3EMOTION

Environmentally Friendly, Efficient Electric Motion

PANEL 1

Technology validation in transport applications

ACRONYM	3EMOTION
CALL TOPIC	SP1-JTI-FCH.2013.1.1 (2): Large-scale demonstration of road vehicles and refuelling infrastructure VI
START DATE	1/01/2015
END DATE	31/12/2019
PROJECT TOTAL COST	€41,8 million
FCH JU MAXIMUM CONTRIBUTION	€14,9 million
WEBSITE	http://www.3emotion.eu/

PARTNERSHIP/CONSORTIUM LIST

VAN HOOL N.V., DANTHERM POWER A.S, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, COMPAGNIA TRASPORTI LAZIALI, COMMUNE DE CHERBOURG-EN-COTENTIN, COMMISSARIAT À L'ÉNERGIE ATOMIQUE ET AUX ÉNERGIES ALTERNATIVES, REGIONE LAZIO, Vlaamse Vervoersmaatschappij De Lijn, Provincie Zuid-Holland, LONDON BUS SERVICES LIMITED, ROTTERDAMSE ELEKTRISCHE TRAM NV, WaterstofNet vzw, FIT CONSULTING SRL, UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA

MAIN OBJECTIVES OF THE PROJECT

By achieving significant reductions of Fuel Cell buses, 3Emotion seeks to bridge the gap between current small scale demonstration projects towards larger scale deployment as foreseen by the Bus Commercialisation study. The demonstration activities in five key EU bus markets: London, Rotterdam, Antwerp, Rome and Cherbourg, the project demonstrates across Europe the potential value of this technology for different types of bus fleets. In addition, key information and opportunities to experience daily FCB operations in several locations in Europe will be generated.

PROGRESS/RESULTS TO-DATE

- The project is installed and functional: first administrative deliverables are defined, future way of working is defined.
- Two sites has ordered the equipment to be demonstrated (FC buses).
- The other sites are in negotiation about the purchase of the equipment. The site of Antwerp has to be redefined.

FUTURE STEPS

Accomplishment of the tender processes for FC Buses in Cherbourg and Rome.
A redefinition of the Antwerp demonstration site.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

Tendering for new technology as FC Buses in a strict defined legal framework has been shown a difficult process.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Reduce FC Bus cost	Not specified for time interval between 2012 and 2017	€850,000	85 %	850,000-900,000 €/bus (tender results 3E)	
Reduce FC Bus fuel consumption	2017: 8.51 kg/100km	Buses not in operation yet	unknown	8-11 kg H_2/100 km, very variable depending on the type of use	
Increase FC bus system lifetime	2017: 15,000 hours	Guaranteed by FC Supplier	100 %	15,000 h (High V.LO City data)	
Increase vehicle availability	2017: 90 %	Preceding project High V.LO City supports the achievability of this target	50 %	85-92 % (CHIC, High V.LO City and HyTransit results)	
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2013-2
Deployment of FC Bus fleets in 2 existing and 3 new sites in Europe: 22 new buses.	(2015) The large scale demonstration of FCEV's including HRI build-up.	4 buses are in production, purchase for 13 in negotiation.		56 FC Buses are in service (CHIC dissemination package)	
The refuelling stations in 3E will be used to refuel fleets of more than 5 buses.	(2015) Focus on hydrogen refuelling stations with higher capacity.	Start of production of HRI's in negotiation.	50 %	Largest amount of buses for one station: 10 (Aberdeen)	

CHIC

Clean Hydrogen in European Cities

PANEL 1

Technology validation in transport applications

ACRONYM	CHIC
CALL TOPIC	SP1-JTI-FCH.2009.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure II
START DATE	1/04/2010
END DATE	31/12/2016
PROJECT TOTAL COST	€81,9 million
FCH JU MAXIMUM CONTRIBUTION	€25,8 million
WEBSITE	http://chic-project.eu/

PARTNERSHIP/CONSORTIUM LIST

EVOBUS and 25 partners

MAIN OBJECTIVES OF THE PROJECT

CHIC aimed to further enhance FC urban bus technology and offer a functional solution for cities to decarbonise their public bus fleets.
For the H_2 Infrastructure targets were set for station refuelling capacity, availability, production efficiency, operating costs, H_2 purity, refuelling times and diesel replacement.
For the H_2FC buses targets were set for FC lifetime, fuel consumption, availability, running distance and hours of operation.

PROGRESS/RESULTS TO-DATE

- Buses have driven >9 million km satisfying daily demands of urban bus routes.
- Avg. 9 kg H_2/100km fuel efficiency for 12m buses -->25-30% more energy efficient vs diesel counterparts.
- High throughput; 350 bar stations are consistently achieving availability (98 %) and capacity (200 kg/day) targets.
- H_2FC buses achieve 10-100 % lower CO_2 emissions than diesel buses, depending on the primary energy source for H_2 generation.
- Bus availability and OPEX for the infrastructure remains a challenge (expected to be overcome with ramping up of bus numbers).

FUTURE STEPS

- CHIC cities are assessing the opportunity to continue operations after project end in Dec. 2016.
- H_2FC Bus Commercialisation Study proposes deploying a pan-European fleet of 500 buses by 2020, targeting cost reduction.
- CHIC project partners are sharing technical info and 'how to' guidelines with cities interested in procuring FC buses.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- CHIC has proved that FC buses can be operated with same flexibility and safety as diesel buses, with 0 tailpipe emissions and <noise.
- Purchase cost of a FC bus is <50 % vs 2011. Further reductions are needed to encourage widespread deployment.
- Many technological issues have been resolved within CHIC to increase bus availability; more buses will increase needed scale in the supply chain.
- Work is proceeding on standardising/simplifying designs for large HRS – to be harmonised at EU and international level.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) - indicate relevant multi-annual plan:					MAIP 2008-2013
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2009
AIP Objectives of the H_2 Infrastructure (Call 2009)					
Capacity of 200kg/day, upgradable to 100 vehicles per day	Capacity of 200kg/day, upgradable to 100 vehicles per day	All Phase 1 cities reached the required refuelling capacity	100 %	N/A	
Availability of station 98 %	Availability of station 98 %	>98 % at most sites	100 %	99,9 %	Project HyTransit achieved target availability. Bolzano and London performed similarly. 2 sites unlikely to reach target (downtime due to compressor)
OPEX <10EUR/kg (excl. tax)	OPEX <10EUR/kg (excl. tax)	>93 % at all sites (average ca. 96 %)	<5 %	No cost data	Electricity appears to be the dominant factor affecting hydrogen cost
H_2 quality will be according to SAE J2719	Hydrogen purity (according to SAE or analogous specification)	OPEX >€10/kg for all phase 1 sites	95 %	N/A	H_2 quality not readily measureable (difficult sampling, few labs, cost). Online quality ex SAE J2719 not feasible
Production efficiency target 50-70 %	Production efficiency target 50-70 %	Not all contaminants can be measured within SAE J2719 accuracy	100 %	50-70 %	Standard commercial performance
AIP Objectives of the Fuel Cell Buses (Call 2009)					
>4,000 h lifetime initially, min. 6,000 h lifetime as program target	Fuel cell lifetime >6,000 h	6,554 h/stack (@03/2016) excl. Berlin ICE buses	100 %	10102 h	>40 stacks in CHIC have exceeded 6,000 hours, 1 has operated in >21,000 h.
Availability >85 % with maintenance as for conventional buses	Average availability of fuel cell buses >85 %	69% based on operation time (@03/2016)		73 %	Availability of all Eur. FC buses excl. Oslo: 74% to 03/2015. Oslo had refueller contamination causing 6 mnoths unavailability
Fuel consumpt. <11-13 kg/100km	Average fuel consumption <13kg depending on drive cycle	12 kg/100km (only FC buses) (@03/2016)	100 %	9.94 kg/ 100 km in average	This calculation includes older Whistler buses. Fuel economy of the Eur. non-articulated FC buses was 10 kg/ 100 km.
(c) Other project objectives					
Additional project target	Replacement of 500,000 l diesel fuel, Running distance (fleet) >2,75 Mio km & >160,000 h of operation (fleet)	@03/2016: Diesel replacement: Phase 0 /1 cities: 2,833,036 / 1,427,883, 9.02 Million km, 475,455 h	100%	N/A	As comparison, the 12 AC Transit buses in California reported 1,423,655 km and 102,615 h in 4 yrs (2011 to 2015).

H2ME

Hydrogen Mobility Europe

PANEL 1

Technology validation in transport applications

ACRONYM	H2ME
CALL TOPIC	FCH-01.7-2014: Large scale demonstration of refuelling infrastructure for road vehicles
START DATE	1/06/2015
END DATE	31/05/2020
PROJECT TOTAL COST	€62,6 million
FCH JU MAXIMUM CONTRIBUTION	€32 million
WEBSITE	www.h2me.eu

PARTNERSHIP/CONSORTIUM LIST

ELEMENT ENERGY LIMITED, H2 MOBILITY DEUTSCHLAND GMBH & CO KG, ICELANDIC NEW ENERGY LTD, SYMBIOFCELL SA, ITM POWER (TRADING) LIMITED, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, LINDE AG, H2 Logic A/S, FALKENBERG ENERGI AB, HYOP AS, AIR LIQUIDE ADVANCED BUSINESS, EIFER EUROPAISCHES INSTITUT FUR ENERGIEFORSCHUNG EDF KIT EWIV, COMMUNAUTE D'AGGLOMERATION SARREGUEMINES CONFLUENCES, McPhy Energy SA, AREVA H2GEN, BOC LIMITED, DAIMLER AG, HYUNDAI MOTOR EUROPE GMBH, CENEX – CENTRE OF EXCELLENCE FOR LOW CARBON AND FUEL CELL TECHNOLOGIES, WATERSTOFNET VZW, OMV REFINING & MARKETING GMBH, HONDA R&D EUROPE (DEUTSCHLAND) GMBH, INTELLIGENT ENERGY LIMITED, Nissan Motor Manufacturing (UK) Limited, AGA AB, BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, RENAULT SAS, DANISH HYDROGEN FUEL AS

MAIN OBJECTIVES OF THE PROJECT

H2ME is the most ambitious coordinated H_2 deployment project attempted in Europe to date. Key objectives are:

- Creation of a physical and strategical pan-European network.
- Real world testing of 4 national H_2 mobility strategies and share learnings to support other countries' strategy development.
- Trial fleets of FCEVs in diverse applications – 200 OEM FCEVs (Daimler and Hyundai) and 125 fuel cell range-extended vans (Symbio FCell).
- Deploy 29 state of the art HRS.
- Analyse the customer value proposition and assess performance to validate the readiness of the technology.

