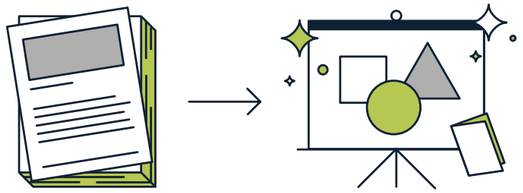
What is TA&D?

TA&D is a process developed by Electric Power Research Institute (EPRI) for sharing the story of the California Energy Commission's (CEC) Electric Program Investment Charge (EPIC) projects funded by Southern California Edison (SCE) rate payers.

TA&D presents learnings and opportunities from each project, distilled into engaging presentations and materials that provide real-time updates on the latest advancements from EPIC integrated demand side management (IDSM) and distributed energy resource (DER) technologies.



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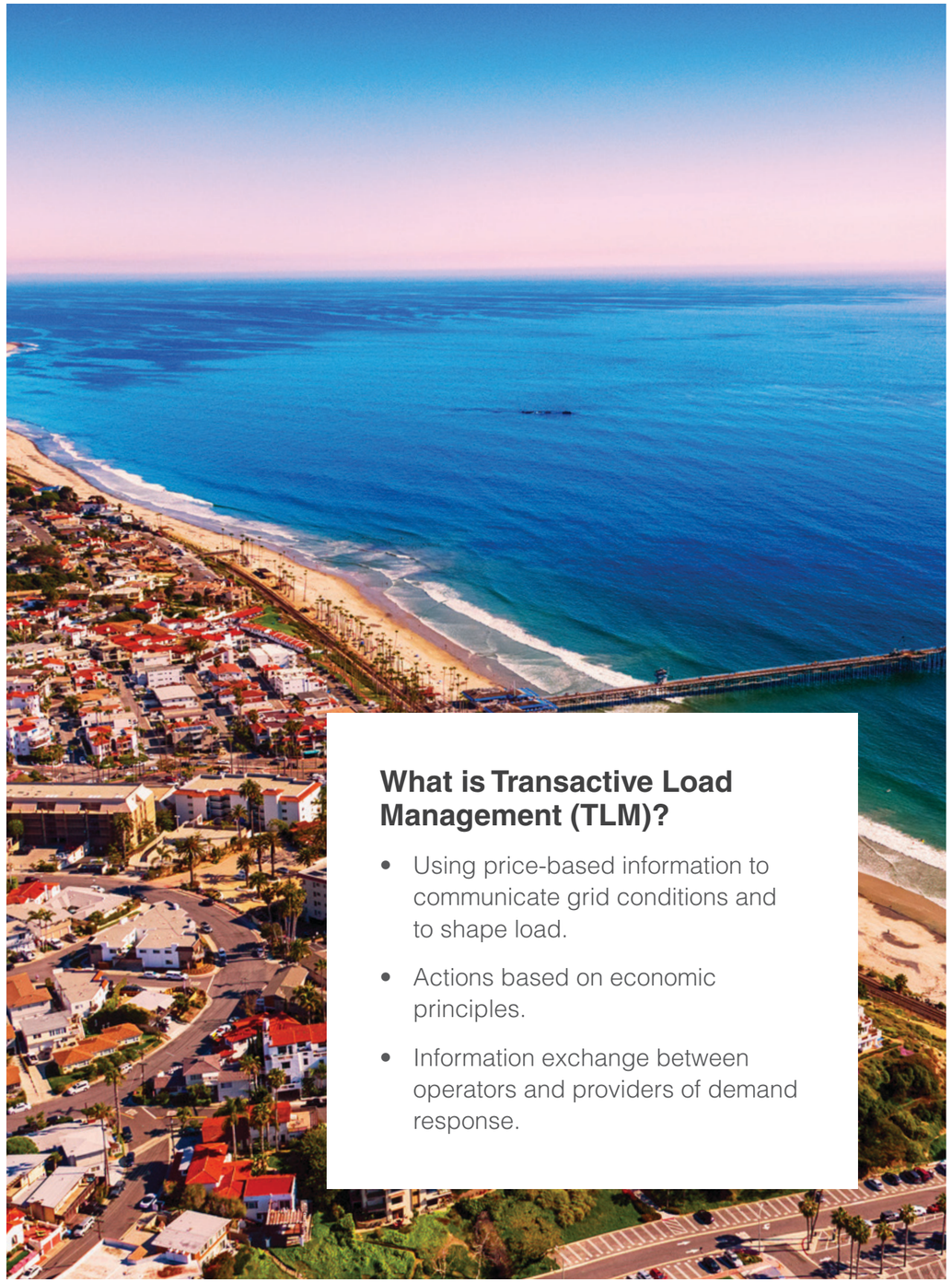
Technology Assessment & Delivery

