Hydrogen Research & Innovation Days
24-25 November 2025

H_2MARINE: HYDROGEN PEM FUEL CELL STACK FOR MARINE APPLICATIONS

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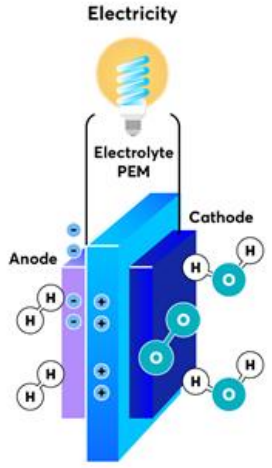
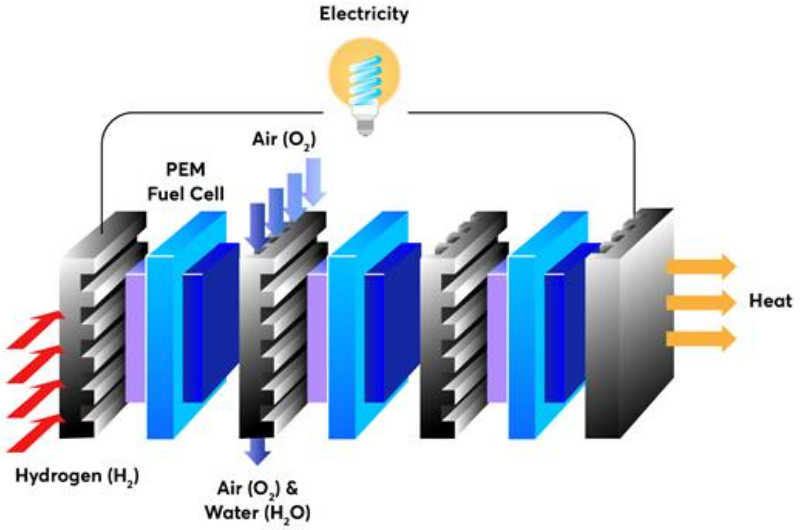
Clean Hydrogen Partnership

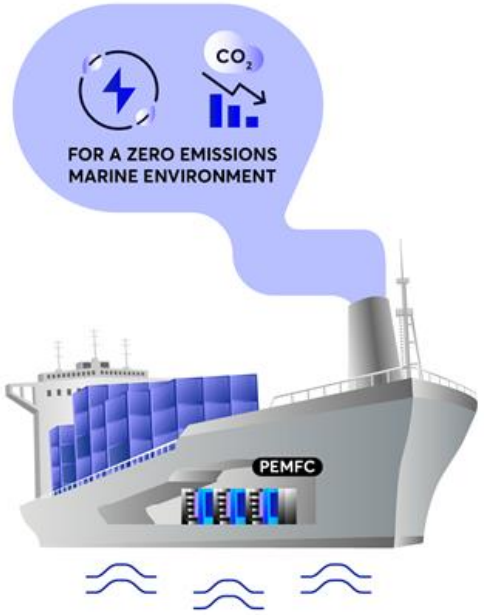
Co-funded by the European Union

H_2Marine at Glance

- **Project Duration:** 42 Months (01/01/2024 – 30/06/2027)
- **Consurtium:**13 Partners from 5 European Countries
- **Objective**: Design, build, test and validate two PEM stacks generating 250 – 300 kW electric power formatted for marine applications in a modular up-scalable design.