PROGRESS/RESULTS TO-DATE

- Fruitful 1st year with 1st HRS commissioned (in Kolding, DK) and vehicles in operation (40 B-CLASS F-CELL Daimlers and 27 SymbioFCell as of Jun 16).
- 1st technical data set delivered and analysed.
- Successful proposal evaluation and launch of follow-up project, H2ME-2, with an extra 1230 vehicles and 20 HRS planned for the next 6 years.

FUTURE STEPS

- Continue deployment activities for H2ME and H2ME 2 projects with an additional 48 HRS and another ~ 1,500 vehicles to be trialled by 2020.
- Commercialisation discussion forum to start with first analysis conducted and disseminated in 2016.
- Increase reachout activities to key audiences.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- FCEVs and fuel cell range-extended vans are operated with very similar patterns to petrol/diesel vehicles (trip distance, refuelling etc.).
- Financial incentives work best in combination with other benefits types for users to develop and support national markets e.g priority lanes access.
- Additional work is required on vehicle needs with regards to HRS deployment and understanding business cases from a customer point of view.
- Lead time for building permits and planning authorisations need to be reduced.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAWP 2014-2020
TRL of HRS and onsite H_2 production (if any) min. 6	TRL of HRS and onsite H_2 production (if any) min. 6	1 HRS deployed with TRL 6.	100 %	TLR 6	N/A
Hydrogen purity min. 99.999 %; refuelling process: SAE J2601; IR communication; SAE J2799. Exceptions allowed if justified	Hydrogen purity min. 99.999 %; refuelling process: SAE J2601; IR communication; SAE J2799. Exceptions allowed if justified	1 HRS deployed meeting standards	100 %	Vary depending on HRS	Exceptions for 350 bar HRS
HRS availability min. 97 % (measured in usable operation)	HRS availability min. 97 % (measured in usable operation)	1 HRS deployed with 99 % availability reached	100 %	95 %	N/A
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AWP 2014
All vehicles are designed to be operated for min. 6,000 h	Vehicle operation lifetime >5,000 h initially and min 6,000 h as program target	Vans are operating for around 500 h/year (start of day to end of day).	100 %	6,000 h	N/A
All vehicles will be operated for min. 1 year or 10,000 km	Minimum vehicle operation during the project 12 months or 10,000 km	9 months operation for 40 B Class F-Cell. Operation period ranging from 9 to 1 month for 27 Symbio FCell	100 %	N/A	N/A
Mean Time Between Failure (MTBF) >1,000 km	MTBF >1,000 km	Observed MTBF >1,000km as no failures reported	100 %	MTBF >1,000 km	N/A
Availability >95 %	Availability >95 % (To be measured in available operation time)	Availability >99 %	100 %	Availability 95 %	N/A
Tank-to-wheel (TTW) efficiency >40 %	TTW efficiency >40 %	Measured TTW efficiency of passenger cars = 46 %	100 %	TTW efficiency 40 %	

HAWL
HYDROGEN & WAREHOUSE LOGISTICS

HAWL

Large scale demonstration of substitution of battery electric forklifts by hydrogen fuel cell forklifts in logistics warehouses

PANEL 1
Technology validation in transport applications

ACRONYM	HAWL
CALL TOPIC	SP1-JTI-FCH.2012.4.1: Demonstration of fuel cell powered material handling equipment vehicles including infrastructure
START DATE	1/09/2013
END DATE	31/08/2017
PROJECT TOTAL COST	€8,5 million
FCH JU MAXIMUM CONTRIBUTION	€4,2 million
WEBSITE	https://hawlproject.eu/en

PARTNERSHIP/CONSORTIUM LIST

AIR LIQUIDE ADVANCED BUSINESS, HYPULSION SAS, CROWN GABELSTAPLER GMBH & CO KG, Toyota Material Handling Europe AB, FM POLSKA SP ZOO, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, DIAGMA, BT PRODUCTS AB, CESAB CARRELLI ELEVATORI SPA, FM France SAS, FM LOGISTIC CORPORATE

MAIN OBJECTIVES OF THE PROJECT

The main objectives of this project are to develop and certify European ranges of fuel cell products and fuel cell ready vehicles, to deploy full fleets of FC powered forklifts in multiple warehouses, to assess and demonstrate the productivity given by the technology, to solve the relevant safety and acceptance issues, to pass required certification steps and to obtain necessary operating permits.
The overall objective is to help increase awareness of the fuel cell technology value proposition on customer sites throughout Europe.

PROGRESS/RESULTS TO-DATE

- 8 types of fuel cells developed by Hypulsion for the European market.
- 4 types of forklifts (reach trucks and pallet trucks from Toyota and Crown) qualified with Hypulsion fuel cell.
- 1 year test in real conditions in a FM Logistic site of a fleet of 10 fuel cell forklift trucks using Air Liquide hydrogen infrastructure.
- Over 5600 refuellings performed on site.
- Productivity business case demonstrated for class 3 trucks.

FUTURE STEPS

- Additional fleet deployment (36 additional forklifts).
- Installation of a second dispenser.
- Operation report and productivity business case demonstration for a large scale deployment.
- Identification of further sites for additional deployments.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Confirmation of the operational interest of the fuel cell solution in material handling applications.
- Solution acceptance by workers.
- French reference code published December 23rd will allow faster permitting and will facilitate deployment.
- Full range of products (fuel cells, hydrogen refuelling infrastructure, vehicles) available to the European market.
- Appropriate funding scheme needed for further developments.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Total cost of FC system (at early volume production) for FC >3kW:	<50 units / < €3,500/kW	< €3,000/kW	100 %	€2,000/kW for class 2 10 kW fuel cell	Achieved
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2012
System lifetime (with service/ stack refurbishment)	Not defined	>7 500 h			Not demonstrated in the project yet
FC system efficiency (%)	>40 %	>45 %	100 %	>45 %	Achieved
Refuelling time	3 min	3 min	100 %		Achieved

HIGH V.LO-CITY

Cities speeding up the integration of hydrogen buses in public fleets

PANEL 1	Technology validation in transport applications
ACRONYM	HIGH V.LO-CITY
CALL TOPIC	SP1-JTI-FCH.2010.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure III
START DATE	1/01/2012
END DATE	31/12/2018
PROJECT TOTAL COST	€29,2 million
FCH JU MAXIMUM CONTRIBUTION	€13,4 million
WEBSITE	http://highvlocity.eu/

PARTNERSHIP/CONSORTIUM LIST

VAN HOOL N.V., RIVIERA TRASPORTI SPA, DANTHERM POWER A.S, SOLVAY SA, Vlaamse Vervoersmaatschappij De Lijn, WaterstofNet vzw, HYDROGEN, FUEL CELLS AND ELECTRO-MOBILITY IN EUROPEAN REGIONS, UNIVERSITA DEGLI STUDI DI GENOVA, REGIONE LIGURIA, FIT CONSULTING SRL, ABERDEEN CITY COUNCIL*, BALLAST NEDAM INTERNATIONAL PRODUCT MANAGEMENT B.V., CNG NET BV, DANMARKS TEKNISKE UNIVERSITET, SANDVIK MATERIALS TECHNOLOGY AB, TOPSOE FUEL CELL A/S, AVL LIST GMBH, CHALMERS TEKNISKA HOEGSKOLA AB, Karlsruher Institut fuer Technologie, THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS, ICE STROMUNGSFORSCHUNG GMBH, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, ELRINGKLINGER AG, HyGear Fuel Cell Systems B.V., ADELAN LTD, CATATOR AB, CONSIGLIO NAZIONALE DELLE RICERCHE, EADS DEUTSCHLAND GMBH, EADS UK Ltd., ERDLE ERICH KONRAD

MAIN OBJECTIVES OF THE PROJECT

The overall objective of High V.LO City is to facilitate rapid deployment of the last generation FC Buses in public transport operations, by addressing key environmental and operational concerns that transport authorities are facing today. This is realized with the demonstration of 14 Fuel Cell buses in 4 different sites: 5 in Antwerp (Belgium), 4 in Aberdeen (Scotland), 3 in Sanremo (Italy) and 2 in Groningen (The Netherlands). These buses are refuelled from sustainable hydrogen by local refuelling stations. The projects achievements are disseminated to new adopters to inform and engage.

PROGRESS/RESULTS TO-DATE

- 9 FC Buses are operational: 5 FC Buses operate in Antwerp (Belgium) and 4 in Aberdeen (Scotland).
- For the two sites acceptable technical availability is noted. The total amount of distance accumulates over 300,000 km.
- 2 HRI are put in place and refuel the 9 operational buses with a very high availability rate (>85 %).

