

Hydrogen Production at Sea

Researchers at the Fraunhofer Institute for Solar Energy Systems ISE, together with project partners, have developed a technical concept and design for a hydrogen production facility optimized for use at sea. Results have shown that it is technically and economically feasible to produce hydrogen directly at sea using a PEM electrolyzer. The work was carried out as part of the two-year »OffsH2ore«.

The task of the overall project was to develop a technically and economically optimized design for an integrated offshore hydrogen production plant using proton exchange membrane (PEM) electrolysis, including a concept for transporting the compressed gaseous hydrogen onto land. The energy for the electrolysis is supplied by an offshore wind park. The results now obtained can serve as a blueprint and starting point for the development of pilot and large-scale projects and the preparation of the corresponding regulations. Until now, offshore hydrogen generation at the scale envisioned by the project, 500 MW, has not yet been realized. With the concept presented by the consortium, rapid and large-scale implementation has become realistic.

Hydrogen production without competition for land use:

»Green hydrogen, obtained sustainably from renewable energy sources, will become an important pillar of the defossilization of our energy system. For countries like Germany, where the large-scale production of green hydrogen is already a challenge due to such factors as the competition for land use, for example, the production of hydrogen at sea with offshore wind energy is an additional option,« explains Marius Holst, who, as coordinator, was in charge of processing the work packages for Fraunhofer ISE. »Hydrogen production at sea offers not only high full-load hours, but also the chance to cover the entire value chain at the national level, while at the same time decoupling offshore wind expansion and expansion of the grid.«

The basis of the concept is an offshore wind park that is directly connected to a 500-MW electrolysis platform. This can produce up to 50,000 tons of green hydrogen per year. The system has a scalable, modular construction that can easily be adapted to different hydrogen production capacities. Fresh water for the PEM electrolyzer is obtained from the desalinization of sea water using the waste heat generated by the electrolysis process. The hydrogen produced is cleaned and dried, compressed up to 500 bar, and loaded onto a transport ship. Up to 400 tons of hydrogen per shipload can be delivered from the offshore platform to land. This concept is independent of hydrogen transport lines and offers flexibility in the choice of location.

Offshore PEM electrolysis is technically and economically feasible:

The work packages of the ISE included the projection of a PEM-electrolysis module. The researchers were able to demonstrate that offshore hydrogen production using PEM electrolysis is technically and economically feasible. »PEM electrolysis is the preferred technology for the offshore environment. With this electrolyzer, we can adapt to the limited space available on the platform and make use of the dynamic operating behavior of this type of electrolysis,« With PEM electrolyzers, operators can react quickly to fluctuations in the energy supply and operate the electrolyzer without any problems, even at partial load.

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Thanks and Regards,

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