

H₂Mare Update

01 / 2023



Focus on green offshore energy

What is the state of play in the H₂Mare hydrogen flagship project? This year's H₂Mare Conference on June 12 and 13, 2023 in Frankfurt/Main revolved around current topics, progress and challenges surrounding research into the offshore production of green hydrogen and derivatives.

In addition to status updates, a series of technical presentations, an expert panel, and ample time for exchange and networking, the program also included a poster exhibition for the more than 100 project partners and guests from science, industry, politics and the professional public, which provided information on current work and initial interim results from the project. The topics of the two-day conference ranged from electrolyser membrane models to offshore maintenance work and air- and water-based emissions from platforms. Issues of acceptance and related communication with civil society were also topics of discussion.

H₂Mare project coordinator Matthias Müller reminded the audience of the need and urgency to act against the backdrop of climate change. The following speakers included Till Mansmann, Member of the German Bundestag and Innovation Commissioner for Green Hydrogen at the German Federal Ministry of Education and Research (BMBF). In his address, he emphasized the great potential of offshore hydrogen for the energy transition. Water technology expert Andrew Walker underlined the great importance of water as a raw material in his following keynote speech.

More pictures and impressions of the event on page 5 and [LinkedIn](#). >>>

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Dear readers,

You are now holding the new H₂Mare newsletter in your hands. Time almost flew by and the project is already past the halfway point. We have used this time well and made great progress in all joint projects. We have also shown this to the public at the trade fairs and events in which we (and you?) have participated.

In H₂Mare, on the way to our goal we discovered that there are also other worthwhile variants of implementation. The good coordination between the partners made it possible to react flexibly to new requirements and to implement sensible changes to the plan in order to move quickly towards the common goal.

At events, we always experience great interest in the state of affairs and in how things will continue after the project. Exploration of further detailed issues will then be added to the agenda. The demands of end users have continued to grow, and interest in this innovative way of generating renewable energy with a wind turbine capable of producing hydrogen is increasing significantly. It is already foreseeable: Everything we invent and research in this project will benefit our children and children's children.

Activities in the national and international environment influence us - and in the other direction, we are also influencing them with our project: For example, cross-project working groups on regulatory issues have formed - together with partners from the other two flagship projects TransHyDE and H₂Giga, issues are being widely discussed and other aspects are being considered. And we are following the activities in Europe with great interest: Germany and Norway are pushing ahead with the construction of a new, large-scale offshore hydrogen pipeline.

There are also projects around the North Sea for which our progress and results are relevant. Here, individual partners repeatedly receive interested inquiries and invitations to explain these further and share findings. We are happy to comply with these invitations and to pass on what we have already discovered.

Best regards from Hamburg



Thomas Schwabe,
Siemens Gamesa – OffgridWind Coordinator

Latest news from our joint projects

OffgridWind

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Preparations at the test site in Floe/Denmark.

Siemens Gamesa

The integration of the turbine with the electrolyzer is proceeding according to plan. Preparations are currently underway for the scaled integration test, where two 1 MW electrolyzers will be tested on an existing onshore turbine.

RWE

A preliminary environmental impact assessment has been prepared. The result of this preliminary assessment will then determine whether an environmental impact assessment, including a carrier procedure, has to be carried out. Furthermore, the transport of the hydrogen via the pipeline and the possible options for a pipeline relocation were examined. The results can be used for discussion with the responsible authorities.

In addition, a preliminary foundation design was worked out. For this purpose, the loads to be transferred to the foundation were provided by Siemens Gamesa. In addition, a 3D visualisation was made in order to be able to better discuss the designs with all parties involved.



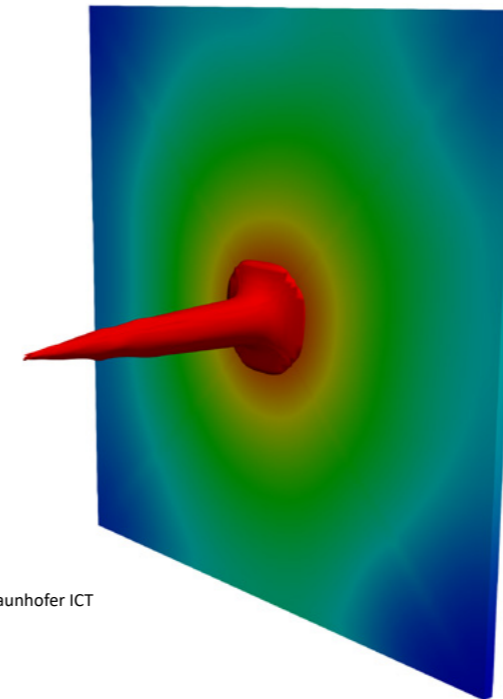
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Draft 3D visualization of a possible foundation design.



