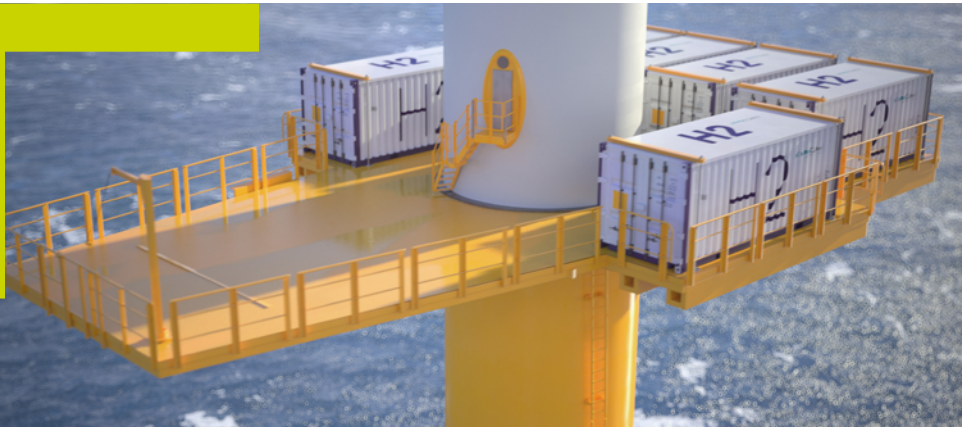


H₂Mare Update

02 / 2022



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Offshore green Hydrogen production: H₂Mare

At sea, conditions are ideal for generating renewable electricity. The focus of this project is on the generation of renewable power from wind. Offshore wind turbines are much more productive and operate more consistently than their onshore counterparts.

The H₂Mare flagship project centers on the development of an innovative wind power plant which, for the first time, will allow green Hydrogen to be produced at an offshore plant using an integrated platform concept. The pioneering project also envisages the production of Hydrogen derivatives at sea.

Advantages:

- More remote marine areas can be used
- No application process or construction phase for grid connection
- Strain is taken off the electric transmission network
- Costs are much lower in comparison with production on land

H₂Mare aims to make a significant contribution to Germany's position as a Hydrogen producer within the project's four-year time frame, and to support the nation in achieving its climate goals by accelerating the reduction in greenhouse gases.

Project facts and figures

Partners:

32 (plus two associated partners)

Funding level:

over EUR 100 million

Project duration:

April 1, 2021 to March 31, 2025

H₂Mare is one of three Hydrogen flagship projects funded by the German Federal Ministry of Education and Research (BMBF) as part of efforts to implement Germany's National Hydrogen Strategy.

Dear readers,

All around the world, Hydrogen and its derived products have now truly come to the fore and are part and parcel of public debate. Gaining an in-depth understanding of Hydrogen technologies used to require attendance at a specialist conference or leafing through a trade magazine. No longer! These days you'll find mention of Hydrogen in all manner of places and in all possible media formats. But "Hydrogen production at sea?!" That's still an unfamiliar concept for most.

The last few weeks and months have seen a whole host of exciting events and in-person gatherings. Many people – perhaps you included – took up the invitation of H₂Mare Coordinator Matthias Müller in the previous editorial to engage with us and our H₂Mare partners. And the general reception has been staggering – from the open house day at the Federal Ministry of Education and Research in Berlin to the AICHEM trade show for the process industry in Frankfurt and WindEnergy Hamburg – the interest in the offshore production of Hydrogen and its derivatives has been huge.

Such events gave us the chance to provide answers to numerous key questions and convince many of you of the benefits of our innovative approach. That said, many challenges need to be addressed in the coming months and years before this technology, which has an essential part to play in reaching net-zero and meeting climate goals, will be ready for commercial use.

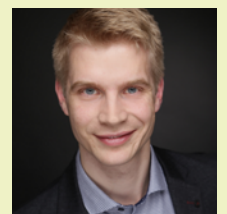
Our second newsletter will focus on the initial progress achieved by our 32 project partners from research and industry and explore developments across H₂Mare's four projects: OffgridWind, H₂Wind, PtX-Wind and TransferWind. We hope this insight will encourage further dialog and we look forward to hearing from you.