FUTURE STEPS

- The sites of Sanremo (Italy) and Groningen (The Netherlands) will be made operational in 2016.
- Conclude about the operational issues met in the different sites that delay start of FC Bus operations.
- Further follow-up operations with detailed data recording and analysis.
- Major dissemination events to be organised.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Local technical assistance is a major requirement for a success story. Traditional mechanics have to be re-educated.
- Immature supply chains cause longer waiting times for parts – will be solved with larger scale fleets.
- FC Buses should be introduced smoothly in diesel fleets.
- Marginal costs for small FC Fleets are large – but will be acceptable for large fleets.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
14 buses operational in 4 sites	500 buses at 10 EU sites (at least 7 new ones)	All 14 buses put in place, 9 buses in services, the other 5 coming soon.	100 %	Not relevant	
15,000 h warranty on FC system	Durability of over 5,000 h	Demonstration is ongoing.	100 %	10,000 – 15,000 h, according to the FC Supplier	
Project target is €2,500/kW	System cost below €3,500/kW	€2,500/kW	100 %		
Operate 4 HRI's for FC Buses	Roadmap for the establishment of a commercial HRI	2 HRI's are installed and operational.	100 %	Not relevant	
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2010
Set up Centres of Excellence to communicate about local FC Bus demonstrations.	Place Europe at the forefront of FC technology worldwide to enable market breakthrough.	High V.LO City dissemination comes into highest gear.	100 %	Not relevant	
Demonstrate 14 buses in operations with the required Refuelling stations.	Speed up the development of hydrogen supply and FC Technology.	High V.LO Cities demands create market demands.	100 %	About 90 FC Buses are planned to be in Europe at the end of 2016, including CHIC and 3Emotion projects.	

HYCARUS

Hydrogen cells for airborne usage

PANEL 1

Technology validation in transport applications

ACRONYM	HYCARUS
CALL TOPIC	SP1-JTI-FCH.2012.1.6: Fuel cell systems for airborne application
START DATE	1/05/2013
END DATE	30/04/2017
PROJECT TOTAL COST	€12 million
FCH JU MAXIMUM CONTRIBUTION	€5,2 million
WEBSITE	http://hycarus.eu/

PARTNERSHIP/CONSORTIUM LIST

ZODIAC AEROTECHNICS SAS, COMMISSARIAT À L'ÉNERGIE ATOMIQUE ET AUX ÉNERGIES ALTERNATIVES, DASSAULT AVIATION SA, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, INSTITUTO NACIONAL DE TECNICA AEROESPACIAL, ARTTIC, Zodiac ECE, DRIESSEN AEROSPACE CZ SRO, ZODIAC CABIN CONTROLS GMBH

MAIN OBJECTIVES OF THE PROJECT

HYCARUS develops a Generic FC System (GFCS) in order to power non-essential aircraft applications such as a galley in a commercial aircraft or to be used as a secondary power sources on-board business jets. Demonstration of GFCS performances in relevant and representative cabin environment (TRL 6) will be achieved through flight tests on-board a Dassault Falcon aircraft. Moreover, HYCARUS will assess how to valorise the by-products (especially heat and Oxygen Depleted Air) produced by the FC system to increase its global efficiency.

PROGRESS/RESULTS TO-DATE

- Completion of specifications and sizing of the GFCS.
- Completion of the design of the different sub-systems and components of the GFCS.
- Completion of the tests of the different sub-systems (except for the hydrogen high pressure sub-system (HHPS) on which only risk mitigation tests were performed) of the GFCS.
- Completion of the Functional Hazard Assessment & Preliminary System Safety Assessment, Achievement of the System Safety Assessment.
- Preparation for the "permit to Fly" including Qualification Program Plan and Test Flight conditions.

FUTURE STEPS

- Verification tests of the HHPS and of the whole GFCS.
- System Safety Assessment completion.
- Flight Readiness Process completion.
- Environmental tests of the GFCS for the flight test configuration.
- Flight tests on-board a Falcon Aircraft.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- The Consortium will build on the results to provide and test the GFCS in a representative aircraft environment, in accordance with TRL6 level.
- The consortium members are engaged into a challenging development and demonstration project.
- HYCARUS will contribute to establishment of certification process for on board FC system in a cabin environment.
- HYCARUS will accelerate market introduction of FC systems on board aircraft.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2011
TRL6 Demonstrator	TRL6 Demonstrator with flight tests on-board an aircraft	TRL4-5. Fuel cell system Demonstrator development in progress. Qualification Program Plan and Test Flight conditions defined	75%	TRL4-5	Fuel cell sub-systems are tested, Functional Fuel Cell system are on going
Demonstrator in the 20-100 kW power range	Fuel Cell System in the 20-25 kW power range to be representative and appropriate for target applications	Fuel Cell system demonstrator development in progress. Power range demonstrated by simulation.	80%	None	Fuel cell sub-systems are tested, Functional Fuel Cell system tests are on going for flight tests configuration (Galley configuration tests are planned later on)
Durability with cycling h: 2500 h under flight representative load profiles	Performing durability tests under flight representative load profiles (AIP 2011: SPI-JTI-FCH-2012.1.6)	Fuel Cell system durability test out of scope of the project. Only Fuel Cell stack (30 cells) durability test performed (2,000 h, under flight representative load profiles)	100%	10,000 h for stationary application 4,000 h for automotive sector	
Fuel Cell system efficiency (LHV) at 25% of rated power: 55%	Fuel Cell system efficiency at 25% of rated power: 55%	Current estimated Fuel Cell system efficiency: 45% (based on simulation results, test to be performed in 2016)	0%	55%	For target application (GFCS), maximum efficiency operating point is 55% of rated power. Corresponding target efficiency is 46% under airborne operating conditions. Due to specific system architecture and rated power (20-25 kW), achievement of this objective was very challenging.
FC system specific power (EOL): 0.65kW/kg					
Proof of concept of H_2 storage and supply on-board an aircraft	TRL6 H_2 storage system demonstration on-board aircraft	Gaseous 350 bars H_2 storage and supply system under development. H_2 leakage and safety management strategy approved. Implementation and demonstration planned for 2017.	75%	None	
Demonstrate operational capability at ranges of altitude and in-flight variations typical for such packaged systems in aircrafts	Demonstrate operation under typical Airbus A320 and Dassault Falcon business jets inflight operating conditions	Fuel cell System demonstrator specification include A320/Dassault and RTCA DO160 environmental requirements. Equipment development and Qualification Plan include either ground or inflight demonstration of performances. Tests to be performed in 2016.	75%	None	

HYFIVE

Hydrogen for innovative vehicles

PANEL 1

Technology validation in transport applications

ACRONYM	HYFIVE
CALL TOPIC	SP1-JTI-FCH.2013.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure VI
START DATE	1/04/2014
END DATE	30/09/2017
PROJECT TOTAL COST	€39 million
FCH JU MAXIMUM CONTRIBUTION	€17,9 million
WEBSITE	http://www.hyfive.eu/

PARTNERSHIP/CONSORTIUM LIST

GREATER LONDON AUTHORITY, BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, DAIMLER AG, HONDA R&D EUROPE (DEUTSCHLAND) GMBH, HYUNDAI MOTOR EUROPE GMBH, TOYOTA MOTOR EUROPE, AIR PRODUCTS PLC, COPENHAGEN HYDROGEN NETWORK AS, ITM POWER (TRADING) LIMITED, LINDE AG, Foreningen Hydrogen Link Danmark, ISTITUTO PER INNOVAZIONI TECNOLOGICHE BOLZANO SCARL, ELEMENT ENERGY LIMITED, THINKSTEP AG, OMV REFINING & MARKETING GMBH, PARTNERSKAB FOR BRINT OG BRAENDSELS CELLER, DANISH HYDROGEN FUEL AS

MAIN OBJECTIVES OF THE PROJECT

To deploy and monitor 185 next generation FCEVs from leading global OEMs (BMW, Daimler, Honda, Hyundai and Toyota).
To place vehicles with end users representative of the likely earliest commercial adopters, study their behaviour and attitudes towards hydrogen transport to inform subsequent roll-out strategies for the technology.
To create viable hydrogen refuelling station (HRS) networks in 3 regions by deploying 6 new 700 bar HRS and incorporating 12 existing HRS in the project.

PROGRESS/RESULTS TO-DATE

- Order placed for 110 vehicles in the three clusters.
- All refuelling stations installed in the southern and Danish cluster (Aarhus, Korsor and Innsbruck) and one of the three stations installed in London.
- Ongoing activities linking the HyFIVE project with other existing FCH JU projects as well as National Projects and Initiatives like the CEP.
- Sites identified and work underway to deploy the other two stations in London in summer 2016.

FUTURE STEPS

- Deploying the new generation Daimler vehicles and the Honda Clarity Fuel Cell.
- Deploying two more stations in London which will have two opening events involving UK politicians and decision makers.