© Siemens Gamesa Renewable Energy

Cooling system for the electric energy converter at the hydrogen production plant in Floe/Denmark.



© Fraunhofer ICT

Temperature surface plot of the heated steel plate. The hydrogen jet flame is symbolized by an isosurface of the temperature.

Fraunhofer ICT

If an unplanned hydrogen leak ignites, for example due to a leaking thread or a pipe rupture, there is an immediate danger for people in the vicinity and the infrastructure on the wind turbine platform. It is conceivable, for example, that tank walls could fail, which in turn would lead to further hydrogen leakage. Within the framework of this project, a first step is being taken to investigate the heat effects of a hydrogen flame using CFD (Computational Fluid Dynamics) simulation.

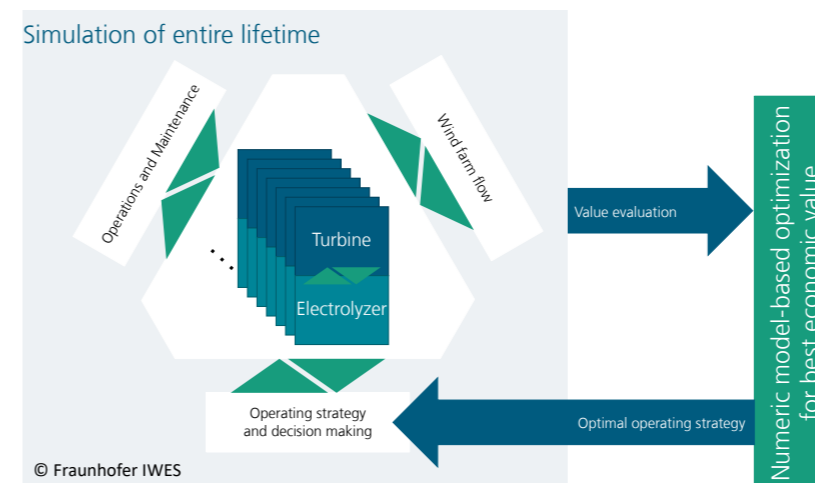
To validate the CFD model, an experiment is carried out in advance: A damaged thread is assumed to be the cause of a hydrogen leak. This is ignited and a flat steel plate is heated. The temperature is measured in the centre of the back of the plate. In the flow simulation software Ansys Fluent, a CFD model is built that simulates the validation case. Different options regarding the type of air and hydrogen inlet are tested and different turbulence models are investigated. In the next step, the validated model will be extended to include the calculation of thermo stresses and transferred to real application cases.

Fraunhofer IWES

In Q4/2022, the integration of the fuel cell into the HydrogenLab Bremerhaven and the test scenarios defined in this work package were developed. The fuel cell is expected to be commissioned in Q3/2023. The start of the measurement campaign and the subsequent evaluation of the data will take place by the end of 2023.

The simulation platform has been further developed and has now reached an intermediate stage that can be used as a prototype. Currently, the focus is on the implementation of models of the turbine, in particular on the modularization and partitioning of the necessary component models. The figure shows the division into models of the turbines with electrolyser and of the system;

overarching models on the level of a wind farm are linked to the set of all individual turbines. A technology comparison of energy converters (fuel cell vs. hydrogen combustion engine) for bridging power supply during windless periods was prepared and concretized. In an exchange with Siemens and Fraunhofer IWES, initial technical boundary conditions for the energy converter were defined for this purpose.



© Fraunhofer IWES

Numeric model-based optimization for best economic value

Interaction of coupled turbine and electrolyzer model with surrounding models for system-wide aspects.

H₂Wind

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In the more detailed investigation of the novel cell design for PEM water electrolysis, the mechanical cell and stack design have been finalized and long runner parts have been ordered. The first casting of the end plate has been successfully completed and meets dimensional accuracy. The stringent requirements of offshore operation have been defined and incorporated into the FEM (finite element method) calculations. For the experimental mechanical validation of the stack as well as critical system components, offshore-specific frequency spectra including acceleration amplitudes are defined in order to reproduce them on a shaker table.

In order to start the test operation in a timely manner, the setup of the planned test fields for the realistic mapping of offshore operation will be further advanced.

