Optimisation of Transport Solutions for Compressed Hydrogen DeliverHy

(Grant agreement number 278796)

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General Overview

- Optimisation of Transport Solutions for Compressed Hydrogen
- 01.01.2012 – 31.12.2013
- Budget (1,249,566 € total budget and 719,502 € FCH contribution)
- Ludwig-Bölkow-Systemtechnik GmbH (Coord.), Air Liquide Hydrogen Energy, CCS Global Group, H2 Logic A/S, Raufoss Fuel Systems, Norwegian University of Science and Technology

DeliverHy

Project & partnership description

- Compressed hydrogen trailers are cost efficient for near term distribution
- 20 MPa trailers currently used are impractical for the supply of larger hydrogen refuelling stations
- Lighter materials + higher pressures allows to increase transported quantities
- Cost increase by advanced technology can be off-set by savings in distribution

No.	Partner	Short Name	Country	Role in the project
1	Ludwig-Bölkow-Systemtechnik GmbH	LBST	Germany	Project coordinator (WP1) WP3 leader, WP6 participation
2	Air Liquide Hydrogen Energy	AL	France	WP4 leader WP2, WP2, WP3, WP4, WP5, WP6 & WP7 participation
3	CCS Global Group	CCS	Great Britain	WP6 leader WP1, WP6 & WP7 participation
4	H2Logic A/S	H2L	Denmark	WP2 leader WP1, WP3, WP6 & WP7 participation
5	Raufoss Fuel Systems	HEX	Norway	WP7 leader WP1, WP2, WP3, WP4, WP5 & WP6 participation
6	Norwegian University of Science and Technology	NTNU	Norway	WP5 leader WP1, WP4 & WP6 participation

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1. Project achievements (slide 2)

Objectives/ Goals:

- Evaluate the effect of the introduction of composite materials for the transport of Compressed Hydrogen
- Justify safety related to introduction of new materials/ technology
- Identify needed changes in Regulations, Codes & Standards (RCS) for facilitating the implementation of this new technology in Europe and elsewhere

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Project Importance/ Targets:

- Documentation of the cost-benefits provided by the introduction of new materials/technology, based on comparison of conventional supply modes with those using state-of-the art technology
- Recommendations to industry and preparation of an action plan for the needed changes to RCS
- Initiation of a dialogue with selected national authorities about these changes

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Milestones

Milestone number	Milestone name	Work packages involved	Expected date[1]	Means of verification[2]
M1	Project coordination		M24	
M2	Limitations of current solution with regard to future needs		M06	
M3	Impact of high pressure composite technology		M15	
M4	RCS barriers/gaps and action plan		M18	
M5	Justification of RCS changes		M16	
M6	Recommendations and Roadmap for RCS		M21	
M7	Interactions with Authorities		M24	

Approach in performing the activities

- WP2: Methodology of the project is based on a characterization of existing transport solutions and description of improved solutions using composite materials
- WP3: Systematic evaluation of the benefits of improved storage solutions using composite materials with regards to economy, energy efficiency and related emissions
- WP4: Identification of existing RCS barriers and preliminary action plan to overcome these barriers
- WP5: Study of safety issues related to higher capacity composite materials
- WP6: Elaboration of optimum transport capacity of CGH_2 and development of Roadmap addressing necessary RCS changes to international bodies
- WP7: Early initiation of discussion regarding change of RCS framework with a representative group of authorities in some of the most committed countries

Technical Accomplishments and Progress towards overall project and state of the art (SoA)

- Tank geometries, pressure levels, tank volumes, lifetime and costs (invest, O&M) to be defined
- High pressure/volume transport of H_2 to be benchmarked against other available transport technologies/concepts (20, 30 MPa, LH_2)
- 40 MPa+ infrastructure compatibility check
- Modeling of hydrogen trailer payload → selection of most relevant tank configurations (max. 3) serving as reference for further analysis tasks
- WtT techno-economic & environmental analysis to be performed
- Through parameter variation consequence analysis results will be provided in view of a) Technology to be used for high pressure trailers and b) RCS implications → assumptions, bandwidths, timelines, sensitivity analysis results thereof to be provided and published in WP6 reports

Correlation of the project with the corresponding Application Area (MAIP/AIP)

- Targets Application Area "AA2 – Hydrogen Production & Distribution"
  - Assessment of safety implications using composite material and higher storage pressure
  - Comparison of state of the art 20 MPa infrastructure with 40 MPa+ equipment in order to determine strengths/weaknesses of 40 MPa+ truck delivery technology
  - Assessment of technical and cost issues for such trailers including impact on energy efficiency and GHG emissions
  - Identification of issues regarding RCS and way-forward for facilitating the use of high pressure trucks