- Using milestones in the project to disseminate information about it to local and national government, decision makers, etc.
- Planning a final event in a coordinated approach in order to maximise the impact.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- More work needs to be done to improve regulations around the use of the technology in vehicles and refuelling.
- More work needs to be done on dissemination of the technology in an interactive way that raises interest and clears myths.
- Learning came out of deploying the stations in the London cluster as these were the first of their kind.
- There is a lot of value coming out of the collaboration between regions.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET (%)	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:				MAIP 2008-2013
Cost of H_2 delivered at refuelling station <€5/kg (€0.15/kWh)	Cost of H_2 delivered at refuelling station <€5/kg (€0.15/kWh)	Hydrogen cost at station <€10/kg (ex. taxes)	This will be met in at least one of the clusters	Our target in the project is <€10/kg and this should be met by end of the project. We will be looking into pathways to lower this.
Durability in car propulsion systems 5,000 h	Durability in car propulsion systems 5,000 h	Vehicle Operation lifetime (>2,000 h initially, min. 3,000 h as programme target)	We expect to meet and exceed this	7,875 cumulative hours driven in the Southern cluster, 1,893 in the Copenhagen Cluster and 290 in the London Cluster
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:				AIP 2013-1
Vehicle availability >95 %	Vehicle availability >95 %	100 % in the London and Copenhagen clusters and 95.9 % in the Southern cluster	We expect to meet and exceed this	The vehicles are intensively in use in the Southern cluster which lead to the Hyundai vehicles issues (not related to fuel cell system)
Hydrogen purity and vehicle refuelling process	According to SAE J2601 and 2719 and ISO specifications. IR Communication according to SAE TIR J 2799	Implemented and on track	Target met	Included on all stations current average of refuelling time of 1.1 min.
Minimum vehicle operation during the project 12 months or 10,000 km	Minimum vehicle operation during the project 12 months or 10,000 km	On average per vehicle we are at an average of 3,000 km in each cluster	We expect to meet this target	In total there have been 20,581 km driven in the Copenhagen cluster, 3,049 in the London cluster and 69,787 in the Southern cluster.
(c) Other project objectives				
Roadmap for the establishment of a commercial European hydrogen refuelling infrastructure	N/A	Out of the 6 stations 4 have been deployed	We expect to meet this target	2 stations in London will be operational in august 2016 and opening events for them will take place in September/October 2016 to ensure better attendance

HYLIFT-EUROPE

Large scale demonstration of fuel cell powered material handling vehicles

MAIN OBJECTIVES OF THE PROJECT

- Demonstration of more than 200 units of hydrogen powered fuel cell materials handling vehicles at vehicle-user sites across Europe.
- Demonstration of state-of-the-art supporting hydrogen refuelling infrastructure at 5-20 vehicle-user demonstration sites throughout Europe.
- Validation of Total Cost of Ownership (TCO) & path towards commercial targets.
- Planning and ensuring initiation of supported market deployment beyond 2015.
- Preparation of best practice guide for hydrogen refuelling station installation.
- European dissemination and supporting of the European industry.

PANEL 1

Technology validation in transport applications

ACRONYM	HYLIFT-EUROPE
CALL TOPIC	SP1-JTI-FCH.2011.4.1: Demonstration of fuel cell-powered Material Handling vehicles including infrastructure
START DATE	1/01/2013
END DATE	31/12/2017
PROJECT TOTAL COST	€22,3 million
FCH JU MAXIMUM CONTRIBUTION	€9,2 million
WEBSITE	http://www.hylift-europe.eu/

PARTNERSHIP/CONSORTIUM LIST

Ludwig-Boelkow-Systemtechnik GmbH, STILL GMBH, MULAG FAHRZEUGWERK HEINZ WÖSSNER GMBH U. CO. KG, AIR PRODUCTS GMBH, COPENHAGEN HYDROGEN NETWORK AS, ELEMENT ENERGY LIMITED, FAST – FEDERAZIONE DELLE ASSOCIAZIONI SCIENTIFICHE E TECNICHE, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, HEATHROW AIRPORT LIMITED, H2 Logic A/S, AIR LIQUIDE ADVANCED BUSINESS, DANTHERM POWER A.S, PRELOCENTRE

PROGRESS/RESULTS TO-DATE

- The first hydrogen refuelling station in the framework of the HyLIFT-EUROPE project started operations in AUG 2015 (Prelocentre / France).
- 46 hydrogen powered fuel cell forklifts and warehouse trucks are in operation at a green field site in a logistics environment (Prelocentre / France).
- As the project has had to overcome some hiccups at the beginning of the project no vehicles from the participating OEMs are in demonstration yet.
- A significant contract for the deployment of forklifts and warehouse trucks has been signed with a retail group (Carrefour / France) in JUN 2016.
- HyLIFT-EUROPE will become one of the leading projects for materials handling vehicle deployments in Europe.

FUTURE STEPS

- Prelocentre fleet size will be enlarged to reach 60 units in 2017.
- Deployment at Carrefour will start operations on 1 JAN 2017 the latest.
- Carrefour fleet size is planned to reach a number of more than 150 units finally.
- Total Costs of Ownership (TCO) calculations will be performed to identify the real TCO in comparison with conventional technology.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- In USA the number of hydrogen-powered fuel cell materials handling vehicles in operation is already beyond 10,000 units.
- The USA success factors are not easily to be transferred to Europe.
- Substantial financial support will be required until supply chains are fully established and enable competitive cost structures.
- Focus has to be on customers with large fleets, three-shift operations and cheap hydrogen available.
- Complete packages comprising vehicles, hydrogen refuelling station and hydrogen supply have to be offered to customers ideally from a single source.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Number of industrial and off-highway vehicles: >200	Number of industrial and off-highway vehicles (2015 target): 500 in total	46 %	90 %	>10,000 [Source: Plug Power]	A signed contract for the deployment of a large fleet (>35 units) as well as the plans and ongoing discussions to enlarge this fleet to more than 150 units might enable reaching the project's target
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2011
Number of FC-systems: >200 units	Number of FC systems: >50 units in project	46 %	90 %	>10,000 [Source: Plug Power]	A signed contract for the deployment of a large fleet (>35 units) as well as the plans and ongoing discussions to enlarge this fleet to more than 150 units might enable reaching the project's target
FC system efficiency (%): 45-50 %	FC system efficiency (%): >45 %	>45 %	100 %	>45 %	Programme objective achieved
Refuelling time: ~3 minutes	Refuelling time: 3 minutes	Class 1: 154 sec Class 3: 73 sec	100 %	<3 min (depending on MHV class)	Project target reached
HRS availability: 98 %	HRS availability: -	>99 %	100 %	>99 % (actual state-of-the-art)	Project target reached

HYPER

Integrated hydrogen power packs for portable and other autonomous applications

PANEL 1

Technology validation in transport applications

ACRONYM	HYPER
CALL TOPIC	SP1-JTI-FCH.2011.4.4: Research, development and demonstration of new portable Fuel Cell systems
START DATE	3/09/2012
END DATE	2/09/2015
PROJECT TOTAL COST	€3,9 million
FCH JU MAXIMUM CONTRIBUTION	€2,2 million
WEBSITE	

PARTNERSHIP/CONSORTIUM LIST

Orion Innovations (UK) Ltd, PAXITECH, UNIVERSITY OF GLASGOW, EADS DEUTSCHLAND GMBH, INSTYTUT ENERGETYKI, McPhy Energy SA, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION

MAIN OBJECTIVES OF THE PROJECT

Development and demonstration of a market ready, portable power pack comprising an integrated modular FC and hydrogen storage system that is flexible in design, cost effective and readily customised for application across multiple low power markets.

PROGRESS/RESULTS TO-DATE

- Developed nanostructured ammonia borane composite H_2 storage material with >5 wt% and no release of toxic gases.
- Developed low temperature hydride tank to demonstrate interoperability of HYPER system.
- Integrated 20 W_e FC modules into complete 100 W_e FC system (including controls and cooling) incorporating results from thermodynamic modelling.
- Initiated field testing of application specific 100 W_e alpha prototypes with both solid and gaseous storage modules.
- Produced first beta prototype design with full safety features, in preparation for CE marking and end user trials.

FUTURE STEPS

- Complete field testing of alpha prototypes and incorporate results into future design development.
- Complete beta design with focus on cost-efficient manufacturing optimised for different power outputs.
- Build beta prototypes and complete CE marking process.

- Trial with independent end users.
- Follow through with the project's commercialisation strategy to reach early sales of FC system.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Ammonia borane composite could provide step change in terms of gravimetric density, but requires more research before integration into storage tank.
- Two working 100 W_e HYPER prototype systems with alternative fuelling are being tested within specific applications.
- Market analysis showed remote monitoring & control to be a particularly attractive applications for HYPER (requirements for reliable low power).
- Independent end users have expressed interest in trialling the complete system as soon as possible.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Field demonstration of HYPER System as 100 We portable power pack and 500 W_e UAV range extender	12,000 – 13,000 portable & micro FC's in the market by 2015	Two 100 W_e systems were tested under field conditions	50 %	Global shipments of portable units (1 W to 20 kW) estimated at 21,200 and 17,600 in 2014 and 2015 respectively, The Fuel Cell Industry Review 2015, E4Tech	Two 100 W_e systems for specific applications were tested, using interchangeable H_2 storage. Field testing of 500 We UAV range was not achieved during the lifetime of the project due to technical difficulties with scale up
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2011
Volume and weight: 100 W_e system: 65 kg/kW and 60 l/kW 500 W_e system: 20 kg/kW and 20 l/kW	Volume and weight: <35 kg/kW and 50 l/kW	100 W_e system, 85 kg/kW and 250 l/kW	50 %	35 – 50 kg/kW for similar 150-200 W H_2-based systems, e.g. BOC Hymera. 3 kg/kW for Horizon Energy Systems miniaturised fuel cells for UAVs (not commercially tested)	High wt and vol due to BoP and cooling requirements. However, call targets will readily be met at lower powers <40 W
<€5,000/kW final system cost	<€5,000/kW final system cost	Current high volume costs anticipated at >€5,000/kW	50 %	Commercial costs not widely available – current estimates at £2,500 to £5,000 for 150 W and 250 W systems respectively (BOC Hymera and EFOY Comfort series)	Cost per kW rises significantly for small FC systems. Composed of compact 20 W modules with limited BoP, the HYPER system is expected to be very competitive at small scales (<40 W)
System efficiency: >50 %	System efficiency: >30 %	Fuel cell efficiency of 50 % achieved	100 %	Most commercial portable products have a rated nominal power at a cell voltage of 0.6V/cell, corresponding to a FC efficiency of 48 % and system efficiency typically <40 %.	HYPER system efficiency will be very close to FC efficiency at low power (<40 W).
Lifetime: 1,000 h, 100 start stop cycles	Lifetime: 1,000 h, 100 start stop cycles	Targets for lifetime and start stop cycles were exceeded for the 20 W_e FC module	100 %	Project targets based on end user requirements (WP1)	Objectives achieved
Operating temperature: -20 °C to 60 °C	Operating temperature: -20 °C to 60 °C	FC demonstrated from -20 °C to 40 °C	100 %	Project targets based on end user requirements (WP1)	40 °C is a maximum operating temperature, but cooling triggered at 41 °C.