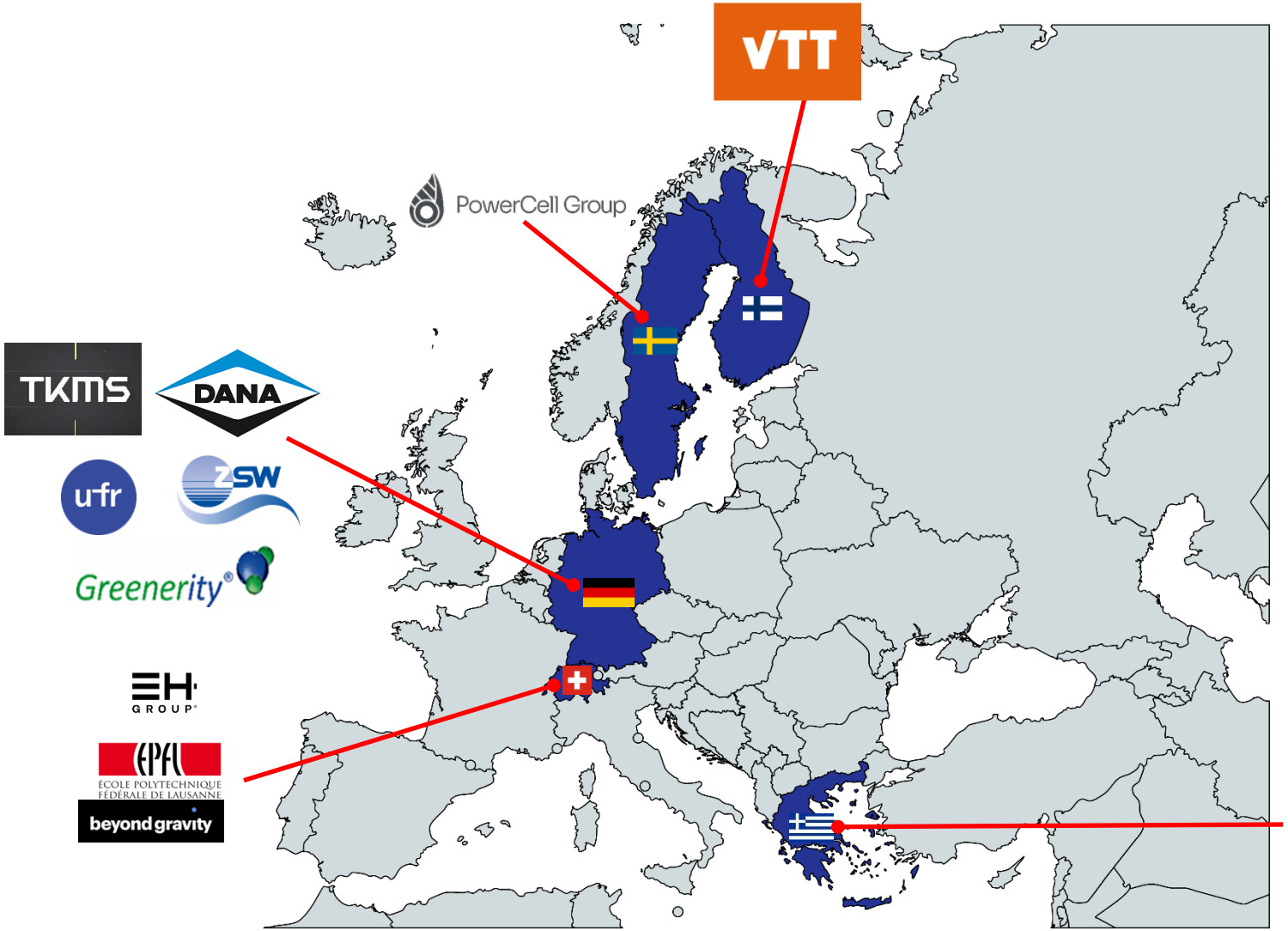






https://h2marineproject.eu

H_2Marine Consortium



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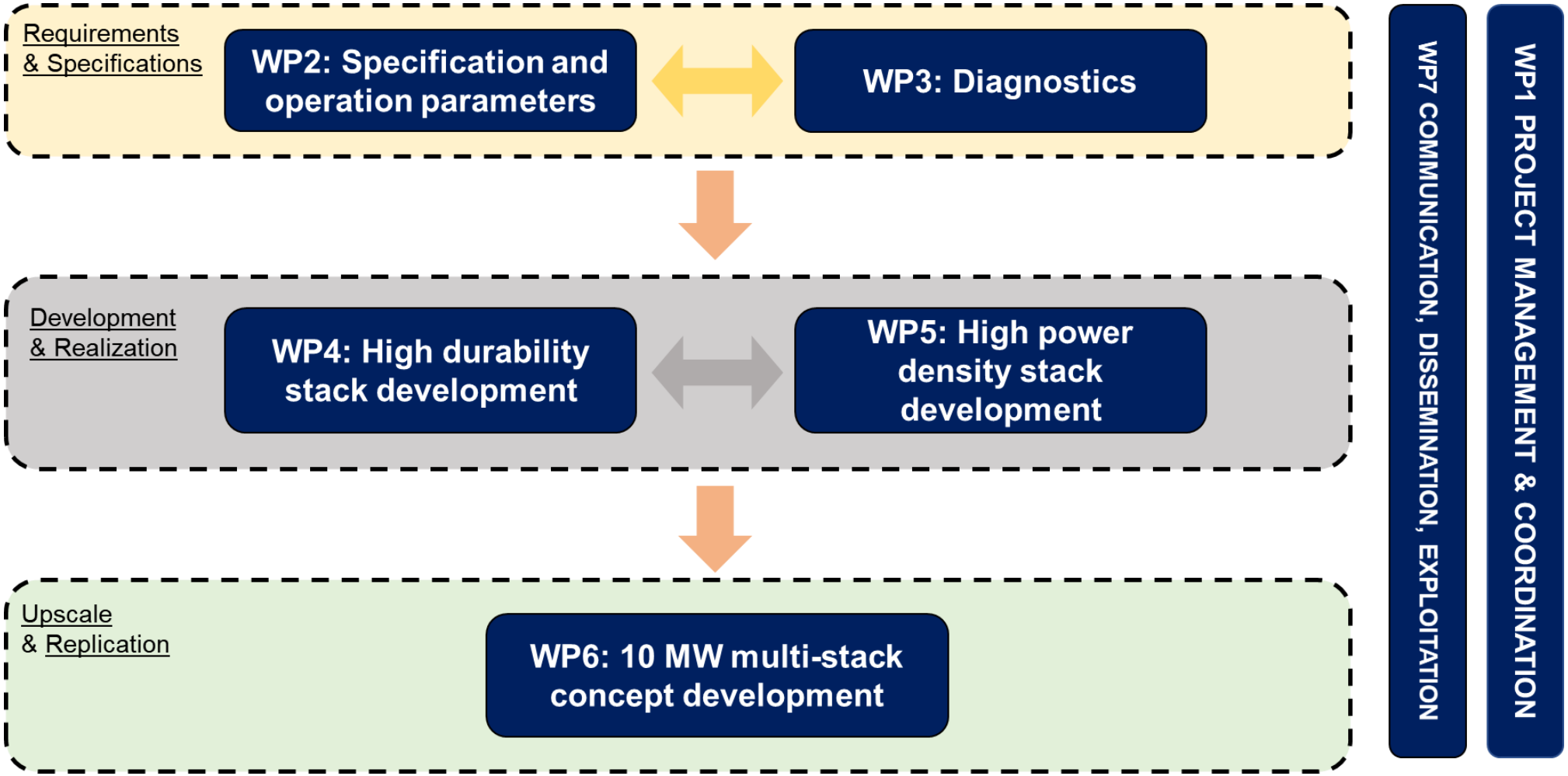
H_2Marine Approach



