



HyFLEET:CUTE

The World's Largest Hydrogen Powered Bus Project

Policy Background

HyFLEET:CUTE is co-funded with the Industry partners through the 6th Framework Programme. The focus is on the priority of Sustainable Development, in particular sustainable Energy Systems. This project specifically addresses the issue of alternative motor fuels. It is broad in scope including:

- a. Demonstration of hydrogen fleets with innovatory extensions of the Clean Urban Transport for Europe Project (CUTE) through testing Hydrogen powered Internal Combustion Engines Buses and hybrid fuel cells buses.
- b. Demonstration of innovative, cost-efficient and safe production, storage, distribution and fuelling systems of hydrogen.
- c. Exploring synergies between sector and technology pathways. Demonstration of the benefits for transport and stationary applications of using hydrogen simultaneously for both cases. Assessment and monitoring from a socio-economic, energy efficiency, environmental and safety perspective.
- d. Communication and dissemination.

The outcomes from HyFLEET:CUTE are directly linked to the European Union Energy Policy objectives. In particular the outcomes of HyFLEET:CUTE relate to cleaner and sustainable transport energy, energy self sufficiency, and economic development through the development of technology based innovations in Europe.

Beneficiaries of the Project

- Communities particularly those in the Cities (Cleaner Air/Less Noise)
- European Economy (Less Reliance on Fossil Fuels; Export Euros from technology; contributing to Kyoto obligations; greater fuel self-sufficiency)
- European Companies (Leaders in the Technology)

Energy Related Results to June 2008

Bus Operations (FC & ICE): Energy related results to June 2008 (Project finishes in September 2009):

1. Kilometers Travelled: 2,500,000 kilometres without CO₂ emissions
2. Hours of Operation: 200,000 hours
3. Passengers transported: 3.5 million
4. Bus Reliability: > 90%. (Across the total fleet)

Infrastructure Operations: Achievements to June 2008 (Project finishes in September 2009):

1. 85% Availability of the Hydrogen Refuelling Stations (over 9 stations)
2. 335 tonnes of hydrogen refuelled
3. One station (Berlin) is testing the use of waste H₂ to power two different stationary fuel cell units. In 2007 the EPS fuel cell achieved about 7,000 kWh electricity in about 2,250 hours of operation. The Axane Fuel Cell achieved 1,400 kWh in 580 hours of operation.



**Please note that figures include data for the preceding CUTE project (2004 - 2006) in relation to Fuel Cell Buses and Fuel Cell refuelling Infrastructure (only). HyFLEET:CUTE encompassed the continuation of the outstandingly successful fuel cell bus demonstration and testing in CUTE in addition to the demonstration and testing of Hydrogen powered ICE buses and a range of other studies.

Environmental Impact of the Project to June 2008

Through the project so far:

- 945,000 litres/Diesel has been replaced
- 2,494,800 kgs of CO₂ has been avoided

Potential Impact:

HyFLEET:CUTE has clearly demonstrated that hydrogen bus technology is near to commercial readiness.

If the bus technology is adopted throughout Europe, this would see the replacement of all city bus fleets with zero CO₂ emission buses. The technology would also enable Europe to have greatly enhanced transport fuel self-sufficiency, and move it strongly towards a renewably based fuel cycle.

Monitoring of the Project

Monitoring of the project's achievements occurs through:

1. Regular feedback to partners and assessment of results at well documented 6 monthly, face to face meetings
2. 12 Month Project Activity Reports against deliverables and milestones
3. 12 Month review presentations in front of European Commission reviewers
4. Use of SoFi (web based sustainability software) supported by some hard copy systems for collection of bus and infrastructure operations data from all project sites worldwide.
5. Associated studies broaden the measurement of the effect of the technological demonstration and testing (see Project Achievements)

Some data collection is as soon as something occurs (eg Safety and Security incidents); others are 6 monthly and others are annually

Monitoring has been the catalyst for a number of active changes in the application of the technology, particularly in the areas of Hydrogen gas management, Quality and Safety and Community Acceptance. Regular meetings and email updates ensure all partners are made aware quickly of learning taking place across the scope of the project

The Project Co-ordinator has ultimate responsibility for ensuring dissemination of the learnings, however, Work Package Leaders have practical responsibility for it. The partners work together to spread the load of the monitoring and dissemination of the learnings.