HYTEC

Hydrogen Transport in European Cities

PANEL 1

Technology validation in transport applications

ACRONYM	HYTEC
CALL TOPIC	SP1-JTI-FCH.2010.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure III
START DATE	1/09/2011
END DATE	31/08/2015
PROJECT TOTAL COST	€29,2 million
FCH JU MAXIMUM CONTRIBUTION	€11,9 million
WEBSITE	http://hy-tec.eu/

PARTNERSHIP/CONSORTIUM LIST

AIR PRODUCTS PLC, Element Energy Limited, EUROPEAN REGIONS AND MUNICIPALITIES PARTNERSHIP ON HYDROGEN AND FUEL CELLS, LTI LIMITED, CENEX – CENTRE OF EXCELLENCE FOR LOW CARBON AND FUEL CELL TECHNOLOGIES, GREATER LONDON AUTHORITY, hySOLUTIONS GmbH, MATGAS 2000 A.I.E., Ludwig-Boelkow-Systemtechnik GmbH, COPENHAGEN HYDROGEN NETWORK AS, KOBENHAVNS KOMMUNE, Foreningen Hydrogen Link Danmark, INTELLIGENT ENERGY LIMITED, LHR AIRPORTS LIMITED, LONDON BUS SERVICES LIMITED, FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, HYUNDAI MOTOR EUROPE GMBH

MAIN OBJECTIVES OF THE PROJECT

The HyTEC project was tasked with creating new H_2 vehicle deployment centres in London, Copenhagen and Oslo. Diverse concepts were adopted and trialled in these cities:

- Copenhagen: Passenger cars trialled alongside a refuelling station dispensing green H_2
- London: Passenger cars & taxis deployed + state-of-the-art refuelling station using innovative delivered H_2 technology.
- Oslo: Passenger cars deployed, utilising existing infrastructure

The experience is being shared with other cities and communities.

PROGRESS/RESULTS TO-DATE

- Installation and operation of the UK's first publicly accessible H_2 fuelling station, in London.
- Vehicle test and shakedown, driver training and certification of five fuel cell taxis and creation of their operations base in London.
- Deployment and operation of FC passenger cars in London and Oslo.
- Tendering process for FCEV in Copenhagen, resulting in delivery and operation of 15 FCEVs (of which 9 supported by HyTEC).
- Installation and operation of three hydrogen fuelling stations based on green hydrogen in Copenhagen.

FUTURE STEPS

- Continued operation and data collection from H_2 vehicles and the fuelling infrastructure in Copenhagen and London (HyFIVE project).
- Sharing results for vehicles and stations: well to wheels life cycle impacts, tech. performance, non-tech. barriers.
- Sharing analysis on future commercialisation of the vehicles.
- Disseminating an approach for the rollout of vehicles and infrastructure, building on the demonstration projects.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- HyTEC addressed the challenge of transitioning from exemplar hydrogen vehicles to fully certified, operational vehicles.
- HyTEC's work led to networks in each country for the ongoing process coordination, leading to H_2 vehicle rollout in UK and DK.
- These networks are still used after the project, supporting continued commercialisation efforts in the hydrogen transport sector.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET(SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:				MAIP 2008-2013
Light Duty Vehicles deployment	~500 units	30 units	100 %	5 FC hybrid taxis & 2 FC cars in London, 15 FC cars in Copenhagen, 8 in Oslo
Additional sites and stations	2 additional sites with 3 new stations	2 additional sites with 4 new stations.	100 %	UK's first public station, 3 new stations in Copenhagen
Vehicle lifetime	>5,000 h	Objectives achieved for passenger cars. For the taxis and scooter, it was demonstrated in test stands in the lab.	100 %	This has been achieved for the passenger cars. For the taxis and scooter, this has been demonstrated in test stands in the laboratory.
Establishment of commercial Eur. H_2 refuelling Infrastructure	Roadmap for establishment of commercial Eur. H_2 refuelling infrastructure	Rollout strategies reports for Copenhagen & London; partnerships w/key stakeholders.	100 %	Statement of collaboration' signed by HyTEC regional/city partners at final project event.
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:				AIP 2010
Vehicle reliability	Mean Time Between Failure (MTBF) >1,000 km	Achieved	100 %	Achieved
Vehicle availability	>95 %	95 %-99 % (average - depending on vehicle type and location)	100 %	95 %-99 % (average - depending on vehicle type and location)
Vehicle efficiency	Efficiency >40 % (NEDC)	Real-world (non-NEDC) consumption of 70-74 km/kg H_2 (avg, depending on vehicle type/location)	Variable	
Refuelling capacity	Stations refuelling @ 35 & 70 MPa with 50 kg capacity & potential for extension to 200 kg	London HRS 35 & 70 MPa – 50kg/d with potential to extend up to 200kg/d. Copenhagen 3 HRS with 70 Mpa, 200kg/d	100 % (excl. 35 MPa in Copenhagen)	35 and 70 MPa, with potential for extension to 200 kg
Station availability	98 %	95 % ->99 % (average - depending on site)	Variable	95% >99% (average - depending on site)
Station hydrogen production efficiency	Efficiency of 50-70 %	N/A (Not tested as yet)	N/A	N/A (Not tested as yet)
H_2 price at pump (€/kg)	€10/kg or price that matches cost per driven km on gasoline	€10/kg or price that matches cost per driven km on gasoline	100 %	€10/kg or price that matches cost per driven km on gasoline

HYTRANSIT

European Hydrogen Transit Buses in Scotland

PANEL 1
Technology validation in transport applications

ACRONYM	HYTRANSIT
CALL TOPIC	SP1-JTI-FCH.2011.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure IV
START DATE	1/01/2013
END DATE	31/12/2018
PROJECT TOTAL COST	€17,7 million
FCH JU MAXIMUM CONTRIBUTION	€6,9 million
WEBSITE	http://aberdeeninvestlivevisit.co.uk/Invest/Aberdeens-Economy/City-Projects/H2-Aberdeen/Hydrogen-Bus/Hydrogen-Bus-Project.aspx

PARTNERSHIP/CONSORTIUM LIST

BOC LIMITED, VAN HOOL N.V., ABERDEEN CITY COUNCIL*, STAGECOACH BUS HOLDINGS LIMITED, HYDROGEN, FUEL CELLS AND ELECTRO-MOBILITY IN EUROPEAN REGIONS, PLANET PLANUNGSGRUPPE ENERGIE UND TECHNIK GBR, DANTHERM POWER A.S, ELEMENT ENERGY LIMITED

MAIN OBJECTIVES OF THE PROJECT

The project objective is to prove that the hybrid FC bus is capable of meeting the operational performance of an equivalent diesel bus in long route operation, whilst offering significant benefits in opex and environmental performance. The project will also address the main commercial barrier to the technology (bus capital cost) by deploying state of the art components to reduce bus unit cost to below €1.1 million (excluding non-recurring engineering costs).

PROGRESS/RESULTS TO-DATE

- 6 Van Hool A330 FC buses built/delivered to Aberdeen (12/2014).
- UK's largest HRS (300 kg/day) installed and commissioned by BOC (03/2015).
- Comprehensive awareness and training programme to inform drivers, technicians and local emergency services conducted (early 2015).
- Europe's largest FC l bus fleet has been operated for over a year in Aberdeen.
- HRS: >1,600 refuelling events, dispensed >35 t H_2.

FUTURE STEPS

- Evaluate the HRS and FC bus performance with life-cycle and technical assessments.

