

DR17.06: Smart Water Heater Retrofit Controller Lab Study

OPPORTUNITY

What have previous studies demonstrated about the potential for water heater retrofit controls?

Water heating is generally regarded as the second largest contributor to energy costs for homes, at approximately 14-18% of utility bills. Water heaters present substantial opportunities for reducing GHG emissions and assisting with grid management. Retrofit controls are available for water heaters, to manage demand/energy consumption and enable Demand Response (DR) control.

TECHNOLOGY

How does automated demand response in water heating work?

The water heater retrofit controller product investigated in this project enables three main DR control schemes: load curtailment controls, time-of-use driven controls, and grid-interactive water heater controls.

M&V

Where did Measurement and Verification occur?

The Calorimeter Controlled Environment Laboratory (CCEL) is a general purpose test chamber located in SCE’s Technology Test Centers (TTC) in Irwindale, CA. The test chamber, used in this study, is suitable for testing a wide range of appliances, plug loads, and electronics.

A randomized annual water usage profile was produced using the DOE Building America Program’s spreadsheet tool. The test rig is a closed-loop water system. There are two tanks to simulate a dual-zone temperature control system.



RESULTS

How did demand response retrofit controllers for water heaters perform in M&V?

Load Curtailment

Load was successfully curtailed by the retrofit controller. Load curtailment may be scheduled through the internet-based fleet dashboard as single load curtailment or recurring load shift events.

Time-of-Use Controls

Water heating element runtimes and energy consumption were successfully decreased from the On-Peak period to Off-Peak periods using TOU controls under the selected weekday usage profile. At the time of this project, all SCE TOU rates could be configured into the TOU controls of the retrofit controls product, but only through the user portal.

Grid Interactive Water Heater Controls

The approximated GIWH controls reduced energy consumption during non-overgeneration periods and showed baseline operation during the generation period. This is not a selectable mode in either the user portal or the fleet dashboard and was approximated with load curtailment from the fleet dashboard, in conjunction with temperature boost scheduling configured in the user portal.

DEPLOYMENT

What are the recommendations moving forward regarding water heater retrofit controllers?

Before implementation of demand response controls for water heaters can be widely distributed to the available market, there are some next steps which need to be taken.

- Advocating for industry best practices to be followed to ensure safe operation of water heaters
- Promoting research and advocacy for standardizing energy-conscious best practice for water heater design
- Working with utilities to enable communication through openADR, set appropriate TOU controls, and establish a communication pathway to inform real time GIWH operation