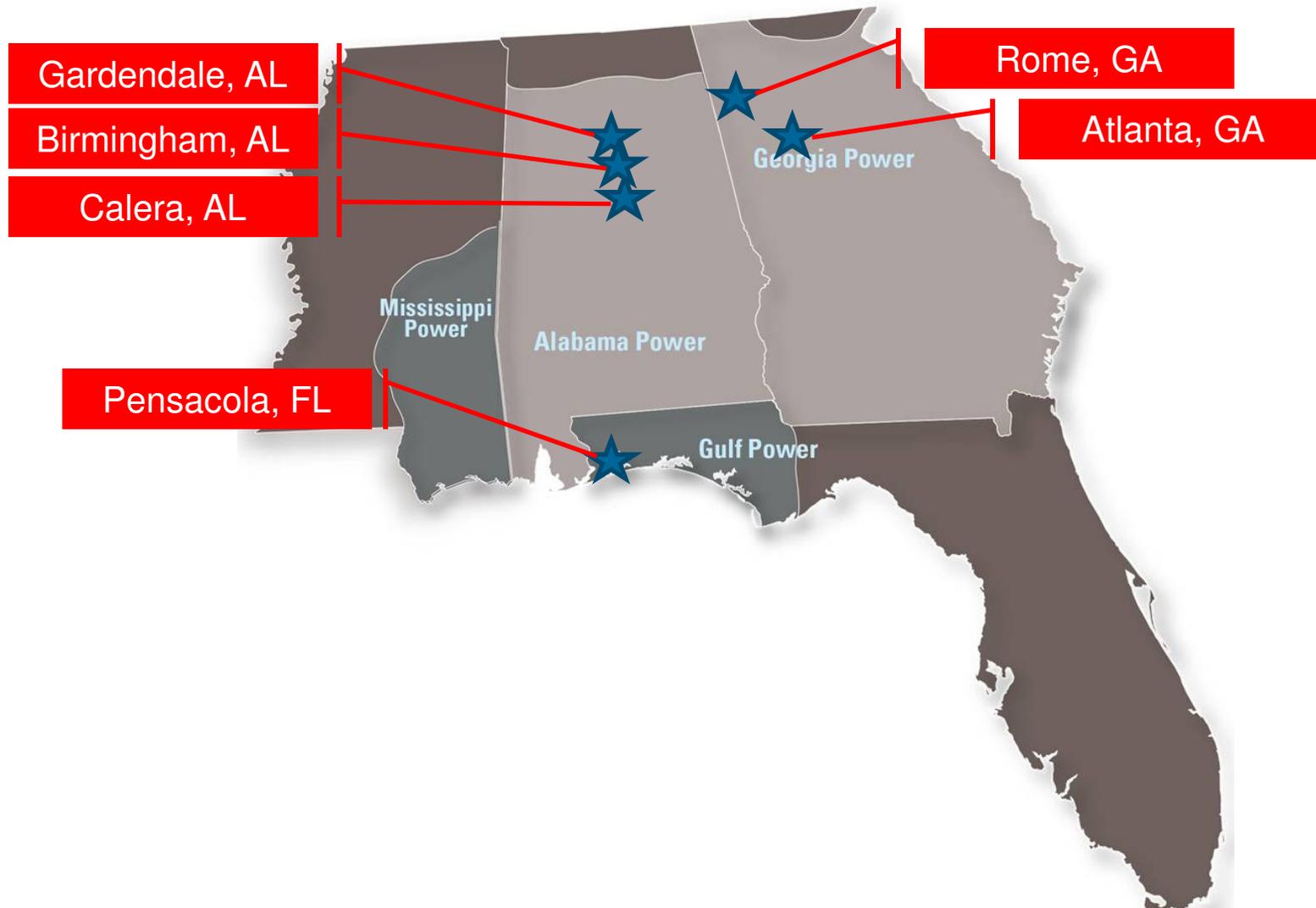# Southern Company Demonstration

Research Questions

- How can OpenADR be integrated into legacy buildings?

- Could OpenADR support a real-time price signal?

- How does OpenADR support critical peak price signals?

- How would building loads respond to these signals?

- What loads should be targeted?