Project Partners:

Government Partners

Department for Planning and Infrastructure, Government of Western Australia, Australia

China FCB Demonstration Project Management Office, People's Republic of China

Transport Companies



Autobus de la Ville de Luxembourg, Luxembourg
BVG, Berlin, Germany
Empresa Municipal de Transportes de Madrid, Spain
GVB, Netherlands
Hamburger Hochbahn AG, Germany
London Bus Services Ltd., United Kingdom
Transports de Barcelona S.A., Spain

Automotive Companies

Daimler AG, Germany
EvoBus GmbH, Germany
MAN Nutzfahrzeuge AG, Germany
NEOMAN Bus, Germany

Energy Companies

Air Liquide, Division des Techniques Avancées, France
BP Gas Marketing Ltd., United Kingdom
Islensk NyOrka ehf (Icelandic New Energy Ltd.), Iceland
Norsk Hydro ASA, Norway
Repsol YPF, Spain
Shell Hydrogen B.V., Netherlands
Hydrogenics Corporation
TOTAL Deutschland GmbH, Germany
Vattenfall

Consulting and Research Organisations

Euro Keys, Belgium
Mechanical Engineering Institute, Instituto Superior Técnico, Technical University of Lisboa, Portugal
MVV Consulting GmbH, Germany
PE International GmbH, Germany
PLANET - Planungsgruppe Energie und Technik GbR, Germany



Stuttgart University, Institute for Polymer Testing (IKP), Germany

Technische Universität Berlin, Germany

University of Iceland, Iceland

Achievement of Project Goals to date.

Work Package (WP) 1 – Operation and Optimisation of Innovative H2 Infrastructure

Production and Storage of Hydrogen as a Fuel:

- HyFLEET:CUTE has successfully demonstrated and tested a range of methodologies for producing Hydrogen and making it available for refuelling. These include:
 - On site production (Steam Reforming & Electrolysis);
 - use of liquid hydrogen;
 - trucked in ‘waste’ hydrogen from fossil fuel process;
 - use of renewable energy (electrolysis) – ongoing.

Refuelling Hydrogen Powered Vehicles

- HyFLEET:CUTE has seen the design, construction, and successful safe operation over 4 years of 9 refuelling station to refuel the Fuel Cell (FC) Buses. A major element of this achievement has been the fact that this refuelling infrastructure has been implemented on three continents around the globe. One additional station in Hamburg has been in operation for 5 years and now supports the operation of 9 Fuel Cell Buses.
- HyFLEET:CUTE has seen the design, construction and successful safe operation over 3 years of a refuelling infrastructure to refuel both Hydrogen powered ICE buses and Hydrogen powered FC and ICE cars in Berlin. The Berlin station extended the demonstration and testing to the use of ‘waste’ hydrogen available from its on-site installations to power two stationary fuel cells which feed electricity to the grid. This station is also unique because it is located within an existing conventional car refuelling station

WP 2 – Development, construction and operation of a fleet of H2 Internal Combustion Engine (ICE) buses

- HyFLEET:CUTE has seen the successful construction and operation of 14 Hydrogen powered ICE buses for the Public Transport fleet in Berlin.

The first buses in the fleet were used to play an important promotional role in the 2006 FIFA World Cup by carrying VIPs, journalists and members of the public visiting from around the world. These buses were conventionally aspirated ICE buses with a power of 150 kW

The final 8 buses were introduced into the fleet by March 2008 and, along with the original four buses, are in on-going, normal operations in Berlin. These buses are turbocharged technology and have a power of 200 kW.

WP 3 – Development, operation and optimisation of a fleet of fuel cell buses

- HyFLEET:CUTE has seen the continuous, safe and highly successful operation of 33 fuel cell buses over 4 years in 7 European cities (Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Reykjavik) and in Beijing, China and Perth Western Australia.
 - 5,000 operating hours achieved for a single fuel cell bus in Luxembourg which is far more than any other fuel cell bus has operated anywhere in the world.

- All the buses have continued safe and successful operation far beyond the original planned two years as a result of the performance of the fuel cell buses which far exceeded expectations.
- The success of the operation of these buses has brought the commercial operation of fuel cell buses closer to reality.

