H2REF-DEMO

HYDRAULIC COMPRESSION FOR HIGH CAPACITY HYDROGEN REFUELLING STATION DEMONSTRATION

Project ID	101101517
PRR 2024	Pillar 2 – H_2 storage and distribution
Call topic	HORIZON-JTI-CLEANH2-2022-02-08: Development of novel or hybrid concepts for reliable, high capacity and energy-efficient H_2 compression systems at real-world scale
Project total cost	EUR 5 786 712.50
Clean H_2 JU max. contribution	EUR 4 617 384.88
Project period	1.1.2023–30.6.2026
Coordinator	Centre technique des industries mécaniques, France
Beneficiaries	Faber Industrie SpA, H2Nova, HYDAC Technology GmbH, Hydrogen Refueling Solutions, Università degli Studi di Modena e Reggio Emilia, Université de Technologie de Compiègne

https://heavy-v.h2ref.eu/about-us/

PROJECT AND GENERAL OBJECTIVES

H2REF-DEMO aims to further develop and quintuple the innovative compression concept developed in H2REF in order to address large vehicle refuelling applications requiring hydrogen to be dispensed at rates of hundreds of kilograms per hour, such as refuelling bus fleets every evening at bus depots, refuelling trucks and refuelling trains. The concept is particularly suited to scaling up, thanks to the scalability of fluid power technology and composite pressure vessel technologies.

As it incorporates the intrinsic modularity of fluid power technology together with that of pressure vessel technology, this disruptive solution will allow the different expected hydrogen supply configurations to be addressed in a cost-effective and reliable manner, in particular those that are the most suitable for large-scale refuelling applications for which daily consumption exceeds 1 t:

- on-site production;
- road delivery with high-pressure trailers (e.g. 500 bar, in carbon composite), as these have an effective payload of around 1 t.

Large-scale hydrogen refuelling involves two distinct types of compression.

- **Compression of hydrogen production for storage.** As production is the supply chain function with the highest cost, it tends to be performed through continuous (24/7) operation of production devices sized on the basis of daily consumption. Storage of the hydrogen produced requires compression at the same rate in order to keep storage size and footprint within acceptable limits.
- **Compression of stored hydrogen for high-capacity dispensing.** This compression function brings hydrogen from storage – that is, a fixed vessel storing hydrogen produced on site, a fixed vessel into which hydrogen has been delivered by trailer or a trailer – maintaining the pressure required for dispensing at the rate required when dispensing takes place, for example at any time of the day when vehicles pull in to refuel, or almost continuously during a certain time frame (e.g. 4–6 h per day at a bus depot). The feed pressure of compression for dispensing is typically higher than that of compression for storage; however, the required throughput is also higher (as dispensing takes place only part of the time).

NON-QUANTITATIVE OBJECTIVES

The main goal of the project is to develop and test at full scale a high-capacity compression module (HCCM) capable of either hydrogen compression for storage prior to dispensing (1.2 t/day) or hydrogen compression for high-capacity (35 MPa) dispensing (150 kg/h–2.5 kg/min), with 1 year's demonstration of use for the high-capacity refuelling of heavy-duty vehicles in a commercially operated refuelling station. Particular attention will be given to optimising design to minimise costs.

PROGRESS AND MAIN ACHIEVEMENTS

In the first year of the H2REF-DEMO project, the following results were achieved:

- multiphysical modelling and simulation of the HCCM process and initial sizing and estimation of potential performance;
- functional specification of the HCCM based on a bladder accumulator and an elementary compression unit;
- functional specification and material selection for bladder and tests on material;
- design of the shell of the accumulator;
- development of an initial safety plan;
- specification and simulation of the global refuelling system;
- specification and simulation of the hydraulic power pack;
- review of existing regulations, codes and standards and identification of gaps with the project activities.

FUTURE STEPS AND PLANS

- Selection of bladder material / manufacture of bladders.
- Manufacture of shells.
- Development of the accumulator and performance of the first tests.
- Development of the hydraulic power pack.
- Start of the development of the gas skid.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	CAPEX	k€/(kg/day)	3.5	
	Availability	%	97	
	Mean energy to 350 bar	kWh/kg	3.5	
	MTBF	days	47	
	HRS contribution to H_2 price	€/kg	2.5	
	Bladder durability	cycles	20 000	

Clean Hydrogen Partnership
Co-funded by the European Union