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Proposed Southern Company Demo Building Locations

Gardendale, AL

Birmingham, AL

Calera, AL

Pensacola, FL

Rome, GA

Atlanta, GA

Mississippi Power

Alabama Power

Georgia Power

Gulf Power

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# Gardendale (AL) and Rome (GA) Demo Locations

- Both are large "Big-Box" retail locations
- Add-on technology for packaged RTU's
  - Provide EE, Demand Management, and OpenADR 2.0

Source: Bing Maps

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Calera (AL) Demo Location

- Southern Company-Owned Building (Training Center)
- Siemens Apogee BAS controlling HVAC
  - 120 ton chiller
  - ~30 VAVs with resistance reheat
- Siemens OpenADR 2.0 interface (Beta version)
  - Waiting for its official release and installation on site

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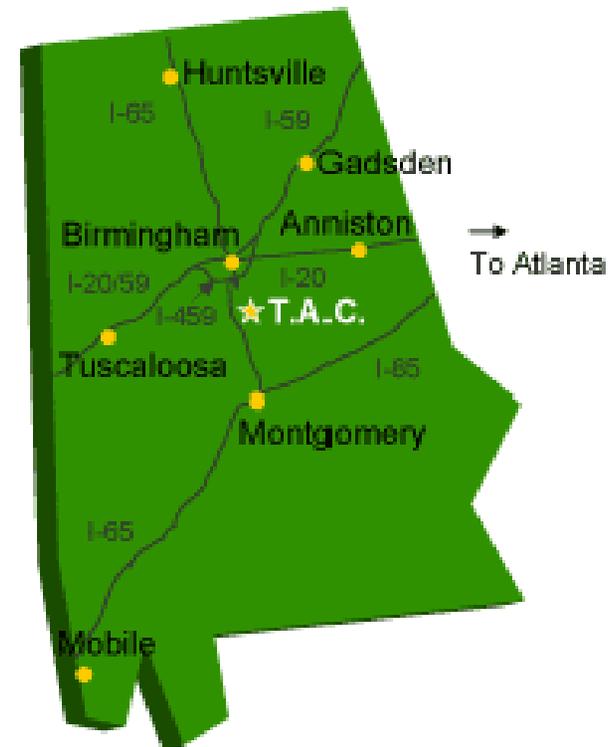
Birmingham (AL) Demo Location

- Southern Company-Owned Building
  - District Operation Center, Customer Service, Appliance Store, Offices, Auditorium

- Trane Tracer BAS controlling HVAC and outdoor lighting
  - 120 ton chiller
  - Thermal Energy Storage tanks

