Smart Grid Standards and Systems Interoperability: A Precedent with OpenADR

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Abstract

This paper describes the Smart Grid standards and systems interoperability through Open Automated Demand Response Standard (OpenADR) conformance development process. The process aligns closely with the national and GridWise® Architecture Council's recommendations for interoperability. This paper looks at the standards development, and certification and testing process through the activities of standards organizations, user-groups, industry alliances, and Smart Grid development. It references the Conformance and Interoperability Process Reference Manuals and requirements of the standards organizations for certification and interoperability of OpenADR standard to address consumers and stakeholder needs. The evaluation framework for OpenADR interoperability is characterized through the data transport mechanisms, harmonization and co-existence with other standards and systems, and Smart Grid interoperability across different markets.

The result is the interoperable information exchange among Smart Grid standards and technology implementations within the national and international standards activities; primarily the interoperability and backward compatibility needs within the California commercial deployments. This process offers significant value to consumers and builds trust in the system. The service providers and vendors can provide cost-effective solutions, which reduce the implementation costs and improve the operational efficiency of DR programs and automation.

1. INTRODUCTION AND BACKGROUND

OpenADR standard development has evolved through going to be a formal standard.[1] This standard, which will be called OpenADR 2.0, is a result of contributions from many standards organizations and the OpenADR stakeholders. The OpenADR Alliance (Alliance) is the managing entity for OpenADR 2.0 and will be the provider of certification and testing programs for interoperability (Alliance, 2011).

1.1. Introduction

OpenADR provides non-proprietary, standardized interfaces to enable electricity service providers to communicate DR and Distributed Energy Resource (DER) signals to customers using a common language and existing communications such as the Internet (Piette et al., 2009b). These OpenADR data models facilitate price-responsive and reliability DR. As shown in figure 1 below, this is achieved through open Application Programming Interfaces (APIs) that provide two-way communications between the service provider (Utility/ISO) and customers (Sites) through a logical interface of an OpenADR server (called a Demand Response Automation Server).

