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HYDROGEN FOR TRANSPORT IN EUROPE



European Commission

MADRID SPAIN

Madrid is one of two locations in Spain taking part in the European fuel cell bus demonstration project HyFLEET:CUTE. In Madrid three DaimlerChrysler Citaro city buses are demonstrated as part of the regular Madrid public bus fleet.

Due to high temperatures in summer and also due to the highly congested traffic, Madrid will challenge the technical performance of the fuel cell drive train working under these conditions.



The hydrogen filling station for the supply of the three buses is located north of Madrid and is in operation since April 2003. The hydrogen is produced on-site through a compact methane steam reformer. Complementary and back-up supply is provided by trucked compressed hydrogen (tube trailers) from a central production plant which produces surplus hydrogen as a by-product.



www.emtmadrid.es/news/news.html?id=52

BARCELONA SPAIN

Metropolitan Transport of Barcelona (TMB) has begun operating its three hydrogen powered fuel cell buses in daily regular service and as part of their fleet. The standard type low floor buses are from DaimlerChrysler. They operate from bottles containing compressed hydrogen located on the roof. The plan is to operate the buses on different routes around the city including those running from the hilly areas of the city to the seaside.



The purpose behind this project is to obtain a silent vehicle which does not pollute, which runs on „clean“ energy and which is suitable to meet the future needs of the City of Barcelona. It is a good opportunity for all users of the public transport system to evaluate these buses.

The hydrogen filling station is in operation since September 2003. The hydrogen is produced on-site by electrolysis. The electricity is produced by a large photovoltaic array on the roof of the station.

GERMANY, ITALY

ZeroRegio is a development and demonstration activity for hydrogen infrastructure and fuel cell cars. Hydrogen refueling stations and passenger cars will be deployed in two European regions, namely Lombardia in Italy and the Rhein-Main area in Germany.

The project aims at developing and demonstrating zero emission road transport systems in regular daily use for the European cities.

Following the installation of hydrogen infrastructure, five DaimlerChrysler F-Cell fuel cell vehicles (Rhein-Main area) and three Fiat Panda fuel cell vehicles (Lombardia) will be demonstrated in different applications. The demonstration phase 2006-2008 is accompanied by an evaluation of the data acquired during the fleet tests with respect to energy efficiency, environmental impact and socio-economic aspects.

Frankfurt, Germany



The filling station in Hoechst near Frankfurt in the Rhein-Main region started operation in February 2007. Hydrogen supply takes place via a high pressure pipeline (85 MPa) of surplus hydrogen from a chemical plant. The public service station will supply liquid hydrogen at -253°C as well as compressed hydrogen gas. For gas refueling a 35 MPa and a 70 MPa dispenser will be employed.

In Lombardia hydrogen will be available from a central production facility as well as from an on-site reformer facility developed within the project. The reformer will produce hydrogen from natural gas at the service station. A 30 MPa dispenser unit for hydrogen gas will be built and integrated in a public multi-fuel service station, starting the operation in May 2007.

Experience gained during the fleet tests and the results obtained in the project will contribute to the short and medium time frame objectives of the European Commission. These are to replace 5% of motor fuel in road transport by hydrogen by the year 2020.

Mantova, Italy



LUXEMBOURG

Since autumn 2003, three fuel cell buses are in commercial service in the City of Luxembourg. The buses can carry a maximum of 70 passengers each.



The hydrogen fuel used to power the fuel cell buses is supplied by a specific hydrogen filling station. Gaseous hydrogen from Germany or Belgium is produced by the reforming of natural or industrial gases. It is transported to the filling station in hydrogen gas trailers. One tank filling allows for a driving autonomy of 200 km. After the first two-year phase, Luxembourg has decided in 2005 to continue the fuel cell bus operation.



http://www.luxembourg-city.lu/vdl_multimedia/brennstoffzellebus.pdf

REYKJAVIK ISLAND

Located in southwest Iceland, Reykjavik is the northernmost capital in the world. Three DaimlerChrysler Citaro fuel cell buses are under demonstration at regular services in Reykjavik and on the entire island. The buses there can be tested under extreme climatic conditions.

