

SHEL: Sustainable Hydrogen Evaluation for Logistics

(Contract number: 256837)



*Oscar Miguel Crespo, CIDETEC –IK4 (Spain)
(SHEL Project Manager)*

*Federico Villatico Campbell, UNIDO-ICHET (Austria-Turkey)
(SHEL Technical Manager)*

Project description:

Started January 2011, **SHEL** aims to demonstrate the market readiness of Fuel Cell Hydrogen powered (FCH) materials handling vehicles, hydrogen refuelling infrastructure, demonstrate end user acceptance, and accelerate early market take-up of Fuel Cell Hydrogen Fork Lift Trucks (FCH FLT) in Europe

Partnership description:

- 13 partners
- 7 EU countries
- research + industry



| Short name | Country | Partner type |
|----------------------|------------------|--------------|
| CIDETEC-IK4 (coord.) | Spain | research |
| UNIDO-ICHET | Austria - Turkey | research |
| AP | UK | industry |
| CRES | Greece | research |
| JRC | Netherlands | research |
| AIJU | Spain | research |
| INTA | Spain | research |
| FHA | Spain | research |
| UH | UK | research |
| FAST / EHA | Italy | association |
| HYGEAR | Netherlands | SME |
| CEGA Logistics | Spain | industry |
| CUMITAS | Turkey | industry |

Project goals and targets

- SHEL will demonstrate 10 FC FLT's and associated hydrogen refuelling infrastructure across 3 sites in Europe (Turkey, UK & Spain).
- Each site represents a likely early market segment (Industrial, Airports and Light Logistics) for future commercialisation.
- SHEL will develop simplified procedures to reduce the time required for product certification and infrastructural build approval
- To ensure the widest dissemination of results the project will build a comprehensive Stake Holder Group of partners to pave the way for wider acceptance of the technology.

Project milestones

| Milestone | Milestone name | Lead beneficiary | Delivery date |
|-----------|---|------------------|---------------|
| 1 | Collaboration agreement in place | CIDETEC | M1 |
| 2 | First Project Steering Committee (PSC) held | CIDETEC | M3 |
| 3 | Agreed parameter data obtained from Benchmark | AP | M3 |
| 4 | Simulation data for each site in place | AIJU | M6 |
| 5 | Site Approval for Demonstration | FHA | M12 |
| 6 | Safety Validation on vehicles | UNIDO-ICHET | M18 |
| 7 | Hydrogen Infrastructure in place and validated | UNIDO-ICHET | M21 |
| 8 | Start of demonstration | UNIDO-ICHET | M18 |
| 9 | Evaluate results of Turkish demonstration with regard to the need for an alternative cell | UNIDO-ICHET | M24 |
| 10 | Identification of further 10 sites | FAST / EHA | M33 |
| 11 | Project End | FAST / EHA | M36 |

Approach in performing the activities

- Approach #1:

SHEL is based on the modification of a standard, “off the shelf”, electric FLT

- Starting point is a previous national project (ECOLIFT Project)



Approach in performing the activities

- Approach #2: a “reference” vs. “practical” H2 supply is defined

| Country | Demo site | Reference H2 scenario | Practical H2 source | Refilling method |
|---------|-----------------------------------|---|---|--|
| TK | Petkim Petrokyma chemical complex | industrial H2 - Chlorine-alkali production line | on-site compressed storage | existing prototype modular hydrogen refuelling station |
| UK | Newcastle International Airport | waste to H2 | tube trailer | commercial vehicle hydrogen refuelling station (AP) |
| SP | CEGA Logistics | H2 from renewables | electrolyser at the site; power from the grid | existing prototype modular hydrogen refuelling station |

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

- *The SoA of FCs systems for FLT applications has been reviewed*
- *The project is now in the phase of purchasing the FC systems and start the fleet assembling phase*
- *Site assessments have been carried out*
- *Certification procedure and main Codes&Standards (RCS) have been reviewed*

Correlation of the project with the corresponding Application Area (as mentioned in MAIP/AIP documents)

- **Call title: FCH JU Call for Proposals 2009 Part 1, “FCH-JU-2009-1”**

Date of publication: 2 July 2009; deadline: 15 October 2009

Area SP1-JTI-FCH.4: Early Markets 10.3

*SP1-JTI-FCH.2009.4.1 **Demonstration of fuel cell powered materials handling vehicles and infrastructure** - Collaborative Project*

- **AIP 2009: 2.1.4 Early Markets**

*“Emphasis of the application area **Early Markets is put on demonstration of readiness of fuel cell systems applied to materials handling vehicles, with the final aim to stimulate market pull for non-highway vehicle applications.**”*

