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DLR scientists achieve solar hydrogen production in a 100-kilowatt pilot plant

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Hydrogen production using solar energy

In the future, hydrogen can play an important role for the energy industry as an energy carrier. For the first time, scientists at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) have now successfully set up a 100-kilowatt pilot plant which uses solar energy to produce this important energy carrier in a renewable, CO2-free way.

Solar energy is by far the most widely available source of energy on Earth. Hydrogen, on its part, is an excellent energy carrier thanks to its high energy density. Moreover, the combustion of hydrogen produces only water and heat. For more than six years already, solar research at the DLR Institute of Technical Thermodynamics (DLR-Institut für Technische Thermodynamik) has been aimed at developing innovative reactors for the solar, thermochemical splitting of water, in the context of the HYDROSOL I and II EU projects. In these reactors, solar energy is used directly to split water into hydrogen and oxygen, bypassing the need to generate electrical power first. The research results obtained in the 10-kilowatt power range have now been successfully applied in a 100-kilowatt pilot plant.

The plant, which has been set up at the Plataforma Solar de Almería (PSA), has a novel solar reactor and was only officially inaugurated this spring. At the moment, its size and level of automation already make it an important prototype for future industrial plants. The reactor technology for this plant was

developed by DLR. The reactor is heated to 800 to 1 200 degrees Celsius by concentrated solar radiation. These temperatures then allow hydrogen to be extracted from water.

"Solar" hydrogen is a CO2-free energy store

Solar tower: DLR developed reactor technology

Renewable hydrogen production using solar energy and the resulting storage of solar energy by this chemical energy carrier are of the greatest technological and economic interest for the energy industry. After an extensive thermal qualification of the solar tower plant, which took place this summer, the plant was recently fitted for the first time with solar absorbers covered in a special coating that enables them to split water and thus to produce hydrogen in a CO2-free way.

Towards commercial application

The successful production of hydrogen marks an important milestone in the ongoing HYDROSOL II project, the more so as the hydrogen yields that were already achieved early on far exceeded expectations. Over the next few months, the hydrogen production tests on the so-called SSPS tower (Small Solar Power System) at the Plataforma Solar de Almería will be continued and stepped up. The primary focus will be on optimising the plant's operating conditions and efficiency. Additional tests using differently coated solar absorbers should then provide pointers to the best materials to use.

The design of the 100-kilowatt pilot plant is based on a modular concept. As a result, this technology can be readily scaled up to the megawatt range. This can be done by multiplying the available reactor units and by connecting the plant to heliostat fields (fields of sun-tracking mirrors) of a suitable size, such as the ones already used commercially in Spain and elsewhere to generate electricity.

Heliostat field in Almería

The HYDROSOL project has already received international accolades

The HYDROSOL project is implemented by an international consortium of partners from Germany, Spain, Greece, Denmark and the UK. Because of its potentially far-reaching consequences, the research and development conducted in the context of HYDROSOL I has received a number of awards, including the Descartes Research Prize of the European Union and the Technical Achievement Award of the International Partnership for the Hydrogen Economy.

In the field of solar research, the DLR Institute of Technical Thermodynamics is one of the leading institutions in the world specialising in concentrating solar power systems. Its objective is to develop, in cooperation with industrial partners, concentrating solar power systems for heat, electricity and fuel generation in order to achieve a sustainable energy supply. In addition to test facilities and laboratories in Cologne and Stuttgart, the research team also has access to the largest European test centre for concentrating solar technologies, the Plataforma Solar de Almería in Spain, through a permanent on-site delegation.

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