

Project ID:	633174
Call topic:	SP1-JTI-FCH.2013.1.1 - Large-scale demonstration of road vehicles and refuelling infrastructure VI
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€38 181 930.72
FCH JU max. contribution:	€14 999 983
Project start - end:	01/01/2015 - 31/12/2022
Coordinator:	VAN HOOL NV, BE
Website:	www.3emotion.eu



BENEFICIARIES: AUTOCARS DOMINIQUE, B.E. GREEN, CONNEXION VLOOT BV, SYNDICAT MIXTE DES TRANSPORTS URBAINS DE PAU PORTE DES PYRENEES, SERVICES AUTOMOBILES DE LA VALLEE DE CHEVREUSE SAS, CENTRO INTERUNIVERSITARIO DI RICERCA PER LO SVILUPPO SOSTENIBILE, COMMUNE DE CHERBOURG-EN-COTENTIN, CONNEXION OPENBAAR VERVOER NV, ACETILENE & GASTECNICI DI BAGNOLI MARIA & C. SAS, COMPAGNIA TRASPORTI LAZIALI, COMMUNAUTE URBAINE DE CHERBOURG, ROTTERDAMSE ELEKTRISCHE TRAM NV, REGIONE LAZIO, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, WATERSTOFNET VZW, PROVINCIE ZUID-HOLLAND, AIR LIQUIDE ADVANCED BUSINESS, LONDON BUS SERVICES LIMITED, DANTherm POWER A.S., AZIENDA PER LA MOBILITA' DEL COMUNE DI ROMA SPA, REGION NORDJYLLAND (NORTH DENMARK REGION), VLAAMSE VERVOERSMAATSCHAPPIJ DE LIJN, AALBORG KOMMUNE, FIT CONSULTING SRL, UNIVERSITA' DEGLI STUDI DI ROMA LA SAPIENZA, AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE, COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES

PROJECT AND OBJECTIVES

The 3Emotion project aims to operate 29 FCBs in 5 leading European cities: London, Pau, Versailles (2x), Rotterdam and in the Province of South Holland, and in Aalborg (DK) and to develop 3 new HRS.

OBJECTIVES

- Lower H₂ consumption <9 kg/100 km
- Integrate latest drivetrain, FC and battery technology < TCO and > lifetime
- Ensure availability >90 %
- Increase warranties (>15 000 hours and improve delivery times of the key components)
- Reduce bus investment costs to €850 000 for a 13 m bus.

STATUS

- 24 operational buses; due to COVID-19, 5 buses are still in production (Safran)
- All are HRS operational.

NON-QUANTITATIVE OBJECTIVES

- Contribution to safety improvements for fuel cell buses
- Solution for the hydrogen sensor problem, which arose earlier in the project, enabled the same issue to be avoided in the new buses.

PROGRESS AND MAIN ACHIEVEMENTS

- 24 fuel cell buses in operation; the remaining 5 buses will follow soon after the coronavirus measures have been eased
- 3 different OEMs, with 2 different fuel cell suppliers, have sold their buses to different EU sites for the 'set' bus price stated in the FCH JU call
- Buses are meeting their targets on hydrogen consumption, and averaging 8kg/100 km, with increasing availability of >90 %.

FUTURE STEPS AND PLANS

- Catch up on the delays and start operation of all buses at all sites, including the last 5 that are stuck in production due to COVID-19
- Use and full operation, meeting the 3 HRS requirement
- Data monitoring and gathering of operational and performance indicators (KPIs) for the FCBs and HRS.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	YEAR FOR SOA TARGET
HRS						
Project's own objectives/AIP 2013	Lower H ₂ consumption for FCBs to less than 9 kg/100 km	kg/100 km	9	Average of 8 kg/100 km	✓	2020
	Ensure availability >90 %	%	90	<=80	✗	
	Increase warranties (>15 000 hours)	Hours	15 000	15 000	✓	
	Investment cost of <€850 k for a 13 m bus	Euro	850 000	850 000	✓	



Project ID:	826215
Call topic:	FCH-01-2-2018 - Demonstration of Fuel Cell applications for midsize passenger ships or inland freight
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€6 790 561.43
FCH JU max. contribution:	€4 999 978.75
Project start - end:	01/01/2019 - 30/12/2022
Coordinator:	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, FI
Website:	https://flagships.eu/



FLAGSHIPS



FERRY
STAVANGER

PUSH
BOAT
LYON

BENEFICIARIES: LMG MARIN FRANCE, LMG MARIN AS, NORLED AS, WESTCON POWER AND AUTOMATION AS, MARITIME CLEANTECH, PERSEE, COMPAGNIE FLUVIALE DE TRANSPORT, BALLARD POWER SYSTEMS EUROPE AS, ABB OY, KONGSBERG MARITIME AS

PROJECT AND OBJECTIVES

The FLAGSHIPS project raises the readiness of zero-emission waterborne transport to an entirely new level by demonstrating two commercially operated hydrogen fuel cell vessels. The Lyon demo vessel is a push-boat operating as a utility vessel on the river Rhône, while the Stavanger demo vessel is a passenger and car ferry operating as part of the local public transport network. In the project, a total of 1.0 MW of on-board fuel cell power will be installed and both vessels will run on hydrogen produced with electrolyzers powered by renewable electricity. Vessels will start to operate during 2021.

PROGRESS AND MAIN ACHIEVEMENTS

- The construction of Stavanger ferry has started at the shipyard
- Maritime specific fuel cell system design has been finished
- Ship and H₂ system design for both vessels is well on the way and continuous safety assessment work is being done.

