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Press Release

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Megawatt electrolyzers – efficient helpers moving the energy transformation along

Fraunhofer ISE opens new laboratory in Freiburg

The Fraunhofer Institute for Solar Energy Systems ISE has opened its new laboratory for water electrolyzers in Freiburg. Now large systems in the megawatt range can be investigated and characterized. Fraunhofer ISE specializes in polymer electrolyte membrane (PEM) electrolyzers, which are known for their extremely rapid response times. Because of this, they are a good choice for producing hydrogen from fluctuating renewable electricity sources for the mobility sector or for energy storage. With such systems in the grid, the problems associated with the planned grid expansion become less urgent.

"Almost one percent of the annual electricity production in Germany is currently being wasted due to curtailed wind power production during grid overload," explains Dr. Christopher Hebling, division director of Hydrogen Technologies at Fraunhofer ISE. "In spite of this, the wind park operators are still reimbursed for the disposed energy and the costs are added onto the electricity price. By placing PEM electrolyzers at the overloaded grid nodes, however, the grid operators can start within seconds to produce energy-rich hydrogen from surplus wind or solar power, which would otherwise be disposed of. The produced hydrogen can be either used directly for fuel cell vehicles or be converted with carbon dioxide into fluid fuels or basic chemicals (Power-to-Liquid)."

For 25 years, the Institute has been a leader in PEM electrolyzer development, a technology which is gaining ever

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more importance worldwide. Beside its much high power density, the fast modulation of the PEM electrolyzer is its greatest advantage over the alkaline electrolyzer used to date. A PEM electrolyzer can be switched from standby to nominal power within seconds. Upon demand, it can even operate at twice its nominal power for up to 15 minutes. This means that for a system with one megawatt nominal power, the grid control center can convert up to two megawatts surplus power into useful hydrogen and that at 75 percent efficiency.

Fraunhofer ISE has extensive experience in the development and operation of PEM electrolyzers. The key component of an electrolyzer is a membrane cell consisting of two electrodes: the anode and cathode. Upon applying a voltage across the electrodes, water is converted into oxygen and hydrogen. The dimensions of the cell area determine the amount of overall current which is needed to produce the hydrogen. Researchers are presently working on large cells up to 1500 square centimeters which can be operated at nominal currents of up to 4000 amperes. 250 cells each with 4000 amperes achieve together one megawatt of power demand. Such dimensions are becoming increasingly relevant in order to carry out frequency and voltage stabilization in the grid. Simulations show that in order to reach the German government's goal to reduce carbon dioxide emissions by 2050 (at least 80% compared to 1990 values), 30 GW installed electrolyzer capacity is required in the distribution grid in a cost-optimized scenario.

Hydrogen is an easily storable carrier of energy. Stored in salt caverns, it can even provide seasonal long-term energy storage in a future energy system. Depending on the political policy, sustainable methanol could soon be economically produced from hydrogen and used to make either basis chemicals or diesel substitutes such as OME (oxymethylene ethers).

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In an energy system based on renewables, a segmentation of the mobility sector could occur, where, for example, battery-electric vehicles predominate in urban areas. Hydrogen would dominate the long-haul routes, fleets and public bus transportation. Renewable liquid fuels would be used for ships, heavy goods vehicles and aviation.

"Water electrolyzers act as efficient helpers who work quietly in the background to support a sustainable energy system," sums up Hebling. "They can use the abundant yet fluctuating electricity supplied by renewables to provide an economical and reliable power supply - also for industry. The biggest impediment hindering the fast dissemination of electrolyzers is not technical but rather due to the burdens imposed on them in grids from the EEG cost allocation and grid fees. As such, the regulatory framework prohibits the creation of interesting business models for private investors. At least for grid-coupled systems with renewable electricity, the burden on electrolyzers should be reduced."

Text of the PR and photos can be downloaded from our website: www.ise.fraunhofer.de

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Test setup for water electrolyzers ©Fraunhofer ISE

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