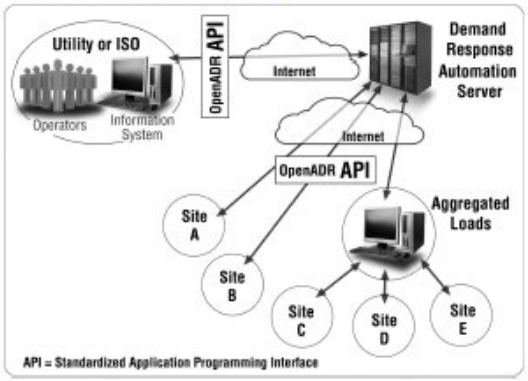
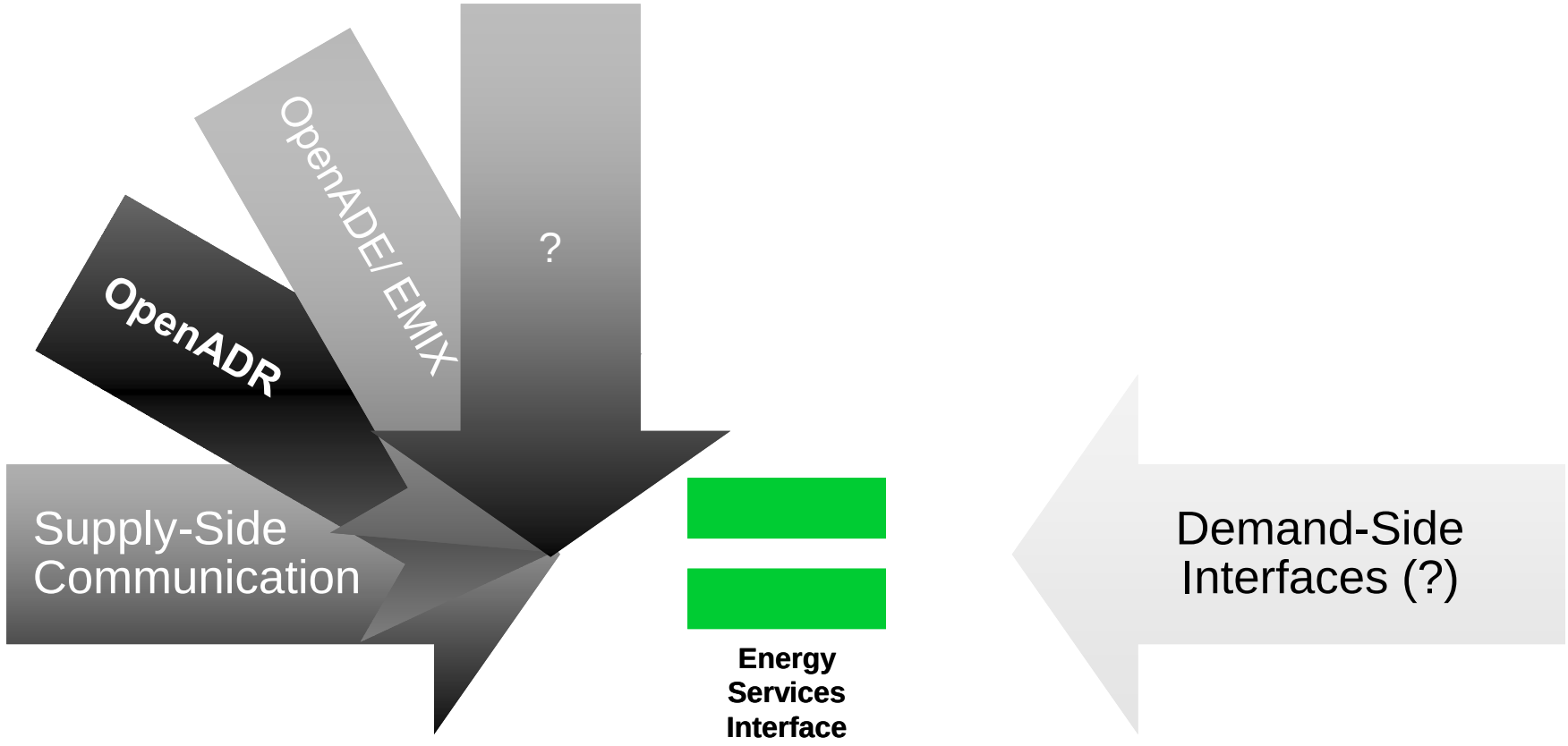


Figure 1: OpenADR Communication Architecture

Agenda

- The Problem Statement
- OpenADR Background
- OpenADR Interoperability Process
- Conformance and Interoperability
- Conclusions and Next Steps