- Evaluate economic and environmental impact compared to operating regular diesel buses.
- Develop a concept design for a FC intercity coach.
- Develop a strategy for continuing FC bus and HRS operation beyond the project.
- Host an expert workshop, two new bus customer workshops and multiple public open days.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Emerging conclusions being prepared/agreed by consortium.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:			MAIP 2008-2013
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:			AIP 2011
FC life: >4,000h initially, >6,000h as program target	The system will have over 12,000h warranty	Not yet reached life time figures quoted	100 %
Availability >85%, with maintenance as for conventional buses	Availability >90%, maintenance based on conventional bus regime	Data is currently being analysed for year 1	100 %
Fuel consumption <11–13 kg of H_2/100km	Less than 10 kg of hydrogen /100 km	Data is currently being analysed for year 1	100 %
Bus platform – not specified	High-floor 13.15 m bus (3 axles),with partial high floor configuration	Buses designed and delivered to this configuration	100 %
Passenger capacity – not specified	Intercity and sub-urban buses need to carry a larger number of seated passengers (longer routes). HyTransit buses will will carrt >44 seated passengers. Through careful chassis design, buses will have same overall capacity as diesel equivalent.	Buses designed and delivered with 42 seated passengers, two wheel chairs spaces.	100 %
Top Speed – not specified	HyTransit buses will achieve a top speed of over 80km/h.	Data yet to be analysed	100 %
Range	Daily routes of 200 - 433 km (9 reservoirs of 205 l, tot. 45 kg H_2)	Daily route achieved on target (10 reservoirs, tot 50 kg H_2)	100 %
Pressure at filling station suitable for 350 and/or 700 bar refuelling	Aberdeen HRS based on 350 bar dispensed at max. continuous rate of 120g/s.	Criteria achieved in operation. Plans to upgrade to 700 bar	100 %
Ensure that 1–2 buses can be refuelled per hour	Station design concept incorporates ionic compressors in booster configuration, which allows continuous dispensing at 120g/s (>AIP targets).	Target achieved and up to 5 buses can be refuelled in an hour	100 %
The refuelling station concept must include a modular expansion to 100/vehicles per day	Station based on modular design to dispense up to 1,000 kg H_2/day to refuel >50 buse or 250 cars/day (with appropriate nozzles). (>the AIP targets).	Station based on modular design - subject to local conditions (space and electricity provision) can reach the target expansion levels	100 %
Station availability >98%	As per AIP target	Target achievable by the technology proposed. Core objective of the station operation.	100 %
H_2 purity/refuelling time according to SAE & ISO specs	SAE & ISO specs as contractual requirements for H_2 supplied by station	Standards in place & being achieved	100 %
H_2 Opex < €10/kg (excl. tax), strategy for €5/kg	H_2 delivered to buses (station opex + H_2 prod. costs) = €6/kg assuming 200kg/day. As this rises to 1,000kg/day, H_2 cost could fall to <€5/kg.	Data to be analysed	100 %

MOBYPOST

Mobility with hydrogen for postal delivery

PANEL 1

Technology validation in transport applications

ACRONYM	MOBYPOST
CALL TOPIC	SP1-JTI-FCH.2009.4.1: Demonstration of fuel cell powered materials handling vehicles and infrastructure
START DATE	1/02/2011
END DATE	30/11/2015
PROJECT TOTAL COST	€8,2 million
FCH JU MAXIMUM CONTRIBUTION	€4,2 million
WEBSITE	http://mobypost-project.eu/

PARTNERSHIP/CONSORTIUM LIST

UNIVERSITE DE TECHNOLOGIE DE BELFORT MONTBELIARD, Steinbeis Innovation gGmbH, EUROPAISCHES INSTITUT ENERGIEFORSCHUNG ELECTRICITE DE FRANCE/UNIVERSITAT KARLSRUHE (TH), MAHYTEC SARL, E.D.I. PROGETTI E SVILUPPO S.A.S. DI DOVERI NICOLO' & C., LA POSTE SA, MES SA, INSTITUT PIERRE VERNIER, H2NITIDOR SRL, DUCATI ENERGIA SPA, ARIEMA ENERGIA Y MEDIOAMBIENTE SL

MAIN OBJECTIVES OF THE PROJECT

MobyPost aims at testing a unique autonomous and sustainable mobility concept based on solar to wheel solution for postal delivery: 2 fleets of 5 FCEV specifically designed for improving ergonomics of postal delivery and 2 related solar hydrogen production and refuelling stations.

PROGRESS/RESULTS TO-DATE

- Metal hydride tanks used to store and deliver H_2 on board to a 1,1kW low temperature PEMFC.
- 10 vehicles built and homologated/certified despite of misfit regulations.
- Each infrastructure built and producing 1,5 kg H_2 per day.
- Demonstration under real environmental conditions running with 5 vehicles and one infrastructure.


FUTURE STEPS

- Further exploitation of project results.
- Follow up projects to finalize the concept.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Niche market on which FCEV could have a high impact.
- Legal frame as well as standards are at the moment inexistent for such technologies (hydrides). Standardisation is necessary for an early market.
- Solar-to-wheel concept as well as the low pressure tank technology used could improve the public acceptance of the fuel cell technologies.
- Technology already well accepted by the postmen using it.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
10 FCEV specifically designed for postal delivery to be developed T	Target 2015: 500 industrial and off highway vehicles	10 vehicles designed, built and functional	100 %		The objectives 2015 are delayed to 2018.
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2009
Perform 1 year demonstration of the whole system under real conditions.	Demonstrate advantages of using FC in material handling vehicles	12 months demonstration at Audi court and 1 month at Perring.	55 %		The demonstration reached 100 % only at Audi court. Due to technical problems only 10 % was achieved at Perring. Nowadays the 10 vehicles are running at the two sites.
2 solar-production and refuelling infrastructure that are autonomous on energy over 1 year	Including coupling with H_2 infrastructure	The 2 infrastructures are functional	100 %		Time needed to find a new partner delayed considerably the commissioning of the second infrastructure, which minimises the time of its demonstration.
Achieve European certification of the vehicle. Identify the leakage in terms of RCS	Development of the certification procedures; identification of potential RCS needs	Certification of the of the vehicles achieved. No certification of the infrastructure needed	100 %	No certification existing for metal-hydride tanks. Certification obtained was an exemption by the French ministry for the demonstration period.	Certification of the hydrogen part more complicated because no regulation existing. Each of the 10 vehicle has its individual vehicle approval from French ministry.
Refuelling time around 3 h	Refuelling time according to the postmen activity	Refuelling time around 3 h	100 %		3 h are largely enough for such an application as postal delivery.
FC system efficiency (%) >40	FC system efficiency (%) >40	The experimental measurements highlight 45 %.	100 %		
H_2 price at pump (€/kg) <€13/kg	H_2 price at pump (€/kg) <€13/kg	Not already measured			
FC price < €4,000/kW	FC price < €4,000/kW	< €5000/kW	0 %		
(c) Other project objectives					
Ergonomics aspects of the vehicles	To be able to park as close as possible to houses or buildings, to be able to park on sidewalks,	With a vehicle width of 1m the vehicle is able to drive and to access on sidewalks.	100 %		
Road holding of the vehicle	Sharing the load on two rear wheels	The load variations don't affect stability of the vehicle.	100 %		

NEWBUSFUEL

New Bus ReFuelling for European Hydrogen Bus Depots

PANEL 1

Technology validation in transport applications

ACRONYM	NEWBUSFUEL
CALL TOPIC	FCH-01.6-2014: Engineering studies for large scale bus refuelling
START DATE	1/06/2015
END DATE	31/12/2016
PROJECT TOTAL COST	€2,4 million
FCH JU MAXIMUM CONTRIBUTION	€2,4 million
WEBSITE	www.newbusfuel.eu

PARTNERSHIP/CONSORTIUM LIST

ELEMENT ENERGY LIMITED, ABENGOA HIDROGENO SA, ABERDEEN CITY COUNCIL*, AIR PRODUCTS PLC, AKERSHUS FYLKESKOMMUNE, BIRMINGHAM CITY COUNCIL, Vlaamse Vervoersmaatschappij De Lijn, EMPRESA MUNICIPAL DE TRANSPORTES DE MADRID SA, EVOBUS GMBH, H2 Logic A/S, HAMBURGER HOCHBAHN AG, HYDROGENICS GMBH, HYOP AS, INGENIEURTEAM BERGMEISTER SRL, ISTITUTO PER INNOVAZIONI TECNOLOGICHE BOLZANO SCARL, ITM POWER (TRADING) LIMITED, KUNNSKAPSBYEN LILLESTROM FORENING, LINDE AG, LONDON BUS SERVICES LIMITED, McPhy Energy Deutschland GmbH, THINKSTEP AG, RIGAS SATIKSME SIA, SIEMENS AKTIENGESELLSCHAFT, STUTTGARTER STRASSENBAHNEN AG, Vattenfall Europe Innovation GmbH, VIP VERKEHRSBETRIEB POTSDAM GMBH, WSW MOBIL GMBH

MAIN OBJECTIVES OF THE PROJECT

1. Produce 13 engineering studies to define optimal designs, H_2 supply routes, commercial arrangements and practicalities involved in refuelling high volumes of H_2 at busy bus depots across Europe.
2. Prepare a range of publically accessible design guideline reports based on analysis across the engineering studies.
3. Kick start the large scale bus deployment projects which are required for the next stage of commercialisation.
4. Disseminate results to a wider audience to ensure the challenge of H_2 fuelling for buses is not seen as a credible reason to delay engagement with the technology.

PROGRESS/RESULTS TO-DATE

- Completed 12 out of 13 feasibility studies.
- Held 9 dedicated working group sessions to promote sharing of information between study teams.
- Produced dissemination guidelines, a project logo and website.