Transactive Incentive Signals to Manage Electricity Consumption

Assessing the System- and Market-based Economics for Transactive Load Management.

CEC EPC-15-045

March 2019



What is Transactive Load Management (TLM)?

- Using price-based information to communicate grid conditions and to shape load.
- Actions based on economic principles.
- Information exchange between operators and providers of demand response.

Key Findings

Successes

- A simulated, price-based signal that can successfully manage customer loads has been developed.
- Delivery of hourly price signals to customers is possible using standard OpenADR protocol.
- The Day-Ahead market is a binding market, providing a platform for a rebate design that could incentivize customers to reduce consumption.
- Real-time pricing could also motivate customers to reduce consumption.
- Lab testing justifies moving on to field testing the TIME systems and TLM signals.

Challenges

- There are limitations on methods for estimating real-time pricing. Data sources are often lacking or incomplete.
- The data is located in a variety of places and not all are accessible.

Recommended Next Steps

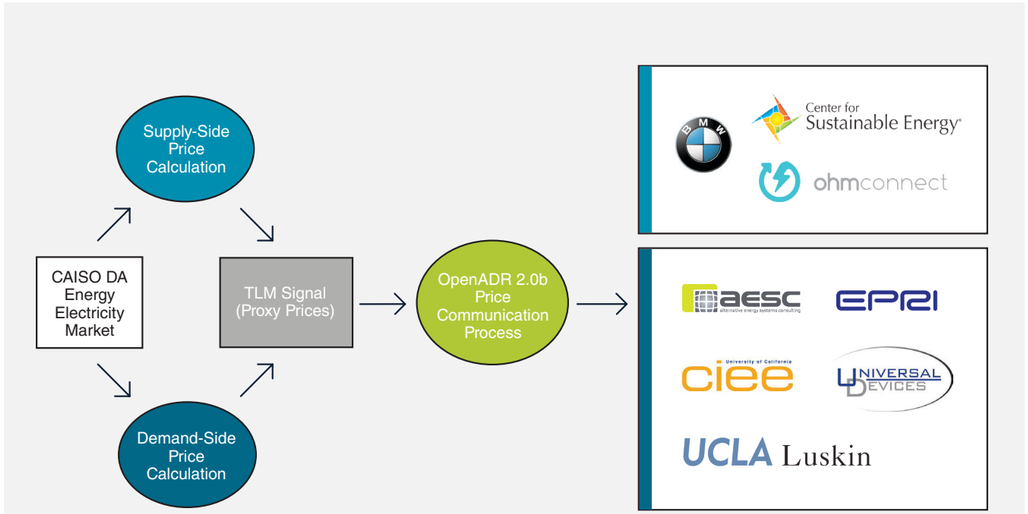
- Operationalize and maintain the TIME systems and TLM signals to determine if electric grid operators, service providers, regulators and technology innovators can use these research findings to identify value in their regions.
- Continue to enhance the retail price signals to better reflect local grid conditions.

Potential for TIME

If field testing is successful, EPC Project 15-045 findings suggest that the TIME systems and TLM signals could result in new practices for widespread adoption of economics-driven transactive technologies and have the potential to support an integrated, electric “grid of the future.”

TIME Signal Design Framework

The design framework allows for multiple configurations, providing an infrastructure that mimics how the transactive signal could operate across the actual system. While the signal design is still a concept and not a reality, the research supports the idea of a universal pricing signal facilitating DR to retail and/or wholesale markets and the idea that a single incentive signal can be used for both.