The Problem Statement

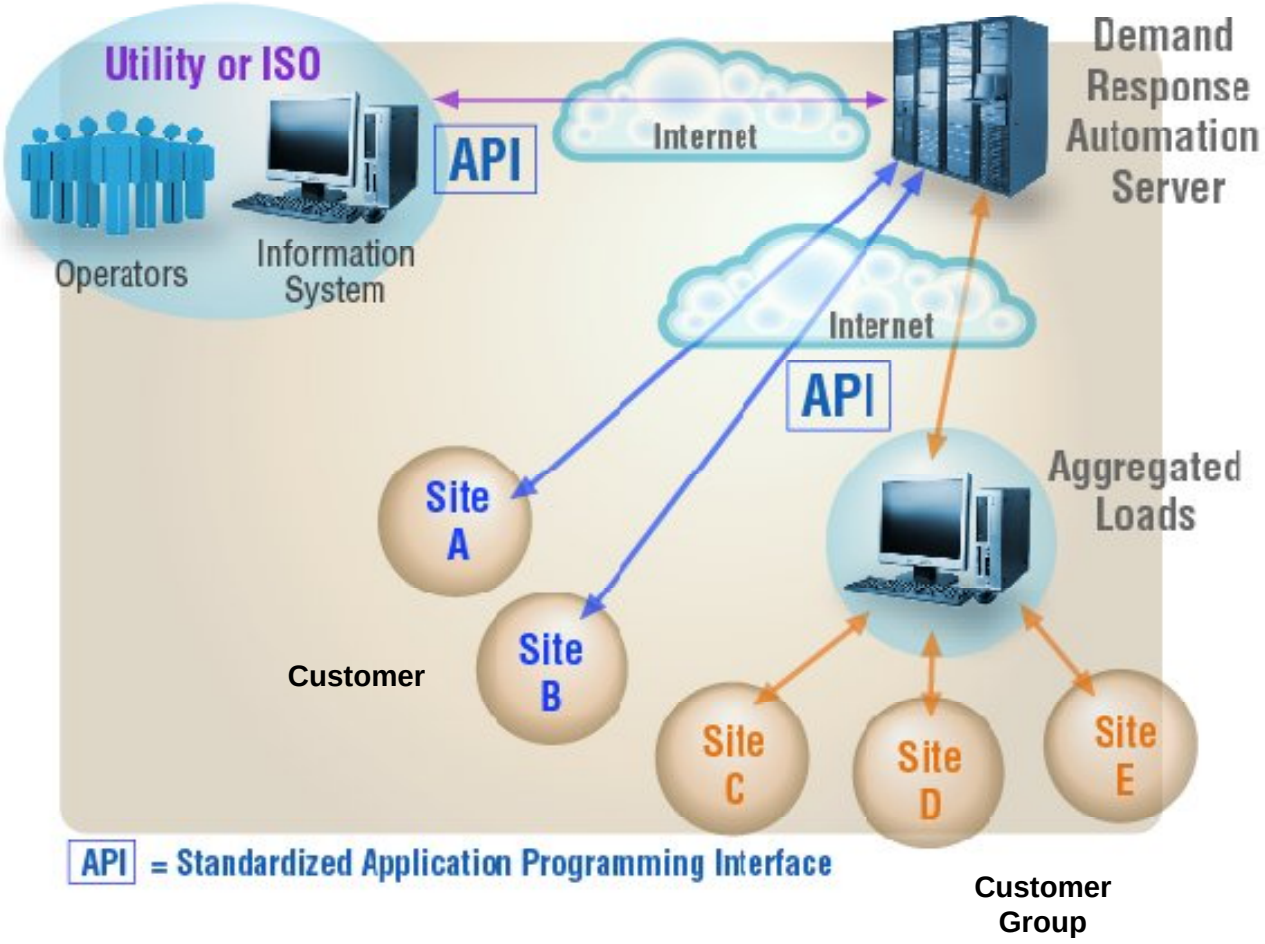


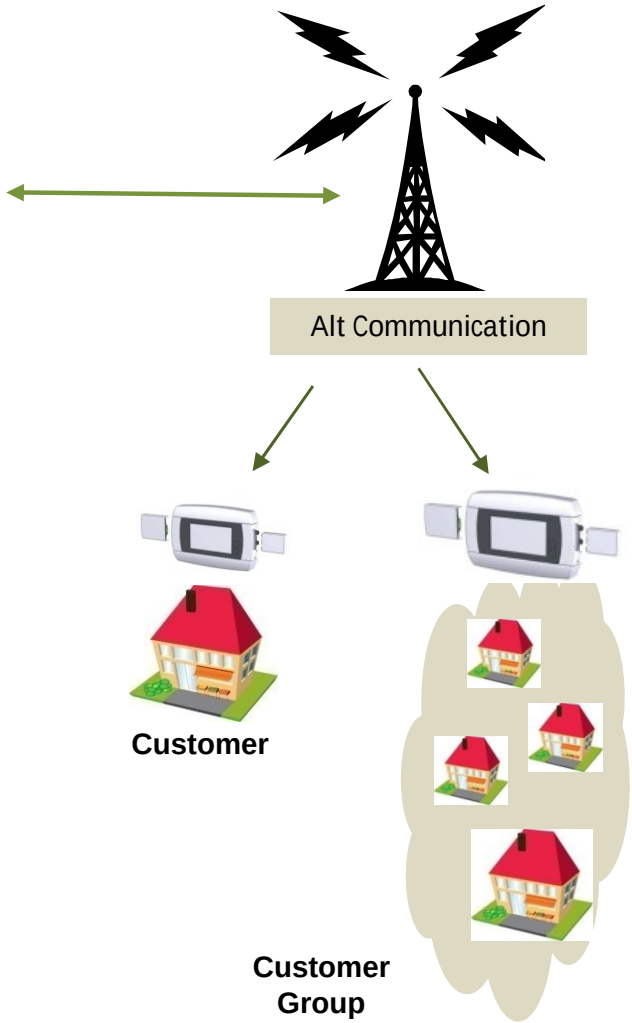
Smart Grid standards in pipeline for interoperability with demand-side and other standards!

- **Goal**: Framework for Smart Grid standards and systems interoperability through Open Automated Demand Response Standard (OpenADR) conformance development process.

Arrows indicate interfaces and not necessarily the communication pathways.

OpenADR Background





Commercial and Industrial

Residential, Small Commercial

OpenADR Interoperability Quest

Research initiated by LBNL/ CEC

Pilots and field trials
