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Fridges of the world, unite!

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Energy efficiency: Smarter appliances that turn themselves down at times of peak demand should mean fewer brown-outs

Illustration by Belle Mellor

IF THE millions of refrigerators, electric water-heaters and air conditioners attached to the average power grid were less selfish, and adjusted their energy consumption according to the state of that grid, there would be less need to run spare coal-fired generating capacity on the off-chance that it might be required—and intermittent power sources, such as the wind, could be accommodated more easily. These things would save money and cut carbon-dioxide emissions. More responsible fridges might even reduce the number of power cuts and brown-outs. But how do you organise such collaboration? Several groups of researchers have been thinking about this, and their answers are now being tested.

The most advanced project is the brainchild of the American Department of Energy's Pacific Northwest National Laboratory (PNNL). Last year it completed the first residential trial of its "Grid Friendly Appliance" controller—a small device that listens to the AC-frequency hum of the electricity supplied by the grid. If the hum goes a little flat, that indicates too much demand on the grid, so whenever a controller notices the American standard 60Hz grid frequency dipping to 59.95Hz (something that usually happens at least once a day) it shuts off the heating element in the appliance it is regulating for two minutes. If, at the end of that time, the grid is still unstable, the element stays off for another two minutes, and so on until a maximum of ten minutes have elapsed.

The PNNL conducted its trial in collaboration with Whirlpool, a maker of domestic appliances. It recruited the inhabitants of 150 homes in the states of Oregon and Washington and fitted 150 dryers and 50 water heaters in those homes with the new controllers. In the dryers, the motor stayed on when the heating element was being turned off to reduce demand, so the drum still turned and the clothes did not crease—an important criterion for Whirlpool. Just turning off the heating element, but leaving the motor running, still reduces demand to a useful degree. At the end of the trial, which lasted a year, most residents said they had not noticed their appliances switching off and said that they had not been inconvenienced at all.

Having shown in this pilot that its technology could act as a "shock absorber" for the grid when demand peaks, PNNL plans to conduct a larger study, involving more than 1,000 homes, in 2009. Whirlpool also wants to try the idea out more widely, and to experiment with other functions that could safely be interrupted, such as the automatic defrosting feature found in some refrigerators.

Whereas PNNL's main interest is in shedding load at times of heavy demand, a small British firm called RLtec is exploring the idea that entire populations of fridges could be programmed to correct continuously for much smaller grid fluctuations, constantly adjusting their power

demands rather like a car's cruise control. That, too, would improve efficiency and reduce the need for standby capacity.

RLtec is four months into a laboratory test in which 100 domestic fridge-freezers have been equipped with the firm's "Dynamic Demand" technology. This is a piece of software that operates within the electronic temperature-control loop of the fridge and makes subtle second-by-second adjustments to the amount of power drawn by the compressor unit, again in response to tiny variations in the frequency of the power grid. So far, according to Andrew Howe, the company's boss, there have been no adverse effects on the temperature inside the fridges or on the lifetimes of their compressors. RLtec is now putting together a team that includes people from Britain's national grid to test the system more rigorously. In a separate, government-sponsored study, Imperial College plans to install fridges fitted with Dynamic Demand controllers in a number of homes to generate data on exactly how much power the system could save.

The first serious use of grid-responsive appliances, though, may be on grids of the smallest scale. Econnect Ventures, a British firm, is helping to prevent power cuts on islands that rely heavily on hydroelectric, wind and solar power, by equipping residents' houses with intelligent power plugs that switch off attached appliances when they detect that the grid is starting to become overloaded. And, building on successful projects on the islands of Foula and Rum in Scotland, and Kythnos in Greece, Econnect is also looking at how its load controllers could enable wind power to be used more efficiently on a wider scale. Every little helps.