Detailed project activities & results/achievements versus MAIP/AIP document targets (from AIP 2009, p.57)

| Overall project objectives / Scope of Work | SHEL approach |
|--|--|
| <ul style="list-style-type: none">• Demonstrate the advantages of using fuel cells with hydrogen refuelling• Development of certification procedure• Identification of potential RCS needs.• Dissemination of results to wider audience, preferably to potential customers• Envisaging a continuation of efforts / a following market introduction | <ul style="list-style-type: none">• Overall project target• WP4 Certification and Planning• WP4 Certification and Planning• Task 2.2: To establish Stake Holder Group• WP7 Continuation Plan and Dissemination; Task 7.2 Continuation Plan |
| Technical goals for forklifts: | SHEL approach |
| <ul style="list-style-type: none">• Total cost of fuel cell system < 4.000 €/kW• System lifetime (with service/stack refurbishment) > 5000 h• System efficiency (tank to wheel) >40%• Refuelling time < 5min | <ul style="list-style-type: none">• Requirements included in bid for FC system suppliers @ WP5 FLT Preparation• Internal specification |

Comments on gaps/bottlenecks in RTD&D proposed by MAIP/AIP documents

–FC systems cost issue:

- MAIP target for FLTs is $< 4,000$ €/kW. Real system cost is approx $\geq 6,500$ €/kW (only FC system, e.g. stack + energy storage - batteries/ultracaps).
 - *(this is probably dependant on “market situation”, i.e. prioritization of foreing suppliers towards their local, possibly more developed markets)*
- H2 refueling infrastructure cost to be included within the overall financial analysis
- MAIP target for system lifetime (with service/stack refurbishment) $> 5,000$ hrs; currently suppliers provide a 18 months guarantee or up to 2,000 hours

– Certification:

- a lot of regulations and different standards are available. No uniform approach at EU level for overall site+infrastructure+MHV (material handling vehicle) certification. Need for converging to a common EU RCS to facilitate on-site applications in different countries

How project addresses and contributes to :

- Training and Education

- **Task 6.2 Handover & Training** (all equipment)

- Safety, Regulations, Codes and Standards

- **Task 4.2 Safety and Environmental study**

A review of existing regulations, codes, standards and relevant technical references guidelines that make use of recognised best practice industry experiences to set safety standards to design and construct the demonstrations. HAZOP study and FMEA analysis to build a Qualitative Risk Assessment of the sites.

- **Task 4.1 Establish Certification (simplified) for 4 EU sites**

Establish a certification process report for four member states...develop a simplified procedure methodology for future continuation projects

- Dissemination & public awareness

- **Task 2.2 To establish Stake Holder Group**

identification of key stakeholders within Europe for a future EU FC FLT industry.

- **Task 7.1 Dissemination of Project**

This activity will be primarily conducted through Stakeholders dissemination workshops.

How project addresses and contributes to :

- Dissemination & public awareness

Dissemination activities target Stakeholders at Local/National/European Level Contact Database with 1500 contacts of: Logistics industry, Knowledge Institutes, Regional/Local Authorities, European Airports and Ports, OEMs, European Associations in Logistics, Materials Handling, Hydrogen and Fuel Cells, Publications in Materials Handling, Distribution, etc.

Targeted Stakeholder Organisations:

European Logistics Association

European Intermodal Association

The Association of Vehicle Logistics

National/European Port and Airport Associations

Fork Lift Truck Association

European Manufacturers Associations of Materials Handling

Storage Equipment Manufacturers' Association



Technology Transfer / Collaborations

the degree to which the project interacts, interfaces, or coordinates with other institutions and projects (especially regional/national/international projects and/or organizations)

- SHEL originated in a national project: ECOLIFT / UNIDO-ICHET
- Link with other HFC FLT projects and activities, i.e.:
 - JRC, UNIDO-ICHET as liaison to standardization bodies (IEC TC 105)*
 - HyLIFT-DEMO : The European Hydrogen Association leverages dissemination between SHEL and the HyLIFT-DEMO Project*
- Plans to develop a National Demo project in Spain based on SHEL infrastructures, with increased R+D component (FC system development)

Need/opportunities identified for increasing cooperation at EU level

Possible contribution to the future FCH JU Programme

- It is proposed that technical thematic workshops are organized by the JU around Action Areas/clusters of topics, etc. (i.e. on a yearly basis) to enhance mutual knowledge of projects underway and to promote joint cooperation.
- Need of more interlink between material handling and refueling infrastructure topic at FCH JU MAIP level (they are included in the same cost model for such H2 application field)

thank you for your attention

SHEL: Sustainable Hydrogen Evaluation for Logistics



www.shel.eu