Electric Procurement Investment (EPC) Project 15-045

Supporting California's Clean Energy Challenge

Demand response (DR) has substantial potential to act as either a demand-side or a supply-side resource. However, this potential has yet to be realized as existing programs and rates do not currently provide a participation incentive structure that accurately reflects system conditions or system costs. The result is higher ratepayer costs, low DR participation and an inability for system operators to regularly utilize demand-side resources.

As California moves toward more distributed generation and intermittent renewable energy generation, integration of those generation resources will further increase costs in the absence of significantly expanded DR resources responding to actual system needs in real time.

Access to the system- and market-based economics to leverage load flexibility from consumers would provide a unique value proposition in support of efficient grid operations—i.e., it would enable Transactive Load Management (TLM).

EPC Project 15-045, led by the Electric Power Research Institute (EPRI) and funded by the California Energy Commission (CEC), supports research to determine if a universal pricing signal can facilitate DR to retail and/or wholesale markets and if a single incentive signal can be used for both.

Project Goals

This project supports the research and development of a path to design, implement and deploy TLM signals, or proxy prices, that would successfully facilitate DR by California utility customers.

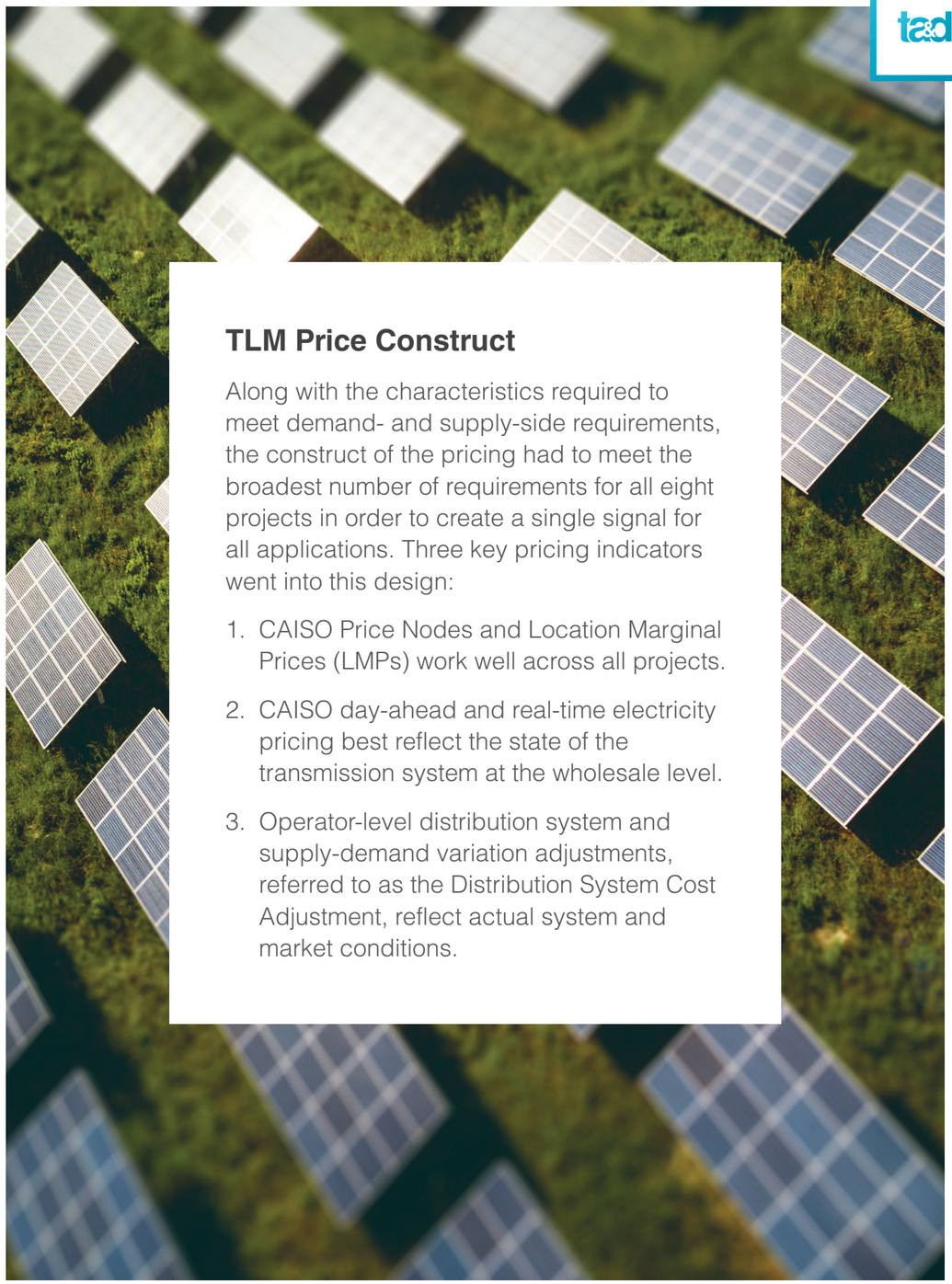
The CEC's goals for a transactive signal include:

