Managing renewables intelligently

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OGEMA 2.0 is easy to use from your tablet, smartphone or computer. Credit: Kurt Fuchs/Fraunhofer IIS

Although more and more of our electrical energy is coming from sources where supply is variable – whether from wind turbines, solar parks or biomass facilities – grid structures, industry and private households alike are not yet prepared to deal with the inevitable fluctuations. Smart energy management systems are the way to put robust supply networks in place and to ensure that renewables are harnessed as efficiently as possible. Researchers from the Fraunhofer Energy Alliance will be showcasing their energy solutions for energy providers, small and

medium-sized enterprises and homes at this year's Hannover Messe from April 7-11.

"Wind, solar and biogas are all energy sources with their own strengths and weaknesses. And it's by combining the strengths of each in a smart way that we'll be able to guarantee Germany's energy supply into the future," says Dr. Kurt Rohrig, deputy director of the Fraunhofer Institute for Wind Energy and Energy System Technology IWES in Kassel. But what happens when, instead of a big power plant, you have a host of individual small energy producers feeding in energy to the grid at varying times? Is reliable operation of the grid still technically feasible? In the "Combined Power Plant 2" research project, both science and industry have answered the question with a resounding yes. Their concept: to use a software platform to bring together a multitude of small energy providers within a "virtual power plant."

Software platform brings decentralized providers together

Experts have already conducted a test showing that this setup does indeed work reliably in practice, having combined numerous wind parks, biogas and photovoltaic facilities delivering a total output of over 80 MW in a virtual combined-cycle power plant. Because small providers work together, regional variations in wind and sun can be evened out via the grid or using biogas facilities that can be regulated according to requirement. Surplus energy is either stored or converted into heat. The result is a powerful network that remains decentralized but can still operate as a larger unit in energy trading markets. And it's not just the facilities brought together in the virtual power plant that can be managed and monitored via the software platform; the energy generated can be marketed, too.

"The results of the Combined Power Plant 2 project demonstrate that network reliability can be guaranteed even when relying purely on renewables," says Dr. Rohrig. Fraunhofer IWES offers the relevant control mechanisms and forecasting systems for a variety of applications, including the Wind Power Management System and Regional Virtual Power Plant for the energy industry.

Dynamic energy management systems

More and more companies are generating energy themselves, using solar installations or systems that recover energy from manufacturing waste, in an effort to cut costs. Now, researchers from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg have developed dynamic energy management systems that manage distributed energy providers, storage and current energy consumption efficiently. Installed in a company, such a system determines whether enough renewable energy will still be available to charge the fleet of electric company cars once power has been supplied to the HVAC system. So that the system can operate fully automatically, the amount of energy required and the amount of power expected to be produced on a given day are measured at first for general planning. In the detailed planning stage, data are supplied for the next fifteen minutes. The researchers use neural networks trained specifically for the particular complex infrastructure to make a forecast, which the system then uses to optimize energy use in the next quarter of an hour automatically.

"We need to change our thinking from the now common generation of power geared toward consumption to consumption geared toward providers. Smart and dynamic management systems ensure that energy is used efficiently all the time," explains Dr. Przemyslaw Komarnicki from the Fraunhofer IFF.

Technologies for smart energy use in the home

With solar cells on the roof and small combined heat and power plants in the basement, homes are also generating energy. But the energy a household generates is seldom sufficient to meet its combined energy requirements throughout the year. The only option is to buy in energy – preferably when it is at its cheapest. "There are significant savings to be made if you can cleverly combine independently generated energy with variable energy tariffs and storage," says Jasmin Specht from the Fraunhofer Institute for Integrated Circuits IIS in Erlangen. In an effort to make this a reality, researchers from Fraunhofer IIS, Fraunhofer ISE and Fraunhofer IWES are working on an open software platform called OGEMA 2.0 that will allow modular energy management systems to be developed efficiently.

OGEMA 2.0 energy management systems can control energy producing, storing and consuming devices to achieve their optimal use. Not only do they facilitate the best possible use of independently generated energy in houses or apartments, they also allow users to store excess energy and to recall it when it is required. On top of providing key management functions, the system can also communicate with other participants in the smart energy network. This allows to actively contribute to supply stability and the inclusion into a virtual power plant.

Secure energy management via apps

The smart energy management system can be accessed via various interfaces, including smartphones, tablets and computers. For example, OGEMA 2.0 enables apps that tell users whether they would be better off using the energy generated by their solar cells themselves or whether they should feed it in to the grid. Such apps are also capable of tracking variable energy tariffs and automatically calculate when and how best to

use connected devices such as heat pumps, storage systems, air conditioning systems and other smaller consumers of energy. OGEMA 2.0 even helps charge electric vehicles cost-effectively, with the E-Car Communication Manager (ECM) coordinating communication among various charge spots (direct and alternating current), the driver and the car's battery system. The system features the maximum security level in line with the protection profiles of the BSI (Federal Office for Information Security). This means smartphone users also have secure access to OGEMA 2.0 while on the move.

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