HYLICAL

DEVELOPMENT AND VALIDATION OF A NEW MAGNETOCALORIC HIGH-PERFORMANCE HYDROGEN LIQUEFIER PROTOTYPE

Project ID	101101461
PRR 2024	Pillar 2 – H_2 storage and distribution
Call topic	HORIZON-JTI-CLEANH2-2022-02-03: Validation of a high-performance hydrogen liquefier
Project total cost	EUR 4 677 848.75
Clean H_2 JU max. contribution	EUR 4 677 848.75
Project period	1.1.2023–31.12.2027
Coordinator	Institutt for energiteknikk, Norway
Beneficiaries	Asociatia Energy Policy Group, Danmarks Tekniske Universitet, ENGIE, Fives Cryo, Helmholtz-Zentrum Dresden-Rossendorf EV, Iberdrola Clientes SA, Magnotherm Solutions GmbH, Shell Global Solutions International BV, SUBRA A/S, Technische Universität Darmstadt, Universidad de Sevilla, Università di Pisa, Universityof European Parliament and Council of the European Union

https://www.hylical.eu

PROJECT AND GENERAL OBJECTIVES

Hylical will contribute to (i) reaching an energy demand of 8 kWh/kg and a reduction in liquefaction cost of 20 % for small liquefaction volumes of 1–5 t/day; (ii) reducing capital expenditure and operating expenditure by at least 20 % in addition to the targeted energy savings; (iii) decentralising the (local) production of liquid hydrogen (LH_2), thus reducing the need for distribution and transport across long distances; (iv) coupling magnetocaloric hydrogen liquefaction (MCHL) technology to hydrogen production from renewables (green hydrogen) for off-grid configurations; (v) integrating into conventional liquefaction plants to increase their overall energy efficiency; and (vi) applying the processes for the liquefaction of hydrogen and for the management of boil-off from LH_2 tanks.

NON-QUANTITATIVE OBJECTIVES

Hylical aims to provide an alternative solution to the conventional vapour compression technology that offers several advantages.

- Reduced complexity will lead to less risk of failure, reduced requirement for regular maintenance and less downtime.
- The MCHL technology developed will be less noisy and will suffer significantly less from the 'economy of scale' than the currently employed vapour compression technology. It will also be more adaptable to fluctuations in loads and demands.

PROGRESS AND MAIN ACHIEVEMENTS

- Prediction of new materials/compositions for MCHL.
- Updated state of the art (SOA) for LH_2 safety provisions.
- Performance of initial simulations for heat transfer in an active magnetic regenerator (AMR) in cryogenic conditions.
- Starting construction of a cryochamber to host the AMR and testing heat transfer and pressure drops in ambient conditions.

FUTURE STEPS AND PLANS

- Synthesis of promising new materials predicted by computational material design.
- Characterisation of magnetic/structural properties and optimisation of materials for targeted applications.
- Upscaling of material production from grams to kilograms to suit the needs of the planned demonstration.
- Detailed simulation of heat flow, inleak and losses in cryogenic conditions.
- Testing of a cryochamber hosting the AMR and assessment of its properties in cryogenic conditions.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SOA result achieved to date (by others)	Year for reported SOA result
Project's own objectives and SRIA (2021–2027)	H_2 liquefaction energy intensity	kWh/kg	8		10	2020
SRIA (2021– 2027)	H_2 liquefaction cost	€/kg	< 1.5		1.5	2020

Clean Hydrogen Partnership
Co-funded by the European Union