

H₂Mare @ TEM 106

Hydrogen for 100% Renewable Energy Systems

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Agenda

1. Introduction
2. Overview & Set-Up
3. Focus: Offshore Hydrogen
4. Focus: Offshore PtX
5. Transfer and Further Focus

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The Hydrogen Flagship Projects

1.

The **three Hydrogen Flagship Projects** are the **central contribution** of the Federal Ministry of Education and Research (BMBF) to the **implementation of the National Hydrogen Strategy**.

Taken together, they represent the BMBF's largest ever funding initiative in the field of energy transition. They provide a **decisive impetus for Germany's entry into the hydrogen economy**.



Flagship Project
H₂Giga



Flagship Project
H₂Mare



Flagship Project
TransHyDE

H₂Mare

1.

H₂Mare does research on **offshore generation of Green Hydrogen** and **further Power-to-X Products** with new **offshore wind turbine** concepts.

The new turbine design comprises an integrated electrolyzer unit and does not need a grid connection.



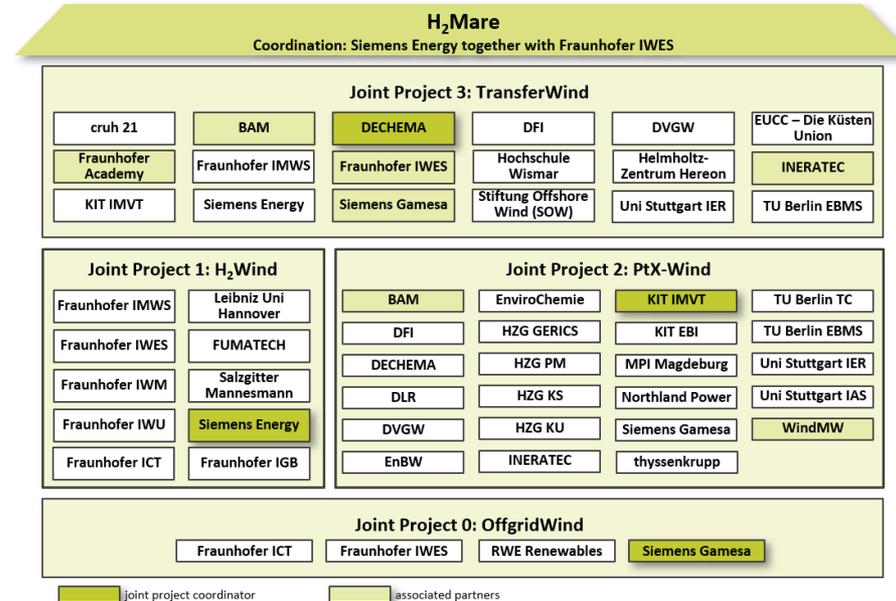
Source: © Siemens Gamesa Renewable Energy

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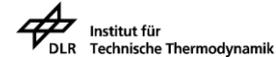
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H₂Mare – Basic Facts

