

Smart-grid 'stockbrokers' to manage your power

- 07 March 2011 by [Duncan Graham-Rowe](#) From issue [2802](#) of *New Scientist* magazine

It sounds strange, but leaving your cellphone plugged in when you're not using it could help cut your carbon footprint. Even better, it could reduce your electricity bill. We just need to start using smart-software agents - programs that act on our behalf - to manage how we store our electricity and charge our devices.

In many countries electricity is charged on a two-tier pricing system - peak or off-peak - even though the real cost of generating electricity varies much more widely, depending upon how much a customer base consumes. This is because in order to meet sudden surges in demand, caused whenever we all simultaneously reach for the kettle during a commercial break, say, additional generators that have been running at half speed have to be cranked up to provide extra power. It's an inefficient and costly system, says Alex Rogers at Southampton University's School of Electronics and Computer Science in the UK. "The ideal would be for the grid's load profile to be absolutely flat."

Nationwide networks of smart meters could one day help manage these peaks better, by feeding household usage data back to utility companies at regular intervals. But there is a growing belief that a centralised management of tens of millions of these meters won't be possible and that a more distributed approach is needed, says Nick Jennings, head of Intelligence, Agents, Multimedia Group, also at the University of Southampton. To create a truly smart grid, he says, what's needed are "smart agents".

"At the moment supply follows demand," says Rogers. This is not ideal, particularly for renewable energy, whereby you need to be using the power when the wind is blowing or the sun is shining. Software-agent systems could make it possible to recruit batteries already present in the home as temporary energy-storage units. Clever management would allow the batteries to smooth out peaks in demand by only drawing electricity when demand is otherwise low, and so the price is low, and storing it, says Rogers. But it's not just batteries inside our homes and gadgets which can be used to store power - electric cars will be able to do it too.

For the last three years Willett Kempton and Nathaniel Pearre at the University of Delaware at Newark [have been running](#) a fleet of seven electric vehicles as part of ongoing research into what is known as vehicle-to-grid, or V2G. Whenever any of these vehicles is plugged in, it communicates wirelessly with an agent-based server that manages the fleet as though it were a distributed utility company. Whenever the local grid company experiences a peak it can call upon the fleet's agents to give back some energy. V2G is also fast, and able to respond to the grid in less than 4 seconds, whereas spinning up a generator within 5 minutes would be considered extremely fast.

It pays to play

The real clincher for V2G technology, though, is that it pays. According to Pearre, each vehicle generates a gross revenue of about \$4000 a year, meaning that it is actually profitable to drive these cars. At the very least, electric vehicles could help our domestic software agents buy cheap energy. A typical electric vehicle runs off a 25 to 30-kilowatt-hour battery pack, roughly the same amount of energy a typical household consumes in a day, says Rogers: "You could effectively run your house off your car battery."

But it's not just about stabilising the grid. Since future smart meters should ideally create more of a varied pricing system for electricity, based on actual demand and cost, these agent-based systems will one day be able to monitor the prices continuously and "buy" electricity like a commodity, storing it in the batteries of our gadgets for later use. These agents could also become our very own energy brokers, with the sole purpose of reducing the cost of electricity to consumers.

Jennings and Rogers have shown in simulations that when armed with game-theory tactics aimed at getting the best deals on electricity, agent-based management systems turn the grid into a dynamic market place. And as with the software trading-agents used in modern financial markets, they tend to have a stabilising effect. Indeed, they found that even if less than half of the homes in the UK were to use this sort of energy management system, the market would reach a stable equilibrium but with enough price fluctuations to allow the average consumer to reduce their bill by about 13 per cent, an annual saving of around £1.5 billion across the nation.

To this end, the University of Southampton has just co-launched a £6.5 million [project called Orchid](#), aimed at developing semi-autonomous agents with this level of sophistication; capable of acting on their own, but which can also be controlled and customised by humans.

"It's interesting that they are taking an agent-based approach," says Gareth Taylor at the Brunel Institute of Power Systems in London. "At the end of the day, the user doesn't want to be thinking about these things, they want smart appliances doing it for them."