

ENDURE

ALKALINE ELECTROLYSERS WITH ENHANCED DURABILITY



Project ID	101137925
PRR 2025	Pillar 1 - H ₂ Production
Call Topic	HORIZON-JTI-CLEANH ₂ -2023-01-03
Project Total Costs	2 492 868.75
Clean H ₂ JU Max. Contribution	2 492 868.75
Project Period	01-01-2024 - 31-12-2026
Coordinator Beneficiary	STARGATE HYDROGEN SOLUTIONS OU, EE
Beneficiaries	FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDROGENO EN ARAGON, PERMASCAND AB, ZENTRUM FÜR SONNENENERGIE- UND WASSERSTOFF-FORSCHUNG BADEN-WÜRTTEMBERG, UNIVERSITE CATHOLIQUE DE LOUVAIN, FRAUNHOFER GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG EV

<https://endureh2.com/>

PROJECT AND GENERAL OBJECTIVES

The main objective of the ENDURE is to bring the performance and durability of alkaline electrolyzers to a new level. More specifically, to drastically decrease the degradation rate and increase the efficiency of alkaline cells and stacks through the development of hierarchically structured flow-engineered monolithic porous transport electrodes, via design/material improvements on stack level, and accelerated testing procedures. If the electrolyser degradation rate could be reduced, it would result in two-fold benefits:

- Lower operating expenditures through lower energy consumption over electrolyzers' lifetime.
- Lower capital expenditures through a lower level of oversizing of the balance-of-plant components needed.

Both would positively affect the levelised cost of hydrogen (LCOH).

NON-QUANTITATIVE OBJECTIVES

ENDURE aims to make alkaline electrolyzers more durable by drastically reducing the degradation rate of alkaline electrolysis cells and stacks, in order to:

- Reduce carbon emissions and mitigate climate change by enabling the widespread adoption of hydrogen as a clean and sustainable fuel source.

- Reduce the cost of hydrogen production, making it a more competitive fuel source and driving the growth of the renewable energy sector.
- Contribute to the development of a more sustainable and resilient energy system that can balance intermittent renewable energy sources with the need for a stable and continuous energy supply.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

WP1:

- An adopted report for ENDURE on harmonised test protocols provided.
- Baseline stack developed and shipped to FHa for testing.
- EIS measurement device purchased by FHa.
- Adaptations of FHa's test rig to accommodate the baseline stack and the EIS device.

WP2:

- Via screen printing and doctor blade coated Ni foams have been characterised with X-ray tomography and tested for flow sensitivity.
- Development of a synthesis route for nickel-molybdenum coated electrodes.
- Electrochemical characterisation nickel-molybdenum electrodes showed very high HER and high OER activity.



WP3:

- Porous material can be effectively simulated.
- Model results show good agreements with experiments.
- First three commercial diaphragm samples characterised for MacMullin number.
- Segmented PTFE gasket approach investigated.

WP4:

- Collection of degradation phenomena and stressors in cooperation with all consortium partners.

WP5:

- The consortium's Dissemination and Communication Strategy is fully defined.
- The consortium's communication tools are fully defined.
- The project website and LinkedIn page were constructed, launched and are running.

- The ENDURE exploitation plan was completed, including both joint exploitation and each partner's individual plans.

WP6:

- Kick-off meeting was held on January 9, 2024.
- Regular consortium meetings held bi-weekly.
- SharePoint folder has been set up.
- A General Assembly meeting was held on September 25, 2024.
- Risks were assessed in M9.

FUTURE STEPS AND PLANS

- Baseline stack is ready and will be delivered to FHA for testing.
- Ongoing testing in WP2 and WP4.
- Work on computer simulations in WP3; sourcing novel gasket materials and starting to build the Prototype Stack.
- General Assembly in Rotterdam.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Baseline degradation profile of a 10-kW electrolysis stack using pre-commercial electrodes at high current density (WP1)	Hours of operation, A/cm ² current density	≥500 hours at 1 A/cm ² for a prototype stack of ≥5 cells with ≥1 000 cm ² electrode footprint	
	Hierarchically structured flow-engineered monolithic porous transport electrodes (PTE) with optimised bubble removal capacity (WP2)	kWh/kg, A/cm ² , V/cell, temperature (°C), hours	47 kWh/kg at 1 A/cm ² and 80°C for 100 hours ≥1.25 A/cm ² at ≤1.95V/cell	
	Developing high-performance and PGM-free catalyst coating for the HER and OER (WP2)	mV, A/cm ² , hours	HER < 150 mV, OER < 250 mV at ±1 A/cm ² after 100 hours of electrode testing	
	Upscaling of porous transport electrodes (PTE)	cm ²	≥1 000 while maintaining electrochemical performance	
	Low-cost high-performance 10-kW stack prototype	€/kW, cm ²	CAPEX target of 150 €/kW for a prototype stack of ≥5 cells with ≥1 000 cm ² electrode footprint	
	Testing and validation of innovative stack components (WP4)	kWh/kg, A/cm ² , number of cells	48 kWh/kg at 1 A/cm ² for a laboratory stack of ≥10 cells with ≥100 cm ² electrode footprint	
	Degradation profile of a low-cost high-performance 10-kW stack	%/1 000h, hours, cm ²	0.1%/1 000h over ≥500 hours for a CRM-free prototype stack of ≥5 cells with ≥1 000 cm ² electrode footprint	