Especially in winter the buses have to face the challenge of extreme low temperatures. Iceland is the first country in the world, willing to convert to a hydrogen based economy. The compressed hydrogen for the buses is produced by electrolysis using hydro- and geothermal electricity at the public station (capacity 60 Nm³/h). It is stored in 7 steel cylinders at the refuelling station.



BERLIN GERMANY

The Clean Energy Partnership Berlin is a hydrogen and fuel cell vehicle demonstration project supported by the German Federal Government as part of its national sustainability strategy. A line-up of international partners from automotive and energy industry demonstrates a fleet of 17 hydrogen vehicles and two hydrogen filling stations to provide the infrastructure needed. This also includes a vehicle service area and a hydrogen information centre.

The vehicles have two different propulsion systems. Some are fuel cell vehicles with electric drive trains others have internal combustion engines. In both options the fuel is hydrogen and both propulsion systems are very clean and without harmful emissions. The vehicles also have different storage options for the on-board hydrogen storage. Compressed hydrogen is stored at 35 MPa as well as at 70 MPa and liquid hydrogen storages are also used.

The filling stations are supplied from three different hydrogen production pathways. In 2004 CEP started with the operation of a fully integrated hydrogen filling station. At this ARAL station gaseous hydrogen is produced on-site via electrolysis and stored in compressed form, while super-cooled liquid hydrogen is delivered by truck and stored in a cryogenic tank.

In March 2006 TOTAL has opened the second CEP hydrogen filling station in Berlin-Spandau. The hydrogen station has been integrated into a new conventional filling station and supplies gaseous and liquid hydrogen for buses and cars. The TOTAL station also provides a platform for the European combined hydrogen project HyFLEET:CUTE, which started its fleet operation with four hydrogen buses operated by the Berlin transport authority BVG.



FRANCE, GERMANY, ITALY, SPAIN

The HYCHAIN Project, launched in January 2006, will allow citizens from four European Community regions to test a total of 158 urban hybrid fuel cell vehicles, including utility cars and minibuses, wheelchairs, scooters and cargo-bikes. This project also will demonstrate the use of innovative logistics for hydrogen distribution: more than 2,000 reusable pressurized hydrogen cylinders, varying in size from 2 to 20 litres and equipped with the innovative Clip'on system will allow users to exchange easily and safely empty cylinders for full ones at designated distribution sites.

The project, which will take place over a five-year period, consists of two phases: the first phase, from 2006 to 2007, will focus on optimizing and manufacturing the vehicles and developing comprehensive hydrogen distribution logistics and services (transport, distribution, dispensing). In the second phase, from 2008 to 2010, the vehicles will be tested under "real-world conditions".

HYCHAIN will bring invaluable experience in ensuring the safe and reliable operation and maintenance of hydrogen fuel cell vehicles. The project will contribute to the creation of pan-European standards, thus facilitating an industrial approach to manufacturing. Moreover there is a strong educational component: HyChain aims to set-up an international training centre and to raise public awareness. More information on the HYCHAIN project and its vehicle showroom can be found at www.hychain.org.



AMSTERDAM, THE NETHERLANDS

The size and nature of the densely populated Amsterdam region are ideal for public transport and offer a range of opportunities for GVB, the Amsterdam city transport company. GVB is operating three DaimlerChrysler Citaro fuel cell city buses as part of the daily bus fleet servicing the Amsterdam area. This bus technology meets two of GVB's major goals: Low emissions and low noise.

The buses are powered by hydrogen, the only emission is water. Due to the electric drive train the buses operate silently especially when waiting at bus stops or traffic lights. The hydrogen is produced by electrolysis using water and 'green' electricity produced from renewable energy sources. Each refuelling will dispense approximately 40 kilogramme of hydrogen in about 10 minutes. The hydrogen is compressed and is stored at 35 MPa.



www.gvb.nl/overgvb/projecten/brandstofcelbus.html

HYDROGEN BUSES DEMONSTRATION PROJECT

BERLIN GERMANY

The HyFLEET:CUTE bus fleet in Berlin will grow to 14 MAN hydrogen buses with internal combustion engine. In the current first stage of the project 4 buses with naturally aspirated hydrogen engines (150 kW) are running as part of the regular fleet of the Berlin transport authority BVG in daily service. In 2007 this fleet will be extended by 9 additional buses with turbo charged hydrogen engines (200 kW) with direct injection. The 14th bus will have an additional power management and a fuel cell for the electricity supply within the bus (APU).