Source: Bing Maps

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Pensacola (FL) Location

- Southern Company-Owned Building
- Automated Logic BAS controlling HVAC
  - 3 heat pumps
- Use Lynxspring (Connexx) JACE to provide OpenADR 2.0 link to building
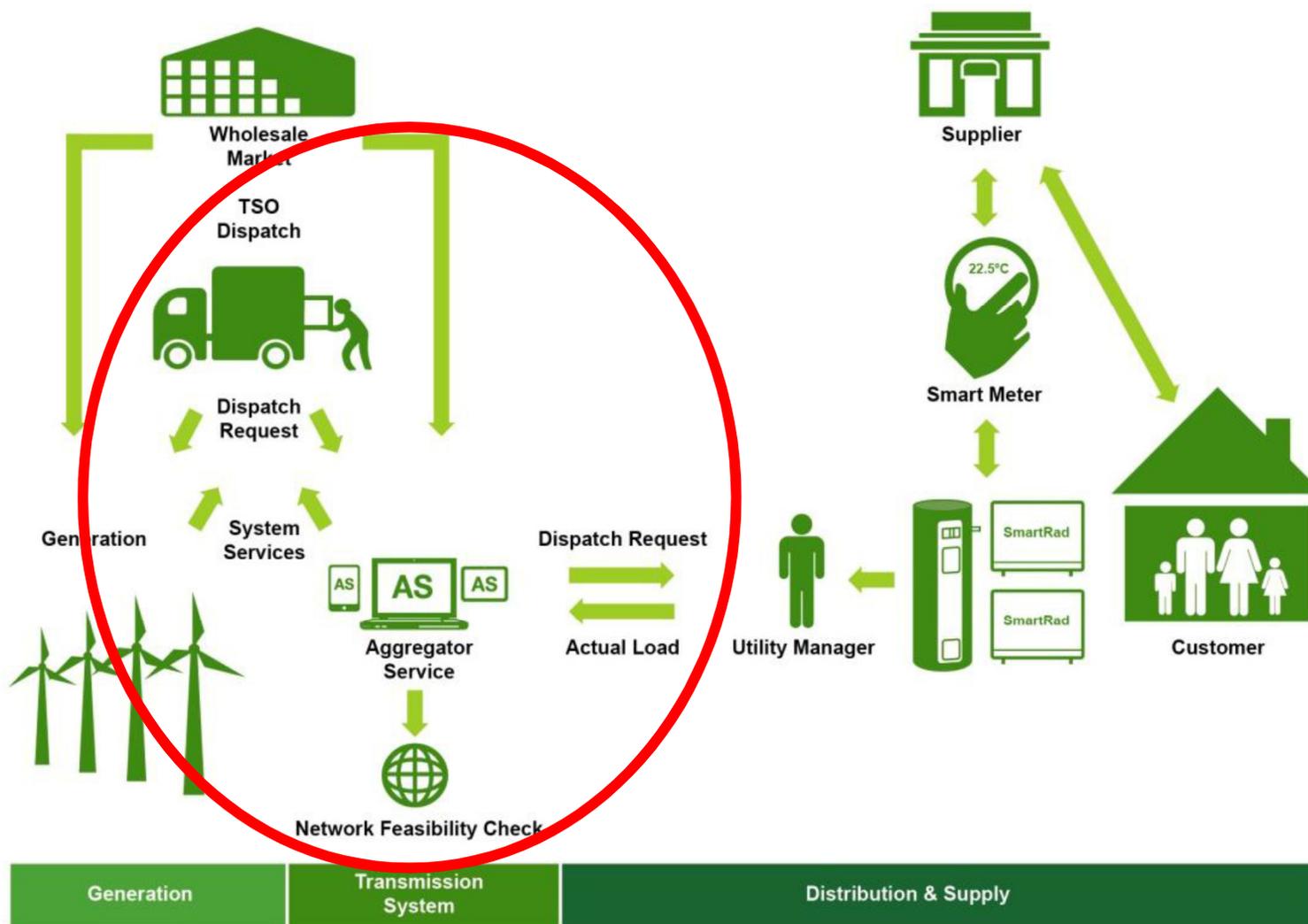

Source: Google Maps

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Southern Company Demo Update

- Working with Connexx to integrate with the EPRI server and allow communication with the one building with controls already in place
  - Working recently on adding security
  - Once that is in place, will begin working again
- Now planning to install a VTN at Southern
  - Avoids security issues in accessing EPRI's cloud server instance
  - More acceptable to their IT security group
- Remain optimistic that there is potential for working with the VENs

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ESB Networks OpenADR Demo

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Europe's RealValue Project

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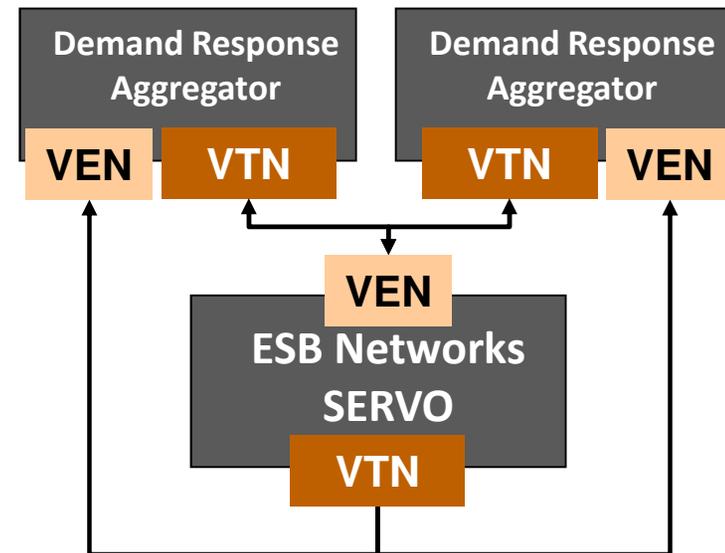
ESB Networks Demonstration