Confirm that utility customers (and the recipients under this solicitation) can utilize TLM as a basis for automating their load management strategies.

Test customer response to a dynamic price or informational signal that reflects and anticipates system conditions.

Measure the impact of California Independent System Operator (CAISO) market prices or utility tariffs as well as other indicators of system conditions.

Enable a comparison of system performance under this signal with the existing program.



TLM Price Construct

Along with the characteristics required to meet demand- and supply-side requirements, the construct of the pricing had to meet the broadest number of requirements for all eight projects in order to create a single signal for all applications. Three key pricing indicators went into this design:

1. CAISO Price Nodes and Location Marginal Prices (LMPs) work well across all projects.
2. CAISO day-ahead and real-time electricity pricing best reflect the state of the transmission system at the wholesale level.
3. Operator-level distribution system and supply-demand variation adjustments, referred to as the Distribution System Cost Adjustment, reflect actual system and market conditions.

TLM Signal Design

Build the Price

The design of a successful TLM Signal required a synthesis of the characteristics needed to meet the demand- and supply-side requirements provided by the eight program participants. The EPRI team began with building the price through a calculation across four TLM Signal constructs:

Price & Generation Resource
(LMP's)

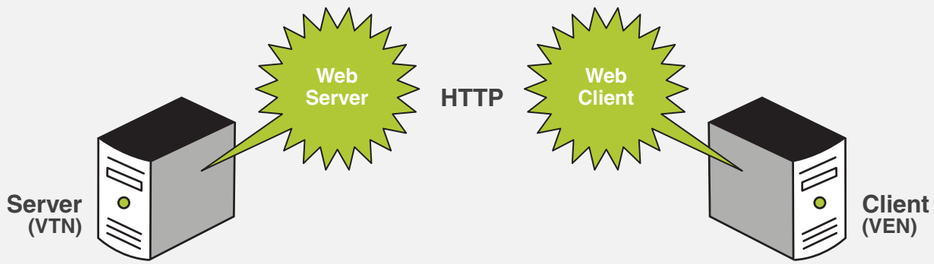
Location Targeting
(LAP, Sub-LAP)

Source of Generation or Social Costs
(Variability, GHG)

Notification Period & Intervals
(Open Standard)

Build the Signal

Communicating the signal was greatly simplified by applying the appropriate electricity price signal using an OpenADR 2.0b-compliant server. This includes the ELECTRICITY_PRICE and the marketCONTEXT and can be modified to pull Load Aggregation Point (LAP) and LMP price data from CAISO Open Access Same-time Information System (OASIS).



TIME Research Methodology

This research reviews California's pathways for a clean energy system with an emphasis on the scope of the solicitation, TLM signals for electricity markets and DR programs. The project focuses on two specific efforts:

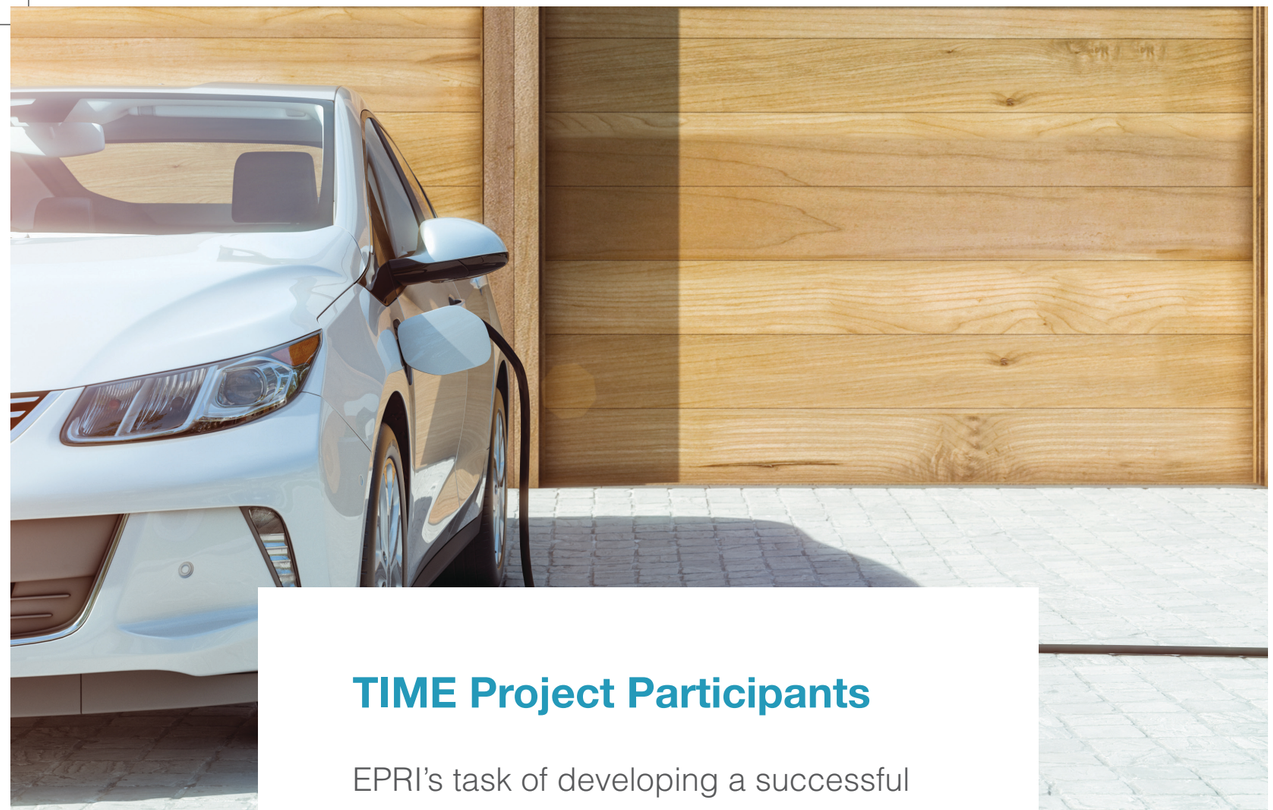
1 Transactive Load Management Signal Design
Create a single TLM pricing signal that could work for both supply and demand.

2 TLM Signal Software Development and Project Integration
Implement the pricing signals and communicate them across eight separate EPC projects.

DESIGN
- Perform literature review of dynamic TLM signal experience
- Survey experts and review related projects for unpublished experiences
- Determine initial definitions for TLM signaling framework and design