FUTURE STEPS AND PLANS

- Finish the design of the vessels and H₂ system
- Finish the construction of the vessels
- Operate the vessels in a commercial operation.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Project's own objectives / MAWP Addendum (2018-2020)	A complete FC & H ₂ system cost	€/kW	4 000	✗
	PEMFC system lifetime	Hours	25 000	



H2HAUL

Project ID:	826236
Call topic:	FCH-01-1-2018 - Large Scale Demonstration of H₂ fuelled HD Trucks with High Capacity Hydrogen Refuelling Stations (HRS)
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€25 141 280.63
FCH JU max. contribution:	€12 000 000.00
Project start - end:	01/02/2019 - 31/01/2024
Coordinator:	ELEMENT ENERGY LIMITED, UK
Website:	www.h2haul.eu



BENEFICIARIES: H2 ENERGY AG, VDL ENABLING TRANSPORT SOLUTIONS BV, VDL BUS CHASSIS BV, EOLY, FPT MOTORENFORSCHUNG AG, HYDROGENICS GMBH, IRU PROJECTS ASBL, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, THINKSTEP AG, IVECO S.p.A., ELRINGKLINGER AG, ETABLISSEMENTEN FRANZ COLRUYT NV, WATERSTOFNET VZW, AIR LIQUIDE ADVANCED BUSINESS, POWERCELL SWEDEN AB, HYDROGEN EUROPE

PROJECT AND OBJECTIVES

H2Haul will lead to the deployment of a total of 16 trucks which will be operated for at least two years in day-to-day service as part of the project. H2Haul will significantly increase the technical maturity of the heavy-duty trucks being developed by two major European OEMs, provide a comprehensive evidence base for the real-world performance of fuel cell trucks for customers in four different countries, disseminate key findings among a broad audience of relevant stakeholders, and provide the foundation for commercialisation of this sector in the 2020s.

NON-QUANTITATIVE OBJECTIVES

- Develop long-haul heavy-duty (26 and 44 t) fuel cell trucks that meet customers' requirements in a range of operating environments
- Truck design ongoing and specifications being designed as per specific customer requirements and mission profiles. Objective expected to be met
- Homologate three fuel cell truck types to certify that they are safe to use on Europe's roads
- Truck OEMs are working closely with hydrogen safety experts and the relevant certification bodies in order to secure all necessary safety approvals to use the trucks on public roads in Europe

- Develop the business case for further roll-out of heavy-duty fuel cell trucks
- H2Haul will provide a valuable database of real-world performance information and insights into the next steps required for commercialisation of this sector. Business case to be developed as a result of FC truck design to meet customers' needs. Operation of FC trucks and subsequent data collection will highlight the costs involved in the technology. Analysis will be carried out to highlight the economics of more ambitious deployments of many tens of vehicles or more
- Prepare the European market for further roll-out of fuel cell trucks through: (i) the development of innovative commercial models; and (ii) disseminating information from the project to a wide audience of relevant stakeholders
- H2Haul's dissemination activities will share key findings with relevant audiences to prepare the market for wider roll-out of fuel cell trucks on a commercial basis. The project's dissemination strategy and communication activities, created in its first year, have stimulated significant interest from relevant audiences.

PROGRESS & MAIN ACHIEVEMENTS

- Successful project launch and dissemination at the start of the project. The H2Haul website was launched in March 2020
- Development of heavy-duty fuel cell truck designs and specifications (ongoing)
- Preliminary designs and planning for HRS serving heavy-duty vehicles (ongoing).

FUTURE STEPS & PLANS

- Truck specifications to be finalised for FPT/IVECO trucks, and continued preparation for full construction
- Development of first prototypes of fuel cell systems and fuel cell trucks, and starting internal testing. Preparation for construction
- Preparatory activities for HRS deployment; all sites selected, permits requested, and the commencement of civil works where possible
- Continued high-profile dissemination and lobbying work through attendance and presentation at key conferences and events
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QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
Project's own objectives aligned with MAWP Addendum (2018-2020)	Truck operational period	Months	Start of operation incl. ramp-up phase: minimum of 24 months	N/A	N/A
	Truck distance travelled	km	Min. 30 000 km per truck and year, on average, per site		
	Truck availability	%	>90 % on a fleet basis after an initial ramp-up phase of max. 6 months		
	Truck specific fuel consumption	kg/100 km	<7.5 kg/100 km (rigid, 80-90 % load, inner city delivery (<25 km/h on average) <8.5 kg/100 km (tractor with semi-trailer 80-90 % load, long-haul delivery (>65 km/h on average)	98	2017
	Availability of station (by project end)	%	99		
	Mean distance between failures	km	Fuel cell MDBF >2 500 km		
	WtW CO ₂ emissions <50 % compared to diesel truck	kg CO ₂ /km	kg CO ₂ /vehicle km (per vehicle type, average across fleet) <50 % compared to diesel truck	N/A	N/A
	Speed of hydrogen dispensing	kg/min	>2.5 kg/min		
	Cost of hydrogen dispensed to HRS	€/kg	≤7.5 €/kg dispensed (excl. taxes) at end of project – in practice, lower values are expected		
	Amount of hydrogen dispensed to project trucks	kg/year	>2 500 kg per truck per year	N/A	N/A

Project ID: 671438

Call topic: FCH-01.7-2014 - Large scale demonstration of refuelling infrastructure for road vehicles

