Kopernikus Project P2X

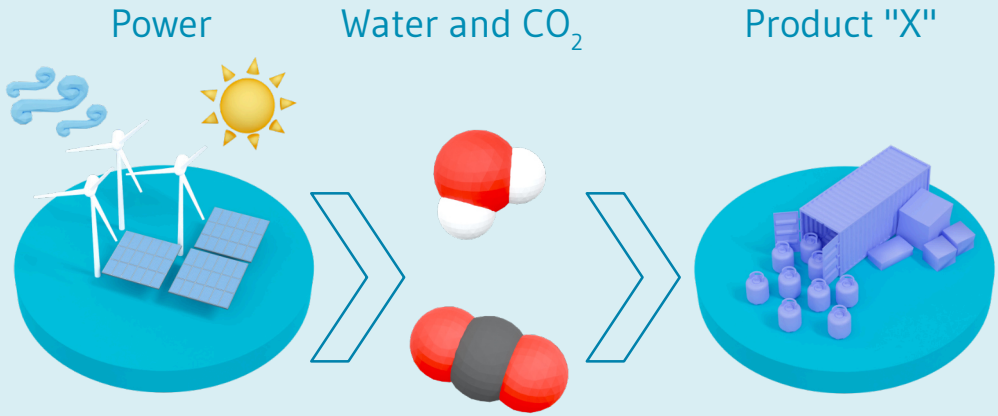
Results of the second funding phase

KOPERNIKUS PROJEKTE
P2X
Die Zukunft unserer Energie

P2X for the energy transition

Industries face the great challenge of mitigating CO_2 emissions and finding sustainable alternatives to fossil resources. Power-to-X technologies (PtX), which are being developed by 42 project partners from science and industry in the Kopernikus project P2X (Power-2-X), represent an important contribution to the success of the energy transition. The project aims to use renewable energy to produce hydrogen (H_2) and apply it where direct electrification is not possible. The objective is to replace fossil raw materials and to develop new production routes for the chemical industries, through which sustainable products can be manufactured from water, CO_2 and electricity based on renewable energy.

Meanwhile, the Kopernikus project P2X is in the second of a total of three funding phases and has already made significant progress in the areas of hydrogen production, infrastructure and the development of fuels, plastics, cosmetics and glassware production.



POWER-to-GAS

Electrolysis

With renewable electricity, water is splitted into hydrogen and oxygen via electrolysis. Two approaches are being pursued within the Kopernikus project P2X: In addition to water electrolysis, CO_2 is also converted into CO in co-electrolysis. Thus, depending on the intended use, pure H_2 or an H_2/CO mixture (synthesis gas) can be produced. One of the most important project results is the optimisation of electrodes for PEM water electrolysis, which manage with greatly reduced iridium loading (up to 10 times lower), thus reducing costs. For high-temperature co-electrolysis (approx. 850 °C), the process control was improved so that the synthesis gas mixture can be varied as desired. In addition, the integration of a module in a power-to-liquid system was successfully demonstrated. In this system, the heat generated during the Fischer-Tropsch reaction can be used to heat the electrolysis, which increases its efficiency. In addition, a CO_2-to-CO electrolyser was developed in the low temperature range (below 100 °C), whose electrolysis cell could be scaled up from 300 cm² to 5000 cm².