I hope you enjoy reading our updates. Please feel free to share any queries or comments via the contact details provided – or why not come and meet us in person at an upcoming event?

With best wishes,

Jens Artz,

DECHEMA e.V., TransferWind Subproject Coordinator



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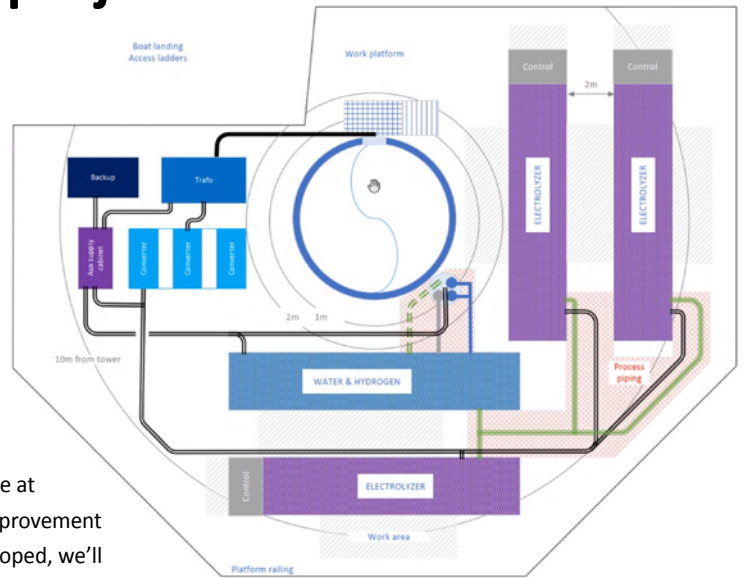
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Latest news from our subprojects

OffgridWind

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As part of the OffgridWind project, all the partners involved are working on combining a wind turbine with the electrolyzer. Now that the initiative has successfully got underway, more attention is being paid to the finer details. Plans are in place for the creation of test structures, with some of these already in construction. What's more, further investigation work is being carried out on the particulars of the platform to ensure an optimized positioning of individual containers. This goes hand in hand with investigations into the optimized maintenance intervals of specific parts to ensure that servicing and maintenance can take place at sea. Further in-depth consideration is now also being given to the improvement of energy management. As soon as the model is sufficiently far developed, we'll start integrating it into existing wind plant models, to which the complete control logic will be applied. This will then be implemented into the onshore testing facility in 2023/2024 and further enhanced during the testing phase.



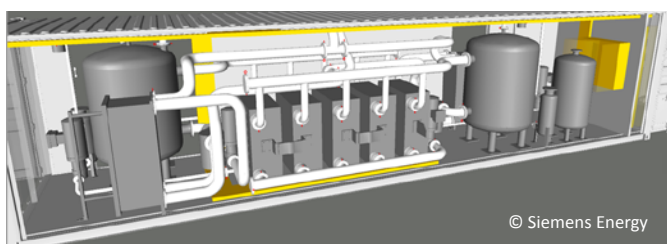
Test arrangement of the electrolyzer on the platform (still with cable connection as back-up)

H₂Wind

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For cells to withstand the extreme demands of offshore operation, advancements in cell and stack design are vital. To this end, efforts are underway to fine-tune the new cell design for PEM (proton exchange membrane) water electrolysis. Test sites are being set up, with the aim of closely recreating all the myriad conditions of offshore operation. Wind simulation, for example, is made possible through development of a test profile that reflects offshore wind conditions by mapping dynamic wind supply information in the performance data.

In terms of refinements to the membrane and materials, research is being carried out on the pressure resistance and gas permeation of membranes at different load and pressure levels. In addition, a series of measurements is being performed that will look into the effect of contamination on cell aging. Two other key areas – water treatment and system management during wind lulls – are also undergoing scrutiny and refinement. Initial test results for the water treatment system are expected by the end of 2023. As for container layout, a number of different scenarios are being assessed. Among the primary considerations are ease of maintenance at sea as well as handling in relation to assembly and transportation.



