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

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A Resource Out of Thin Air

ZSW Coordinates Project to Extract CO_2 for Manufacturing Plastics and Fuels

Carbon dioxide (CO_2) is a greenhouse gas. However, it can also be a valuable resource—for example, for making plastics or renewable fuels—that could eventually replace the fossil fuels natural gas and oil. Extracting CO_2 from the air can contribute to the fight against climate change in several ways. It reduces the concentration of the greenhouse gas in the atmosphere. The chemical industry can then put this CO_2 to good use. It may even be converted into renewable fuels, all of which would drastically reduce future emissions. A project called CORAL—an acronym made up of the German words for CO_2 as an airborne resource—is underway to determine which extraction process works best. Trials will then be conducted in a suitable testing facility. The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) is coordinating the project. Its partners are the University of Stuttgart's Institute of Polymer Chemistry (IPOC) and the Heidelberg Institute for Energy and Environmental Research (ifeu).

Most chemical products such as plastics, gasoline, diesel and kerosene are based on oil and natural gas. These fossil fuels will have to be replaced by renewable resources. "Carbon dioxide is one of these resources and air is a practically inexhaustible regenerative source," notes Dr. Ulrich Zuberbühler, deputy head of ZSW's Regenerative Energies and Processes division. The three-year CORAL project is investigating ways to tap CO_2 from air. The scientists involved in the project are determined to present an economically and ecologically sound solution that will benefit plant operators, especially those who do not have ready access to concentrated sources of CO_2.

Several technologies are able to extract CO_2 from the air so that it can be used for fuel synthesis. CORAL is aimed to identify the most efficient and cost-effective process for further development. The next step is to build a facility to test this process. "We want to demonstrate that key chemical compounds such as methanol, dimethyl ether and propylene can be produced using renewable resources only," says project manager Zuberbühler.

"CO_2 extraction from the air will be particularly important for power companies at remote locations," says Zuberbühler. "For example, wind farm operators on the Chilean coast could convert their electricity into the regenerative fuel sources hydrogen and methane in on-site power-to-gas plants. The CO_2 needed for methanation could be extracted from the air so it would not have to be brought in from locations

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thousands of kilometers away. And there would be no need to build power lines because electricity is converted and stored as chemical energy." The waste heat from the electrolysis and methanation process can be used to generate CO_2. This would reduce the processes' overall energy consumption, which is another important objective of the project.

ZSW is coordinating the project and focusing on building and operating the test plant. IPOC is developing new materials for reversible CO_2 adsorption based on monolithic polymers and fabrics made of cellulose fiber. And ifeu is conducting lifecycle analyses to investigate the technology's environmental impacts and compare it to other methods. For example, scientists want to know to what extent this would reduce CO_2 emissions in comparison to today's production methods, if any toxic substances escape into the environment when the CO_2 system is built and operated, and what resources this will require.

ZSW constructed a pilot plant back in 2009, successfully demonstrating that concentrated CO_2 can be extracted from the air for use in converting electrical power into methane (power-to-gas or P2G®). Based on this experience the researchers of ZSW, IPOC and ifeu have joined forces to search for new solutions.

The Federal Ministry of Education and Research is supporting the project with a €755,000 grant from the CO_2Plus research funding program.

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 230 scientists, engineers and technicians employed at ZSW's three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants.

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Pictures and a fact sheet on ZSW are available from:

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