



European demonstration of hydrogen powered fuel cell material handling vehicles – HyLIFT-DEMO (Grant agreement number 256862)

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European demonstration of hydrogen powered fuel cell material handling vehicles

01/2011 – 12/2013 (36 months)

Total budget € 2.9 Mio.

FCH JU contrib. € 1.2 Mio.

Main objectives

- Demonstration of > 30 hydrogen powered fuel cell material handling vehicles
- Ensuring commercial market deployment from 2013 on

HyLIFT-DEMO partners



DanTruck 3000 Power Hydrogen





STILL RX60-25 H2





MULAG Comet 3 FC





Hydrogen refuelling stations (HRS)

- Target: demonstration of 3 (new) units
- HRS product ready: variable inputs of hydrogen supply from 0.5 – 10 MPa
25-100 kg/d (14-55 complete refuellings per day)
- Construction of HRS to start after signing of contracts with end-users
- 3 small HRSs available at H2 Logic to support test trials and to bridge potential delays in HRS construction

H2Station[®] MH-100
Hydrogen refueling for Material Handling vehicles
35MPa OptiH-fill™ | 25-100kg/day

H2 Logic
Hydrogen Fuel Cell and Power Systems

The H2Station[®] MH-100 is designed to provide 35MPa hydrogen refueling for material handling vehicles such as forklifts and tow tractors, matching the price and performance of diesel and LPG. All equipment necessary for the refueling is integrated into a compact station module allowing for easy transport and installation in only two days. Installation cost is kept at a minimum and construction time at site is limited, thus avoiding interruption of the customer's daily operation.

The MH-100 can be configured to provide between 25 to 100kg of hydrogen per day at variant inlet pressures, enabling cost optimization to fit the exact needs and available hydrogen supply. Instant refueling capacity can also be configured to fit the vehicle fleet size and operation cycles.

The low investment required combined with a high energy efficiency makes the MH-100 capable of providing hydrogen at a dispensing cost competitive with conventional use of diesel or LPG.

The MH-100 is based on 35MPa H2Station[®] technology from H2 Logic that has been developed and tested extensively for several years. Refueling is based on the H2 Logic developed OptiH-fill™ protocol & active cooling that ensures a safe and fast refueling with a high state-of-charge.

% OF FULL TANK

10	20	30	40	50	60	70	80	90	100
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H2 Logic H2Station[®] MH-100





Total Cost of Ownership (TCO) calculations

- For each potential customer a specific TCO calculation has to be performed
- This TCO calculation compares fuel cell material handling vehicles with conventional technology currently operated at customers site applying real world data
- Enabling end-user attributes (to achieve TCO calculation beneficial for fuel cell material handling vehicles):
 - Fleet sizes of more than 10 material handling vehicles intensely used at least 2,000 h/a
 - High LPG/diesel prices
 - Access to low cost hydrogen



End-user contracts

- Target: Demonstration contracts signed with material handling vehicle end-users by MAR 2012
- Additional signatures of contracts still pending due to delayed delivery of 1st vehicles to be used for short-term real-world trials at potential end-user sites
- 204 potential customers identified and evaluated
- 50 of high relevance for HyLIFT-DEMO
- 36 end-user specific TCO calculations performed with beneficial results for fuel cell vehicles compared to LPG / diesel trucks
- 32 end-users waiting for fuel cell vehicle trials
- 2 end-users: withdrawal based on management decision



Fuel cell system testing – vibration, shock and climate tests

- Target: final results available in JUN 2012
- Test equipment booked and tests in start-up phase at JRC Petten
- Test procedures and specifications fixed and agreed on with H2 Logic
- Tests to be performed in OCT 2012

Fuel cell system testing – accelerated durability tests

- Target: final results available in DEC 2012
- Installation of test equipment ready at H2 Logic's premises
- Test procedures and specifications fixed and agreed on with H2 Logic
- Tests to be performed from OCT 2012 on