Project activities & results/achievements versus MAIP/AIP targets

- DeliverHy:
  - will include 40 MPa+ composite materials storage swap bulks and dump-off tube-trailers for benchmarking with existing 20/30 MPa storage/transport technologies
  - analysis regarding usable hydrogen delivered,
  - identify/ define applicable safety factors and pressure limitations,
  - perform energy efficiency, economic and environmental analysis
  - Identify RCS barriers/ propose changes required
    - reduction of abnormally high safety factor required for transportable composite vessels
    - acceptance of tubes with a water capacity exceeding 3000 L

Gaps/bottlenecks in RTD&D proposed by MAIP/AIP documents

- Due to long period for feeding in RCS findings into intl. committee work, here ADR, Europe-wide for improved trailer storage technology will not be fully completed before end of decade
- Also international standardisation on ISO level required
- Real funding rates too low for service activities (coord., project management)
- Challenges to be dealt with at the same time with the same intensity in order to find the right balance between cost and safety are: *new material, larger cylinder sizes, higher pressure, unreasonable safety margins*

Priorities and topics possibly under/over-estimated in the AIPs in terms of technical challenge

- For this topic, time frames needed for RCS to be in place are considerable (about at least 5 years for a consensus ADR adaptation).
  Therefore the delay incurred in reinitiating pre-normative research in continuation of the StorHy project (currently performed in HyComp started in 2011) due to lack of funding results in the same additional delay in the establishment of the needed RCS framework within DeliverHy.

Expected output AIP Topic: 2.6 Call: 2010	Objectives Project	Status at 38% of the project	Expected revised objectives
Assessment of safety implications by using composite materials and higher pressure	*WP5.1 Justification of RCS changes on composite pressure vessels*	50%	-
	WP5.2 Proposal max. stress level in composite pressure vessels	25%	-
Comparison 20 MPa with 40+ MPa hardware: materials and components behaviour, lifetime assessment, cost comparison and energy consumption	*WP2.1 Technical & cost limitations of state-of-the-art 20 MPa CGH2 distribution*	100%	-
	WP2.2 Distribution impact, interface and issues at HRS	100%	-
	WP2.3 Allowable costs + design parameters over supply chain	90%	-
Assessment of technical issues and cost-benefit analysis of using higher capacity trailers, including impact on energy efficiency and GHG emissions	*WP3.1 Definition of benchmark technologies for delivery task and compilation of data*	90%	-
	WP3.2 Comparison of high pressure/volume delivery with benchmark technologies	50%	-
	WP3.3 Sensitivity analysis and strategic conclusions	0%	-
Identification of issues to be addressed and way-forward for facilitating the use of high pressure trucks with regards to RCS	*WP4.1 Identification of barriers/gaps*	50%	-
	WP4.2 Preliminary action plan	0%	-
	WP6.1 Summary of findings and proposed actions	0%	-
	WP6.2 Recommendations to industry and RCS bodies	0%	-
	WP6.3 Dissemination to industry (H2&FC community) and to WP7	0%	-
	WP7.1 Identifying Authorities	0%	-
	WP7.2 Strategy plan	0%	-
	WP7.3 Communication and harmonisation	0%	-

Training and Education

- No training and education activities foreseen in the project

Safety, Regulations, Codes and Standards

- Performance-based analysis of all critical failure mechanisms of the pressure vessel + lifetime analysis will show that these failure mechanisms will not occur under specified static, dynamic and short and long-term service loads (FMECA)
- Identification of existing RCS limitations + action plan on how to establish an RCS framework for introducing safe higher capacity transport solutions based on fibre-reinforced composite materials high pressure vessels will be developed to provide basis for RCS roadmap towards authorities at EU (ADR, TPED), UN and ISO level

Dissemination & public awareness

- Interaction with authorities on RCS roadmap dissemination

Technology Transfer / Collaborations

- *DeliverHy will seek exchange and corporation with HyCOMP among others assisted by the three DeliverHy partners also being HyCOMP partners (AL, CCS, RAFS)*
- *Close exchange with DoE projects on "Development of High Pressure Hydrogen Storage Tank for Storage and Gaseous Truck Delivery" through partner Hexagon and its subsidiary Lincoln Composites – which are at the forefront of large-scale high pressure gas tube trailer carriers with up to 8,400 l per tube*

Project Future Perspectives

- Proposed future research approach and relevance
  - *Continued interaction with authorities in all EU member states required to implement necessary RCS changes beyond project lifetime is required*

  → *this will require additional manpower support after DeliverHy*
- Improved cooperation between EC and Member States with regard to RCS could enhance and accelerate introduction of improved RCS framework and thus larger-scale H_2 trailer supply
- DeliverHy will significantly contribute to more efficient bulk delivery of high compressed hydrogen gas to HRS's

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New Energy World JU

fuel cells & hydrogen for sustainability

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