PRD 2020 Panel: 1 - Trial and Deployment of Fuel Cell Applications - Transport

Project total costs: €62 840 820.79

**FCH JU
max. contribution:** €32 000 000.00

Project start - end: 01/06/2015 - 30/05/2020

Coordinator: ELEMENT ENERGY LIMITED, UK

Website: www.h2me.eu



BENEFICIARIES: LINDE AKTIENGESellschaft, ELEMENT ENERGY, LINDE GAS GMBH, H2 MOBILITY DEUTSCHLAND GMBH & CO KG, COMMUNAUTE D'AGGLOMERATION SARREGUEMINES CONFLUENCES, FALKENBERG ENERGI AB, HYOP AS, DANISH HYDROGEN FUEL AS, OMV REFINING & MARKETING GMBH, BOC LIMITED, HONDA R&D EUROPE (DEUTSCHLAND) GMBH, AGA AB, HYUNDAI MOTOR EUROPE GMBH, SYMBIO, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, AREVA H2GEN, INTELLIGENT ENERGY LIMITED, ITM POWER (TRADING) LIMITED, CENEX - CENTRE OF EXCELLENCE FOR LOW CARBON AND FUEL CELL TECHNOLOGIES, MCPHY ENERGY, NUCELLSYS GMBH, WATERSTOFNET VZW, NISSAN MOTOR MANUFACTURING (UK) LIMITED, AIR LIQUIDE ADVANCED BUSINESS, NEL HYDROGEN AS, TOYOTA MOTOR EUROPE NV, ICELANDIC NEW ENERGY LTD, EIFER EUROPAISCHES INSTITUT FÜR ENERGIEFORSCHUNG EDF KIT EWIV, LINDE AG, RENAULT SAS, BAYERISCHE MOTOREN WERKE AKTIENGESellschaft, DAIMLER AG

PROJECT AND OBJECTIVES

Hydrogen Mobility Europe (H2ME) has brought together Europe's four most ambitious national initiatives on hydrogen mobility (in Germany, Scandinavia, France and the UK). The project has expanded their developing networks of HRS – 29 new stations will be deployed in total – and the fleets of FCEVS operating on Europe's roads – 339 vehicles – creating both a physical and strategic link between these four regions and three 'observer countries' – Austria, Belgium and the Netherlands – which are using what has been learnt by this project to develop their own strategies.

NON-QUANTITATIVE OBJECTIVES

- Minimum of 100 FCEVs and 23 HRS
- 325 vehicles and 28 HRS deployed to date – with additional vehicles (339) and HRS (29) by the end of the project
- Further activities for deployment of HRS and FCEVS after the project
- Further FCH JU and CEF projects applications were submitted (H2ME2, COHR, ZEFER, etc.)
- HRS to be accessible for private users and preferably integrated into petrol forecourts

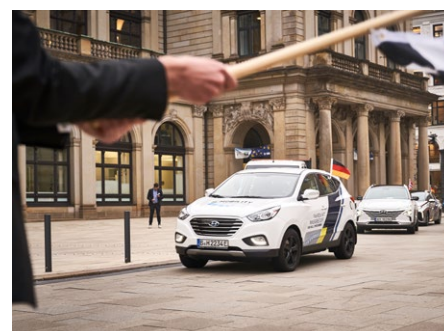
- All of the 700 bar HRS will be accessible for private drivers. The 20 x 700 bar HRS in Germany will be integrated into petrol forecourts
- Ensure cross-fertilisation of knowledge acquired in the project and comprehensive dissemination
- Dedicated work package and dissemination and exploitation plan to achieve this. Three observer countries are included in the consortium.

FUTURE STEPS AND PLANS

- Continued data collection for the final period of the project and beyond when possible as part of H2ME 2
- Solid and growing basis of operational data from vehicles and station and further fact-based analysis of vehicles and HRS performances
- Final report and final project activities reporting.

PROGRESS AND MAIN ACHIEVEMENTS

- Successful deployment of all activities. To date, 28 HRS deployed (29) and all vehicles operational (14 additional Mirai to be deployed by Sept 20)
- Building a rich dataset valuable for Europe: jointly with H2ME2. Since 2016, 14 340 000 km have been driven and 134 t of H₂ distributed in 61 850 events
- Testing commercial readiness of vehicles: up to 594 km range, close to 100 % availability reached, 100 km/1 kg H₂; and for HRS: >95 % availability.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
FC VEHICLES							
Project's own objectives aligned with AWP 2014/ MAWP Addendum (2018-2020)	Min. vehicle operation during the project	Months	12	61	✓	12	2017
	Vehicle availability	%	>95	Estimated >95 %	✓	98	
HRS							
Project's own objectives aligned with AWP 2014/ MAWP Addendum (2018-2020)	HRS availability	%	96	96.7	✓	98	2017
	Min HRS operation	Months	24	48	✓	32	
		Hydrogen purity	%	99.99	99.99	✓	99.99

Project ID:	700350
Call topic:	FCH-03.1-2015 - Large scale demonstration of Hydrogen Refuelling Stations and FCEV road vehicles - including buses and on site electrolysis
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€101 449 352.03
FCH JU max. contribution:	€34 999 548.50
Project start - end:	01/05/2016 - 30/06/2022
Coordinator:	ELEMENT ENERGY LIMITED, UK
Website:	www.h2me.eu



