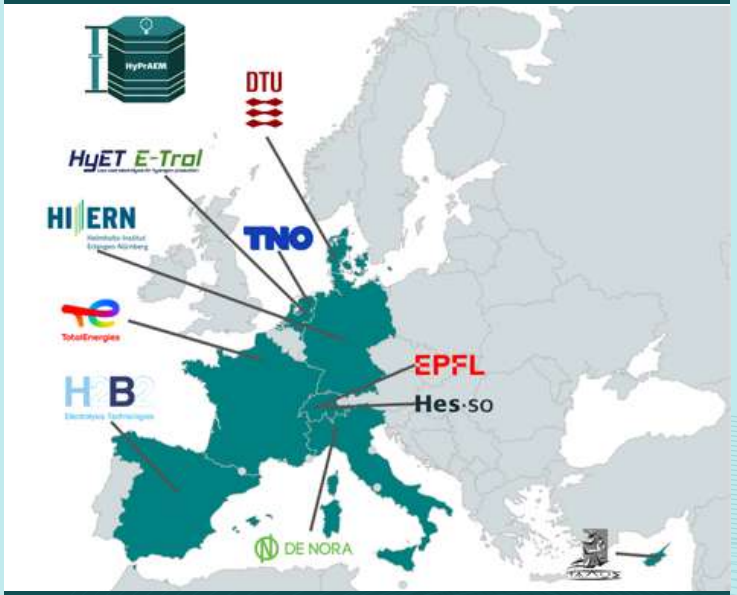
Objectives

The key objectives of HyPrAEM are to:

1. Develop a disruptive Anion Exchange Membrane ELectrolysis (AEMEL) stack and balance of plant (BoP) layout capable of producing hydrogen directly at 100 bar.
2. Develop a 100 kW AEM stack with a nominal current density of 2 A/cm^2 at 1.75 V cell voltage at ~ 70 °C, corresponding to an energy consumption of ~ 46.9 kWh/kg.
3. Develop high-performance critical raw materials (CRM)-free/lean catalysts, and reinforced AEM membranes and ionomers for high pressure operation.
4. Optimize the design of porous transport layers, membrane electrode assembly, stack and BoP for high-pressure operation.
5. Improve existing component, cell, and stack level EU-harmonised Accelerated Stress Test protocols, emphasizing their validation in relation to Real-World Degradation.
6. 100KW AEMEL system development (stack +BoP) and demonstration.
7. Develop a digital-twin for the 100 kW AEM electrolyser and validation.
8. Carry out an integrated sustainability analysis on components and technologies developed in the project and in-depth techno-economic analysis on a use-case relevant to the thermochemical industry.

Consortium



More Information

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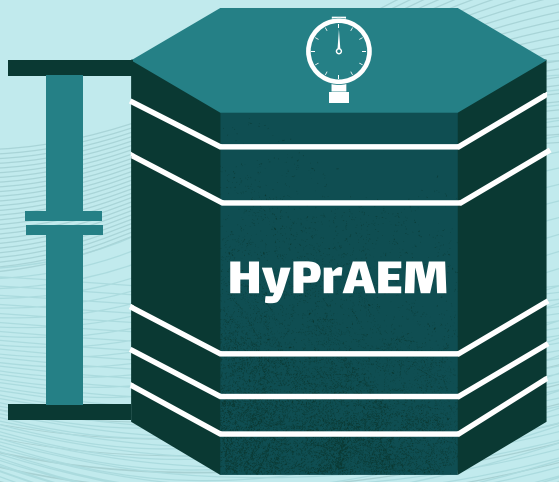

High-Pressure Anion Exchange Membrane electrolyzers for large-scale applications

Starting date
01/01/2025

10
Partners

Budget
5 329 639.69
EUROS

Project duration
48
months

8
Countries

Challenge

Global warming presents a critical threat to life on Earth, driving the urgent need to shift from fossil fuels to sustainable energy sources.

Electrification and green hydrogen are key to decarbonization, with green hydrogen being vital for sectors like heavy industry and long-duration energy storage that are difficult to decarbonize. However, the current high cost of green hydrogen limits its feasibility, demanding innovation in production and transport of hydrogen.

Methodology

The HyPrAEM project aims to advance high-pressure hydrogen production to decarbonize the thermochemical industry by integrating compression directly into the electrolyser stack. This integration reduces system components, enhances efficiency, lowers costs, and broadens the green hydrogen market. The project involves developing novel stack components for high-pressure operation (up to 100 bar) and improving performance, durability, and scalability of AEM electrolyser technology.

Key innovations include low-CRM electrocatalysts, high-performance ionomers, reinforced membranes, and optimized porous transport layers. These components will be lab-tested, scaled up, and demonstrated in a 100 kW system. A novel stack design, Computational Fluid Dynamics modelling, and a dedicated BoP system will be employed, with a >3000-hour field test by TotalEnergies.

The project also includes upstream integration with renewable energy sources and intermittent operation studies. Sustainability and techno-economic analyses will guide future development, while a comprehensive exploitation and communication plan ensures widespread dissemination and potential long-term benefits for partners and the EU.

Impact

By 2050, hydrogen is expected to constitute around 13-14% of Europe's energy mix, according to the European Commission's Strategic Vision for Climate Neutrality.

Recent assessments suggest a significant rise in electrolyser capacity by 2035, ranging from 37-66 GW, yet the technology falls short of the required key performance indicators .

“Elevating Hydrogen Production to Industrial Standards”

HyPrAEM targets align with Clean Hydrogen Strategic Research and Innovation Agenda goals for AEMEL by 2030, enhancing the EU's leadership and setting a new industry standard.