NOTE: The operation of the fuel cell buses was ended as planned by the end of 2007. Hamburg and Amsterdam continue the operation of the FC buses beyond the scope of the project, i.e. did this without EU funding

WP4 – Quality and Safety

HyFLEET:CUTE has successfully operated to its performance target of **zero accidents with zero lost time injuries**.

This performance has been continually monitored through two recording schemes:

- Recording through the SoFi** software system of all incidents according to the Quality and Safety Indicators
- Incident reporting using the hard copy Incident Reporting Scheme managed by the Task Force on Safety and Security (Note: Incidents were defined as events that might potentially lead to a safety situation under some circumstances, especially if no action were taken.)

While many 'incidents' have been recorded no accidents or lost time injuries have occurred. However, the incident recording arrangements have provided a great deal of highly valuable information on where deviations from what might be described as 'normal operations' in hydrogen infrastructure and hydrogen powered vehicle use might occur.

**Note: SoFi is a Web based reporting system used in HyFLEET:CUTE

WP5 – Accompanying Studies

To support the demonstration and testing of this leading edge technology, the project partners have taken the opportunity to undertake a broad range of other studies, some over and above those articulated in the project Description of Works. These include, but are not limited to:

- A published study of community acceptance of Hydrogen as a Fuel. The study canvassed the views of over 2000 people in 8 European cities.
- The development and publication of Guidelines for undertaking Community Engagement when developing Hydrogen refuelling infrastructure, based on the broad experience of the partners, .
- A completed study of what the Refuelling Station of the Future might look like.
- Financial modelling and analysis of some of the cost constraints involved with using Hydrogen as a Fuel.
- Analysis of the socio-economic implications of the Hydrogen Economy
- Scientific study of Stationary Fuel Cells at Berlin Station

While most of the results of these studies are public and are on the project web site, some are confidential to the Project Partners and the Commission as the major funding body.

WP 6 – Dissemination through the Global Hydrogen Bus Platform



To underscore its world leading role in hydrogen powered public transport, the HyFLEET:CUTE project partners established their dissemination package as a 'Global Hydrogen Bus Platform'. This implemented a range of strategies and activities including:

- A website with a Global focus and pro-active supplying of information about hydrogen as a transport fuel to the world at large through a regular "in brief" news service (see www.global-hydrogen-bus-platform.com).
- A six monthly publication of up to the minute, 'easy' reading E-Newsletters on the activities within HyFLEET:CUTE (See: <http://www.global-hydrogen-bus-platform.com/News/Newsletters>)
- The release of a 13 minute video on the HyFLEET:CUTE Project designed to be used as a promotional/education tool (see Home Page at www.global-hydrogen-bus-platform.com) .
- Undertaking 'outreach' workshops on the successes and learnings of HyFLEET:CUTE in Melbourne Australia (2006); Beijing, China (2007; and in Berlin for New Member States of the European Union (2008). The latter workshop was held in Berlin so that participants could have hands on experience of both the ICE & FC buses and the infrastructure.
- HyFLEET:CUTE has collaborated extensively with related EU Projects such as HyLights, HyApproval, Premia, Roads to HyCom and with other international projects such as the USA FTA funded International Fuel Cell Bus workshop.
- Project representatives have participated in numerous conferences around the globe such as the European Hydrogen Technical days and the National Hydrogen Association conferences in the USA.

WP 7 – Project Management

The achievement of successfully managing 31 extremely diverse partners in a wide ranging project of this nature should not go unacknowledged.

The project has an exemplary record in meeting implementation and reporting requirements as acknowledged by the project's European Commission appointed reviewers. It would not be overstating the case to say the partners have been welded into a group committed to achieving the best possible outcome for the project and for each other.

8. Future Planned Achievements

Please describe future actions and milestones of your project/ programme, together with implementation or achievement dates:

Development of the next generation hybridised Fuel Cell bus is well advanced. This vehicle may well form the basis of future commercial public bus fleets. Second Half of 2009

Report on the Total Life Cycle of the transport systems 2009

Final Project Public Report (Brochure format) 2009

Final Project Conference 2009

While not a formal part of this project, many of the project partners have already commenced discussions and plans for subsequent partnerships and projects which will further progress the vehicles and refuelling infrastructure technology.



Total Budget:

- 43160000 Euros
- Financial Source: 30 Industry Project Partners: 56%; European Commission: 44%

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