BENEFICIARIES: TOYOTA NORGE AS, TOYOTA DANMARK AS, ELEMENT ENERGY, B. KERKHOFF & ZN BV, TECH TRANSPORTS COMPAGNIE, ALPHABET FUHRPARKMANAGEMENT GMBH, LINDE GAS GMBH, ISLENSKA VETNISFELAGID EHF, COMMUNAUTE URBAINE DU GRAND NANCY, STEDIN DIENSTEN BV, SOCIETE DU TAXI ELECTRIQUE PARISIEN, H2 MOBILITY DEUTSCHLAND GMBH & CO KG, HYOP AS, BRINTBRANCHEN, NEW NEL HYDROGEN AS, COMPAGNIE NATIONALE DU RHONE SA, HYDROGENE DE FRANCE, HONDA R&D EUROPE (DEUTSCHLAND) GMBH, GNVRT SAS, AGA AB, SYMBIO, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, AREVA H2GEN, SOCIETE D'ECONOMIE MIXTE DES TRANSPORTS EN COMMUN DE L'AGGLOMERATION NANTAISE (SEMITEAN), MINISTERIE VAN INFRASTRUCTUUR EN WATERSTAAT, INTELLIGENT ENERGY LIMITED, MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN, ITM POWER (TRADING) LIMITED, CENEX - CENTRE OF EXCELLENCE FOR LOW CARBON AND FUEL CELL TECHNOLOGIES, KOBENHAVNS KOMMUNE, hySOLUTIONS GMBH, MCPHY ENERGY, NUCELSYS GMBH, NISSAN MOTOR MANUFACTURING (UK) LIMITED, AIR LIQUIDE ADVANCED BUSINESS, RENAULT TRUCKS SAS, NEL HYDROGEN AS, ICELANDIC NEW ENERGY LTD, EIFER EUROPAISCHES INSTITUT FUR ENERGIEFORSCHUNG EDF KIT EWIV, STEDIN NETBEHEER BV, RENAULT SAS, BAYERISCHE MOTOREN WERKE AKTIENGESSELLSCHAFT, AUDI AKTIENGESSELLSCHAFT, OPEN ENERGI LIMITED, DAIMLER AG, THE UNIVERSITY OF MANCHESTER

PROJECT AND OBJECTIVES

H2ME 2 brings together actions in 8 countries in a 6-year collaboration to deploy over 1200 vehicles and 20 new HRS. The project will perform a large-scale market test of a large fleet of fuel cell electric vehicles operated in real-world customer applications across multiple European regions. In parallel, it will demonstrate that the hydrogen mobility sector can support the wider European energy system via electrolytic hydrogen production.

NON-QUANTITATIVE OBJECTIVES

- Min. of 1 200 fuel cell vehicles and 20 HRS
- > 1 200 fuel cell vehicles and > 20 HRS foreseen by the end of the project
- Demonstration of electrolyser integrated HRS operating in grid balancing
- H2ME 2 has a dedicated WP to assess the way in which electrolytic hydrogen production in the mobility sector can link to the wider energy system
- Vehicles supplied from multiple OEMs, including cars and utility vehicles

- H2ME 2 will deploy cars, light-duty vans and trucks from OEMs, including Daimler, Honda, Symbio, Hyundai and Toyota
- Ensure cross-fertilisation of knowledge acquired in the project
- Dedicated WP and dissemination and exploitation plan to achieve this. Three observer countries are included in the coalition.

PROGRESS AND MAIN ACHIEVEMENTS

- Demonstration under way for 284 vehicles from 5 OEMs (Daimler, Honda, Hyundai, Symbio and Toyota) and 9 HRS from 5 suppliers across 5 countries
- Demonstration of positive business cases under H2ME 2 has led to further commitments from partners to expand fleets in France, Denmark and Germany
- Building a rich dataset valuable for Europe – jointly with H2ME. Since 2016, 14 340 000 km have been driven and 134t of H₂ distributed at 61 850 events.

FUTURE STEPS AND PLANS

- Most of the 20 HRS planned for the project are expected to have been commissioned and to be in operation
- Most of the vehicles planned for the project are expected to be deployed, including the new generation of the Renault Kangoo Z.E Hydrogen (by Symbio)
- Solid and growing basis of operational data from vehicles and stations and further fact-based analysis of vehicles and HRS performances
- Further exploitation of results.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
HRS							
Project's own objectives aligned with AWP 2015/MAWP Addendum (2018-2020)	HRS availability	%	96	96.7	✓	98	2017
	Min HRS operation	Months	36	~36	✂	32	
	Hydrogen purity	%	99.99	99.999	✓	99.99	
FC VEHICLES							
Project's own objectives aligned with AWP 2015/MAWP Addendum (2018-2020)	Minimum vehicle operation during project	Months	36	37	✓	12	2017
	Vehicle availability	%	98	>99	✓	98	



HIGHVLOCITY

HIGH V.LO-CITY CITIES SPEEDING UP THE INTEGRATION OF HYDROGEN BUSES IN PUBLIC FLEETS

Project ID:	278192
Call topic:	SP1-JTI-FCH.2010.1.1 -Large-scale demonstration of road vehicles and refuelling infrastructure III
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€30 494 110.49
FCH JU max. contribution:	€13 491 724.00
Project start - end:	01/01/2012 - 31/12/2019
Coordinator:	VAN HOOL NV, BE
Website:	highvlocity.eu/