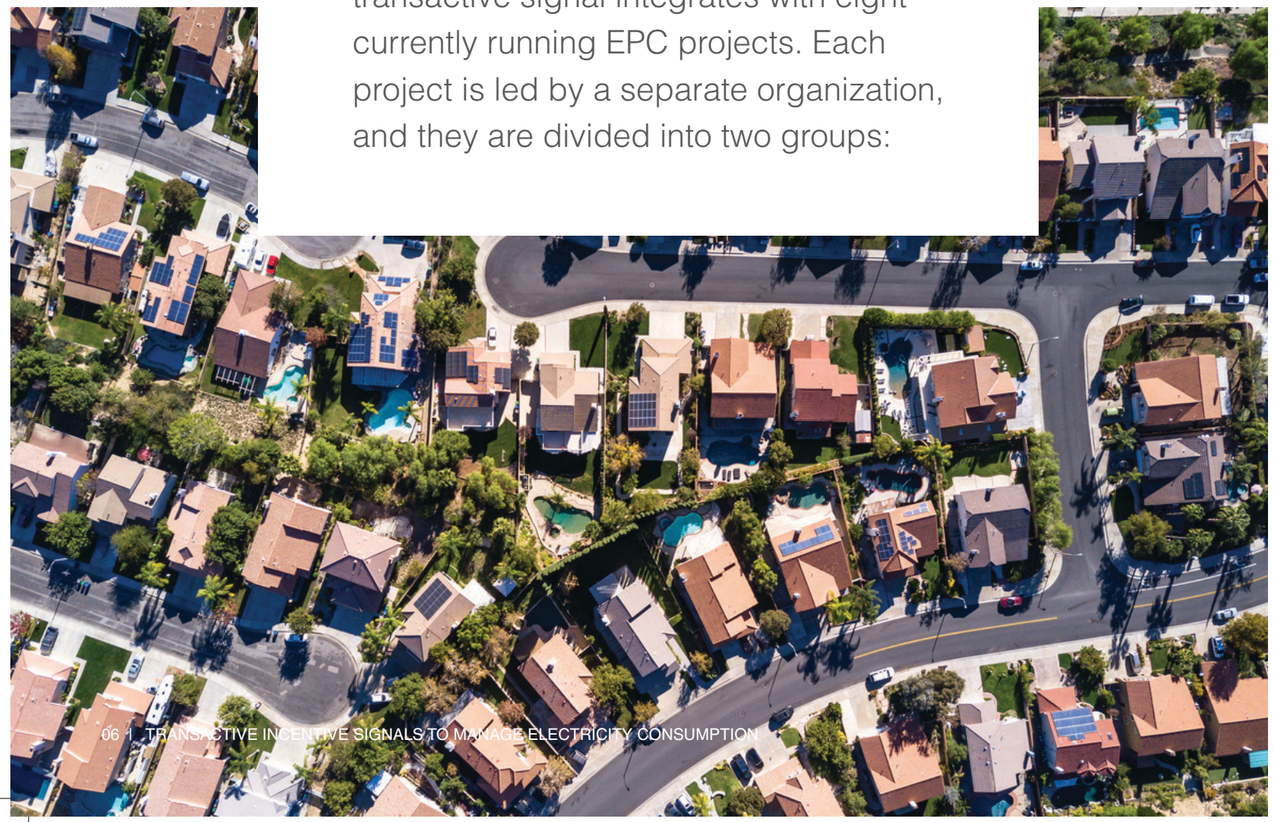
IMPLEMENT
- Interface to required data sources and calculate TLM signals
- Send reference TLM signals via standard communication infrastructure
- Integrate and test TLM signals with Group 1 and 2 projects

OPERATE
- Provide operational TLM signals to Group 1 and 2 projects
- Use Group 1 and 2 feedback to refine and improve TLM signals



TIME Project Participants

EPRI's task of developing a successful transactive signal integrates with eight currently running EPC projects. Each project is led by a separate organization, and they are divided into two groups:



Group 1 – Supply-Side Resources

- **BMW** – EV smart charge management and optimization based on cost and carbon savings.
- **Center for Sustainable Energy (CSE)** – Demonstrate the resource model for CAISO Proxy DR (PDR).
- **OhmConnect** – Generate load changes from large numbers of residential customers at specific times and in specific geographical areas.

Group 2 – Demand-Side Resources

- **Alternative Energy Systems Consulting (AESC)** – Demonstrate optimization of residential energy consumption based on day-ahead hourly pricing posted to the home energy management system or aggregation.
- **California Institute of Energy and Environment (CIEE)** – Use real or projected prices to initiate control sequences in small to large commercial building HVAC, lighting and plug loads.
- **Electric Power Research Institute (EPRI)** – Demonstrate aggregation of a wide variety of load types and products for residential and small/medium sized business customers.
- **UCLA Luskin Center** – Study how consumer response to incentives varies with weather, day of the week and time of day.
- **Universal Devices** – Demonstrate residential and commercial automated and self-managed energy use and storage.