H_2Marine Concept

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Definition of: (a) end-users needs (b) maritime environments (c) test requirements and conditions

Designing, building and validation of two PEM FC stacks generating 250 - 300 kW electric power designed for marine applications

Testing of the proposed solutions in relevant environment

Designing of the stack modules in an optimum manner for up-scaling up to 10 MW power train systems

Assessment of the technology and economic feasibility of the solution

Testing of several diagnostics for the stack and overall system integrity as well as for the health status prognosis of critical components

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H_2Marine Targets

Design & Build: Two PEM stacks generating 250-300 KW for marine vessels

Diagnostics & Testing: Improved system integrity & health monitoring for critical component

Scalability: Flexible designs adaptable to various power needs – Up to 10 MW systems by 2030

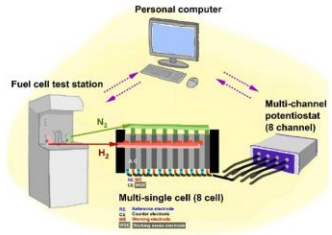
Stack Lifetime: Achieving 40.000 to 80.000 operational hours

Cost Efficiency: CAPEX <1,500 EUR/kW for 2024, 1,000 EUR/kW for 2030

H_2Marine Results & Innovations

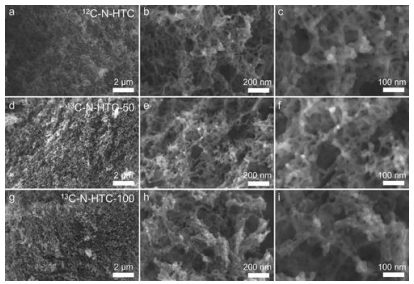
Specifications & operation parameters

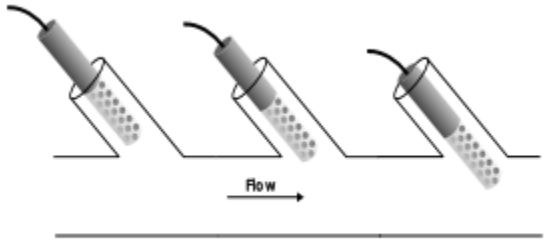
- **Definition of real end-users needs:** Assessment of the requirements of a FC system in terms of operation and integration on-board, Description of how a fuel cell system can be used to serve the needs of the operating profile and electric power needs of an LH_2 carrier, Description of the design considerations of marine FC systems and their installation on-board vessels
- **Definition of maritime environments:** inclinations, vibration & shock, seawater temperature, air temperature, air salinity
- **Definition of ASTs:** Definition and validation of three ASTs → To determine if ultimate target (40,000 h) can be reached, To develop methods for determining stable stack operating range, To determine if H2 soak or idling should be applied



Specifications & operation parameters

- Improvements in design, diagnostics and monitoring procedures of FC stacks
- Improve PEMFC lifetime by selection and using of H_2 and H_2O sensors
- Characterization & evaluation of in house developed cell voltage monitoring (CVM) system
- Use of ^{13}C catalyst support in advanced diagnostics
- Improve PEMFC lifetime by using particle and chemical sensors – Testing & selection of appropriate air filter solutions
- Implementation of CVM and additional diagnostic units
- Post-mortem analysis of component