BENEFICIARIES: PITPOINT.PRO BV, PITPOINT.BE, QBUZZ BV, CNG NET BV, BALLAST NEDAM INTERNATIONAL PRODUCT MANAGEMENT B.V., RIVIERA TRASPORTI SPA, ABERDEEN CITY COUNCIL*, WATERSTOFNET VZW, HYDROGEN, FUEL CELLS AND ELECTRO-MOBILITY IN EUROPEAN REGIONS, DANTHERM POWER AS, REGIONE LIGURIA, SOLVAY SA, VLAAMSE VERVOERSMAATSCHAPPIJ DE LIJN, UNIVERSITA DEGLI STUDI DI GENOVA, FIT CONSULTING SRL

PROJECT AND OBJECTIVES

The overall objective of High V.LO-City was to facilitate deployment of the last-generation fuel cell hybrid buses (FCB) in public transport operations by addressing key environmental and operational concerns that transport authorities are facing today. Through the strategic location of the project's four demo sites it envisions demonstration and the dissemination of actual FCBs in these different European geographic locations and their performance in normal bus operations. The project was completed and ended on 31 December 2019.

NON-QUANTITATIVE OBJECTIVES

- FCBs centre of excellence website
- The fuel cell busses.eu knowledge portal and centre of excellence was created and is now part of the JIVE project
- Improvements in the FCBs supply chain
- Next concepts for service and onsite storing of components were introduced during the project, which now is the way to go for all projects.

PROGRESS AND MAIN ACHIEVEMENTS

- The development, construction and operation of all (14) the hydrogen buses planned for in the project at four sites
- The installation and operation of three hydrogen generation and refuelling stations in three of the four sites
- The development, usage and dissemination of the results to interested operators and stakeholders via the detailed 'FC-bus centre of excellence' website.

FUTURE STEPS AND PLANS

- The project has finished.



QUANTITATIVE TARGETS AND STATUS

PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
Fuel consumption	kg/100 km	11-13	9-13	✓	7-9	2020
Demonstration size	Buses/site	5	5,5,3 & 2		>20	
Refuelling time	Min./fuelling	10-12	10-12		10	
Bus cost	€/bus	1 300 000	1 100 000 - 1 300 000		650 000	
Fuelling station capacity	kg/day	200	285	✗	>300	
Fuelling station availability	%	98	96.8		99	

Project ID:	303467
Call topic:	SP1-JTI-FCH.2011.1.1 - Large-scale demonstration of road vehicles and refuelling infrastructure IV
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€17 850 708.85
FCH JU max. contribution:	€6 999 999
Project start - end:	01/01/2013 - 31/03/2019
Coordinator:	BOC LIMITED, UK
Website:	https://www.fuelcellbuses.eu/projects/hytransit



BENEFICIARIES: STAGECOACH BUS HOLDINGS LIMITED, VAN HOOL NV, ABERDEEN CITY COUNCIL*, HYDROGEN, FUEL CELLS AND ELECTRO-MOBILITY IN EUROPEAN REGIONS, DANTHERM POWER AS, ELEMENT ENERGY LIMITED, PLANET PLANUNGSGRUPPE ENERGIE UND TECHNIK GBR

PROJECT AND OBJECTIVES

HyTransit aimed to trial a fleet of six hybrid fuel cell buses in daily fleet service, together with one state-of-the-art HRS in Aberdeen, Scotland. By operating the vehicles rigorously on long inter-urban routes, the project aimed to prove that a hybrid fuel cell bus is capable of meeting the operational demands of an equivalent diesel bus, whilst offering significant benefits in terms of environmental performance. Beginning in January 2013, the project finished in March 2019, allowing for four full years of operation of the FCBs and the HRS.

NON-QUANTITATIVE OBJECTIVES

- Develop six A330 hybrid fuel cell buses specifically modified for long sub-urban routes
- The six FCBs deployed in Aberdeen were specially designed by Van Hool, with help from Stagecoach and Aberdeen City Council
- Initiate the first step of a large-scale roll-out of hydrogen buses in Scotland
- Following the success of HyTransit, Aberdeen City Council has committed to deploying more FCBs through

the JIVE project. In addition, other Scottish cities, such as Dundee, have committed to deploying FCBs

- Prove that a hybrid fuel cell bus is capable of meeting the operational performance of an equivalent diesel bus on demanding UK routes
- The project results can be evidenced to prove the capability of the FCBs. These results are also used by the project in dissemination work to spread the positive message
- Address the main commercial barrier to the technology (namely bus capital cost) by deploying state-of-the-art components
- The premium of fuel cell buses has reduced significantly over diesel buses since 2013. The premium is now c. £70 000/year, down from c. £170 000/year
- Disseminate the project results to the public and key stakeholders who will be responsible for decisions on the next steps towards commercialisation of the technology
- The HyTransit project has been widely disseminated across Europe.

PROGRESS AND MAIN ACHIEVEMENTS

- Kittybrewster HRS has exceeded expectations with the highest average availability (99.5 %) and utilisation (46 %) results seen to date across Europe
- Nearly 1.4 million kilometres have been driven by the fleet of buses and approximately 1.3 million passengers have used the service
- By using FCBs instead of conventional diesel vehicles, >400 000 litres of diesel has been saved and >1 000 tonnes of direct GHG emissions avoided.

