The virtual power plant: Stable supply of electricity from renewable energies

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A conglomerate of many smaller power plants can replace traditional power plants. The research project Combined Power Plant 2 (Kombikraftwerk2) shows how it is possible to provide power using renewable energies both today and in the future, without increased risk of a blackout. Researchers of the Fraunhofer Institute for Wind Energy and Energy System Technology IWES in Kassel are introducing the project at the Hanover Trade Fair at Booth N71 in Hall 27 from April 8 to April 12, 2013.

"Each source of energy – be it wind, sun or biogas – has its strengths and weaknesses. If we manage to skillfully combine the different characteristics of the regenerative energies, we can ensure the power supply for Germany," predicts Dr. Kurt Rohrig, Deputy Director of IWES. The combined power plant shows: It is technologically possible to let each individual producer feed their electricity into the grid and have the grid remain stable during this process. To ensure that this will work, the IWES scientists and colleagues from the Siemens Group have developed a software platform as part of the E-Energy Initiative of the German federal government under the motto "Together we are strong", in which many small power plant operators can act together as a "virtual power plant".

The virtual power plant put to the test in practice:

Since January 2011, the scientists have such a power plant on trial in the

Harz regenerative model region (RegModHarz) – with very good results. Here, they have linked together via the Internet 25 plants with a nominal power output of 120 megawatts and, as simulated storage, a pumped storage power plant and electric vehicles. A central control ensures that the disadvantages of the renewable energies are reduced, because the sun does not always shine, and the wind does also not blow continuously. However, when many small producers work together then the regional differences regarding wind and sunshine can be balanced out by the power grid or controllable biogas facilities. In addition, surplus power can be stored or turned into thermal energy. A powerful network decentralized, can act as a larger entity. In order for this to work, the control room takes on two roles simultaneously: In its function as the "power plant facility manager", it monitors the facilities that are interconnected within the virtual power plant. And, acting as the "pool coordinator", it simultaneously markets the energy that was produced.

The software of the virtual power plant in the Harz region is being partially adopted for the Combined Power Plant 2 and expanded with grid stabilization functions.

Renewable energies can stabilize the grid In Germany, on some days of the year, the electricity being generated from sun, wind, biomass, water and geothermal production is already accounting for more than half of the load being required. "Ensuring that the electricity continues to reach the consumer reliably with a voltage of 230 volts and a frequency of 50 Hertz, that is a challenge that the regenerative energies will have to meet in the future," says Kaspar Knorr, project manager of the Combined Power Plant2 research project at IWES. The renewable energy sources will also have to increasingly make contributions to the ancillary services. In the current system that is geared towards a few central producers, primarily traditional power plants ensured that these requirements were being met. In their project, the scientists are modeling in detail what the power supply system of the future will look

like and how the individual facilities might be distributed across Germany. They also determine the requirements for ancillary services such as frequency and voltage stabilization, black start capability and inertia reserve, so that the renewable electricity will stably reach the consumer.

"Due to their decentralized character and innovative developments, the renewables can contribute to stabilizing the power supply system already today. With the Combined Power Plant 2, we are able to show what changes are in store for our power supply. And we demonstrate how the renewables master this task and how they can ensure the stable supply of electricity in the future, as well," emphasizes Knorr.

Research project and partner:

The "Kombikraftwerk2" research project examines how a power supply fed only by renewables could work and what kind of ancillary service requirements there will be. The experts determine possibilities, at the same time, how the plants for renewable energies can provide these ancillary services that are necessary for grid stability. The solution approaches are tested at real facilities. The partners of the consortium are: CUBE Engineering GmbH, German Weather Service, ENERCON GmbH, Fraunhofer Institute for Wind Energy and Energy System Technology IWES, ÖKOBIT GmbH, Department of Electrical Power Supply of Leibniz University Hanover, Siemens AG, SMA Solar Technology AG, SolarWorld AG and the Agency for Renewable Energies. The project is sponsored by the German Federal Ministry for the Environment and follows up the Combined Power Plant 1 project that was begun already in 2007 which, among other things, indicated the feasibility of an electrical power supply that is based solely on renewable sources.

A current film on the Combined Power Plant2 research project shows

the technical modules and challenges being faced in order to have a supply of electrical power that is stable and derived exclusively from renewable resources.

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