PtX-Wind

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In PtX-Wind, all project partners continue to work on the planning and construction of the individual demo plants for the PtX processes as well as the required infrastructure. This is supported by work on dynamic process simulation of all synthesis routes.

The focus of the work for the demonstration of the entire PtX process chain in a maritime environment for the production of synthetic fuels (Fischer-Tropsch synthesis) was the detailed elaboration of the design of the experimental platform and the clarification of the boundary conditions. Furthermore, work was started on the process control system for the operation of the platform.

Within the scope of the work for the purification of the various process effluents, detailed experimental investigations are underway at the partners, as well as for seawater desalination and the investigation of the supply chain of ultrapure water for the syntheses. This is supported by the development of models and concepts for water management and processes. At the moment, the focus is on methanol and methane production.

Investigations of the environmental impact on the platform as well as of the platform on the environment and society are an important part of the research. This is accompanied by acceptance analysis and stakeholder analyses. Factors in the population and in various interest groups for the acceptance of renewable energy projects were identified and statements were formulated on this basis. These statements will be used to gauge opinion and acceptance in future interviews.

The test profile, which shall reproduce offshore wind conditions, is defined and shall be applied in conjunction with a standard test profile for the qualification of the stack. From this, degradation rates shall be extrapolated over the lifetime of a stack. In the field of membrane and material optimization, investigations on gas permeation and degradation of membranes with a defined test profile will be performed. The first prototype for the seawater treatment plant has been completed and is in commissioning. The container layout of the electrolysis plant is being advanced in coordination with the platform design from the collaborative project OffgridWind in order to incorporate the structural mechanical requirements into the piping, electrical and structural design of the containers. In addition to ease of maintenance on the high seas, the focus is also on EHS (Environment, Health, Safety) requirements and the handling of materials with regard to assembly and transport.

TransferWind

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As a technical bracket around the joint projects, TransferWind is dedicated to overarching issues as well as knowledge transfer and communication.

A particularly important instrument within the project is the scientific panel, which is open to all project partners. Some relevant topics have been identified (e.g. buffers and storage, water management, regulation), which will be discussed more intensively in demand-oriented working groups.

With the inventory of regulatory framework conditions with regard to licensability, as well as concepts for a regulated and safe construction and operation, as well as requirements of environmental law, some gaps could be identified that could inhibit technology development and realization. This was confirmed most recently during a public online workshop on 'Regulatory needs for offshore hydrogen production from the perspective of science and practice'. For this reason, the work on the topic of regulation will be expanded and intensified in the further course of the project in order to proactively promote rapid development of the legal framework.

In the area of education and training and knowledge transfer, initial findings from the project were translated into new teaching content. This includes, for example, the expansion of existing courses to include H₂- or offshore-relevant content (e.g. [DFI experimental course](#)), the creation of new lectures (at [KIT](#)), and the development of an [information module](#) on the classification and evaluation of green hydrogen in the Sustainable Development Goals (SDGs) of the United Nations (UN). In the context of the overarching knowledge transfer, an [online workshop](#) on the topic of 'Environmental Impacts at Sea' was held in March 2023 and a citizens' dialog on Helgoland in May 2023 (see also p. 7).

Events

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H₂Mare Conference 2023

Leading experts, updates and intensive discussions: impressions of the H₂Mare Conference in Frankfurt/Main.



Events

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Minister visits Hydrogen Flagship Projects at Hannover Messe

Bettina Stark Watzinger, Federal Minister for Education and Research, visited H₂Mare at Hydrogen + Fuel Cells Europe in April as part of a tour at Hannover Messe. At the joint stand of the three Flagship Projects, she informed herself about various hydrogen technologies and was given an insight into the current state of developments.

H₂Mare was also represented by project coordinator Matthias Müller and PtX-Wind coordinator Prof. Dr. Roland Dittmeyer, who answered questions about the offshore production of green hydrogen and

other power-to-x products in the Public Forum. A camera team from ServusTV also reported on H₂Mare in a feature on the Hannover Messe.

The Flagship Projects' booth was highly frequented on all five days of the fair. The international, diverse audience asked all kinds of questions about the project and showed keen interest in the innovative approaches pursued in H₂Mare. In addition to the H₂Mare newsletter, the unique H₂Mare boats were in great demand among the visitors.



Course on H₂Mare: Experts answered the visitors' questions thoroughly.

Minister Bettina Stark-Watzinger on a flying visit to the Hydrogen Flagship Projects' booth.