Developments, tests (Auto-CPP w/ PG&E)

OpenADR Commercialization
(PG&E, SCE, and SDG&E)

Official OpenADR specification (v1.0) by LBNL/CEC*

1. Anytime DR Pilots and field trials
   - Wholesale markets
   - International demonstrations
   - Dynamic pricing
2. All end-use sectors

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

1. OpenADR donated for Standards Development
   - OpenADR Standards profiles (v2.0)
2. NIST Smart Grid, PAP 09

openADR ALLIANCE
Certification/Testing (v2.0)

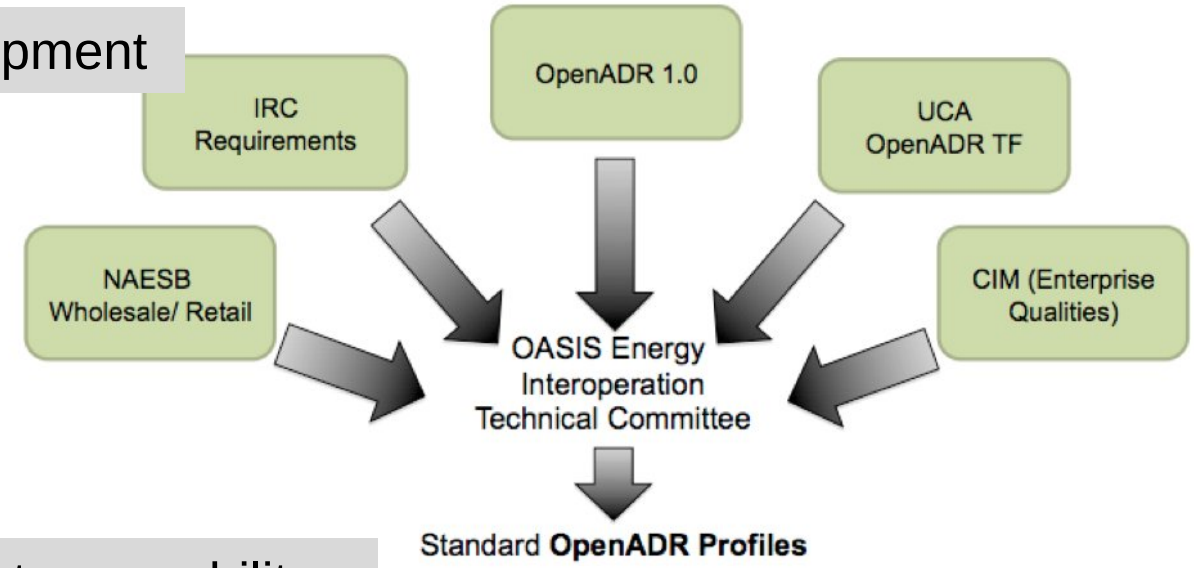
Standards *Lifecycle* Process: A complete process before a standard is ready for commercial adoption.

