PowerMand, Inc.

Technology Impact on Demand Response

Household Sector Summary

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Executive Summary

This white paper summarizes the impact of technology on demand response implementations, and demonstrates the value of PowerMand's technology solution. It includes published information from consultant studies and Department of Energy sponsored pilots. The studies consistently point to the positive impact of enabling technology on household energy savings, with 2kW of peak reduction available on a per household basis.

Ahmad Faruqui and Sanem Sergici published one of the most recent surveys of household response to dynamic pricing events on November 13, 2008. Their study of 17 programs found that, on average, households (residential customers) respond to higher prices by lowering usage. The magnitude of price response depends on several factors, such as the amount of the price increase, the presence of central air conditioning and the availability of enabling technologies such as two-way programmable communicating thermostats and gateway systems that allow multiple end-uses to be controlled remotely. Across the range of experiments studied, time-of-use rates induced a drop in peak demand that ranged between three to six percent, and critical-peak pricing tariffs led to a drop in peak demand of 13 to 20 percent. When accompanied by enabling technologies, the latter set of tariffs led to a drop in peak demand in the 27 to 44 percent range.

An early study comprehended in the Faruqui and Sergici examination was the Automated Demand Response System Pilot (ADRS) published by the Rocky Mountain Institute, March 31, 2006. It concluded that Customers with ADRS technology (communicating thermostats, load control modules) and subject to CPP-F (critical peak pricing) rates in Climate Zone 3, successfully achieved load reductions compared to control customers without ADRS technology on standard tiered rates in both 2004 and 2005. The load reductions were substantial and stable across a range of days and temperatures for both years. Super Peak period load reductions on event days were consistently about twice the load reduced during peak periods on non-event days. Some of the load reduction was attributable to the dynamic pricing tariff. However, technology appears to be an important driver in reducing load, especially Super Peak load, for high-consumption homes. Customers with technology in the ADRS pilot consistently reduced more than twice the load of residential customers in other demand response programs without enabling technology.

Peak period load reductions for high consumption ADRS homes by Utility
July – September 2005

	Event Days			Non-Event Days		
	Average reduction, kW	5-hour total, kWh	% Reduction	Average reduction, kW	5-hour total, kWh	% Reduction
PG&E	0.83	4.15	29%	0.47	2.36	18%
SCE	1.85	9.24	49%	0.89	4.47	30%
SDG&E	1.17	5.84	38%	0.69	3.46	27%
Statewide weighted average	1.42	7.10	43%	0.73	3.67	27%

The final recommendation in the ADRS study concluded, "…we recommend that residential demand response programs for high consumption households should include automated technology regardless of whether dynamic pricing is in place. In this way, utilities would have the ultimate flexibility to induce reductions in air conditioning and other residential end use loads in response to system needs, or for reliability purposes."

Other well-published studies on household energy reduction include those from the Bonneville Power Administration (BPA). An article published in the January 10, 2008 edition of the New York Times, entitled "Digital Tools Help Users Save Energy", summarizes the findings:

> "…The results of the research project by the Pacific Northwest National Laboratory of the Energy Department, released Wednesday, suggest that if households have digital tools to set temperature and price preferences, the peak loads on utility grids could be trimmed by up to 15 percent a year…In the Olympic Peninsula, west of Seattle, 112 homes were equipped with digital thermostats, and computer controllers were attached to water heaters and clothes dryers. These controls were connected to the Internet…The households in the demonstration project on average saved 10 percent on their monthly utility bills…"I was astounded at times at the response we got from customers," said Robert Pratt, a staff scientist at the Pacific Northwest National Laboratory and the program director for the demonstration project. "It shows that if you give people simple tools and an incentive, they will do this."

Similar results were achieved by another BPA study in 2005, conducted in Ashland, Oregon. In a pilot of over 100 single family homes, load control of electric water heaters typically resulted in a demand reduction of 0.6 kW per water heater. Lowering the heating set-point of the thermostat of an electrically-heated home by 4ºF during the morning peak period typically resulted in a demand reduction of 1.2 kW per home. BPA found that it could gain just under two kilowatts per home by remotely curtailing loads in the summer. In winter experiments, the gain was closer to 2.4 kW per home.

The key devices at each site were a programmable thermostat and a few remote-control switches on appliances. The thermostats allowed BPA to remotely raise or lower the temperature setting. Using the remote switches, BPA could also turn off the heating elements in water heaters or turn off pool pumps.

The above environmental scan clearly identifies technology as an essential element to increasing the effectiveness of utility demand response and pricing programs, and provides a benchmark average of 2kW of peak reduction that can be attained from households alone. PowerMand's DreamWatts Energy Management System, in production since 2008 and based on the above technologies, has extended the residential savings into the light commercial building segment where additional efficiencies and peak reductions are attainable. Using the DreamWay intelligent gateway, communicating through a broadband Internet connection to a datacenter, and managing an on-site wireless network of communicating thermostats, load control devices and sensors, enables end users to achieve energy efficiency while allowing Utilities to cost-effectively reduce peak demand with predictable load shedding capabilities.