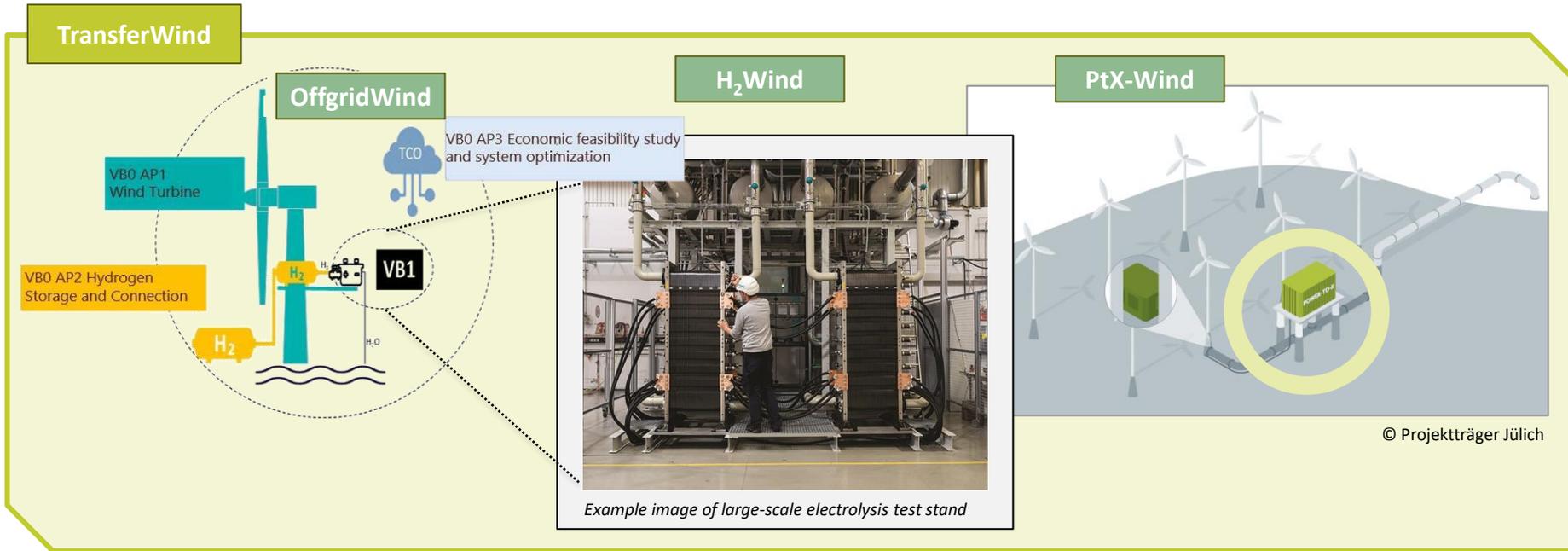
- 2. } Focus: **Autonomous production of green hydrogen and synthesis products offshore**
- } 32 partners
- } Divided into 4 projects (VB0 – VB3)
- } Requested project budget: ~ 150 M €
- } Funding-quota: ~ 70 %
- } Requested project funding: ~ 105 M €
- } Duration: April 2021 – March 2025



Powerful partners supporting H₂Mare



H₂Mare – Value chain in the overall context



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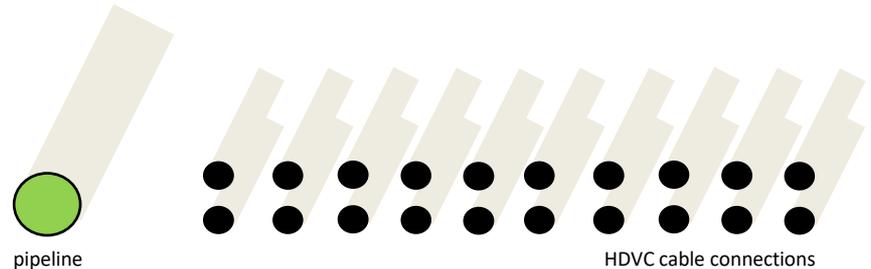
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Advantages of hydrogen offshore production

- For 5 wind farms with 2 GW (10 GW) electricity production each, 10 HVDC cable connections to the coast are needed according to the current state of the art; 5 in the future
- The amount of hydrogen derived from 10 GW can be transported with one link only



© AquaVentus



- Producing hydrogen offshore demands less material for the transport of the gas to shore
- Less space on the seabed is needed to produce hydrogen offshore (less environmental stress)

Decentralized Offshore Hydrogen Generation



“Plug and Play” containerized electrolyzer solution



Modified and adapted offshore wind turbine



- **CAPEX reduction** by replacing high voltage infrastructure with pipes network



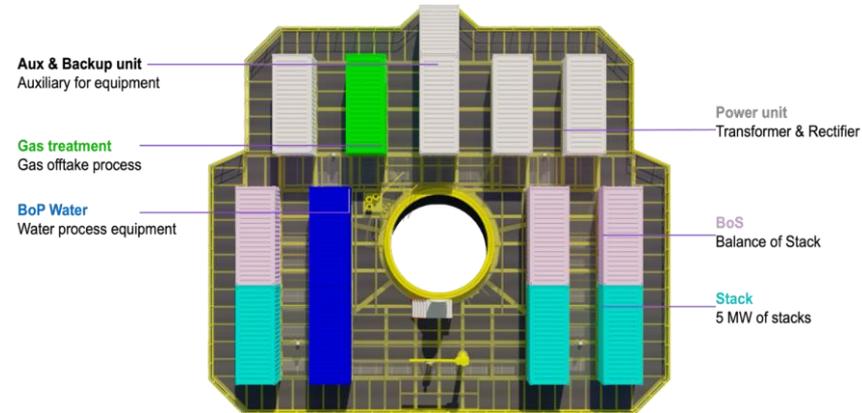
- **Increase of system efficiency** due to lower electrical losses