Container layout of the electrolyzer system

TransferWind

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In addition to a wide range of technical R&D initiatives, TransferWind is particularly concerned with exploring the overriding issues surrounding different sustainable value chains. As well as looking at the way the offshore location affects construction, standardization and scaling, the project is working to identify possible prospects and investigate the environmental and safety aspects of energy carriers produced offshore and their supply.

Since the last newsletter, this highly dynamic process has already started delivering exciting results. These include the appraisal of relevant offshore regulations and the creation of an integrated water management system for power-to-X applications as a starting point for the general concept of isolated offshore production sites.

In order to achieve a successful transfer of knowledge to the general public, a high degree of acceptance for these new technologies must be fostered within society at an early stage. With this in mind, TransferWind staged a workshop that delved into the subject of acceptance management, with contributions from science and industry experts from all H₂Mare subprojects. Find out more in this edition's guest article.

The Science Committee, a wide-ranging expert forum, provides a platform for discussing controversial issues, initially on an internal project basis. Its aim is to foster a consensus and establish a common foundation for the analysis of entire value chains. The next meeting of the Science Committee is scheduled for early 2023. External input with regard to overarching themes, such as regulation, standardization and technical issues, is always welcome.

PtX-Wind



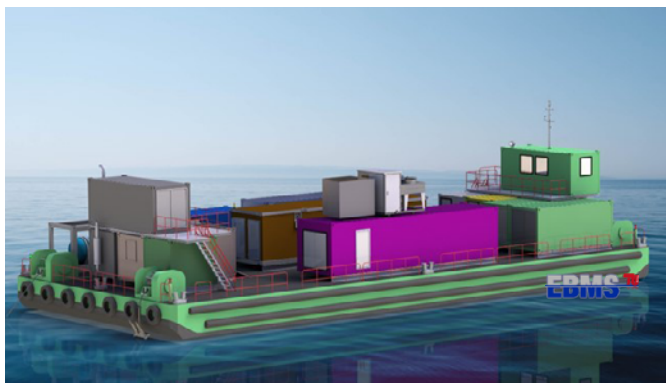
© Karlsruhe Institute of Technology, IMVT

Energy Lab 2.0 research facility at the Karlsruhe Institute of Technology (KIT). Here, direct air capture with solid oxide electrolysis from the German Aerospace Center (DLR) is being linked up with Fischer-Tropsch synthesis with product upgrading from KIT. The University of Stuttgart is in charge of providing the superordinated process control system.

As part of the PtX-Wind project, over the past months a great deal of effort has been channeled into the modular containers which will initially be set up at the KIT Energy Lab 2.0. There, individual modules from various partners will be connected up, commissioned and tested, before they are deployed out at sea.

The planned plant configuration for the offshore test platform has also been finalized. The system essentially comprises direct air capture (DAC), solid oxide electrolysis (SOEC) and Fischer-Tropsch synthesis with integrated product upgrading. The product upgrading process, consisting of hydrocracking and hydrotreatment for the purposes of hydrogenation, splitting and isomerization, will be combined with subsequent product separation. This will enable the direct production of e-kerosene from airborne CO₂, electricity and water. Commissioning of the Fischer-Tropsch container at the Energy Lab 2.0 is planned for March 31, 2023. Further areas of exploration are seawater desalination for the supply of demineralized water and wastewater treatment. A superordinated process control system will enable customized operation.

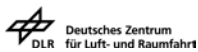
To allow individual modules to be used in offshore areas, these will first be positioned on a floating test platform. Important factors to bear in mind, here, are the power supply, material storage as well as the logistics for supplying the platform. Once they have been put through their paces at Energy Lab 2.0, the containers will be transported to the test platform and then recommissioned and retested in a safe harbor location. A trial offshore operation will then go ahead when suitable weather conditions arise.



