Fraunhofer IWES

Data and facts

Hydrogen Lab Bremerhaven – Focus on challenge of offshore production

The Hydrogen Lab Bremerhaven (HLB) 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.

At the Hydrogen Lab Bremerhaven (HLB), the focus is on the integration of hydrogen technologies into the energy and economic system now and in the future. The increasing decentralization of power generation resulting from the integration of renewable energy sources places high demands on power grids, which have been designed for the parallel operation of centralized large generators until now. In the context of offshore wind farms, too, the development, assessment, and operation of which are among Fraunhofer IWES' key competences, there is a considerable need for development in order to ensure the security of supply. The production of green hydrogen, H_2, has a high potential to increase the security of supply in decentralized power grids by smoothing out supply and demand peaks, for example, by means of the production and reconversion of H_2 into electricity. The focus of the research activities at the HLB is especially on the interaction between wind turbines and different electrolyzer technologies on a real-life scale, the profound, cross-sector integration of electrolysis (e.g., through the use of heat), and the use of reconversion technologies for microgrid- and grid-supporting applications. In the scope of the H_2Mare flagship project, IWES is investigating integrated seawater desalination among other aspects.

The HLB, which has been funded by the State of Bremen and the EU, tests this approach on up to twelve test areas ready to accept a total capacity of up to 10 MW. The energy will primarily come from wind power, that is to say directly from an 8 MW wind turbine installed on site or from partners in the energy economy with corresponding wind energy capacities in their portfolios. Above all, the direct interaction between the fluctuating power feed-in from wind energy with electrolyzers, especially with regard to the electrical properties, is an open research area.

Hydrogen CHP at the HLB testing area with the AD8-180 offshore wind turbine prototype in the background.

One fundamental building block for the electrotechnical integration is the direct connection to the virtual 44 MVA medium-voltage network at the Dynamic Nacelle Testing Laboratory (DyNaLab). Among other things, this allows typical grid faults such as voltage dips to be emulated with a high repetition frequency. The high-performance grid emulator allows the conduction of static tests, in order, for example, to determine the active and reactive power output under different grid conditions. Dynamic changes in the grid frequency can also be specifically emulated and their effects on the test specimen investigated.

The areas for the test operation of electrolyzers are designed in such a way that either each test specimen can be operated independently of the activities at the other test areas or multiple test areas can be operated together. This modular concept makes it possible for interested industrial companies to utilize the HLB as an independent test and validation platform for their own development or planned major investments so as to gain additional insight and security with regard to operational and financial risks in the scope of specific, individual questions. Furthermore, the HLB team is intensively involved in the development and implementation of international norms and standards, with the aim that these globally relevant and recognized performance criteria and guidelines can also be tested at the test fields.

The operation of the HLB will also produce a significant quantity of green hydrogen. As such, the integration of the production, storage, and use of hydrogen for the development of a local hydrogen economy also falls within the research infrastructure's spectrum of activities. For example, storage capacity in H_2 gas tanks will be reserved for the distribution of green hydrogen to the region. This is complemented by cooperations with local research partners, who will investigate the use of H_2 in the food industry as well as the production of synthetic natural gas (SNG) and methanization processes among other topics. The investment volume in plant technology amounted to €12.9 million.

Overview of services

- Production: Testing of electrolyzers in the single-digit megawatt range.
- Storage and reconversion into electricity: Stationary storage at low pressures and semi-mobile storage at high pressures. Fuel cells and combined heat and power (CHP) plant available for reconversion.
- In addition to electrolyzers, it is also possible to investigate systems for H_2 application at the test areas.
- Import and distribution: Storage and transport via mobile storage units, fueling systems possible.
- Mobility: Testing of (stationary) fuel cells possible, projects with local shipping industry are being pursued.
- Testing for manufacturers in the field of hydrogen technologies prior to market launch, independent validation for operators of hybrid energy farms, commissioning, evaluation, and optimization of innovative technology components.
- Digital Integration: Validation of system models, prediction of optimized operation and identification of potential challenges.
- Test bench for integrated seawater desalination.

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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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