- **Increase of plant load factor** as electrolyzer load more flexible than electrical network requirements

OffgridWind: Status Quo

- Planning of the test setups and the associated components are being carried out
- Simulation of hydrogen production to determine the buffer volume
- Adjustment of the work progress due to technical changes that have become necessary
- Investigation of added value of a fuel cell compared to pure hydrogen wind turbine



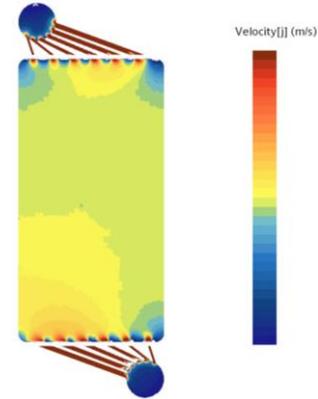
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H₂Wind: Status Quo I

- ▮ Novel, compact and pressurized cell design &
- ▮ Membrane and material optimization
- Design and Optimization ongoing

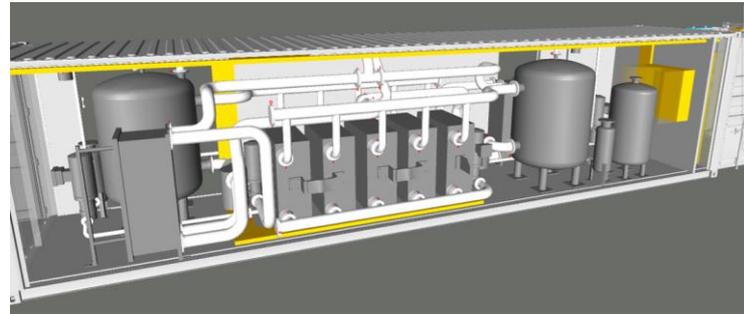
- ▮ Development of the offshore test profile
- Detailed investigations ongoing

- ▮ Assessments of all sub-systems in terms of offshore-application ongoing



H₂Wind: Status Quo II

- Water management
 - Test system for water treatment has been delivered
- Compact H₂ electrolysis system design
 - Work on the P&ID of the 5MW electrolyzer are progressing very well



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Scope of PtX-Wind

3.



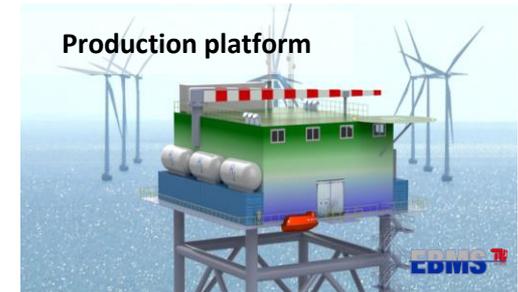
Graphic illustration of an offshore PtX production platform.
Source: TUB EBMS

- ▮ **Liquefied synthetic methane** from carbon dioxide and hydrogen (shipping fuel, replacement for natural gas in industry)
- ▮ **Methanol** from carbon dioxide and hydrogen (shipping fuel, chemical intermediate, further conversion to jet fuel or motor gasoline)
- ▮ **Ammonia** from nitrogen and hydrogen (shipping fuel, chemical commodity, hydrogen transport)
- ▮ **Liquid hydrocarbons** from carbon dioxide and hydrogen via the Fischer-Tropsch route (FT crude for international trade to be processed to jet fuel, marine diesel or Naphtha)

PtX-Wind different platform types

- Development of designs for research and production platforms, storage concepts and logistics

3.