© TU Berlin, EBMS

Generic illustration of an offshore test platform from the PtX-Wind project. The test platform is being designed in a collaborative effort by TU Berlin university, the DLR, EnBW, Siemens Gamesa, Northland Power, Wind MW and KIT.

Powerful partners supporting Flagship Project H₂Mare !



Guest article on acceptance management

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Information, communication and participation – how acceptance management can support the build-out of renewables

Guest article by Marlen Sunnyi Bohne, Project Manager at the German Offshore Wind Energy Foundation



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The success of the energy transition is reliant on the rapid expansion of renewable energy sources, and that includes the ramping up of green Hydrogen technologies and Hydrogen derivatives. For this to happen, widespread societal acceptance of new technologies and their practical applications is absolutely essential. This can prevent potential conflicts and resistance, and can also result in the proactive involvement of the general public and other stakeholder groups. One approach is to employ acceptance management techniques, including information and communication campaigns and the creation of opportunities for participation. A workshop on this subject was organized by the German Offshore Wind Energy Foundation. Held on August 30, 2022, this initial knowledge transfer event saw around 45 industry and research experts taking part in a four-hour webinar.

Introductory talks on the theoretical principles of acceptance research and practical findings were accompanied by interactive sections. As part of this, attendees were asked to devise possible measures, based on an illustrative Hydrogen project life cycle, and work out the opportunities and stumbling blocks that would be faced when putting them into practice. The conclusion was that renewable energy is generally held in positive regard. However, concerns do remain and, moreover, there are still gaps in people's knowledge that need to be filled by providing a continuous flow of information and engaging in two-way communication.

The video recording of the event can be accessed [here](#).



Events

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H₂Mare on show!

H₂Mare Conference on June 8 and 9, 2022, in Berlin

In early June, the H₂Mare network met in Berlin for its first on-site project conference. Day one was open to the public and also streamed online. Its aim was clear and simple – to provide a general overview of H₂Mare.

On the second day it was down to business, with much hard work and discussion centering on internal project particulars. The talks by Siemens Gamesa and RWE professionals were particularly helpful. The overall message was that the technical risks of combining offshore wind power generation and Hydrogen production are minimal. On the other hand, the opportunities and prospects are virtually limitless and global in scope. All participants agreed that working proactively with (local) stakeholders is especially important. A possible lack of resources and the recycling of raw materials are key issues and could hold up plans for expansion.



The H₂Mare Conference was a complete success and has taken the project a step further forward.



ACHEMA from August 22 to 26, 2022, in Frankfurt am Main

H₂Mare also put in its first-ever appearance at this year's ACHEMA in Frankfurt. ACHEMA is a leading international trade fair specializing in chemical plant construction and hence attracts a different audience to the usual wind energy customers. This made it all the more exciting to see what kind of conversations we would have. The opening podium discussion was extremely popular, while the following session, which included presentations on H₂Mare, also witnessed constructive and hearty debate.



The trade booth was well attended, with science enthusiasts and many supplier representatives keen to talk to us.



AquaSummit on August 28, 2022, in Salzgitter

At the end of August, our team was given the fantastic opportunity to present an update on the H₂Mare project at the annual meeting of the AquaVentus initiative. The overall aim of AquaVentus is to establish up to 10 gigawatts of offshore wind-enabled production capacity for green Hydrogen by 2035 in the German sections of the North Sea and to put in place the necessary transport infrastructure (via the associated AquaDuctus project). The presentation was extremely well received and sparked many highly interesting conversations.