FUTURE STEPS AND PLANS

- The project has finished.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)
HRS						
AIP 2011 target for fleet	Availability	%	>85	78	✗	85
FC VEHICLES						
Project's own objectives	Availability of the hydrogen refuelling unit	%	>98	99.5	✓	98
	Cumulative amount of hydrogen dispensed	kg	>140 000	146 823		N/A
	Operating hours per bus	Hours	70 000	88 824		
	Number of passengers	Number	>1 000 000	1 302 487		



JIVE JOINT INITIATIVE FOR HYDROGEN VEHICLES ACROSS EUROPE

Project ID: 735582

Call topic: FCH-01.9-2016 - Large Scale Validation of fuel cell bus fleets

PRD 2020 Panel: 1 - Trial and Deployment of Fuel Cell Applications - Transport

Project total costs: €110 375 045.243

FCH JU max. contribution: €32 000 000

Project start - end: 01/01/2017 - 31/12/2022

Coordinator: ELEMENT ENERGY LIMITED, UK

Website: <https://www.fuelcellbuses.eu/projects/jive>



BENEFICIARIES: REBELGROUP ADVISORY BV, IN-DER-CITY-BUS GMBH, ESWE VERKEHRSGESELLSCHAFT MBH, MAINZER VERKEHRSGESELLSCHAFT MBH, VERKEHRS-VERBUND MAINZ-WIESBADEN GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, REGIONALVERKEHR KÖLN GMBH, EUE APS, DUNDEE CITY COUNCIL, WEST MIDLANDS TRAVEL LIMITED, SASA SPA AG SOCIETÀ AUTOBUS SERVIZID'AREA SPA, HERNING KOMMUNE, WSW MOBIL GMBH, RIGAS SATIKSME SIA, TRENTINO TRASPORTI SPA, EE ENERGY ENGINEERS GMBH, THINKSTEP AG, ABERDEEN CITY COUNCIL*, hySOLUTIONS GMBH, SÜEDTIROLER TRANSPORTSTRUKTUREN AG, HyCologne - WASSERSTOFF REGION RHEINLAND EV, LONDON BUS SERVICES LIMITED, PLANET PLANUNGSGRUPPE ENERGIE UND TECHNIK GBR, BIRMINGHAM CITY COUNCIL, FONDAZIONE BRUNO KESSLER, UNION INTERNATIONALE DES TRANSPORTS PUBLICS, HYDROGEN EUROPE

PROJECT AND OBJECTIVES

The JIVE project aims to assist the commercialisation of fuel cell buses (FCBs) as a zero-emissions public transport option across Europe. The project's goal is to address the current high ownership cost of FCBs relative to conventionally powered buses and the lack of hydrogen refuelling infrastructure across Europe by supporting the deployment of 142 FCBs in 9 locations. This will more than double the number of FCBs currently operating in Europe.

NON-QUANTITATIVE OBJECTIVES

- Providing experience of the suitability of FCBs for wider roll-out
- Through the publication of project deliverables, such as the Best Practice and Commercialisation Report 2, information flows have been established to interested observer parties
- Raise awareness of the readiness of fuel cell technology for wider roll-out – with a focus on bus purchasers and regulators
- As before, a strong observer group within the JIVE

consortium has been established which monitors discussions and best practice emerging from the project. This will ensure that the momentum for fuel cell bus uptake in Europe continues beyond the project

- Deliver positive environmental impacts by operating FC buses for extended periods
- As per JIVE's objectives, all buses deployed thus far in the project are replacing diesel technology, which means that they will lead to CO₂ abatement and will not simply operate as a 'visible extra'.

PROGRESS AND MAIN ACHIEVEMENTS

- To date, 92 of the 142 buses envisaged originally have been ordered from 3 different bus manufacturers
- In addition, the first 10 buses have entered into commercial operation in Cologne
- Finally, the project has published its second Best Practice and Commercialisation Report, providing information for new sites on the lessons learned in JIVE.

FUTURE STEPS AND PLANS

- By September 2020, the aim is that all buses due to be deployed in the project will have been ordered (although this depends on the ongoing pandemic)
- Once these orders have been placed, the next objective is for all buses to be manufactured and deployed by the end of 2021
- At this point in the project, the first operational data will be analysed and key project findings communicated to demonstrate technological readiness
- In addition, engagement with further external parties, including industry, other observer cities and political networks will begin in earnest.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Project's own objectives/ AWP 2016	Vehicle operational lifetime	Years	8	✗
	Distance travelled	km/year	Min. 44 000	
	Operating hours per fuel cell system	Hours	Over 20 000	
	Availability	%	90	
	Mean time (distance) between failures	km	Over 2 500	
	Fuel consumption	kg/100 km	Better than 9	✓
	Efficiency	%	Over 42	
	Vehicle capex	Euro	Below 650 000	
	Vehicle opex	Euro	Max. 100 % more than diesel bus opex	
				✗



JIVE 2 JOINT INITIATIVE FOR HYDROGEN VEHICLES ACROSS EUROPE 2

Project ID:	779563
Call topic:	FCH-01-5-2017 - : Large scale demonstration in preparation for a wider roll-out of fuel cell bus fleets (FCB) including new cities – Phase two
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€107 398 381.75
FCH JU max. contribution:	€25 000 000.00
Project start - end:	01/01/2018 - 31/12/2023
Coordinator:	ELEMENT ENERGY LIMITED, UK
Website:	www.fuelcellbuses.eu/projects/jive-2



