



## TIP 336: Scaled Deployment and Demonstration of Demand Response using Water Heaters with CTA 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 CTA 2045 controlled water heaters in the Pacific Northwest (PNW), and execute demand response event use cases over a period of 8-12 months.

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 manufactures of electric water heaters that provide units that conform with the ANSI/CTA-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 CTA-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 CO<sub>2</sub> 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 CTA 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.

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**Project Start Date:** October 1, 2015

**Project End Date:** September 30, 2018

## Reports, References, Links

## Related Projects

TIP 272a: EPRI P170 Supplemental: CTA 2045 Standard Modular Communications Interface for Demand Response

## Funding

Total Project Cost: \$960,460

BPA FY2017 Budget: \$454,500

## For More Information Contact:

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## Participating Organizations

Portland General Electric (PGE)

Northwest Energy Efficiency Alliance (NEEA)

Pacific Northwest National Lab (PNNL)

Utilities showing strong interest to participate (have not signed participation agreements yet)

Tacoma Power

Clark PUD

EWEB

Emerald PUD

Springfield Utility Board

Consumers Power

Puget Sound Energy

Chelan PUD

Seattle City Light

