Liquid organic hydrogen carrier

Demonstration of a liquid organic hydrogen carrier for distribution and/or storage of hydrogen, including hydrogenation at a hydrogen production facility; transport of the hydrogenated compound and/or storage of the compound over several days and dehydrogenation at the point or time of hydrogen use.

The system should demonstrate

- chain efficiency above 70% by:
    - Utilization of released heat during the hydrogenation step, preferably within hydrogen production system feeding the LHOC system with hydrogen;
    - Reduce energy use for releasing the hydrogen below 10 kWh/kg H_2 by system & catalysis improvements or utilizing waste heat.
- the use of existing infrastructure for distribution and/or storage of gases or liquids;
- overall cost below that of gaseous high pressure (500+ bar) truck distribution and/or gaseous hydrogen storage;
- suitability of the technology for the intended application with regards to operational aspects, i.e. footprint and noise on a retail station;
- safety along the chain, including toxicity and health aspects;
- quality of hydrogen that fulfils ISO 14687:2-2012. It shall be demonstrated that trace amounts of liquid organic hydrogen carrier in line of ISO norm or demonstrated to not affecting PEMFC performance for road transportation.

The scope includes the following analyses, comparing to gaseous storage and/or distribution:

- an economic analysis;
- a lifecycle greenhouse gas emissions analysis;
- if relevant, a local pollutant emissions analysis.

It is expected that the technology starts at TRL 4 and reaches TRL 6 at the end of the project.

International collaboration in this field is highly encouraged, especially with IPHE members.

Any safety-related event that may occur during execution of the project shall be reported to the European Commission's Joint Research Centre (JRC), which manages the European hydrogen safety reference database, HIAD (dedicated mailbox JRC-PTT-H2SAFETY@ec.europa.eu).

The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 2.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

A maximum of 1 project may be funded under this topic

Expected duration: 3 years

The amount of hydrogen that can be transported by a compressed gas distribution trailer is limited to 300 kg (at 200 bar). The pressure in hydrogen delivery trucks is expected to rise from 250 to around 550 bar increasing payload up to 600 kg. Using liquid organic hydrogen carriers (LHOC)[[Liquid hydrogen (LH2) is excluded from this topic]] this amount can be more than doubled, while using lower cost distribution trailers at the same time. Similarly, the storage of these hydrogen carriers is more cost effective than the storage of hydrogen itself. Additional advantages are the lower flammability and lower explosive nature of LOHC's compared with compressed hydrogen storage. Some LOHC's show even no explosive nature, reducing the storage costs considerably.

However, the use of these carriers requires a hydrogenation step at the hydrogen production facility and a dehydrogenation step at the point, or time, of use. Recent advances in hydrogen carriers have led to end-to-end system cost that could be comparable or better than gaseous hydrogen storage and distribution.

This topic calls for the demonstration of such a carrier for large scale hydrogen storage and/or hydrogen distribution

- Demonstrate to reach the following MAWP KPI's in 2020 and perform an engineering study to show path towards 2023 targets:

Topic	Parameter	Unit	2012 (SoA)	2020	2023
H_2 transport	Trailer Capex	M€/t capacity	0.55 @400kg	0.55 @800kg	0.45 @1000kg
H_2 storage	System Capex	M€/t	0.5	0.45	0.40

- Proof of competitiveness of liquid/gaseous carrier technology compared with compressed hydrogen gas technology at 500+ bar;
- Cost reduction for storage and/or distribution of hydrogen;
- Enabling of large scale storage of hydrogen independent of location and/or reduction of the number of hydrogen distribution truck kilometres;
- Proof of hydrogen quality fulfilling ISO 14687:2-2012.

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