PRESSHYOUS

PRESSURISED HYDROGEN PRODUCED BY HIGH TEMPERATURE STEAM ELECTROLYSIS

Project ID	101101337
PRR 2024	Pillar 1 – Renewable hydrogen production
Call topic	HORIZON-JTI-CLEANH2-2022-01-01: Development and validation of pressurised high temperature steam electrolysis stacks (solid oxide electrolysis)
Project total costs	EUR 2 499 426.00
Clean H_2 JU max. contribution	EUR 2 499 426.00
Project period	1.9.2023–31.8.2026
Coordinator	Commissariat à l'énergie atomique et aux énergies alternatives, France
Beneficiaries	Aktsiaselts Elcogen, École polytechnique fédérale de Lausanne, Genvia, Haute école spécialisée de Suisse occidentale, HyGear BV, HyGear Fuel Cell Systems BV, HyGear Hydrogen Plant BV, HyGear Operations BV, HyGear Technology and Services BV, Nederlandse Organisatie voor toegepast natuurwetenschappelijk onderzoek, Teknologian tutkimuskeskus VTT Oy

https://cordis.europa.eu/project/id/101101337

PROJECT AND GENERAL OBJECTIVES

Presshyous aims to deliver scientific insights on SOEL H_2 production under pressure and to therefore foster rapid industrial empowerment. It will provide two major deliverables: a validated lab-scale 30-bar/20 kWe stack in a pressurised vessel and a 10-bar pressurised stack operated without needing a pressure vessel.

NON-QUANTITATIVE OBJECTIVES

PressHyous is a project that aims to optimize individual components in large-scale HP SOEL systems using modelling tools developed by partners. Currently, SOEL-stacks operate at atmospheric pressure, but pressurised operation has only been shown on a limited scale. PressHyous aims to develop a pressurised SOEL system capable of operating up to 30 bar using a pressure vessel, demonstrating its functionality at a 20 kWe scale. This will positively impact downstream equipment sizing and costs, and reduce energy consumption for compression. PressHyous will also allow for the reduction of the number of compression stages, reducing energy consumption for compression. The lack of specification for H2 delivery conditions renders LCA results hardly comparable. A LCA of a pressurised H2 production process based on PressHyous concepts will help identify major environmental aspects and analyze the environmental benefits of energy system integration throughout the project's use cases.

PROGRESS AND MAIN ACHIEVEMENTS

The main achievements during months 1–6 were:

- the characterisation protocol of SOEL cells under pressurised conditions.
- the definition of use cases, in collaboration with the Advisory Board.
- the delivery of reference single cells and the start of the testing campaign.