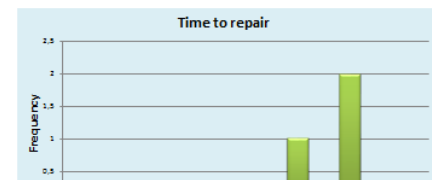
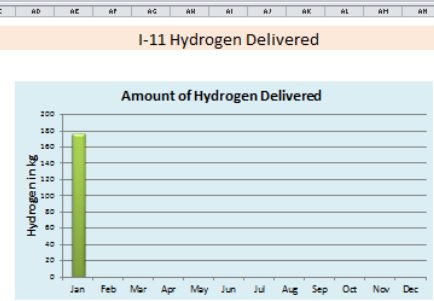
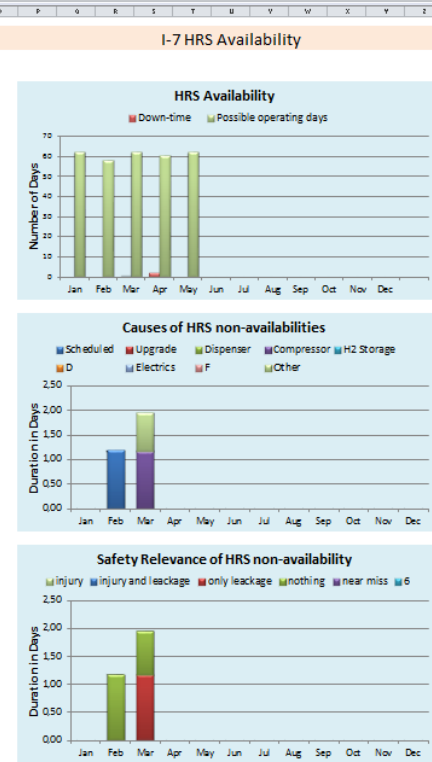
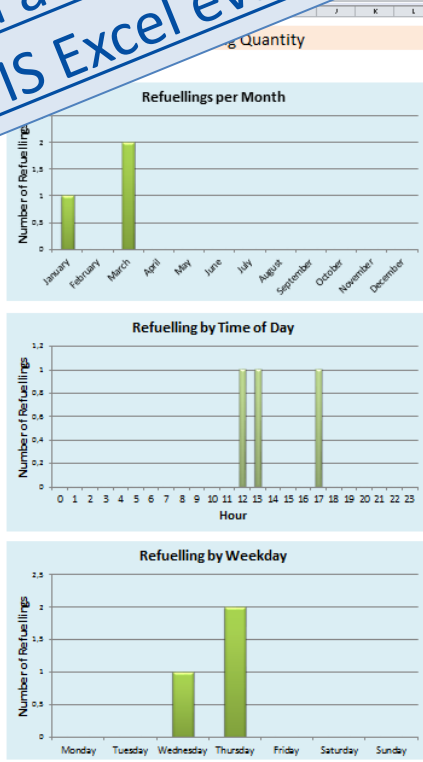
Demonstration monitoring

- Target: data acquisition & analysis system available in NOV 2011
- Specific performance indicators for fuel cell material handling vehicles and hydrogen refuelling stations based on the HyLights Monitoring and Assessment Framework (MAF) agreed on
- Specific confidentiality levels of each performance indicator and methodology for data collection and handling defined
- Ready to get started!



Monitoring and assessment framework dashboard in MS Excel evaluation sheet*

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* dummy data



Securing & planning commercialization

- Target: successful initiation of commercialisation should be supported by “Suggestions for deployment support mechanisms” (JUN 2012 / publication under preparation), “Guidelines for regional fuel cell vehicle projects” (AUG 2012 / under preparation) and a “Commercialisation Plan” (DEC 2012 / under preparation)
- Next step for a commercial introduction of fuel cell material handling vehicles in Europe: a fleet of 200 fuel cell systems will enable H2 Logic and its supply chain partners to ramp-up production and assembly lines towards series production. The project proposal HyLIFT-EUROPE prepared for AIP 2011 is dedicated to increase the number of vehicles to be demonstrated to 200



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

- Targets Application Area “Early Markets”:
 - 2010: 20 industrial and off-highway vehicles
 - 2015: 500 industrial and off-highway vehicles
- HyLIFT-DEMO: at least 30 fuel cell material handling vehicles and preparation of commercialisation (series production)
- Target “Better integration of SMEs”: SMEs are not only directly involved via project partnership (H2 Logic) but also via the various supply chains