1. Research and development
2. Pilots and field trials
3. Standards development
4. Conformance and interoperability

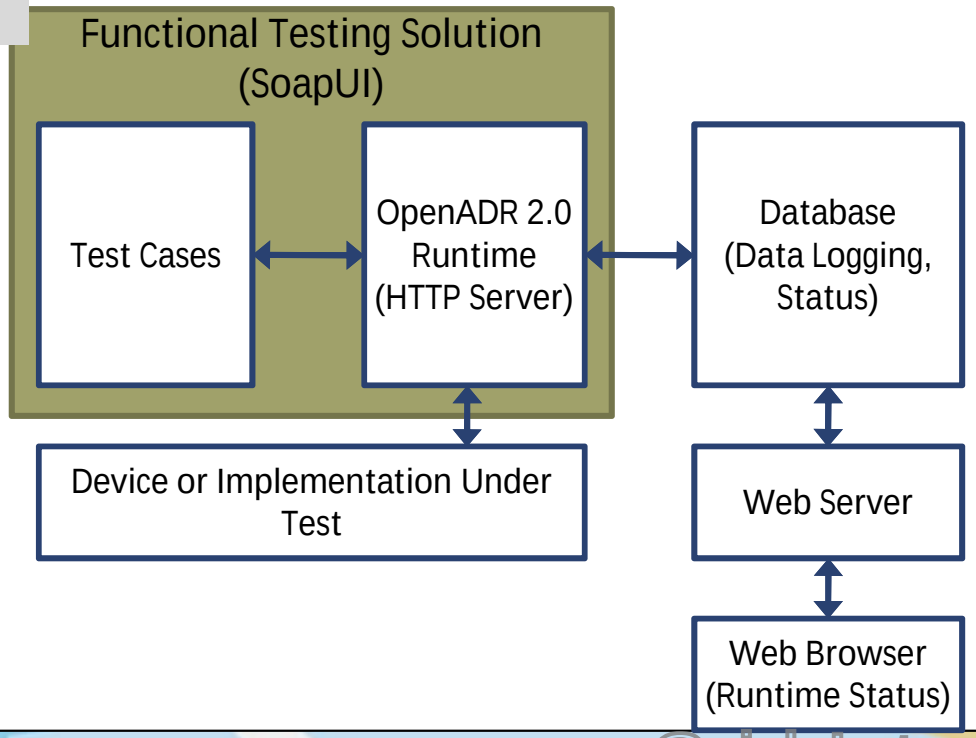
*OpenADR v1.0: http://openadr.lbl.gov/

Standards, Conformance & Interoperability

Standards development



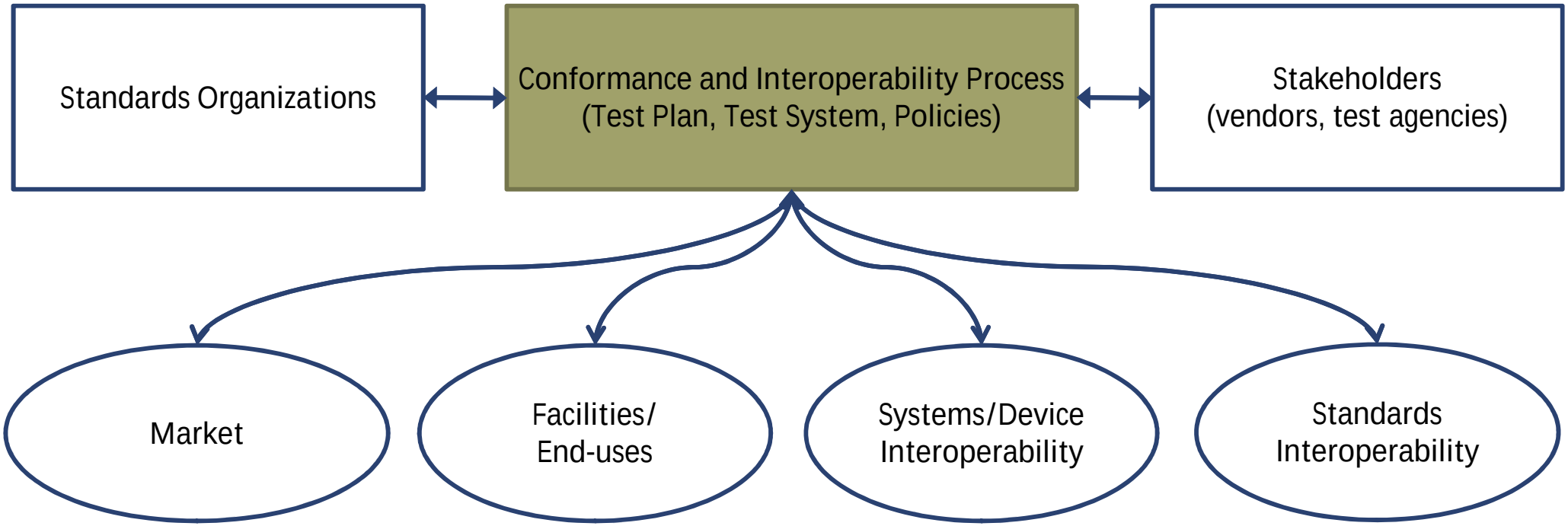
Conformance & interoperability



Interoperability Framework

Ascertain that OpenADR is flexible and interoperable to provide services across markets and Smart Grid domains

- Product feature sets
- Transport mechanisms
- Plug-fests



Conclusions and Next Steps

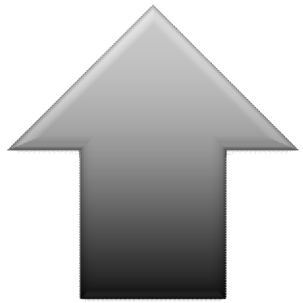
- Conclusions
  - Standards development must consider real-world experience.
  - OpenADR 2.0 provide valuable lessons for Smart Grid standards and systems interoperability.
  - Lessons are relevant, as other standards start evolving and become ready for market adoption.
- Next Steps
  - Backward compatibility, and standards and legacy systems interoperability needed through revisions and market adoption.
  - Comprehensive analysis and adoption of security, transport mechanisms, and feedback through interoperability framework.
  - R&D of price-responsiveness, ancillary services (Fast-DR), renewable integration and DERs, and policy framework.

Backup Slides

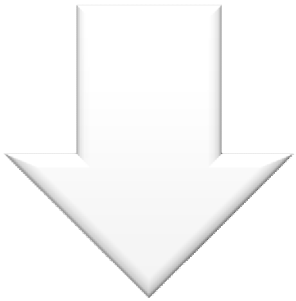
DRRC Activities

- DRRC established by California Energy Commission (CEC) in 2002 and managed by LBNL.

1. **Energy Technologies and Systems Integration**
   - Valuing Demand Response
   - Dynamic Tariffs and Rate Design
   - ***Communications Infrastructure***
2. **Buildings**
   - ***Automation, Communications and Control***
   - ***End-Use Control Strategies and Models***
   - Behavior –response to dynamic tariffs
3. **Industry, Agriculture, and Water**
   - ***Automation, End-Uses and Control.***



Supply



Demand