ESB NETWORKS

Targeted Demand Response

Proof-of-concept DR Program Architecture

- Experiment is designed to process proposed third-party demand response signals in near-real time

Use of OpenADR 2.0

- Interface between SERVO and DR Aggregator
- Designed to manage LV and HV network constraints while at the same time equitably managing customer participation
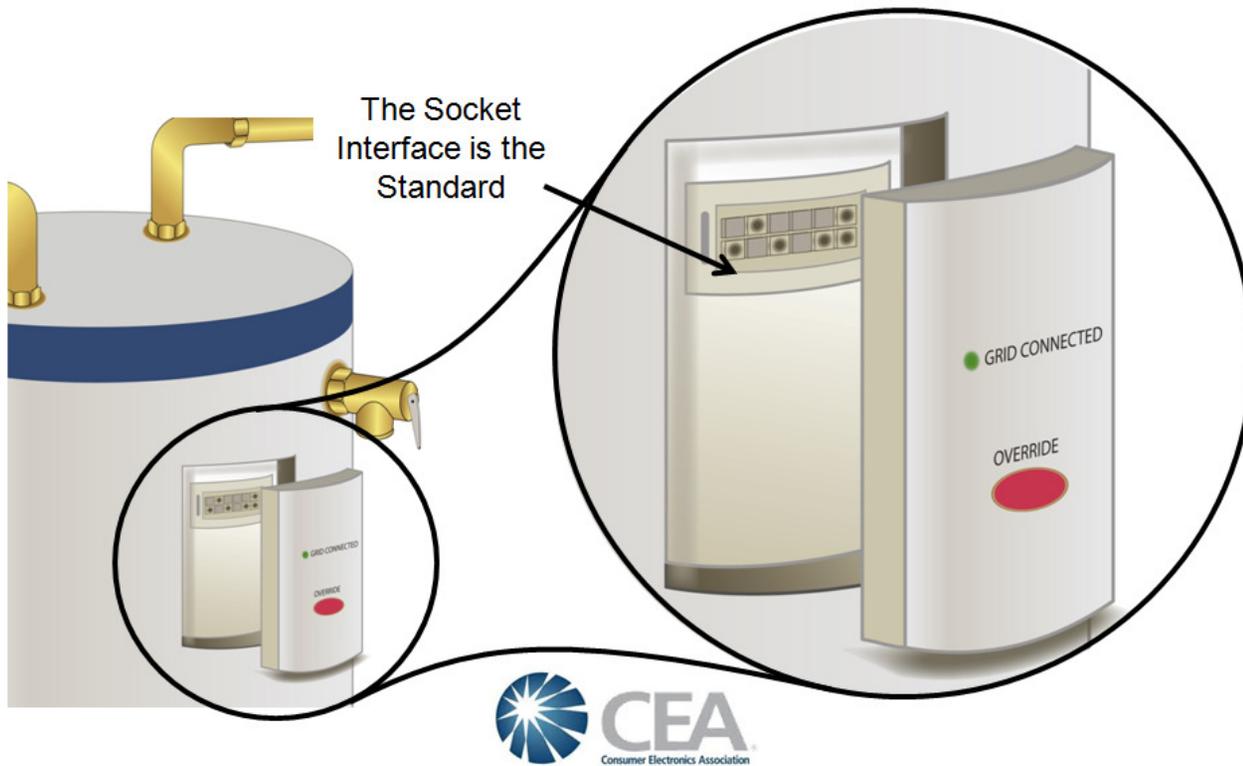- Experiment uses OpenADR source code developed under this project

Managing Network Constraints Using OpenADR

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The EPRI CEA-2045 Project

OpenADR-Related Aspects

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Decoupling the Network
A Modular Approach

The Socket Interface is the Standard

GRID CONNECTED

OVERRIDE

HOMEPLUG®
POWERLINE ALLIANCE

Wi Fi™

ZigBee®
Control your world

ECHONET

LonMark®

X-10

enocean alliance
No Wires. No Batteries. No Limits.

