

PRESSHYOUS

PRESSURIZED HYDROGEN PRODUCED BY HIGH TEMPERATURE STEAM ELECTROLYSIS



Project ID	101101337
PRR 2025	Pillar 1 - H ₂ Production
Call Topic	HORIZON-JTI-CLEANH ₂ -2022-01-01
Project Total Costs	2 499 426.00
Clean H ₂ JU Max. Contribution	2 499 426.00
Project Period	01-09-2023 - 31-08-2026
Coordinator Beneficiary	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR
Beneficiaries	HyGear Fuel Cell Systems B.V., GENVIA, HYGEAR OPERATIONS BV, HYGEAR HYDROGEN PLANT BV, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, HYGEAR TECHNOLOGY AND SERVICES BV, AKTSIASELTS ELCOGEN, HYGEAR FUEL CELL SYSTEMS BV, HYGEAR BV, HAUTE ECOLE SPECIALISEE DE SUISSE OCCIDENTALE, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO

PROJECT AND GENERAL OBJECTIVES

PressHyous aims to deliver relevant scientific insights on solid oxide electrolysis (SOEL) hydrogen production under pressure and to therefore foster rapid industrial empowerment, through the following goals:

- A validated lab-scale 30 bar/20 kWe stack in a pressurised vessel.
- A 10 bar pressurised stack operated without needing a pressure vessel.

NON-QUANTITATIVE OBJECTIVES

PressHyous aims to optimise individual components in large-scale HP SOEL systems using modelling tools. 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 life cycle assessment results hardly comparable. A life cycle assessment of a pressurised H₂ production process based on PressHyous concepts will help identify major environmental aspects and analyse the environmental benefits of energy system integration throughout the project's use cases.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Definition of use cases with advisory board.
- System modelling and hazard identification to assess the feasibility of configurations in relation to the selected case studies and provide feedback for the development of stacks and system.
- Design and manufacture of two new generation cells for operation in electrolysis mode up to 30 bar.
- Operation of pressurised-stack up to 7 bars, reaching 1.5 A/cm² at the thermoneutral voltage and 750°C.

- Design of an integrated 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 H₂/day), and selection of balance of plant (e.g. vessels, stack, compression system, heat exchangers, etc.).
- Implementation of techno-economic analysis and life-cycle analysis and first analyses conducted on the selected case studies.

FUTURE STEPS AND PLANS

- Improvement of cells and other stack components for H₂ production under pressure to be continued (including interconnects, sealings, interconnect protective coatings, stack clamping system etc.).
- Finalised design, assembly, installation and validation of 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 H₂/day).
- Investigation of a promising pressurised stack concept without pressure vessel relieving the cost of plant balance.
- Lifetime of cells and stacks (without pressure vessel) to be estimated up to 30 bars.
- Supply of model-based insights for H₂ production for up to five identified use cases, on expectable performances of both stack concepts (with or without pressurised vessel) towards large scale developments, in strong link with techno-economic analysis (TEA) and life-cycle analysis (LCA).
- TEA and LCA of use cases showing the applicability and the benefits of the developed technologies and its two stack concepts versus alkaline electrolyzers (AEL) and proton exchange membrane electrolyzers (PEMEL) operating under pressure. This 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	Achieved to date by the project	Target achieved?
Project's own objectives	Current density	A/cm ²	-1	-1	✓
	Pressure	bar	5 - 30	7	⚙️
	Lifetime	%/kh	1	-	
	H ₂ production cost	€/kg	3	-	