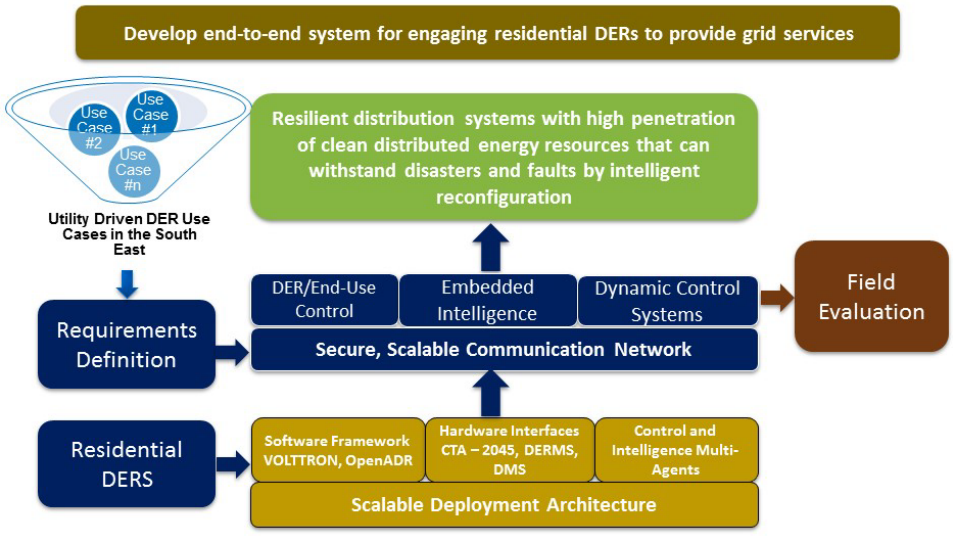
Integration of Responsive Residential Loads into Distribution Management Systems



The team will evaluate and field-test home energy management systems as an interface to deliver grid services from residential DERs, thereby improving grid resilience.

CHALLENGE

More residences and small-to-medium commercial buildings are adopting smart, internet-connected devices that could enable simple, scalable, and low-cost interactions between utilities and residential electrical loads and generation sources. These residential distributed energy resources (DERs), if aggregated and cost efficiently controlled, could become significant enough to help balance grid operations, thus improving operational efficiency, reliability, and resiliency.

The challenge is that these loads are widely dispersed, relatively small in size, and operate under user constraints. Some utilities use third-party companies to sign up customers for voluntary curtailment programs for specific appliances such as air conditioners. But those services can be costly for utilities, typically use proprietary software, and don't take advantage of the range of multi-vendor devices available in the emerging smart appliance world.

For utilities to adopt the aggregation of small, distributed DERs, they must be convinced of the feasibility and the economic value of doing so.

At-A-Glance

PROJECT LEAD

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LAB COLLABORATOR

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PARTNERS

- Electric Power Research Institute
- National Rural Electric Cooperative Association
- Southern Company
- Tennessee Valley Authority
- Duke Energy
- Con Edison
- Electric Power Board
- Jackson EMC

BUDGET

DOE and EPRI: $5M
Industry: $1.3M

DURATION

October 2017 – September 2020

TECHNICAL AREA

System Operations, Power Flow, and Control

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APPROACH

The goal of this project is to provide electric utilities with the necessary software and hardware, all based on open standards, to leverage demand-side management of residential DERs.

The team will develop and validate a home energy management system (HEMS) as a grid interface with a utility. The HEMS will serve as a platform for deploying intelligent algorithms to execute grid-responsive functionality of a collection of residential multi-vendor devices. The team will develop hierarchical, decentralized control and optimization systems capable of providing the response needed to deliver guaranteed grid services to utilities.

The team will work with selected Southeast utilities to identify existing or future grid service programs of interest, such as demand response or renewables integration, for five appliance types: water heaters; heating, ventilation, and air conditioning systems; electric vehicle chargers; pool pumps, and residential photovoltaic inverters.

Control signals and interactions will be tested in a laboratory environment, then deployed with a small number of each appliance type in strategic locations across the southeast United States. These tests and field trials will validate advanced controls that support distribution resiliency and end-to-end interoperability, using open standards and open-source platforms.

EXPECTED OUTCOMES

This project improves the economics and resilience of grid operations by taking advantage of a rapidly increasing trend in homes and small businesses: internet-connected smart appliances. With access to the project's open-source specification and reference implementation, utilities and co-ops can cost effectively use aggregated residential loads to offer resilience-based grid services to their customers.

This gives utilities an important new tool to balance supply and demand, even in times of unexpected fluctuations, thereby improving grid resiliency.

LAB TEAM

OAK RIDGE National Laboratory

Pacific Northwest NATIONAL LABORATORY

As part of the U.S. Department of Energy's Grid Modernization Initiative, the GMLC is a strategic partnership between DOE Headquarters and the national laboratories, bringing together leading experts and resources to collaborate on national grid modernization goals. The GMLC's work is focused in **six technical areas** viewed as essential to modernization efforts:

Devices and Testing | Sensing and Measurements | Systems Operations and Control
Design and Planning | Security and Resilience | Institutional Support