Storing green electricity as natural gas

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Throughout the world, electricity generation is based more and more on wind and solar energy. So far, the missing link for integrating renewable energy into the electricity supply is a smart power storage concept. Because when the wind is blowing powerfully, wind turbines generate more electricity than the power grid can absorb. Now, German researchers have succeeded in storing renewable electricity as natural gas. They convert the electricity into synthetic natural gas with the aid of a new process. The process was developed by the Center for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW), in cooperation with the Fraunhofer Institute for Wind Energy and Energy System Technology IWES. Currently, Solar Fuel Technology, the Austria-based partner company, is setting up the industrial implementation of the process. One advantage of the technology:it can use the existing natural gas infrastructure. A demonstrationsystem built on behalf of Solar Fuel in Stuttgart is already operating successfully. By 2012, a substantially larger system -- in the double-digit megawatt range -- is planned to be launched.

For the first time, the process of natural gas production combines the technology for hydrogen-electrolysis with methanisation. "Our demonstration system in Stuttgart separates water from surplus renewable energy using electrolysis. The result is hydrogen and oxygen," explains Dr. Michael Specht of ZSW. "A chemical reaction of hydrogen with carbon dioxide generates methane -- and that is nothing other than natural gas, produced synthetically."

With the rapid expansion of renewable energies, the need for new storage technologies grows massively. This is of special interest for energy utilities and power companies. "So far, we converted gas into electricity. Now we also think in the opposite direction, and convert electricity into 'real natural' gas," explains Dr. Michael Sterner of Fraunhofer IWES, who is investigating engineering aspects and energy system analysis of the process. "Surplus wind and solar energy can be stored in this manner. During times of high wind speeds, wind turbines generate more power than is currently needed. This surplus energy is being more frequently reflected at the power exchange market through negative electricity prices." In such cases, the new technology could soon keep green electricity in stock as natural gas or renewable methane.

"Within the development of this technology, ZSW has been guided by two core issues," explains Michael Specht: "Which storage systems offer sufficient capacity for fluctuating renewable energies that depend on the wind and weather? And which storage systems can be integrated into the existing infrastructure the easiest?"

The storage reservoir of the natural gas network extending through Germany is vast: It equals more than 200 terawatt hours -- enough to satisfy consumption for several months. The power network has only a capacity of 0.04 terawatt hours by

itself. The integration into the infrastructure is simple: The natural gas substitute can be stored like conventional natural gas in the supply network, pipelines and storage systems, in order to drive natural gas cars or fire natural gas heating systems.

The new technology aims at facilitating the integration of high shares of fluctuating power generation from renewable energies into the energy system. One goal is to structure the delivery of power from wind parks on a scheduled and regular basis. "The new concept is a game changer and a new significant element for the integration of renewable energies into a sustainable energy system," adds Sterner. The efficiency of converting power to gas equals more than 60 percent. "In our opinion, this is definitely better than a total loss," says Michael Specht. A total loss looms if, for instance, wind power has to be curtailed. The predominant storage facility to date -- pumped hydro power plants -- can only be expanded to a limited extent in Germany.

In order to push the new energy conversion technology forward, the two German research institutes have joined together with the company Solar Fuel Technology of Salzburg. Starting in 2012, they intend to launch a system with a capacity of approximately 10 megawatt.

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