BENEFICIARIES: ENGIE ENERGIE SERVICES, CA DE L'AUXERROIS, RHEINISCHE BAHNGESSELLSCHAFT AKTIENGESellschaft, SOCIETE PUBLIQUE LOCALE D'EXPLOITATION DES TRANSPORTS PUBLICS ET DES SERVICES A LA MOBILITE DE L'AGGLOMERATION PALOISE, STRAETO BS, OPENBAAR LICHAAM OV-BUREAU GRONINGEN EN DRENTHE, PAU BEARN PYRENEES MOBILITES, LANDSTINGET GAVLEBORG, REBELGROUP ADVISORY BV, REGIONALVERKEHR KOLN GMBH, DUNDEE CITY COUNCIL, WSW MOBIL GMBH, RIGAS SATIKSME SIA, KOLDING KOMMUNE, THINKSTEP AG, BRIGHTON & HOVE BUS AND COACH COMPANY LIMITED, RUTER AS, PROVINCIE ZUID-HOLLAND, VATGAS SVERIGE IDEELL FORENING, NOORD-BRABANT PROVINCIE, UNION INTERNATIONALE DES TRANSPORTS PUBLICS, HYDROGEN EUROPE

PROJECT AND OBJECTIVES

The JIVE 2 project aims to assist the commercialisation of fuel cell buses (FCBs) as a zero-emissions public transport option across Europe. The project's goal is to address the current high ownership cost of FCBs relative to conventionally powered buses and the lack of hydrogen refuelling infrastructure across Europe by supporting the deployment of 152 FCBs in 14 locations. This will more than double the number of FCBs currently operating in Europe.

NON-QUANTITATIVE OBJECTIVES

- Providing experience of suitability of FCBs for wider roll-out
- Through the publication of project deliverables, such as the Best Practice and Commercialisation Report 2, information flows have been established to interested observer parties
- Raise awareness of the readiness of fuel cell technology for wider roll-out – with a focus on bus purchasers and regulators

- As before, a strong observer group within the JIVE consortium has been established which monitors discussions and best practice emerging from the project. This will ensure that the momentum ** 9 for fuel cell bus uptake in Europe continues beyond JIVE 2
- Deliver positive environmental impacts by operating FC buses for extended periods
- As per the project objectives, all buses deployed thus far are replacing diesel technology. This means that the buses will lead to CO₂ abatement and will not simply operate as a 'visible extra'.

PROGRESS AND MAIN ACHIEVEMENTS

- To date, 90 of the 152 buses envisaged originally have been ordered from 3 different bus manufacturers
- In addition, the first 5 buses have entered into commercial operation in Pau
- Finally, the project has published its first Best Practice Information Bank Report, providing

information to new sites on the lessons learned in JIVE 2.

FUTURE STEPS AND PLANS

- By September 2020, the aim is that all buses due to be deployed in the project will have been ordered (although this depends on the ongoing pandemic)
- Once these orders have been placed, the next goal is for all buses to be manufactured and deployed by the end of 2021
- At this point in the project, the first operational data will be analysed and key project findings communicated to demonstrate technological readiness
- In addition, engagement with further external parties, including industry, other observer cities and political networks will begin in earnest.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Project's own objectives/ AWP 2017	Vehicle operational lifetime	Years	Same as diesel bus	
	Distance travelled	km/bus	150 000	
	FC stack lifetime	Hours	Over 20 000	
	Availability	%	Over 90	
	MTBF	km	Over 3 500	
	Fuel consumption	kg/100 km	under 9	
	Efficiency	%	Over 42*	
	Vehicle capex	Euro	Under 625 k for 12 m bus	
	Vehicle opex	%	Max. 100 more than cost of diesel bus	

* Efficiency for Standardized On Road Test 1 & 2 drive cycle

Project ID: 779589

Call topic: FCH-01-7-2017 - Validation of Fuel Cell Trucks for the Collect of Urban Wastes

PRD 2020 Panel: 1 - Trial and Deployment of Fuel Cell Applications - Transport

Project total costs: €8 706 255.00

FCH JU max. contribution: €4 993 851.00

Project start - end: 01/01/2018 - 31/12/2021

Coordinator: TRACTEBEL ENGINEERING, BE

Website: h2revive.eu/



BENEFICIARIES: GEMEENTE GRONINGEN, SAVER NV, SUEZ NEDERLAND HOLDING BV, AZIENDA SERVIZI MUNICIPALIZZATI DI MERANO SPA, SEAB SERVIZI ENERGIA AMBIENTE BOLZANO SPA, SWISS HYDROGEN SA, E-TRUCKS EUROPE, GEMEENTE GRONINGEN, GEMEENTE BREDA, SYMBIO, STAD ANTWERPEN, WATERSTOFNET VZW, ELEMENT ENERGY LIMITED, GEMEENTE AMSTERDAM, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES

PROJECT AND OBJECTIVES

REVIVE will significantly advance the state of development of fuel cell refuse trucks by integrating fuel cell powertrains into 15 vehicles and deploying them at 8 sites across Europe. The project will deliver substantial technical progress by integrating fuel cell systems from four major suppliers and developing effective hardware and control strategies to meet the highly demanding refuse truck duty cycles.

NON-QUANTITATIVE OBJECTIVES

- Demonstrate a route to high utilisation of HRS to support the roll-out of hydrogen mobility for light vehicles
- Delayed due to delayed truck deployment
- Demonstrate clear pathways to cost-effective zero-emission waste-collection solutions
- Data collection framework is finalised. Business case tool framework is developed.

PROGRESS AND MAIN ACHIEVEMENTS

- All original partners have ordered their truck(s) – in total, 11 trucks ordered
- First HD FC delivery by Proton Motor (for REVIVE)
- First FC integration for REVIVE.

