Albert Molderink

Our energy supplies will radically change when households start to generate some of their electricity themselves. Albert Molderink is developing new algorithms for energy management, in order to remove the consumption peaks.

Saving energy using virtual power plants

"Households can save a lot of energy in the future if they have a combined heat and power boiler installed, also known as a micro-CHP appliance (in Dutch: microWKK). This device replaces a conventional high-efficiency boiler. It generates electricity, as well as utilizing the heat it produces, or storing it for later use. Currently, we are researching the possibility of an islanded house, which is completely self-sufficient as regards electricity. However, this means it would have to be able to store electricity using batteries. A more attractive option would be to feed the excess electricity into the grid of a modest-sized islanded neighbourhood for example. If the electricity is consumed close to where it's generated, the transmission losses are kept down. A cluster of micro-CHPs could then combine to form a virtual power plant."

"To be able to use these new systems efficiently, we have to thoroughly study the supply and demand for energy. Today's power stations are geared towards the peaks in demand, the effect being that they run less efficiently at off-peak times. If you want to use a single micro-CHP or a cluster of micro-CHPs, you have to bring the energy produced and the demand into balance. With this in mind, we want to make the peak levels as low as possible. Accordingly, I'm studying energy consumption patterns and what can be done to achieve a more even spread. Good energy management makes optimum use of the combination of heat and power."

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"What becomes immediately clear is that people are creatures of habit. You can learn a lot about someone from their pattern of energy consumption. By installing sensors as well, we can obtain additional information. In this way, we hope to make reliable predictions and hence effective planning of the energy consumption. You'd really like to predict all aspects, but, for example, there's a limit on the number of sensors it makes sense to install. For one thing, the sensors themselves use energy, while we're trying to reduce the consumption. By the same token, the algorithm we use to determine the optimum planning must also be lightweight."

"I also look at each individual piece of equipment in a household to see if it can be used more intelligently. Suppose the supply of electricity is high at a given moment, maybe the fridge can be set to a lower temperature for a while, so that it uses less electricity later. Or the heat from the micro-CHP can be fed directly to the washing machine, so that it, too, will use less electricity."

"Another way to remove energy peaks is to defer many activities. If someone switches on the washing machine when they go to work, it doesn't have to start right away. The command could be the equivalent of: 'Only wash at low peak times, but make sure you've finished by the time I get home.' The same goes for an electric car battery that will need charging soon: 'Do the charging at low peak times, but make sure my car is ready to drive in the morning.'"

"For the virtual power plant to work, it is essential that you can depend on a certain proportion of micro-CHPs operating. Just as with solar energy and wind energy, there's a degree of supply uncertainty. Nevertheless, with six micro-CHPs for a group of 20 houses, for example, it's now possible to achieve promising results and a flat line for consumption. If someone still wants to use electricity during peak hours, I expect they'll have to pay more in the future. I certainly notice that I'm a lot more conscious of my energy use, as a result of studying these patterns. I no longer leave my PC on all day if I'm not using it."