The hydrogen refilling takes place at the premises of the BVG bus fleet but also has a public part for various hydrogen vehicles including a dispenser for liquid hydrogen. Hydrogen is produced on-site via a petroleum gas (LPG) reformer. Two stationary fuel cells are also installed to provide electricity and energy for heating.



<http://www.bvg.de/index.php/de/Bvg/Index/folder/323/name/Technologie>

LONDON UNITED KINGDOM

The city of London takes part in the European HyFLEET:CUTE project and demonstrates three hydrogen powered fuel cell buses as part of the regular bus fleet. The project is a key part of the Mayor of London's transport and air quality strategy, designed to help to give Londoners a cleaner and healthier air in the future.

The hydrogen filling station located at Hornchurch in East London has been in operation since April 2005. The hydrogen is produced by steam reforming of natural gas and then liquefied by cooling it down to -253°C. The liquid hydrogen is delivered to the station where it is stored underground. An evaporation and compressor unit provide compressed gaseous hydrogen to fill the three Citaro fuel cell buses.

LONDON HYDROGEN PARTNERSHIP

The London Hydrogen Partnership (LHP) was launched in April 2002, to work towards a hydrogen economy for London and the UK. The Partnership is chaired by the Deputy Mayor of London, and includes more than 16 partners from industry and academia. The objectives are:

- to support the development of a hydrogen economy for London – an overall energy infrastructure based on hydrogen as a principle energy carrier,

- to contribute to the growth of London's green economy through the development of hydrogen and fuel cell-related industry and employment,
- to improve air quality and reduce greenhouse gases and noise in London
- and to improve energy security for London.

The Partnership is currently working on a strategic approach to the development of hydrogen infrastructure in London for demonstrations and beyond. The Mayor has agreed to support the five-year transport programme. This programme involves the operation of 70 hydrogen-fuelled vehicles by 2010/11 including 10-12 buses, working with Transport for London, London Fire & Emergency Planning Authority and the Metropolitan Police.

The London Hydrogen Partnership Communications Programme aims to raise public awareness of hydrogen and fuel cell technology. This involves education and training of key sectors as well as advocacy, seminars and public events.



HAMBURG GERMANY

In 2005 the municipality of Hamburg established an initiative on hydrogen and fuel cells in order to stimulate the deployment of hydrogen and fuel cell applications in the City of Hamburg. Hamburg aims to become one of the leading regions for the commercialization of renewable energies and hydrogen in order to provide sustainable growth for the future. All activities are furthermore targeted to strengthen the competitiveness of local industry and to ensure a leadership position in expertise and technology. The coordinating body "hySOLUTIONS" is a public private partnership to support ongoing projects and to evolve further demonstration activities.

Initially there are two major projects in the field of hydrogen for transport in Hamburg: The HyFLEET:CUTE project and the ZEMSHIPS project.

ZEMSHIPS

Water is ubiquitous in Hamburg. So it is quite obvious to also demonstrate clean waterborne transport based on hydrogen and fuel cells. In the ZEMSHIPS project a new vessel with a 100 kW fuel cell system will be added to the existing fleet of the famous Alster steamers which offer city and canal excursions. The vessel can carry up to 100 passengers and operates very silently. The onboard hydrogen storage consists of 35 MPa pressure tanks and the filling station is supplied with trucked liquid hydrogen.



HyFLEET:CUTE

As being part of the large European HYFLEET:CUTE project, which is co-funded by the European Commission, Hamburg hosts a fleet of 9 DaimlerChrysler Citaro fuel cell buses which are under regular service in the City of Hamburg. At present this is the largest fuel cell bus fleet worldwide. The hydrogen filling station is located at the bus depot in Hamburg Hummelsbüttel and has been in operation since September 2003.

