DELHYVEHR

DELIVERY OF LIQUID HYDROGEN FOR VARIOUS ENVIRONMENT AT HIGH RATE

Project ID	101137743
PRR 2025	Pillar 2 – H_2 storage and distribution
Call topic	HORIZON-JTI-CLEANH$_2$-2023-02-05
Project total cost	EUR 5 064 971.25
Clean H_2 JU max. contribution	EUR 3 711 901.13
Project period	01-01-2024 - 31-12-2026
Coordinator Beneficiary	ENGIE, FR
Beneficiaries	TRELLEBORG CLERMONT FERRAND SAS, Fives Cryomec AG, CESAME-EXADEBIT SA, TRELLEBORG SEALING SOLUTIONS UK LIMITED, DEKRA SERVICES SA, ASOCIATIA ENERGY POLICY GROUP, EUROPEAN RESEARCH INSTITUTE FOR GAS AND ENERGY INNOVATION, BENKEI, ARIANEGROUP SAS, ABSOLUT SYSTEM SAS, ELENGY SA, UNIVERSITY OF ULSTER

https://delhyvehr.eu/the-project/

PROJECT AND GENERAL OBJECTIVES

DeLHyVEHR, coordinated by ENGIE, will develop a liquid hydrogen high-rate bunkering station with a refueling flowrate over 5 TPH and zero boil-off losses, dedicated to maritime, aviation and railroad applications. The project is expected to complete its demonstration by 2026. Alongside market maturity the cost of distribution is expected to be halved by 2030. DeLHyVEHR will drive the maturation of each main system constituting the large-scale refuelling station, with a specific focus on pumping (FIVES Cryomec AG), metering (CESAME-Exadébit SA), loading (TRELLEBORG) and boil-off gas management systems (ABSOLUT SYSTEM SAS) to the full demonstration apparatus (ArianeGroup SAS). Throughout the project, hydrogen safety management activities (UNIVERSITY of ULSTER) will support the maturation plan and de-risk design and operation. Technology, economic and environmental, policy and governance studies will allow the assessment and replication of the demonstration's performance.

NON-QUANTITATIVE OBJECTIVES

- Facilitate the industrialisation of high-rate refuelling stations for aviation, maritime, and rail applications.
- Reduce helium consumption—which could become a showstopper in liquid hydrogen development—by using gaseous nitrogen for sanitation.
- Provide harmonised guidelines and recommendations for the deployment of bunkering stations.
- Decarbonise heavy-duty vehicle transport and dedicated infrastructure to achieve a hydrogen-related carbon footprint in line with the second edition of the Renewable Energy Directive (below 3.38 kg CO_2/kg H_2).

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

The first designs of each component and their integration have been explored to prepare for the prototyping phase. This comprises the following activities:

- A global assumption book was created and presented at the project kick-off meeting, allowing to frame each partner's work and highlight their interdependency.
- The minimum requirements for the cryogenic pump have been defined, while sub-systems' design and quotation have been performed with selected suppliers.
- Following iterative improvement, FIVES delivered a prototype design and started the manufacturing process.
- A conceptual design review of the coupling system for the loading line has been conducted and is still ongoing, while a prototype has been tested with liquid hydrogen by Trelleborg UK.
- The vacuum jacketed flexible hose size has been frozen, and a first prototype has been manufactured and is ready to be tested.
- Technologies for liquid hydrogen and gaseous hydrogen and flowmeters for gaseous hydrogen have been analysed and pre-selected.
- Preliminary simulations performed with in-house model allowed to feed the consortium with first boil-off gas inventory. A qualitative selection of boil-off gas management strategies have been performed by AS and the preferred technologies will be studied in depth.
- Alongside the functional analysis performed that pre-defined the station's general architecture, a test bench design has been developed, validated and its most critical components are under contracting.

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- Refinement of planning and budgeting for the prototyping and demonstration phases is ongoing.
- Preliminary cost estimations of the liquid hydrogen station for maritime and aviation business cases have been completed, including a Class IV estimate and a deep dive of operational expenses.
- An analysis of liquid hydrogen and refuelling station markets within the EU and worldwide has been launched and will be finalised.
- Finally, the safety studies identified the list of hazards to be considered for safety engineering and informed the initial project safety plan, which has now been completed.
- Multi-phase computational fluid dynamics model of liquid hydrogen fuelling through the entire equipment of LS-LHRS is under development. In parallel the identified hazards are being studied with computational fluid dynamics simulations.

FUTURE STEPS AND PLANS

DeLHyVEHR will first define each application's high-level requirements based on a functional design analysis with the support of end-users from the advisory board. Through modeling, design, manufacturing and functional testings, the project will increase the technological maturity of each key component of the refuelling line in a dedicated track. These developments will feed into the integrated design and associated protocol specifications, forming components that will be assembled into a demonstration unit at ArianeGroup SAS's unique European facility in Vernon, France.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	LH_2 flowmeter calibration uncertainty on the mass flow rate	%weight	0.6	
	Delivered liquid hydrogen flowrate	kg/h	5 000	
	Cryogenic pump design hydraulic efficiency	%	60	
	Endurance test duration on demonstrator	hours	10	
	Gas for connection/disconnection inserting operation	-	GN2	
	Number of connection-disconnection tested	Number	20	
	BOG recovery rate achievable	%	80	

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