BEST4HY

SUSTAINABLE SOLUTIONS FOR RECYCLING OF END OF LIFE HYDROGEN TECHNOLOGIES

Project ID	101007216
PRR 2024	Pillar 5 – Cross-cutting
Call topic	FCH-04-4-2020: Development and validation of existing and novel recycling technologies for key FCH products
Project total costs	EUR 1 586 015.00
Clean H_2 JU max. contribution	EUR 1 586 015.00
Project period	1.1.2021–31.12.2023
Coordinator	Parco Scientifico Tecnologico per l'Ambiente SpA, Italy
Beneficiaries	Aktsiaselts Elcogen, Commissariat à l'énergie atomique et aux énergies alternatives, EKPO Fuel Cell Technologies GmbH (from March 2021), ElringKlinger AG (up to February 2021), Hensel Recycling GmbH, IDO-Lab GmbH, Politecnico di Torino, RINA Consulting SpA, Univerza v Ljubljani

https://best4hy-project.eu/

PROJECT AND GENERAL OBJECTIVES

The overall objective of Best4hy was to identify and develop viable recycling strategies, supported by innovative technologies, that will provide the best solution for material recovery from fuel cell and hydrogen (FCH) products (i.e. proton-exchange membrane fuel cells (PEMFCs) and solid oxide fuel cells (SOFCs)) and proof of concept for the recovery of iridium and palladium from proton-exchange membrane water electrolysis with novel technologies. The following specific objectives were set, according to the call challenges.

- Complete the adaptation and validation (in a relevant environment) of processes already used in conventional recycling and recovery centres to make them suitable for use in FCH commercial systems, including those involving key materials such as the platinum group metals.
- Complete the selection and validation (in a relevant environment) of at least two novel recycling techniques for key materials contained in FCH commercial products, such as PEMFCs / proton-exchange membrane water electrolysis, alkaline water electrolysis and SOFCs; the focus should be on recovering the precious metals used in the stacks as catalysts, reducing pre-consumer scraps, etc.
- Validate the suitability of the material(s) recovered for reintroduction into the supply chain of different FCH systems and/or different industrial sectors.
- Ensure the quality standards of industry in open-loop and/or closed-loop recycling applications.
- Undertake comprehensive environmental–economic analysis of the considered strategy.
- Overcome the main barriers of existing regulations.

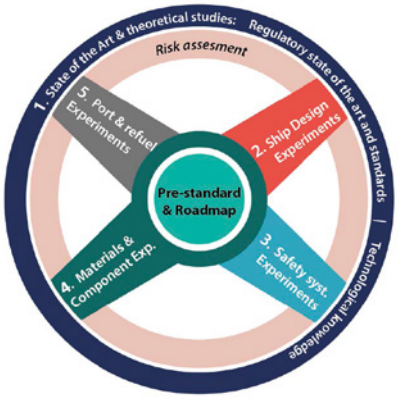
PROGRESS AND MAIN ACHIEVEMENTS

The Best4hy project developed a new gaseous-phase dismantling process for end-of-life (EOL) PEMFC processing, aiming to maximise the recovery of CCMs and achieve high recovery percentages of materials and components. Two patent applications were filed for the gaseous-phase dismantling process. The project also adapted a hydrometallurgical process and developed two novel processes for recovering Pt (as a salt precursor for PEMFCs), the ionomer and metallic Pt. High yields were achieved, with up to 95 % recovery for Pt and 80 % recovery for the ionomer. The recovered Pt salt was synthesised into a recycled catalyst for membrane electrode assembly production. CCMs were manufactured up to an industrial scale with 100 % recycled catalyst, showing good performance compared with that of commercial cells. A cradle-to-grave/gate-to-gate life-cycle assessment study was completed for both PEMFCs and SOFCs, adopting Best4hy recycling technologies and findings to support different EOL management scenarios and further research and development. All developed EOL processes, with their associated mass and energy balances, represent significant advances in SOFC manufacturing and EOL technologies.

FUTURE STEPS AND PLANS

The project has finished.

However, an exploitation strategy was developed for each of the 13 key exploitable results identified in the project. Partners are seeking opportunities to continue the development of the technology readiness level 5 technologies and to exploit the results commercially.



PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	Year for reported SOA result
Project's own objectives	GHGs in the overall production	%	– 20	– 20	✓	N/A
	La and Co recovery	%	> 80	La: > 78 %; Co: > 87 %		2023
	Pt recovered	%	90	95		2023
	Membrane	%	100	100		2022
	Pt recovered	%	80	95		2023
	Ionomer recovered	%	80	80		2023
	Anode material recovered overall for SOFCs	%	80	> 80		2023

Clean Hydrogen Partnership
Co-funded by the European Union