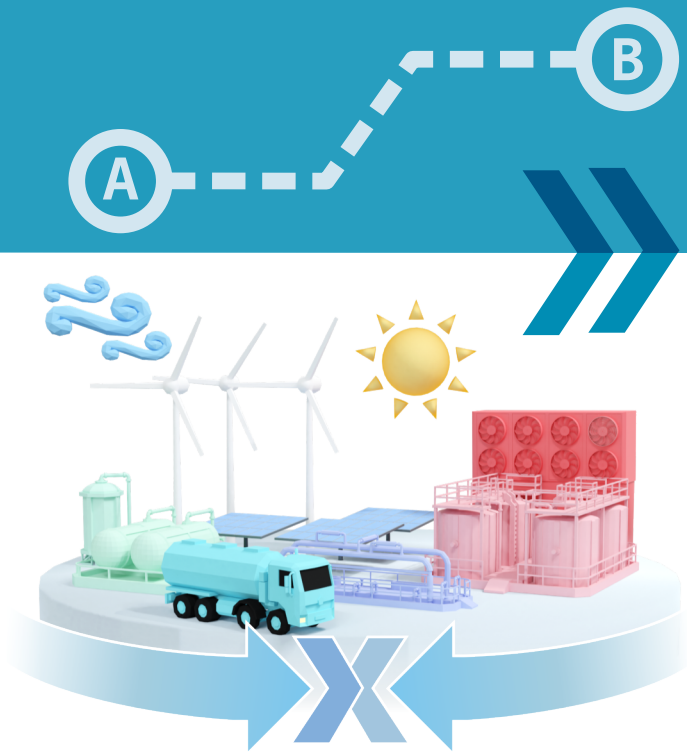
INFRASTRUCTURE

H_2-Transport

By using liquid organic hydrogen carriers (LOHC), it is possible to chemically bind H_2 in liquid form. Compared to the gaseous state, the bound H_2 can be stored in much higher energy density and transported with existing infrastructure such as tankers. In contrast to H_2, the LOHC are difficult to ignite in the loaded and unloaded state. In the second phase of the project, reactors, catalysts and the hydrogen carrier were optimised.

H_2-filling-station

In addition, a concept for a H_2-filling-station is being developed. A feasibility study describes the necessary technical components and shows the most favourable filling station configuration.



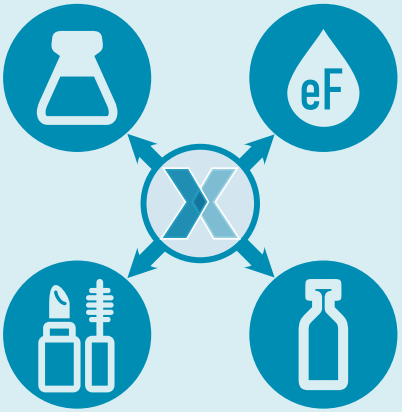
APPLICATIONS

Polymers

Too much CO_2 in the atmosphere harms the climate. In the chemical industry, it can be a valuable raw material. In the Kopernikus project P2X, new reaction routes are being developed with which CO_2 is first converted into different formaldehyde derivatives. In the next step, these molecules can be converted into polymers, which can be used as foam for mattresses or in sports shoes. A patent application now exists for the production and use in the field of adhesives. The focus of the project is shifting from the development of reaction routes towards industrial feasibility.

Care products

Green H_2 (from electrolysis) and CO_2 can also replace fossil resources in the cosmetics industry. For this purpose, CO_2 is converted by microorganisms through fermentation into long-chain alcohols, which can be a starting material for various raw materials for cosmetics. In the second phase of the project, it was possible to increase the yield of the long-chain alcohols and optimise the cultivation conditions.



Fuels

Synthetic fuels (also called e-fuels) are to be used everywhere where direct electrification lacks technical maturity, for example in aviation, shipping and heavy goods transport. The project is testing a modular container system that can be used to produce e-fuels in a decentralised manner. It contains all the essential components to produce fuels from water and CO_2 from the air. In the second funding phase, it was possible to produce standard conforming fuels such as kerosene, petrol and diesel.

Glassware production

Glass production is particularly energy intensive and could become more climate-friendly through the use of PtX. A test for glass melting with hydrogen instead of natural gas was successfully completed within the project. It was possible to achieve a similar burner performance at comparable temperatures as in conventional operation with natural gas and oxygen. The quality of the innovatively produced glass was also comparable to that from conventional production.

» Roadmapping

A roadmap continuously evaluates the feasibility and potential of the different PtX technologies. These are imperative for achieving the climate goals, which was shown by the economic, ecological and social analyses carried out along a uniform model (up to 2045) developed in the project.

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Foto: WWF Deutschland

Communication & educational work

PtX products will become part of everyday life in the future, e.g. in cosmetics or sports articles. Therefore, it is important to provide information about the development of PtX products and to make them known to the general public at an early stage in order to lay the foundation for their acceptance. For this reason, the project's scientific and technical work is accompanied by a variety of communication and educational measures. This includes various event formats for experts, interested citizens and students. To explain the subject in a vivid way, the project cooperated with influencers who creatively presented the topic of PtX on their channels. Additionally, a virtual reality world makes PtX "tangible", an e-learning course provides further insights and even more educational content can be expected by the Kopernikus project P2X.

Consortium

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