Fraunhofer IWES

Data and facts

Hydrogen Lab Leuna – Green hydrogen in the chemical industry

The Hydrogen Lab Leuna (HLL) is one of a total of three hydrogen labs already in operation or being set up at Fraunhofer IWES. The Hydrogen Labs offer for the first time a digitally networked infrastructure with testing and qualification capacities for the electrolysis and fuel cell systems totaling of up to 26 megawatts (MW), required for the energy transition. They can address almost the same basic requirements, but also set special research priorities. The result is a globally unique range of pilot plants along the entire value chain of the hydrogen economy. Fraunhofer IWES is able to control the allocation of testing capacities and the utilization optimally. Customers thus receive precisely tailored supraregional offers.

In the Central German Chemical Triangle, the Fraunhofer-Gesellschaft is making a new generation of test infrastructure for hydrogen technologies available with the HLL funded by the State of Saxony-Anhalt and the EU. Embedded in the material network of the Leuna Chemical Park, the HLL offers three separate test stations in the outdoor area for electrolysers up to 5 MW, which are supplied with deionized water, steam, compressed air, nitrogen and hydrogen. There is also a 2 MW test stand for stack tests and other smaller test stands in the technical center up to approx. 50 kW. In the future, the outdoor area will be supplemented by further test stations for Power-to-X pilot plants. The green hydrogen produced is analyzed on site, purified, and fed directly into the 157-km-long H_2 pipeline, from where it is distributed to the industrial sites in the region for use in chemical processes. Fraunhofer IWES is the owner and operator of the HLL infrastructure.

Overview of services

- H_2 generation: Continuous and stress testing, load-flexible operation of electrolyzer systems of any type (PEM, SOEC, AEL, AEM) up to 5 MW and electrolyzer components up to 50 kW, supplemented by new stack tests up to 2 MW in real operation with renewable energies, testing of auxiliary units.
- Integration in the chemical industry: Supply with media (deionized water, steam, N_2, H_2, compressed air) and feeding of produced H_2 into pipeline.
- Power-to-X technologies: Coupling of electrolyzers with processes for chemical use of H_2 on a pilot scale.
- Performance evaluation: Electrochemical evaluation of stacks, cells, and electrolyzer components up to 300 cm², development of test protocols, model-based data analysis and correlation. Microstructural fault diagnostics (in cooperation with the Fraunhofer IMWS).
- Technoeconomics: Modeling of real-world operating scenarios for cost-optimized design of electrolyzers, storage units, etc., especially in operation with renewable energy sources.
- Analysis and preparation of process flows: Real-time monitoring of H_2 and O_2 purity, GC-MS trace analysis. Preparation, parallel process simulation for assessment and optimization of parameters possible (in cooperation with Fraunhofer CBP).

Testing of electrolyzers on an industrial scale

The HLL offers the capacity for testing of industrial-scale electrolyzers of any type – PEM, AEL, AEM, or SOEC – in 24/7 continuous operation, with the possibility of simulating dynamic load profiles during operation with electricity from photovoltaic systems and wind turbines in order to investigate the performance, cost-efficiency, and long-term behavior in real-world operation as well as in accelerated aging tests. The data collected will provide the basis for future certification, which will form operators with assurance about the reliability and efficiency of such plants.

The Fraunhofer IWES' competences in electrochemical analysis make it possible to trace degradation phenomena on critical components such as membranes and bipolar plates back to material properties and utilize these findings for the continuous further development of materials and components. In addition, test stands for electrolyzer stacks from 4 kW to 2 MW enable the testing of new components as well as operation under particularly challenging conditions (mechanical and thermal stress load).

Commodity chemicals from green hydrogen

The green hydrogen produced at HLL can be used in partnership with the Fraunhofer CBP for the decarbonization development of chemical load-flexible processes. The integration of the HLL into the Leuna Chemical Park and its materials network allows innovative processes for sector coupling to be demonstrated on a pilot scale and tested under realistic conditions directly at the chemical industry site.

This offers SMEs in particular an excellent, time- and cost-saving way to scale up new technologies with the aim of faster product development and market launch as well as to develop them further under Fraunhofer's scientific guidance. This will be followed by the Leuna 100 project with the project partners C1, Fraunhofer UMSICHT, DBI and the TU Berlin, another innovative research project on a pilot scale for the load-flexible production of green methanol continued. The investment volume for the HLL amounted to over EUR 10 million.

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Further information

Fraunhofer IWES develops innovative methods to accelerate the expansion of the wind energy and hydrogen economy, minimize risks and increase cost efficiency. Innovations in technological developments are validated and innovation cycles are shortened. Planning and development of offshore wind farms are accelerated and made more precise. At present, there are more than 300 scientists and employees as well as more than 100 students employed at the nine sites: Bochum, Bremen, Bremerhaven, Görlitz, Hamburg, Hannover, Leer, Leuna, and Oldenburg.

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