DR10SCE1.16.02: Demand Response Potential of Residential Appliances – Clothes Washer (GE)

OPPORTUNITY

What is the potential for demand response (DR) using smart appliances?

Several appliance manufacturers have begun implementing advanced control features into their products that are focused on energy reduction and the ability to react to adverse grid conditions or price signals. In California, clothes washers are present in nearly all homes, with a market saturation of 96% for single-family homes. The average unit energy consumption for these clothes washers is 121 kWh and that does not account for water-heating.

TECHNOLOGY

How does DR using smart appliances work?

Ultimately the appliance receives a signal from the utility requesting that action be taken to reduce load. The Smart Appliances have built-in algorithms that allow them to determine whether they can respond to the signal while maintaining a minimal level of service to the consumer.

RESEARCH

Where did Measurement and Verification occur?

This study focuses on demand response (DR) lab testing and evaluation of a clothes washer manufactured by General Electric (GE). Functional testing was performed in Design and Engineering Service's (DES) Technology Test Centers and was complemented by the communication testing performed at the Advanced Technology Organization's HAN lab. The appliance tested in this project is one of three GE appliances installed in customer residences as part of the ISGD project.

Image 1: GE Clothes Dryer

Findings

How did DR for smart appliances perform?

UP TO ~50% The clothes washer demonstrated its capacity to reduce load between 9% and 53% during critical price signal events during various stages of operation.

TOTAL ENERGY Similar reductions were seen in total energy, and savings potential varied as a function of when the DR event was initiated and the selected wash mode setting.

WASH CYCLE The results indicate that DR events may or may not yield reduction in peak demand, due to the washer responding to DR events by reducing the duty cycle. Thus, the reductions in max total power are largely due to shifting the stages of the wash cycle.

RECOMMENDATIONS

What are the conclusions and next steps determined by the study?

Generally, the clothes washer consistently performed in a manner compliant with its originally intended strategy and has the potential to avoid its peak demand of roughly 600W. The DR benefits depend on factors such as price signal, duration and time of event occurrence vs. washer stage of operation.

The DR responses do not fully comply with the Association of Home Appliance Manufacturers (AHAM) guidelines and would likely provide less beneficial demand reduction to the utility. Further simulation and better understanding of the DR programs used to activate these systems are required to fully evaluate the grid-level impacts of various schemes. Subsequent testing and future increased interaction with AHAM and standards-setting agencies will attempt to address these issues.