Hydrogen is produced on-site by electrolysis with certified 'green electricity' from Vattenfall Europe. It is stored as compressed gas in 8 storage tubes (total capacity 400 kg, 46 MPa) and is available for refilling at 35 MPa. Each bus needs about 40 kg hydrogen per day, the refilling time is ten minutes.



HYNOR AND THE SHH-PARTNERSHIP

NORWAY, SWEDEN, DENMARK

The Norwegian joint project HyNor was established in Spring 2003 with partners from major industrial and energy companies, transport companies, regional and national public authorities, and R&D institutes.

Its purpose is to demonstrate real life implementation of various hydrogen production technologies (electrolysis, biomass gasification, natural gas steam reforming with CO₂ treatment; industrial by-product hydrogen) and uses of hydrogen – buses, taxis, private cars; urban, regional and long transport.

Norway is unique in its position as an energy nation with rich resources in hydro power, natural gas and biomass, and in particular a long industrial history in production of hydrogen from hydro power. The main goal of HyNor is that it shall be possible in 2009 to drive hydrogen powered cars between Oslo and Stavanger, one of the countries' main corridors. To reach this goal, five hydrogen refueling stations along the way have to be built. About 20 hydrogen hybrid ICE cars (Toyota Prius, TH!NK) will be operated within the project.

In August 2006, the first hydrogen refueling station was opened in Stavanger by Statoil. The next fueling station to be opened in Spring 2007 is located in Porsgrunn and will be supplied with industrial by-product hydrogen.

In June 2006, HyNor together with Hydrogen Link of Denmark and HyFuture of Sweden, formed the Scandinavian Hydrogen Highway Partnership (SHHP). The three organisations are each representing a network of actors from industry, local government, universities and other organisations in each respective country.

The SHHP vision is to make the Scandinavian region one of the first regions in Europe where hydrogen is commercially available and used in a network of refuelling stations. The initial focus will be on the South/South East of Norway. However, it is expected that additional regions in Scandinavia such as the Swedish West Coast and Denmark, will be included as the partnership evolves.



FURTHER EUROPEAN HYDROGEN PROJECTS

HFP – The European Hydrogen and Fuel Cell Technology Platform

The HFP facilitates and accelerates the development and deployment of cost-competitive, world class European hydrogen and fuel cell based energy systems and technologies for applications in transport, stationary and portable power. The establishment of the HFP has been facilitated by the European Commission.

www.hfpeurope.org

HyWays

HyWays is an integrated project which is co-funded by research institutes, industry and by the European Commission. The outcome will be a proposal for an EU Hydrogen Energy Roadmap for the timeframes 2020, 2030 and 2050. Preferred hydrogen production methods, different supply infrastructure and end-use technologies are taken into account for 10 different member states.

www.hyways.de

HyApproval

The HyApproval project aims to provide a handbook for the approval of hydrogen refuelling stations in Europe. This handbook will be used to certify public hydrogen refuelling stations throughout the European Union.

www.hyapproval.org

StorHy

The StorHy consortium carries out concrete R&D work covering the whole spectrum of hydrogen storage technologies - compressed gas, cryogenic liquid and solid materials - with a focus on automotive applications.

www.Storhy.net

Roads2HyCom – R2H

The purpose of the R2H project is to assess and monitor Hydrogen and Fuel Cell technologies for stationary and mobile energy application. This is done by considering what the technology is capable of, relative to current and future Hydrogen infrastructures and energy resources, and the needs of communities that may be early adopters of the technology. By doing this, the project will support the European Commission and stakeholders in planning future research activities.

www.roads2hy.com

HyLights

HyLights aims to accelerate the commercialisation of hydrogen and fuel cells in the field of transport in Europe. HyLights assists all stakeholders in the preparation of the next important phase of the transition to hydrogen as a fuel – the phase of large scale demonstration projects in Europe.

www.HyLights.eu

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WEBLINKS



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www.scandinavianhydrogen.org



www.zeroregio.com



www.cep-berlin.de



LONDON HYDROGEN PARTNERSHIP

www.lhp.org.uk



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