FUTURE STEPS

- Finalise all 13 feasibility studies.
- Finalise all 13 engineering studies.
- Extract, aggregate and anonymise data from studies to prepare design guideline reports.
- Host industry workshop to disseminate project outputs in late 2016.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Industry partners have developed engineering studies with significant variation.
- Bus operators have prioritised maximum infrastructure availability and reliability through provision of sufficient redundancy in station designs.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:			MAWP 2014-2020
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:			AWP 2014
Depot designs capable of refuelling between 60 to 150 12 m buses, capacity of 1,000-4,000 kg/day	Consider fuelling station requirements for at least 75 – 150 buses operating from the bus depots	All designs are in-progress and due to be completed by end of July/August 2016	100 %
Consider range of technical solutions supplying H_2 to depots, including off and on-site production	Assess options: on-site (WE and SMR), and delivered (compressed, pipeline and liquid)	All feasibility studies collectively considered full range of supply options	100 %
Each study will assess CO_2 emission impact of the H_2 dispensed, using a commonly agreed methodology	Pathways to decarbonisation should be developed in line with local emission reduction pathways	All designs are in-progress and due to be completed by end of July/August 2016	100 %
'Standardised Reports' for each study will describe all requirements	Designs should focus on costs, components, approvals processes and practical implications	All standardised reports are due to be completed by end of July/August 2016	200 %
A cross cutting WP will determine common specifications and other common ground between studies	Opportunities for standardising components/specifications should be assessed across the depots	Nine cross cutting working group sessions have been held so far. Outputs due in September 2016	300 %

PURE

Development of auxiliary power unit for recreational yachts

PANEL 1

Technology validation in transport applications

ACRONYM	PURE
CALL TOPIC	SP1-JTI-FCH.2011.4.4: Research, development and demonstration of new portable Fuel Cell systems
START DATE	1/01/2013
END DATE	30/06/2016
PROJECT TOTAL COST	€2,8 million
FCH JU MAXIMUM CONTRIBUTION	€2,8 million
WEBSITE	http://pure-project.eu/

PARTNERSHIP/CONSORTIUM LIST

HyGear Fuel Cell Systems B.V., DANMARKS TEKNISKE UNIVERSITET, CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS, JRC -JOINT RESEARCH CENTRE – EUROPEAN COMMISSION, SCHEEPSWERF DAMEN GORINCHEM BV

MAIN OBJECTIVES OF THE PROJECT

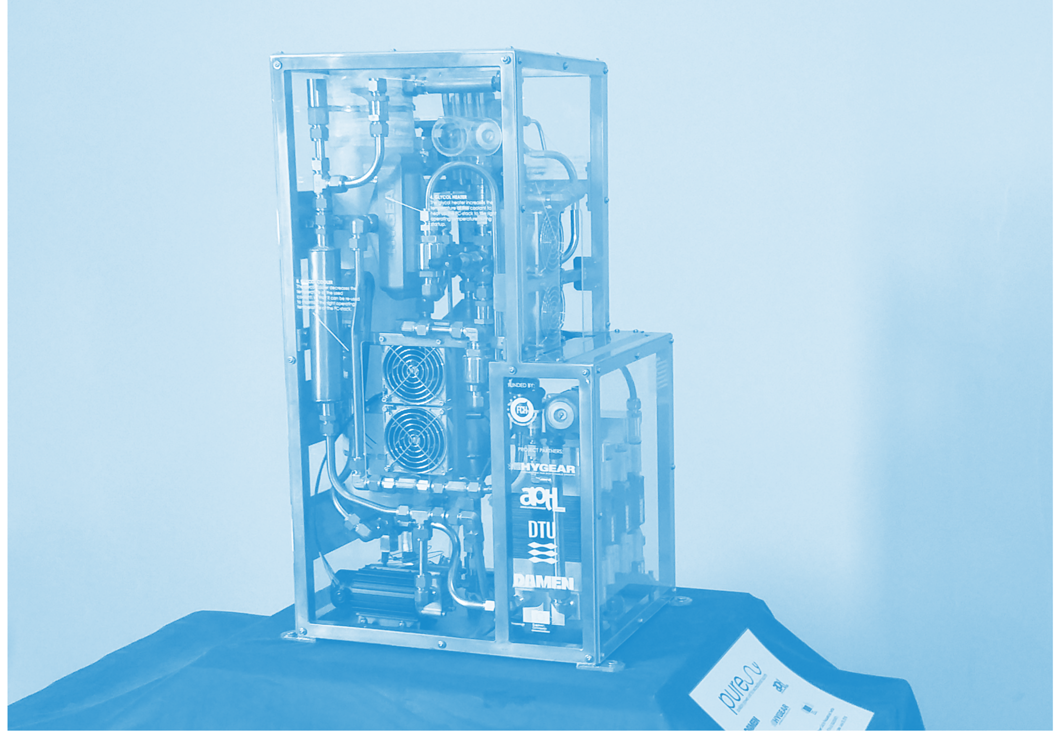
The objectives of the PURE project are to design, build and test an APU system for maritime applications. The system is fed by LPG and produces electricity of maximal 500 W using high temperature PEM stack Fuel cell technology. The objectives include: on board LPG fuel processor, Electrical power production of 50-500W. System weight target: 35kg/kW, System size target: 50 l/kW, System cost; €5,000/kW.

PROGRESS/RESULTS TO-DATE

- 2 system prototypes build and in testing campaign.
- Sulphur tolerant autothermal reformer (ATR): stable performance at 33 ppm S in LPG.
- Successful testing of 3D metal printed heat exchangers.
- Precious metal reduction of the MEA of 28 %.
- Successful preparation of binderless electrodes.

FUTURE STEPS

- Finalize testing of the system in environmental chamber.
- Finalize PURE project.



CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- Significant improvement in size and weight of the system vs. State of the art.
- Cost reduced MEA's successfully stack and system.
- MEA's capable of running on ATR reformate (50 % H_2) need development.
- 3D metal printing of heat exchangers is successful but has opportunity for further improvements.
- Air cooled stack required to meet size specifications.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Development of miniaturized BoP for specific devices	Develop system targeting a total weight of 50l/kW and 25kg/kW	prototype has been built and results in 100kg/kW and 160 l/kW which is an improvement of 50 % vs SoA	50 %	160kg/KW and 380 l/kW (www.truma.com)	Targets not reached in prototype. Plan for reaching objectives for commercial units are identified
12,000-13,000 portable & micro FC on the EU market in 2015	2 prototypes with a cost outlook for the future systems	2 prototypes in testing campaign	100 %	No widespread integration of FC in maritime sector (DAM)	System design has outlook of €2400
Assessment of fuelling supply options	LPG based system	System proven to run on LPG	100 %	LPG available in maritime, recreational sector	Downscaling of the technology successful
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2011
Stack power max. 50-500 We net	stack power of 500 W	Stacks built and tested	100 %	500 W reformate stacks available	Reduction in precious metal of 28 % achieved with good performance.
Fuel processing on board	LPG Fuel processor module	System build and tested	100 %	No widespread integration of FC in maritime sector (DAM)	
(c) Other project objectives					
Sulphur tolerant ATR catalyst	N/A	catalyst has stable performance at 33 % S. Monoliths coated and built in prototype	100 %	This CERTH/ APTL catalyst is SoA in 2016: Stable performance at 33ppm S in LPG	
3D printed heat exchangers	N/A	hardware printed and integrated in prototype	100 %	first time this technology was used for this application	3D metal printing needs further investigation in printer settings. More development in size reduction of Heat exchangers possible

SUAV

Microtubular solid oxide fuel cell power system developement and integration into a mini-UAV

PANEL 1
Technology validation in transport applications

ACRONYM	SUAV
CALL TOPIC	SP1-JTI-FCH.2010.4.5: Research and development on new portable and micro Fuel Cell solutions
START DATE	1/12/2011
END DATE	30/11/2015
PROJECT TOTAL COST	€3,7 million
FCH JU MAXIMUM CONTRIBUTION	€2,1 million
WEBSITE	www.suav-project.eu

PARTNERSHIP/CONSORTIUM LIST

HyGear Fuel Cell Systems B.V., ADELAN LTD, CATATOR AB, CONSIGLIO NAZIONALE DELLE RICERCHE, EADS DEUTSCHLAND GMBH, EADS UK Ltd., ERDLE ERICH KONRAD, THE UNIVERSITY OF BIRMINGHAM, ZACHODNI-OPOMORSKI UNIWERSYTET TECHNOLOGICZNY W SZCZECINIE, SURVEY COPTER SAS

MAIN OBJECTIVES OF THE PROJECT

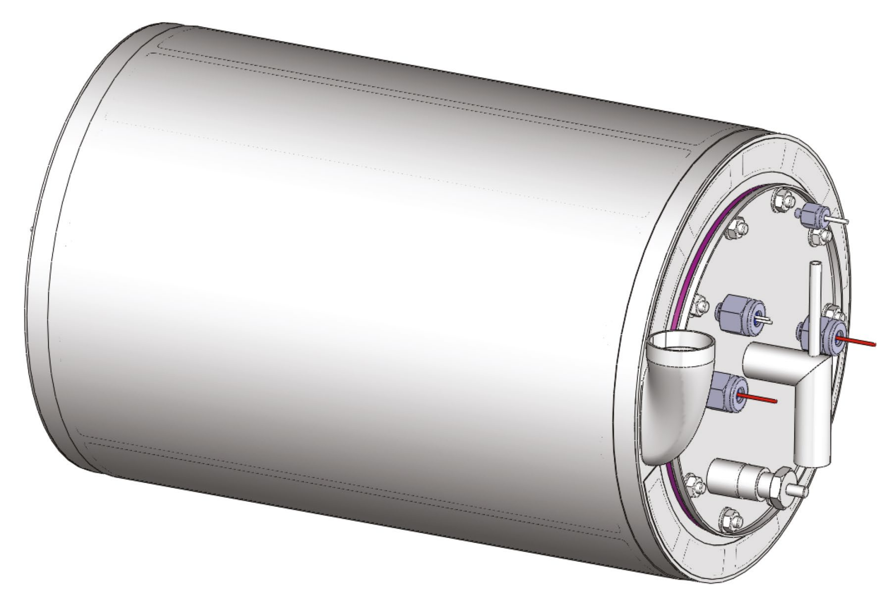
SUAV aims to design, optimise and build a 310W mSOFC stack, and to integrate it into a hybrid power system comprising the mSOFC stack and a battery.