INSTEON

Modbus

KNX

Z-wave

ASHRAE BACnet™

CEA
Consumer Electronics Association

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OpenADR-to-CEA-2045 Overview

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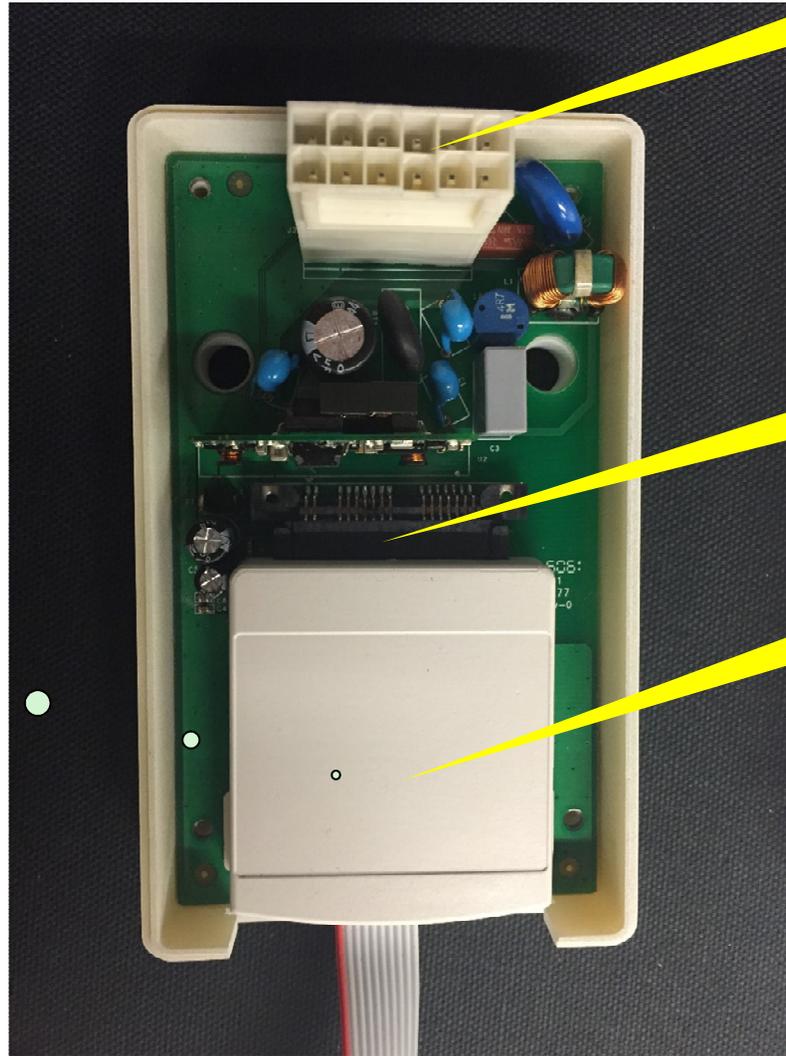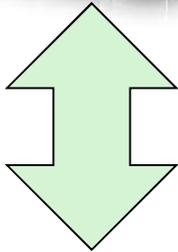
CEA-2045 AC-to-DC Form Factor Adapter

OpenADR Server

CEA-2045 Interface AC Port

CEA-2045 Interface DC Port

OpenADR Client

Wi-Fi

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End-Use Device Allocations

Participating Utilities	Water Heater	HPWH	Thermostat	Pool Pumps	EVSE	PTAC	PV Inverter
Ameren	●	●	●	●	●		
American Electric Power	●	●	●	●	●		
Bonneville Power Authority		●					
Duke Energy	●	●		●	●		
Electricité de France (EDF)	●						
Hawaiian Electric	●						
Hydro One	●						
National Grid (NYSERDA)						●	
Portland General Electric	●				●		
Southern Company	●		●				
Tennessee Valley Authority	●		●	●	●		
Tri-State G&T	●						
Southern California Edison							●
Sacramento Municipal Utility District							●

Project Participants

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Together…Shaping the Future of Electricity

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