WindEnergy from September 27 to 30, 2022, in Hamburg

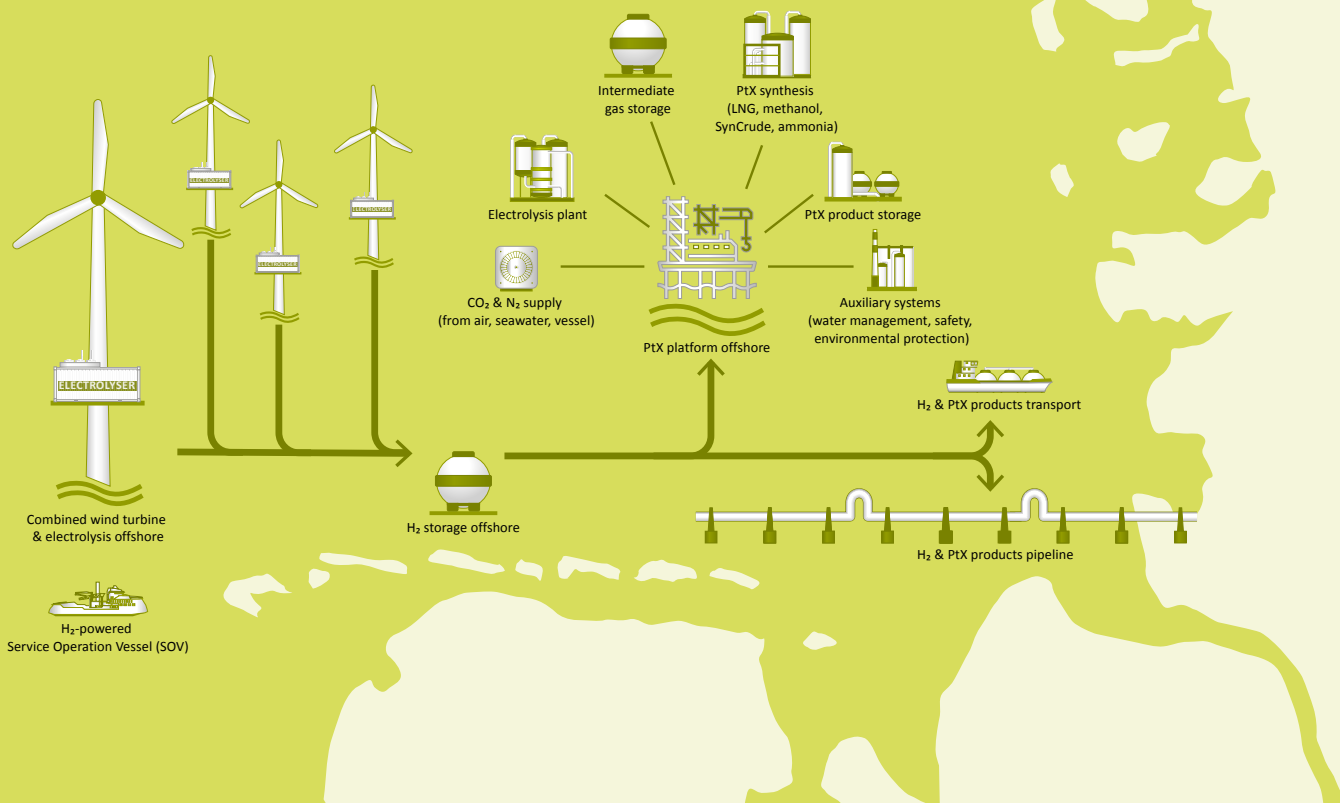
It was with great anticipation that H₂Mare's Technology Platform Office (TPO) set about preparing for its presence at WindEnergy Hamburg, which was held at the end of September. And for good reason: This is the go-to trade show attended by virtually everyone in the entire wind industry! H₂Mare exhibited alongside the two other Hydrogen flagship projects, H₂Giga and TransHyDE, at their shared booth in Hall A2.

Expectations were not disappointed! Klaus Litty, TPO Project Manager, summed up the event: "The considerable interest among wind farm operators, project developers and component suppliers at a national level and especially from Asia shows that our H₂Mare project is meeting a real and significant industry need. We are now considering how we can better exploit the opportunities that are emerging for the H₂Mare consortium in order to drive offshore Hydrogen production forward at an even greater pace."



The high level of demand and enthusiasm displayed by visitors to our booth at WindEnergy Hamburg has proved to us that, by focusing on Hydrogen production at sea, we are on the right path to meeting climate objectives.





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This newsletter is published twice a year
 in English and German.

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 Potential of H₂ & PtX
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