H2Drive batch production at H2 Logic premises





Project activities & results / achievements versus MAIP/AIP targets

- AIP 2009 targets:
 - Total cost fuel cell system < 4,000 €/kW ▶ achievable
 - System lifetime > 5,000 h ▶ to be validated in project
 - Refuelling time < 5 min ▶ < 3 min achieved
 - Hydrogen price at pump < 13 €/kg ▶ achievable
 - Demo of at least 10 vehicles at 1 demo site ▶ under preparation
 - HRS functionality and end-user acceptance ▶ to be demonstrated
 - Certification procedures ▶ prerequisite for demos

HyLIFT-DEMO

2. Alignment to MAIP/AIP (2b)



Expected output AIP Topic: 4.1 Call: 2009		Objectives Project	Status at 50% of the project	Expected revised objectives
<i>Number of vehicles</i>	10	30	8	30
<i>Total cost of fuel cell system (€/kW)</i>	<4,000	< 3,100*	<3,100*	< 3,100*
<i>System life time (with service/ stack refurbishment) (h)</i>	>5,000	>5,000	tests not finalized	>5,000
<i>System efficiency (tank to wheel) (%)</i>	>40	>48% (@10 kW)	49% (last value obtained)	>49% (@10 kW)
<i>Refuelling time (min)</i>	<5	3-4	<3min	<3 min
<i>H2 price at pump (€/kg)</i>	<13	<12	14.2 (average)	<12

* Price after public support when reaching stated volume



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

- Project proposal processing is too slow and projects are too complex and bureaucratic to attract end-user participation (They are used to periods of ~3 months from decision to operation start of vehicles)
- Program optimized for research and development, not for demonstration; funding rates OK for demonstration, too low for supporting activities such as coordination activities or project management
- Project funding options unclear after 2013



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

- From today's perspective the priorities and topics are well set in the AIPs. The technical challenges are addressed appropriately in the light of the material handling sector



Training and Education

- No training and education activities are foreseen in this project

Safety, Regulations, Codes and Standards

- In principle sufficient RCS is in place to get certifications for fuel cell systems, fuel cell material handling vehicles and hydrogen refuelling stations. However, standardisation is required to enable reduced efforts for certification procedures on a European and a global level

Dissemination & public awareness

- FC forklift truck presented at material handling fair CeMAT in May 2011
- Presentations and posters at several events (EUSEW Brussels, WHEC Toronto / Canada, Hannover Fair, FCH JU SGA, etc.)



HyLIFT-DEMO booth at CeMAT 2011 in Hannover

3000 Power **HYDROGEN**

DANTRUCK 3000 POWER HYDROGEN

Kraftvoll in die Zukunft!

Hydrogen / Brennstoffzelle
Null Emission
Leistungsstarker Antrieb

HyLIFT
Clean Efficient Power
For Materials Handling

European demonstration of fuel cell forklift trucks and supporting hydrogen refueling stations.

More than 1,000 fuel cell forklift trucks from various suppliers are in operation in the U.S.
Europe is next!

Become one of the first customers! Join HyLIFT-DEMO

HYLIFT DEMO AND R&D IS SUPPORTED BY

HYLIFT DEMO PARTNERS





HyLIFT-DEMO booth at CeMAT 2011 in Hannover





Technology Transfer / Collaborations

- Tight cooperation with second FCH JU project on material handling SHEL enabled by the partners HyRaMP-EHA and JRC IET. No further projects on material handling contracted by FCH JU so far
- Close contacts to national and regional activities via HyRaMP-EHA and coordinator (e.g. NIP / NOW in Germany) existing
- Coordination with various material handling industrial associations e.g. the European Federation of Materials Handling and Storage Equipment (FEM)



Project Future Perspectives

- This project, with about 30 units, is an important but not the last step towards commercialisation of hydrogen powered fuel cell material handling vehicles. The next step needs to see figures in the hundreds of units as proposed e.g. in the HyLIFT-EUROPE project (200 units)
- In parallel authorities at all levels (European, national, regional) are asked to implement dedicated support mechanisms enabling a rapid market uptake in time. A specific task in HyLIFT-DEMO will propose appropriate measures
- The project enables the key partners to establish contacts to potential end-users which are currently not ready to enter in a contract (e.g. because of a less beneficial TCO) but might adopting the technology as soon as the next step towards maturity has been taken



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The project partners would like to thank the EU for establishing the fuel cells and hydrogen framework and for supporting this activity.