To the Media

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Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Location: Meitnerstr. 1,
70563 Stuttgart
Germany

More Efficient Direct Air Capture of CO_2 for Regenerative Fuels

New ZSW pilot plant up and running well

Electric cars powered by green electricity or renewable hydrogen will make tomorrow's transportation more climate-friendly. Aircraft and ships, however, are sure to run on hydrocarbon fuels for some time yet. A sustainable way of producing these fuels is to combine green hydrogen with carbon dioxide (CO_2). The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) has developed a more efficient and more affordable process to capture CO_2 from the atmosphere for use as a feedstock. Rather than relying exclusively on electricity for power, the trick is to use the waste heat produced in other steps of this process to help cover its energy demands. Scientists have been running successful trials with this new process since April 2019 at a demo plant in Stuttgart. This research effort is part of the CORAL project, an acronym made up of the German words for CO_2 as an airborne resource. The Federal Ministry of Education and Research is supporting CORAL with a €755,000 grant.

This short video clip shows how the new process works (in German only): www.zsw-bw.de/mediathek/filme.html

The atmosphere is a practically inexhaustible and renewable source of carbon dioxide. It can be tapped anywhere in the world to produce regenerative fuels that help curb the greenhouse gases emitted by vehicles, industry and power companies. Other sources of concentrated CO_2 are less well suited for this purpose. Biogas, for example, is a local rather than global resource containing a finite amount of carbon dioxide. The carbon dioxide emitted by fossil-fuel power plants is not where it needs to be for future use. On top of that, CO_2 of fossil origin may contain contaminants.

Scientists develop a CO_2 separation process

Earlier methods of capturing CO_2 from the air relied exclusively on electricity for power, which is less efficient and holds little economic appeal. The CORAL research project aims to redress that, which is why its scientists first identified the most efficient and cost-effective method, and then set up a test facility.

"We use a chemical that binds with CO_2 and is soluble in water to extract carbon dioxide from the air – that is, to separate it from nitrogen and oxygen. When air is blown through this solution, the carbon dioxide remains suspended and can be released again later," says Dr. Ul-

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rich Zuberbühler, Deputy Head of the ZSW's Regenerative Energy Sources and Processes division. To this end, the scientists developed a process that involves scrubbing with an aqueous solution and subsequent CO_2 desorption. The researchers use electrical power to blow air through the scrubber. The waste heat produced by electrolysis and a methanation unit such as a power-to-gas plant then serves to expel the CO_2 from the solution.

This final step slashes total energy consumption and costs. It takes just four to five kilowatt hours of waste heat and only one to two kilowatt hours of electricity to filter a cubic meter of CO_2 out of the air. Without the energy from the waste heat, this would require around three times as much electricity. The reused waste heat brings this new process's costs down to a level that could well compete with those incurred by commercial CO_2 suppliers, which extract CO_2 mostly from fossil sources. The gas's quality and purity are on par with the prevailing standards. ZSW researchers are now working out the plant's exact consumption levels and investigating its long-term behavior.

Useful for producing e-fuels

This new process is sure to intrigue operators of green electricity plants that lack ready access to sources of concentrated carbon dioxide. The method developed by ZSW researchers looks to be an economically and ecologically sound solution for these operators. “CO_2 extraction is a very interesting option when using vast amounts of electricity to produce e-fuels – that is, electricity-based regenerative fuels – in places like Chile and Australia that have excellent solar and wind conditions, but lack extensive power grids or sources of concentrated CO_2,” says Zuberbühler by way of explanation.

The ZSW is collaborating with the University of Stuttgart's Institute of Polymer Chemistry (IPOC) and the Heidelberg Institute for Energy and Environmental Research (ifeu) in the CORAL project. The ZSW's brief is to coordinate the project, and build and operate the test plant. IPOC is pursuing several aims that include developing new materials for reversible CO_2 adsorption based on monolithic polymers and fabrics made of cellulose fiber. ifeu is conducting lifecycle analyses to gauge the technology's efficiency and environmental impacts, and compare it to other methods.

About ZSW

The Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Württemberg, ZSW) is one of the leading institutes for applied research in the areas of photovoltaics, renewable fuels, battery technology, fuel cells and energy system analysis. There are currently around 260 scientists, engineers and technicians employed at ZSW's three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants.

Media contacts ZSW

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ZSW's pilot plant produces one cubic meter of CO_2 per hour.

Photos: ZSW

Images are available from Solar Consulting or at https://energie.themendesk.net/zsw/.

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