

# HYLICAL

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



Project ID	101101461
PRR 2025	Pillar 2 – H <sub>2</sub> storage and distribution
Call topic	HORIZON-JTI-CLEANH <sub>2</sub> -2022-02-03
Project total cost	EUR 4 677 848.75
Clean H <sub>2</sub> JU max. contribution	EUR 4 677 848.75
Project period	01-01-2023 - 31-12-2027
Coordinator Beneficiary	INSTITUTT FOR ENERGITEKNIKK, NO
Beneficiaries	MAGNOTHERM SOLUTIONS GMBH, ASOCIATIA ENERGY POLICY GROUP, FIVES CRYO, SUBRA A/S, IBERDROLA CLIENTES SOCIEDAD ANONIMA, SHELL GLOBAL SOLUTIONS INTERNATIONAL BV, HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF EV, UNIVERSIDAD DE SEVILLA, UNIVERSITA DI PISA, UNIVERSITY OF ULSTER, ENGIE, TECHNISCHE UNIVERSITAT DARMSTADT, DANMARKS TEKNISKE UNIVERSITET

<https://www.hylical.eu>

### PROJECT AND GENERAL OBJECTIVES

HyLICAL will contribute to:

- Achieving an energy demand of 8 kWh/kg and a reduction in liquefaction cost of 20% for small liquefaction volumes of 1-5 TPD/day.
- Reduced capital expenditures (CAPEX) and operating expenses (OPEX) by at least 20% in addition to the targeted energy savings.
- Decentralised (local) production of liquid hydrogen (LH<sub>2</sub>), reducing the need for distribution and transport across long distances.
- Coupling of the magnetocaloric hydrogen liquefaction technology to hydrogen production from renewables (green hydrogen) for off-grid configurations.
- Integration into conventional liquefaction plants to increase their overall energy efficiency.
- Application of the processes for liquefaction of hydrogen and boil-off management of LH<sub>2</sub> tanks.
- Development and validation of a new magnetocaloric high-performance hydrogen liquefier prototype.

### NON-QUANTITATIVE OBJECTIVES

- Development of an innovative concept for hydrogen liquefaction that is different from what is used today.
- Increased efficiency and reduced costs of hydrogen liquefaction technologies.
- Contribution to the roll-out of next generation liquefaction technology to new bulk hydrogen production plants.

- Positive impact on other Hydrogen Europe roadmaps related to liquid hydrogen.
- Improvement of the sustainability and circularity aspects related to the liquefaction of hydrogen.

### PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Prediction of more than 150 new materials and compositions via machine-learning and computational materials design.
- Characterisation of more than 30 materials with respect to their thermo-magnetic and structural properties.
- Initial simulations of an active magnetic regenerator operating in the cryogenic region.
- Construction of a test bench for characterising magnetocaloric materials in the cryogenic region under process-relevant conditions.

### FUTURE STEPS AND PLANS

- Up-scaling and processing of five to seven of the most promising materials to bridge the necessary temperature span (20-80 K).
- More detailed device simulations for the active magnetic regenerator and its integration into the liquefaction process, including heat exchangers, coldbox, liquid nitrogen pre-cooling etc.
- Construction of the liquefier prototype and performance test with optimised materials.

### PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Energy efficiency	kWh/kg	8	
	Liquefaction cost	€/kg	1.5	