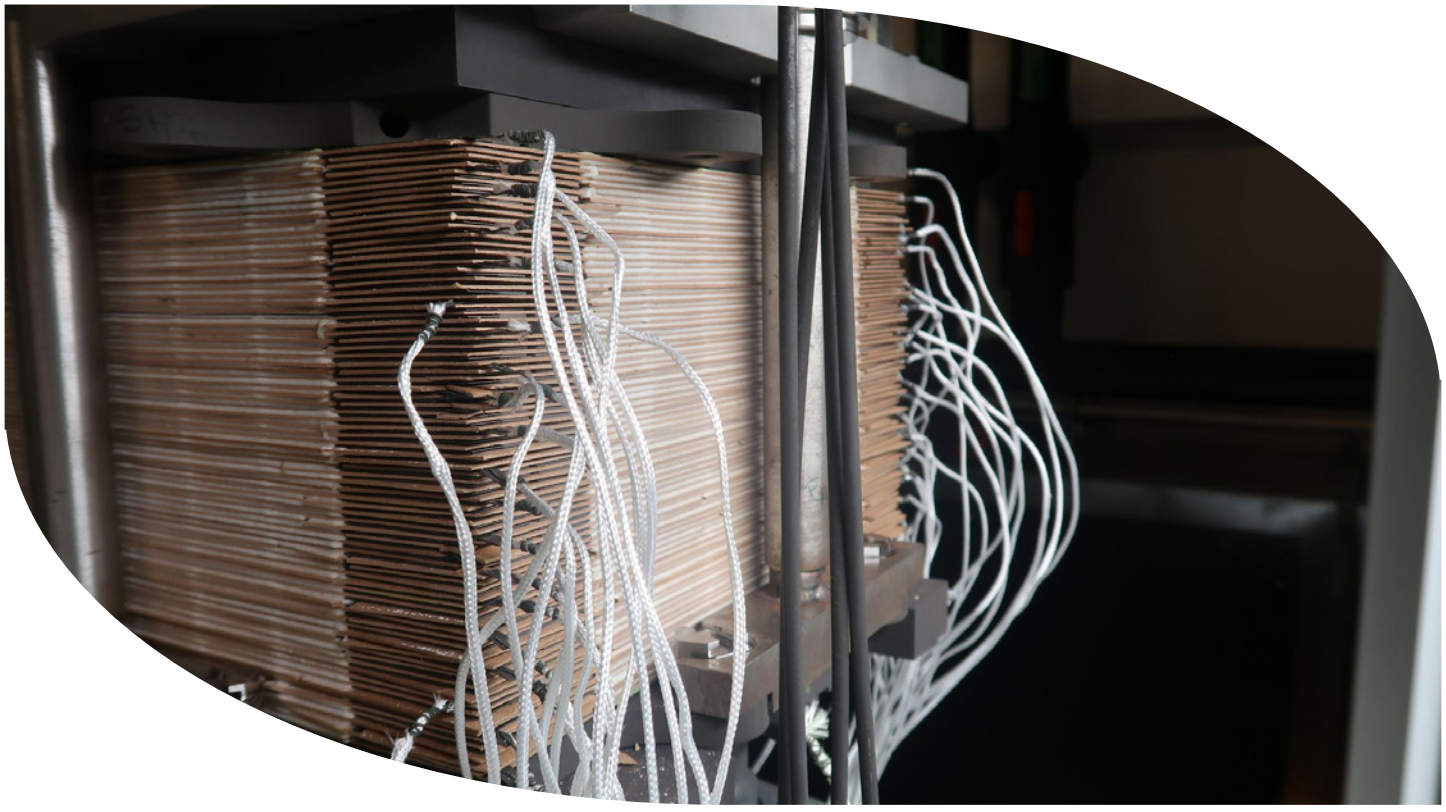
FUTURE STEPS AND PLANS

- The project will improve the cell and other stack components (including interconnects, sealings, interconnect protective coatings and stack clamping system).
- Presshyous will design, assemble and validate the long-term operation of a lab-scale device comprising a SOEL stack and a pressure vessel (up to 30 bar) at the scale of 20 kWe (eq. 13.5 kg H_2/day).
- It will investigate a promising pressurised stack concept that does not need a pressure vessel, thus relieving the cost of the balance of plant. This will be tested up to 10 bar at the short-stack scale, with a similar current density to the stack operated in a pressurised vessel.
- Presshyous will supply model-based insights for H_2 production for up to five identified use cases, providing information on the expectable performances of both stack concepts (with or without a pressurised vessel) in large-scale developments. This work will be strongly linked to TEA and LCA.
- The project will complete TEA and LCA of the use cases, showing the applicability and the benefits of the developed technologies and the two stack concepts compared with alkaline electrolysis and proton-exchange membrane electrolysis when operating under pressure.

These steps will demonstrate the viability of pressurised high-temperature steam electrolysis technology for industrial use, and further increase the confidence in SOEL as a technology capable of decarbonising hard-to-abate industries.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SOA result achieved to date (by others)
Project's own objectives	Heat demand @ nominal capacity	kWh/kg	9		9.9
	Hot idle ramp time	seconds	300		600
	Current density	A/cm²	1		0.6
	Degradation @ UTN	%/1 000 h	1		1.9
	O&M cost	€/(kg/day)	130		410
	Electricity consumption @ nominal capacity	kWh/kg	34–36		40
	Cold start ramp time (P-stack)	hours	8		12
	CAPEX	€/kW	1 250		2 130



Clean Hydrogen Partnership
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