

Technology Innovation Project



Project Brief

TIP 336: Scaled Deployment and Demonstration of Demand Response using Water Heaters with CEA 2045 Technology

Context

Water heaters are inherent energy storage devices. They can serve 3-4 hour DR events well with full curtailment of the heating source. With more refined algorithms water heaters can serve a substantial load shifting function.

BPA & PGE have spent the last several years working with EPRI and other utilities and vendors to develop the capability to use smart water heaters for not only traditional peak load demand response, but also for everyday applications like arbitrage and renewable generation integration.

Smart water heaters have internal electronic controls that cycle the heating elements/compressor and, most importantly, a communication interface (a serial port) that lets the customer insert a communication device that can allow remote management of the water heater. This approach, while limited to new water heaters, dramatically reduces the cost of adding a water heater to a demand response program.

Description

This project will deploy 300 electric resistance and 300 heat pump CEA 2045 controlled water heaters in the Pacific Northwest (PNW), and execute demand response event use cases over a 12 month period.

The project will be led by the Principal Investigators from BPA and PGE. The project plan includes the following participants:

- i. Two to six utilities that will serve as the host sites for approximately 600 water heaters.
- ii. Two manufacturers of electric water heaters that provide units that conform with the ANSI/CEA-2045 modular communication interface specification
- iii. A demand response service provider that acts to aggregate and control all water heaters with the same strategy.
- iv. A communication network service provider that provides two-way data services between the DR aggregator and water heaters. This provider also supplies the CEA-2045 compliant communication module that “plugs” into the water heater.
- v. Northwest Energy Efficiency Alliance (NEEA) who will provide the quantitative analysis of collected data.

Why It Matters

If market transformation caused every new electric water heater in the PNW (heat pump or resistance types), to be sold with this standard approach, then advanced 24/7 demand response becomes economically attractive on every water heater.

In the PNW, this represents a total economic potential of about 1,800 MW and 16,000 MWh of controllable power and storage over 20 years, assuming a mix of 25% heat pumps and 75% resistance tanks.

In addition, in terms of deferring the need for new peaking power plants, 24/7 operation could yield a reduction in natural gas use in power plants of more than 15 trillion Btu/year (at maximum economic potential) and a corresponding CO₂ reduction.

Goals and Objectives

Demonstrate/educate the region of the value of grid interactive "smart" water heaters;

Determine a statistically valid kW reduction (on-peak) from "smart" resistance and heat pump type water heaters;

Demonstrate a 24/7 control paradigm for arbitrage and renewables integration that includes:

- Regular shift of kWh into a shaped load at night,
- Use of water heaters to absorb (or curtail) day-ahead and hour ahead wind forecast error

Deliverables

The project report provided by NEEA will include:

1. A PNW demand response performance specification for water heater OEMs;
2. Evaluation of customer acceptance/impact of 24x7 DR operation of their water heaters.
3. A business case for market transformation (i.e., all PNW water heaters with CEA 2045);
4. A market transformation plan to inform the most cost effective way to make DR-ready water heaters the primary type installed in the PNW.

TIP 336: Scaled Deployment and Demonstration of Demand Response using Water Heaters with CEA 2045 Technology

Project Start Date: October 1, 2015

Project End Date: September 30, 2018

Reports & References

Links

Funding

Total Project Cost: \$960,460

BPA FY2016 Budget: \$114,460

For More Information Contact:

BPA Project Manager:

Tony Koch, PE, CEM , CMVP

Mechanical Engineer

Seattle, WA

jakoch@bpa.gov

PGE Principal Investigator

Conrad Eustis, Dir. Retail Technology Strategy

Portland, OR

conrad.eustis@pgn.com

Participating Organizations

Portland General Electric (PGE)

Northwest Energy Efficiency Alliance (NEEA)