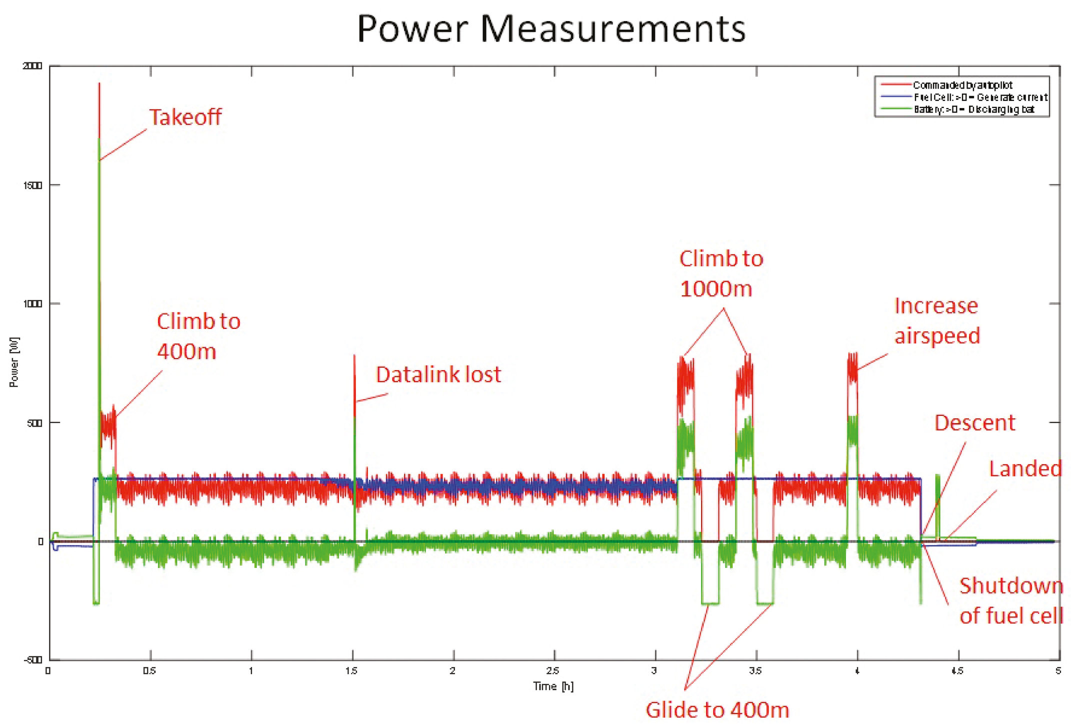
PROGRESS/RESULTS TO-DATE

- A tubular mSOFC stack has been developed having a high power density better than 280 W/l.
- A low weight/low volume system has been designed; 3 kg and 3.3 l for a system providing more than 280 W at EoL.
- The power density of stack plus reformer subsystem is better than 110 W/kg.
- A hybrid system comprising an SOFC subsystem, a battery pack is developed capable of supplying power for a complete UAV flight.
- Various models have been developed. The models can be applied for the design of other hybrid systems.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- A low weight/low volume system has been designed.
- A hybrid system comprising an SOFC subsystem, a battery pack is developed.
- The developed technology can also be applied outside aerospace in other applications.





CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:		MAIP 2008-2013
1 complete micro FC system with stack @250We (net) + backup stack as prototypes	12,000-13,000 portable and micro FC's	'Stack and system tested separately
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:		AIP 2010
System with 250 We net	Maximum power should be limited to 200We net	310 W is achieved for stack for a short time, is equivalent to a 280 W net system
Reformer catalyst development	Fuel Processing	Catalyst developed with sufficient efficiency to convert propane
2 250 We net stacks, with suitable fuel and air delivery manifolds	Stack	2 stacks made; 1 failed immediately, second produced of 310 W of power
Light weight – low volume balance of plant components	Balance of Plant	Light weight BoP designed. Heavier version build as this system will not be put in the UAV
FC-Battery Hybridization – control electronics – telemetry	Power electronics and controls integration	Hybridization and control done for complete system with commercial Fuel Cell subsystem.

SWARM

Demonstration of Small 4-Wheel fuel cell passenger vehicle Applications in Regional and Municipal transport

PANEL 1
Technology validation in transport applications

ACRONYM	SWARM
CALL TOPIC	SP1-JTI-FCH.2011.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure IV
START DATE	1/10/2012
END DATE	31/12/2017
PROJECT TOTAL COST	€15,6 million
FCH JU MAXIMUM CONTRIBUTION	€6,8 million
WEBSITE	http://www.swarm-project.eu/

PARTNERSHIP/CONSORTIUM LIST

ELEMENT ENERGY LIMITED, RIVERSIMPLE LLP, H_2O E-MOBILE GMBH, GESPA GMBH, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, THE UNIVERSITY OF BIRMINGHAM, COVENTRY UNIVERSITY ENTERPRISES LIMITED, BIRMINGHAM CITY COUNCIL, UNIVERSITE LIBRE DE BRUXELLES, UNIVERSITE DE LIEGE, JADE HOCHSCHULE WILHELMSHAVEN/OLDENBURG/ELSFLETH, EWE-Forschungszentrum für Energietechnologie e. V., UNIVERSITAET BREMEN, TUV SUD PRODUCT SERVICE GMBH, SERVICE PUBLIC DE WALLONIE, PLANET PLANUNGSGRUPPE ENERGIE UND TECHNIK GBR, DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH, TUV SUD AG

MAIN OBJECTIVES OF THE PROJECT

The overarching objectives of the project are:

1. Deploy H_2 technologies in small low cost vehicle classes, demonstrating a complementary approach to H_2 vehicle drive trains – these vehicles are built in battery dominant hybrid mode. This is a novel approach, which optimises the cost, performance and energy efficiency of the vehicles.
2. Create new H_2 fuelling networks and seed three European regions for future commercial rollout.
3. Strong involvement of European research institutions and SMEs – by involving a range of SMEs and research partners in the development and deployment activities.

PROGRESS/RESULTS TO-DATE

- Two MicroCab Hydrogen Electric Vehicles (H_2EVs) are in operation in Coventry (UK) alongside a recommissioned HRS at Coventry University.
- The existing HRS at Birmingham University was recommissioned in early 2016, consolidating further the hydrogen refuelling network in the Midlands (UK).
- Another MicroCab H_2EV has been transferred to ULB (BE) and is now in use on private test roads there for optimisation activities.
- Successful build of the Riversimple Mark2 Alpha prototype. The car is running and has been launched publicly in February 2016.
- The Air Liquide HRS has been commissioned in Belgium at the Toyota premises in Zaventem in April 2016. This is the 1st public HRS in Belgium.

FUTURE STEPS

- The MicroCab fleet will soon be completed by an additional 8 vehicles, including the newly developed HyLITE vehicles.
- The host city for the trial of 20 Riversimple cars in the UK has now been announced and the site planning for the refuelling is under preparation.
- Development and beginning of operation for the H_20 e-mobile fleet.
- Commissioning of a Air Liquide HRS in Bremen.

CONCLUSIONS, MAJOR FINDINGS AND PERSPECTIVES

- High interest from vehicles users and policy makers for alternative transport concepts.
- Local Authority support is key to success of siting activities for HRS planning.
- Key milestones will be achieved in the coming period with the vehicles and HRS demonstration activities starting in the three regions.

CONTRIBUTION TO THE PROGRAMME OBJECTIVES

PROJECT OBJECTIVES / TARGETS	CORRESPONDING PROGRAMME OBJECTIVE / QUANTITATIVE TARGET (SPECIFY TARGET YEAR)	CURRENT PROJECT STATUS	PROBABILITY OF REACHING INITIAL TARGET	STATE OF THE ART 2016 – VALUE AND REFERENCE	COMMENTS ON PROJECT PROGRESS / STATUS
(a) Project objectives relevant to multi-annual objectives (from MAIP/MAWP) – indicate relevant multi-annual plan:					MAIP 2008-2013
Vehicle Efficiency / energy consumption 1 kg/100 km	Vehicle Efficiency / energy consumption 1 kg/100 km	Observed	100 %	1 kg/100 km	Only 4 vehicles in operation so far from two suppliers
(b) Project objectives relevant to annual objectives (from AIP/AWP) if different than above – indicate relevant annual plan:					AIP 2011
HRS Availability >95 %	HRS Availability >95 %	Achieved for Air Liquide Alternative Technologies HRS in Brussels	100 %	Availability >95 %	2 further new HRS will be commissioned
€10/kg for target hydrogen price dispensed at pump	€10/kg for target hydrogen price dispensed at pump	Achieved for Air Liquide Alternative Technologies HRS in Brussels	100 %	€10/kg for H_2 price dispensed at pump	2 further new HRS will be commissioned
HRS Efficiency of 50-70 %	HRS Efficiency of 50-70 %	HRS Efficiency of 50 %	100 %	HRS Efficiency of 50 %	2 further new HRS will be commissioned
>2,000 h lifetime initially, then 3,000 h	3,000 h lifetime	Under validation	100 %	6,000 h lifetime	Only 4 vehicles in operation so far from two suppliers
MTBF >1,000 km	MTBF >1,000 km	Under validation	100 %	MTBF >10,000 km	Only 4 vehicles in operation so far from two suppliers
Vehicle availability >95 %	Vehicle availability >95 %	Under validation	100 %	Availability >95 %	Only 4 vehicles in operation so far from two suppliers
Efficiency >40 % (NEDC)	Efficiency >40 % (NEDC)	Under validation	100 %	Efficiency >40 % (NEDC)	Only 4 vehicles in operation so far from two suppliers