FUTURE STEPS AND PLANS

- Final deadline for purchase orders set for September 2020
- Different FC suppliers to speed up the FC deliveries
- Start diesel truck data gathering for smooth integration of data-collection framework.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT
AWP 2017	Tank-to-wheel efficiency	%	>42	No trucks deployed yet
	Operational lifetime	Hours	>20 000	
	Minimum distance between failure	km	>2 500	
	Availability	%	>90	
	70 % of energy consumption comes from H ₂	%	>70	
	FC power	kW	>40 kW	30-45 kW



ZEFER

ZERO EMISSION FLEET VEHICLES FOR EUROPEAN ROLL-OUT

Project ID:	779538
Call topic:	FCH-01-6-2017 - Large scale demonstration of Hydrogen Refuelling Stations and Fuel Cell Electric Vehicle (FCEV) road vehicles operated in fleet(s)
PRD 2020 Panel:	1 - Trial and Deployment of Fuel Cell Applications - Transport
Project total costs:	€25 883 005
FCH JU max. contribution:	€4 998 843
Project start - end:	01/09/2017 - 31/08/2022
Coordinator:	ELEMENT ENERGY LIMITED, UK
Website:	zefer.eu/



BENEFICIARIES: LINDE AKTIENGESellschaft, GREEN TOMATO CARS LIMITED, BREATH, SOCIETE DU TAXI ELECTRIQUE PARISIEN, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, ITM POWER (TRADING) LIMITED, CENEX - CENTRE OF EXCELLENCE FOR LOW CARBON AND FUEL CELL TECHNOLOGIES, AIR LIQUIDE ADVANCED BUSINESS, VILLE DE PARIS, LINDE AG, BAYERISCHE MOTOREN WERKE AKTIENGESellschaft, MAYOR'S OFFICE FOR POLICING AND CRIME

PROJECT AND OBJECTIVES

In 2017, ZEFER began to demonstrate a viable business case for hydrogen mobility in fleet applications and to highlight a solution to the problem of low FCEV uptake and poor HRS utilisation. The project will deploy 180 FCEVs into high-mileage fleet services, such as taxis, private hire vehicles and emergency services, across three major European cities (London, Paris and Brussels). Through intensive use of the vehicles, ZEFER will test the performance of FCEVs and their supporting HRS to ascertain whether FCEVs can provide a direct alternative to petrol/diesel vehicles.

NON-QUANTITATIVE OBJECTIVES

- Develop comprehensive understanding from the deployment project
- Public deliverables have been produced covering topics such as customer acceptance, the business case for FCEVs, and the technical performance of HRS and FCEVs during high utilisation
- Develop the confidence of investors and policymakers in FCEV and HRS roll-out
- Analysis in ZEFER has proven that FCEVs and HRS are capable of meeting the demands of high-mileage fleet operations. This has led to fleet operators

increasing the number of FCEVs in their fleet and attracting investors into joint ventures (HySetCo)

- Maintain and, if possible, increase SME participation in FCH JU projects to or over 25 %
- 50 % of partners in ZEFER are SMEs. In fact, 84 % of project funding targets SMEs
- Reduce the production cost of fuel cell systems to be used in transport applications while increasing their lifetime levels to make them competitive with conventional technologies
- The project will demonstrate the lifetime of fuel cells in FCEVs at utilisation levels well beyond those currently deployed. The bulk procurement of FCEVs is also expected to have reduced FCEV costs to their lowest level
- Increase the energy efficiency of hydrogen production while reducing operating and capital costs so that the combined system is competitive with alternatives in the marketplace
- ZEFER aims to reduce the cost of hydrogen at the pump to <€10/kg. This will be achieved by providing a stable demand for hydrogen at an HRS. The project will also trigger further cost reductions by creating a climate of investment in low-cost green production systems required to drive the delivered cost below this level.

PROGRESS AND MAIN ACHIEVEMENTS

- Of the 180 FCEVs to be deployed, 120 are in everyday operation – 60 in Paris and 60 in London – in high-demand fleet applications
- The FCEVs are being used rigorously in everyday service amassing more than 2.7 million kilometres with no reports of reliability problems
- Project HRS are being highly utilised and are performing well, even prior to the completion of HRS upgrades in Paris.

FUTURE STEPS AND PLANS

- Confirm the approach for the Brussels deployment and begin operating the FCEVs
- Commission all HRS upgrades in Paris and Brussels
- Continue data collection on the FCEVs and HRS to better understand how performance is impacted by long-term high utilisation levels
- Production of project reports analysing the business case for FCEVs in high-mileage applications. This will be supported by a customer survey analysis
- Higher visibility dissemination work towards policymakers to ensure that the fleet operation use case can be expanded across other European regions.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
FC VEHICLES							
Project's own objectives	Min. distance for vehicles	km/vehicle	90 000	Average of ~ 42 000 km per year. The first vehicles deployed in April 2018 already achieved the target of 90 000 km	✓	FCEVs in taxi operation in H2ME drive on average ~44 040 km per year	2019
	Vehicle availability	%	>98	>99	✓	>99	
	Vehicle Operation Lifetime	Hours	>6 000	Average of ~1 800 hrs per year. Will achieve targets after ~1+ years	✗	4 000	2017
HRS							
Project's own objectives	HRS availability	%	>98	96	✗	98	2016
	Hydrogen purity	%	99.99	99.99	✓	99.99	2018
	Level of back-to-back vehicle refuelling	Refuelling incidents/hour	6	6	✓	6	2019

