OUTFOX

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

Project ID	101101439
PRR 2024	Pillar 1 – Renewable hydrogen production
Call topic	HORIZON-JTI-CLEANH2-2022-01-09: Scaling-up technologies for SOEL
Project total costs	EUR 2 925 824.50
Clean H_2 JU max. contribution	EUR 2 925 824.00
Project period	1.2.2023–31.1.2027
Coordinator	Nederlandse Organisatie voor toegepast natuurwetenschappelijk onderzoek, Netherlands
Beneficiaries	Aktsiaselts Elcogen, Convion Oy, Elcogen Oy, Fondazione Politecnico di Milano, Linq Consulting & Management Ltd, Politecnico di Milano, Shell Global Solutions International BV, Teknologian tutkimuskeskus VTT Oy

http://outfoxproject.com

PROJECT AND GENERAL OBJECTIVES

The main objective of the Outfox project is to remove scale as a limiting factor in the deployment of SOEL technologies, while proving their potential to become the preferred option for green hydrogen production. By combining experimental results at 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 EUR 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 to the forefront of the green hydrogen technological landscape.

PROGRESS AND MAIN ACHIEVEMENTS

Reference scale cells with 400 and 300-micron half-cell thicknesses were manufactured to be implemented in short-stack and 80 kW stack manufacturing. Using the manufactured reference cells, reference-scale stacks for electrochemical testing have been manufactured. Upon successful implementation of the aforementioned activities, the first milestone of the project was reached. The reference-scale short stacks are being tested electrochemically. The successful completion of the testing activity of the reference-scale short stacks will result in the completion of the second milestone of the project. In addition, the following activities are in progress: (i) manufacturing and performance evaluation of industrial scaled-up cells (300 cm^2) and next-generation cells (900 cm^2) with reduced thicknesses, (ii) conceptual design of an upscaled solid oxide electrolysis module aiming to achieve even flow distribution using a 3D model (the initial simulation results are physically and numerically reasonable) and (iii) design of a modified 80 kW module with simplified and streamlined assembly. In addition, the design phase of a plant model for techno-economic and scale-up analysis has been finalised. The initial results are planned to be disseminated at the World Hydrogen Energy Conference and European Fuel Cell Forum during 2024.

FUTURE STEPS AND PLANS

Future steps include (i) validating high-surface-area cells (300 cm^2 and 900 cm^2) as single repeating units, (ii) determining an optimal cell size for near-future large-scale SOEL, (iii) optimising the industrial manufacturing process for scaled-up cells, (iv) modelling a novel stack architecture for scaled-up cells and (v) installing and validating an 80 kW system in a relevant industrial environment.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	LCOH	€/kg	2.7*	
	Cell area	cm^2	300–900	
	Module size	kW	400	
SRIA (2021–2027)	Current density	A/cm^2	0.85	
	Cold start ramp time	hours	12	
	Degradation @ UTN	%/1 000 h	< 1	
	O&M cost	€/(kg/day)/year	85	
	Hot idle ramp time	seconds	300	
	CAPEX	€/(kg/day), €/kW	600**, 400**	
	Electricity consumption @ nominal capacity Heat demand @ nominal capacity	kWh/kg	39 9	
	Footprint	m^2/MW	< 150	
	Current density	A/cm^2	0.85	

* Fixed OPEX is 2 €/kg, based on electricity price of 50 €/kg.
**This KPI value is based on system production volumes exceeding > 300 MW/year.

Clean Hydrogen Partnership
Co-funded by the European Union