OUTFOX

OPTIMIZED UP-SCALED TECHNOLOGY FOR NEXT-GENERATION SOLID OXIDE ELECTROLYSIS

Project ID	101101439
PRR 2025	Pillar 1 - H_2 Production
Call Topic	HORIZON-JTI-CLEANH$_2$-2022-01-09
Project Total Costs	2 925 824.50
Clean H_2 JU Max. Contribution	2 925 824.00
Project Period	01-02-2023 - 31-01-2027
Coordinator Beneficiary	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO, NL
Beneficiaries	LINQ CONSULTING AND MANAGEMENT LTD, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, CONVION OY, ELCOGEN OY, AKTSIASELTS ELCOGEN, FONDAZIONE POLITECNICO DI MILANO, SHELL GLOBAL SOLUTIONS INTERNATIONAL BV, POLITECNICO DI MILANO

http://outfoxproject.com

PROJECT AND GENERAL OBJECTIVES

The main objective of OUTFOX is to remove scale as a limiting factor in the deployment of oxide-based electrolysers (SOEL) technologies while proving their potential to become the preferred option for green hydrogen production. By combining experimental results up to the 80 kW scale with the identification of optimal cell, stack and system designs, OUTFOX will prepare SOEL for industrial scale systems of 100 MW with a levelised cost of hydrogen as low as 2.7 €/kg H_2 and applicability to mass manufacturing lines.

NON-QUANTITATIVE OBJECTIVES

OUTFOX will lead to the realisation of ground-breaking large geometric area electrolysis cells, a novel stack and module architecture and new approaches for reproducible, high-volume manufacturing. OUTFOX aims to overcome the current economic and technological SOEL roadblocks, and push Europe into the forefront of the green hydrogen technological landscape.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

Cell development:

- Reference cells for short stack and first batch 80 kW demonstration have been manufactured successfully; over 1 000 cells have been manufactured and delivered.
- OUTFOX is developing two types of scaled-up cells: (i) industrial cells with a cell area ≥300 cm^2 by ELCOAS, (ii) next generation cells with a cell area up to 900 cm^2. Industrial scaled-up cells have been developed and manufactured and have been electrochemically tested at the beginning of 2025. Next generation cells have been developed and manufactured. A current density of 1.15 A/cm^2 has been achieved at thermonetural voltage at 750 °C. The cell has been operated at minimum 0.85 A/cm^2 for more than 2 000 hours.

Stack development:

- Three reference short stacks (with 15 cells) have been manufactured. Stack 1 and 2 have cells with 400 micron thickness, while stack 3 has cells with 300 micron thickness.
- The reference stacks have been tested electrochemically under 0.5 and 0.85 A/cm^2. Each test involved a durability test under predetermined nominal operation up to 2 000 hours.

System development and module scale-up:

- A modelling tool based on computational fluid dynamics has been developed to explore aspects of SOEC stack scaling by design, considering various constraints relating to the physics of flow distribution, thermomechanics, and current density.
- The conceptual design of a larger system module using scaled-up stack is in progress. The design of 80 kW module has been updated.

Techno-economic analysis, circularity, roadmap to pilot:

- A plant/system model has been developed successfully for techno-economic and scale-up analysis. The developed system model is able to capture the plant's modularity, from the stacks to the full-sized plant, with expected capacities up to hundreds of MWel and GWel.
- Techno-economic analysis has been initiated.

FUTURE STEPS AND PLANS

- Validation of electrochemical performance of industrially scaled-up cell as single repeating unit.
- Determining an optimal cell size for near-future large-scale SOEL.
- Optimising industrial manufacturing process for scaled-up cells.
- Delivering stacks for 80 kW (first phase testing campaign).
- Installing and validating an 80 kW system in a relevant environment.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Current density	A/cm^2	0.85	
	Levelised Cost of Hydrogen	€/kg	2.7	
	Module size	kW	400	
	Footprint	m^2/MW	< 150	
	Cell area	cm^2	300 - 900	✓