- 10 kW_{el} (input electrolysis)
- Implementation in Energy Lab 2.0 and later offshore
- Operating time: months

- 5 MW_{el} (for initial calculations)
- Detailed concept as a result of the PtX-Wind project
- Operating time: years

- 100 MW_{el} (for initial calculations)
- Concept as a result of the PtX-Wind project
- Operating time: decades

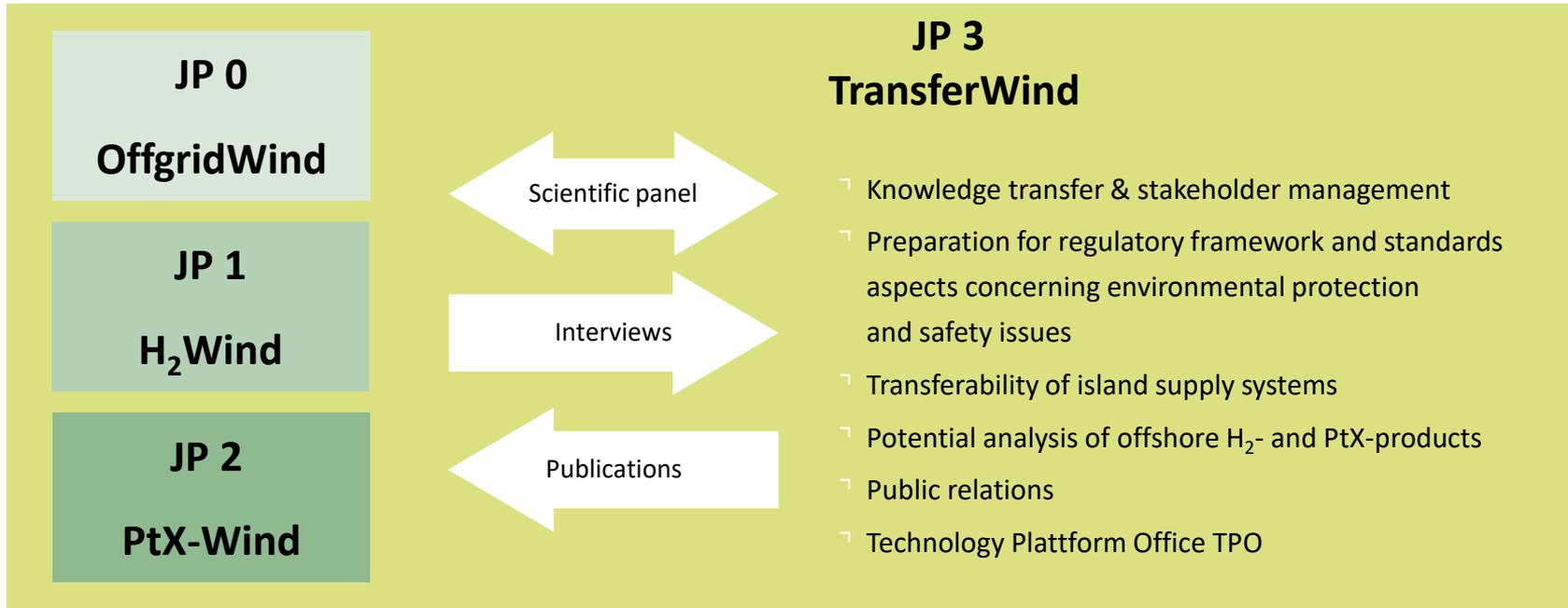
PtX-Wind: Status Quo

- ▢ Design and construction of new laboratory- and pilot-scale test facilities and development of simulation models were started
- ▢ A basic layout for the experimental platform was developed; decision made to demonstrate the Fischer-Tropsch route on the experimental platform
- ▢ Purchase and construction/completion/retrofit of the process containers and platform under way

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TransferWind – Context of the flagship project H₂Mare



TransferWind: Status Quo

- Internal and external exchange:
 - Scientific panel:** exchange and definition of cross-H₂Mare topics and issues
 - Exchange with WLP sister projects H₂Giga and TransHyDE (e.g. on communication and regulation)
 - Highlight: **Knowledge transfer workshop on "Acceptance management of hydrogen"**
 - Conduct public dialogues and develop initial training and further education concepts (for universities and experts)
- Milestone:** Inventory of existing and applicable regulations for the operation of H₂ and PtX plants



Check-boxes to an autonomous H₂-turbine...

Offshore Conditions

Sea Water Treatment

Installation Concept

Service Concept

Stakeholder Engagement

Volatile Energy Availability

Integrated Control Concept for Island Mode

Operation Modes

Environmental Interaction

Approvals & Certification

5.



Half Time!



5.

- Planning and design phases about to end
- Purchasing of major equipment finalized, construction ongoing
- Detailed design calculations in final stages
- First bigger tests (e.g. scaled system integration, water desalination) to start this year

Thank You! Your questions?

www.h2mare.de

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