HY-SPIRE

HYDROGEN PRODUCTION BY INNOVATIVE SOLID OXIDE CELL FOR FLEXIBLE OPERATION AT INTERMEDIATE TEMPERATURE

Project ID	101137866
PRR 2025	Pillar 1 - H_2 Production
Call Topic	HORIZON-JTI-CLEANH$_2$-2023-01-02
Project Total Costs	2 999 523.00
Clean H_2 JU Max. Contribution	2 999 523.00
Project Period	01-02-2024 - 31-01-2027
Coordinator Beneficiary	INSTYTUT ENERGETYKI, PL
Beneficiaries	SOLYDERA SPA, FUNDACIO INSTITUT DE RECERCA DE L'ENERGIA DE CATALUNYA, FONDAZIONE BRUNO KESSLER, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV, DANMARKS TEKNISKE UNIVERSITET

https://hy-spire.eu/

PROJECT AND GENERAL OBJECTIVES

Hy-SPIRE aims to boost the potential of oxide-based electrolysers (SOEL) by lowering the operating temperature below 700°C, and increasing its flexibility in order to fit with renewable energy source generation profiles. Hy-SPIRE will develop novel cells with low degradation equal to or lower than 0.75% per 1 000 hours, operation at high current densities of 1.2 A/cm^2 and the ability to operate dynamically with fast ramping. Hy-SPIRE will aim to:

- Develop oxygen ion- and proton-conducting cells (O-SOE and P-SOE) on ceramic and metallic supports, therefore analysing a broad range of technological possibilities.
- Develop new cells and stacks beyond the state-of-the-art technology in terms of designs, performance and operation.
- Conduct techno-economic analysis, supported by life cycle assessments to evaluate the project innovations and market potential.
- Define barriers and research directions to achieve SRIA objectives, such as reduction of hydrogen production cost to 3 €/kg by 2030, reduction of CAPEX 520 €/(kg/kW) and OPEX 45 €/(kg/kW).
- Design cells and stacks technologies for large-scale production, tailored for coupling with renewable energy sources and other industry sectors.

NON-QUANTITATIVE OBJECTIVES

- Optimisation of the design and materials of cells in order to allow flexible operation with reduced startup time, rapid cycling and faster stop.
- Application of thin electrolytes which substantially reduce the content of critical raw materials (CRM) in stack repeating units (SRU) paving a way for compact stack design.
- Establishing compact design of solid oxide electrolyser stacks with reduced volume which will be able to operate dynamically and easier to thermally manage.
- Establishing stacks with reduced operating temperature and reduced footprint which will ease the integration of SOEL with renewables and industrial process.
- Demonstration of the scalability of ultra high-temperature sintering which will shorten the fabrication time (by reducing thermal treatments from several hours to minutes) and the energy cost of the fabrication of the electrochemically active components of SOELs.
- Adaptation of existing and newly developed testing protocols for electrolysers which operate at the elevated temperature (i.e., SUSTAINCELL, NewSOC, FCTESQA, SOCTESQA, and the harmonised testing protocols for EU (EU harmonised testing protocols for high-temperature steam electrolysis, 2023)).

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Development and adaptation of testing protocols for oxygen-ion conducting solid oxide electrolysers (O-SOE) and proton-conducting solid oxide electrolysers (P-SOE). These protocols build upon and refine existing methodologies from key initiatives such as SUSTAINCELL, NewSOC, FCTESQA, and SOCTESQA, as well as the harmonised EU testing protocols for high-temperature steam electrolysis (2023).
- Establishment of standardised evaluation procedures, enabling reliable performance assessment, durability testing, and benchmarking of O-SOE and P-SOE technologies.

FUTURE STEPS AND PLANS

The developed testing protocols for single-cell Solid Oxide Electrolysers (SOE) with oxygen-ion conducting electrolytes (O-SOE) and proton-conducting electrolytes (P-SOE).

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Degradation rate	%/1 000 h	0.75	
	Current density	A/cm^2	1.2	
	Thickness of the electrolyte	um	1-2	
	Hot idle ramp time	sec	240	
	Cold start ramp time	hours	6	

Clean Hydrogen Partnership
Co-funded by the European Union