Next important events

Open Day at the BMBF
August 19–20 in Berlin
www.bundesregierung.de

Husum Wind
September 12–15 in Husum
www.husumwind.com

Hydrogen Dialogue
Dezember 6–7 in Nürnberg
www.hydrogendialogue.com

www.h2mare.de

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.

Acceptance management

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First Dialogue Forum Green Hydrogen on Helgoland

As part of the sustainability driven 'Green Week', the H₂Mare project partners Coastal Union Germany EUCC-D and FOUNDATION OFFSHORE WIND ENERGY invited interested citizens to the first 'Green Hydrogen Dialogue Forum' on the North Sea island of Helgoland on May 2, 2023.

The program, consisting of expert presentations and a panel discussion, was organized by Dr. Rebecca Ballstaedt (green steer), Dr. Laura Schmidt (Helmholtz-Zentrum hereon), Jonathan Hanto (Europa-Universität Flensburg) as well as Prof. Dr. Roland Dittmeyer and Prof. Dr. Harald Horn (both Karlsruhe Institute of Technology).

The discussion focused on topics such as risk impact assessment, transparent on-site communication and participation opportunities for the population as well as the technical implementation of the planned H₂Mare research platform off the coast of Helgoland. Nardine Stybel (EUCC-D) moderated the event. Around 25 visitors

took part. A [recording](#) of the event is available on the YouTube channel of the FOUNDATION OFFSHORE WIND ENERGY.



Technical presentation and discussion at Helgoland's 'Green Week'.

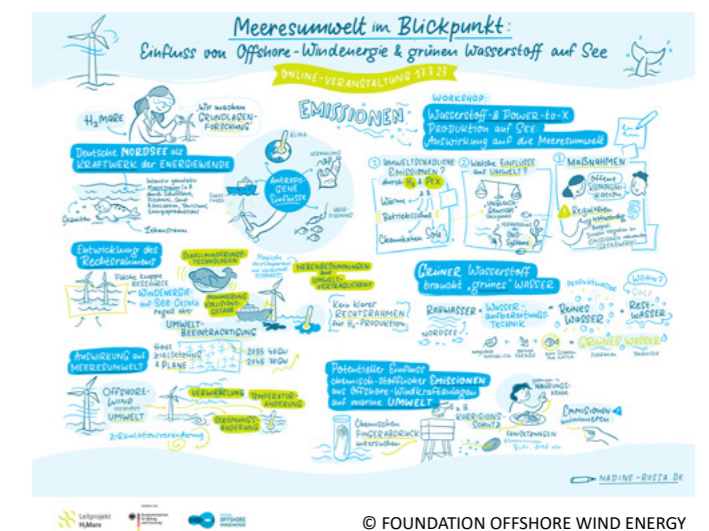
Knowledge transfer event focuses on impact of offshore energy on marine environment

TransferWind partner FOUNDATION OFFSHORE WIND ENERGY hosted its second online knowledge transfer event on March 17, 2023. The event, entitled 'Focusing on the marine environment: Impact of offshore wind energy and green hydrogen at sea', brought together around 70 experts from H₂Mare and the renewable energy sector.

Keynote speeches on the topic were given by Dr. Ursula Prall (cruh21), Prof. Dr. Corinna Schrum (Helmholtz Center hereon), Dr. Daniel Proefrock (Helmholtz Center hereon) and Nicolas Heyn (Terawater GmbH). The topics covered ranged from emissions from offshore-produced hydrogen to potential impacts on the offshore environment and measures to reduce negative emissions impacts.

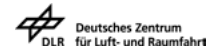
As it turned out, there is still a lack of a number of legal foundations on this complex of topics, both at national and European level. From the point of view of the participants, there is an acute need for action with regard to licensing procedures for offshore-produced hydrogen as well as fixed limit values for emissions. Research can make a significant contribution here by means of broad-based environmental monitoring.

The event was organized by Marlen Sunnyi Bohne and Dr. Matthias Wehkamp (both OFFSHORE-WINDENERGIE Foundation). A recording of the presentations is available on [YouTube](#).



Sketchnote capturing the highlights of the event by Nadine Roßa.

Our partners in the



Published by:

Technology Platform Office (TPO):

Matthias Müller (Siemens Energy)

Klaus Littig (Fraunhofer IWES)

Heike Gehritz (Fraunhofer IWES)

Christian Hiemisch (Fraunhofer IWES)

Britta Rollert (Fraunhofer IWES)

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



Contact us

h2mare@iwes.fraunhofer.de



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