

Smart appliances learning to save power grid

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updated 11/26/2007 7:25:46 PM ET

It's one small delay for dry socks and underwear, one giant leap for the national power grid.

Researchers at an appliance lab that looks more like a utility room are fine-tuning washers, dryers, water heaters, refrigerators — even coffeemakers — to help ward off the type of colossal power failures that plunged much of the Northeast into darkness in 2003 and blacked out big chunks of the West in 1996.

If you're a bit skeptical as to whether subtle tweaks to your dryer or dishwasher might help keep the lights on, you're not alone. But in two related experiments, scientists from Pacific Northwest National Laboratory in Richland, Wash., found that providing homeowners with smart appliances and information on how to save money cut their energy costs but also reduced overall power consumption during peak use periods, when the nation's aging power grid is most susceptible to breakdowns.

Appliances outfitted with computer chips were able to sense when the transmission system was stressed and partially turned themselves off to save critical kilowatts — potentially staving off catastrophe. Consumers experienced minimal impact when their dryer's heating element temporarily cooled as the drum kept tumbling until the grid restabilized. During a simulated grid emergency back in the lab, a refrigerator's light similarly stayed on while its compressor imperceptibly clicked off.

Rob Pratt, the lab's program manager for a multiagency collaboration dubbed GridWise, later said such subtlety was the whole point. One year-long project showed that smart appliances could readily sense when the electrical grid system was under duress — about once a day, on average — and adapt accordingly by reducing demand for brief periods of time. Even better, they did so without drawing unnecessary attention to themselves.

Pratt said researchers spent an average of \$1,000 on appliances, equipment and monitoring capabilities for each of the roughly 200 homes participating in two related studies. But for more widespread and routine residential use, he expects the upfront costs to run about \$400 to \$500 and potentially less if computer chips can be built into the appliances before they leave the factory. "If this becomes cheap enough, even your coffeemaker can help the grid out," he said. And if eventually adopted throughout the country, the energy-saving appliances could translate into savings of about \$70 billion in new power plant construction and power distribution costs over 20 years.

For a power grid on the blink, a neighborhood or city or state full of laundry rooms all feeling its pain could dramatically — and automatically — reduce the energy load and give grid operators a chance to bring other grid-soothing resources online. All well and good, but would consumers buy it?

A more involved study that examined human behavior, called the Olympic Peninsula Demand Response Project, equipped volunteers with control boxes for their water heaters as well as new thermostats and grid-friendly dryers all linked to the Internet. The setup not only provided real-time information on electric pricing per kilowatt-hour but gave the homeowners several options for tweaking their energy use accordingly. "They could think about it once, set it and forget it," Pratt said.

One customer involved in the trial run was so impressed, in fact, that he wrote his own report — a sort of statistical ode to his energy-saving thermostat, water heater and dryer. Jerry Brous of Sequim, Wash., said he signed up for the program as soon as he heard about it on a local radio station.

In the Brous household and others throughout Washington's Olympic Peninsula, smart water heaters and thermostats provided updated electric prices about every five minutes, depending on what was available and needed (most utilities instead charge a flat rate per kilowatt-hour, regardless of cost fluctuations). Homeowners could adjust their settings to decrease power consumption and save money during peak demand or override the controls at any point, like when they were hosting dinner guests or a fussy relative.



At the GridWise lab, a refrigerator, washer, dryer, dishwasher, water heater and even coffeemaker

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has a bad habit of fluctuating on short timescales, he said, but manipulating power loads over five-minute intervals can help smooth out those fluctuations.

For the behavioral study, which will be released this month, Pratt and his collaborators analyzed how Brous and other volunteers reacted to the costs of energy delivery by giving them something all too familiar to homeowners: electric bills. Unlike the real world, however, the bills were only simulated with pretend money kept in fake accounts. As a perk for participating in the GridWise program and reducing their electric consumption, though, the volunteers' savings could be converted into actual cash.

As part of the experiment, the researchers found that they could cut the peak electricity load among participating homes by half for three days in a row. "That was astounding," Pratt said. The homeowners were rewarded for the inconvenience, but the study suggested that a similar power reduction might be feasible during a prolonged grid emergency.

Overall, Brous said his electricity load dropped by 15 percent, and he compiled his own Excel spreadsheet to determine the percentage of power flowing to his water heater, heat pump and dryer to pinpoint how he might save even more. He also received quarterly checks from the program reflecting his savings, including a recent one for \$37. During several camping trips, Brous could tell his house to "go to sleep or wake up," simply by logging onto an Internet site and remotely turning his heat and hot water heater on or off.

Richard Katzev, an expert on social and environmental behavior and president of Portland, Ore.,-based Public Policy Research, said merely providing more information to consumers would be ineffective without also giving them incentives to act. Homeowners will readily accept money-saving devices that require fairly easy lifestyle adjustments, he said, like delaying a dishwasher or dryer run to obtain cheaper rates.

"The evidence is clear that those devices do promote electricity conservation on the aggregate," he said. And adding a social element to the decision-making can lead to even bigger behavioral changes.

How might Brous' friends and neighbors greet a similar project? "I think they would welcome it with open arms," Brous said. "I don't think there would be any question about it. If you give people the tools, they're going to put them to use to save electricity." And perhaps the power grid in the process.

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