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H_2Marine Results & Innovations

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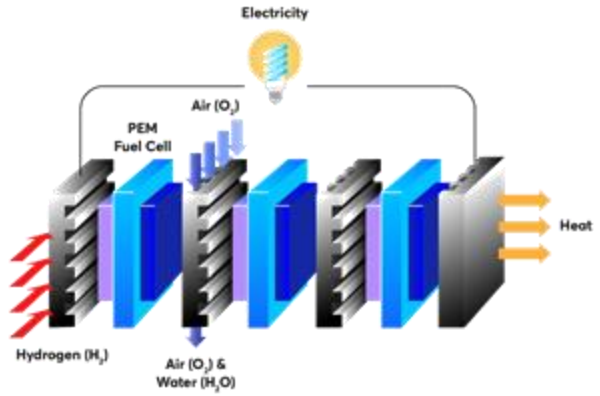
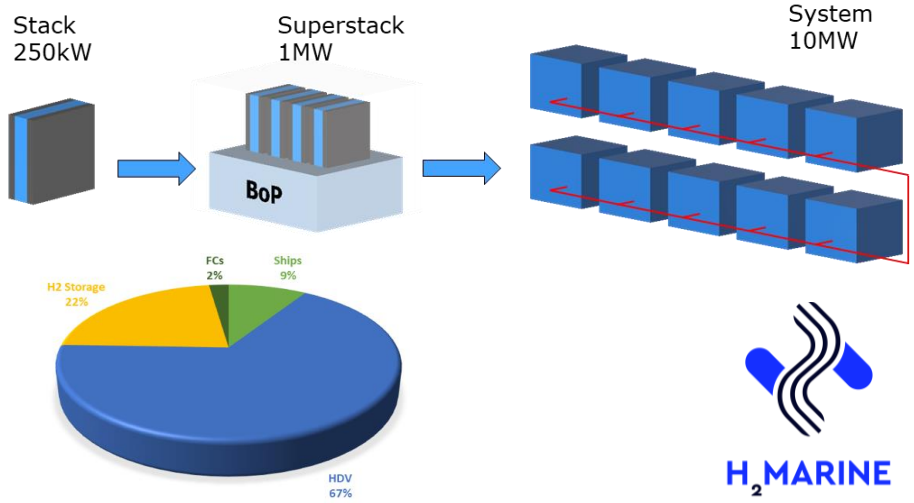
High durability & Power Density FC stacks development

- Development of a 250-300 kW PEMFC stack for marine applications with a design enabling direct interconnection of stacks to form a “superstack” with a power output at MW-scale.
- Selection and design of a high durability MEA concept with reduced PFSA content and scale-up of the MEA concept for improved robustness
- Large footprint BPP design for marine operation conditions with highly durable coating
- GDL modifications and design optimisations (Production study, Material selection, Validation of performance and degradation)
- BoS and stack housing design for marine environments with a scalable stack concept both regarding number of cells and number of cell packages (=single stacks) for MW applications
- A stack test campaign focused on verification of the stack concept including MEA, BPP and BoS to TRL6



10 MW multi-stack concept development

- Leverage of project results (respective operating conditions, BPP/BoS designs, durability as well as design principles) towards the full-scale implementation and respective studies of the solutions at higher capacities (up to 10 MW).
- Study and evaluation of different architecture variants of stacks combination (modular, monolithic) for maritime superstacks to determine the optimal degree of modularity in this application.
- Safety analysis → lead at a safe and robust platform for multiple stacks with the same BoP
- Total Cost of Ownership (TCO) and reliability analysis for MW-multistack systems



H_2Marine Impact

- H_2Marine will increased competitiveness of EU FC manufacturing companies in the emerging global market for FC technologies in the maritime sector
- The targeted cost reductions of H_2MARINE will provide incentives to the shipping industry for the employment of green solutions “made in Europe”.
- H_2MARINE will provide valuable scientific insights in the stack design/development diagnostics, monitoring and upscaling of PEMFCs in maritime applications
- H_2MARINE will enable the utilization of hydrogen in the maritime sector, which is heavily relying on fossil fuels, and provide an opportunity to reduce GHG emissions.
- H_2MARINE will create job opportunities across the entire renewable energy, hydrogen and maritime value chain, enable the training of energy-transition ready workforce and foster cross-sectorial cooperation’s.


The development of higher power density and durability PEMFC technology with upscaling designs will pave the way to solve critical issues in order to make PEMFCs a key solution and H_2 a vital fuel/component for the decarbonization/defossilization of the marine sector

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Thank you!

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