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Short communication

# The clean energy partnership Berlin—CEP

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**Abstract**

The clean energy partnership (CEP) is an international cooperation comprising 11 energy and technology companies as well as car manufacturers (Aral/BP, BMW, Berliner Verkehrsbetriebe (BVG), Daimler, Ford, GM/Opel, Hydro, Linde, TOTAL, Vattenfall Europe and Volkswagen AG). The vision of mobility based on hydrogen is commonly shared by the partners. The objective of the CEP is to prove everyday suitability of hydrogen for transportation purposes by real-life operation of hydrogen stations integrated into conventional filling stations, by efficient and reliable hydrogen vehicles in customer operation and by fast, convenient and safe fuelling of vehicles with liquid an gaseous hydrogen.


*Keywords:* Demonstration; Hydrogen-filling station; Hydrogen vehicles; Fuel cell vehicles

## 1. Introduction

As part of the German national strategy for sustainability the CEP is supported by the Federal German Government. It started in 2002 and the current phase 1 will end in 2007. An extension, developing the CEP to become the largest European lighthouse project, is planned in two phases until 2016.

In November 2004, the first CEP hydrogen fuelling station at the Messedamm in Berlin started its operation. A second station – the TOTAL station at Heerstraße – was opened in 2006. Both stations are being used by 17 hydrogen-powered vehicles. These vehicles are being operated in day-to-day driving providing the car manufacturers with valuable technical data as well as with first hand customer feedback.

## 2. Hydrogen-filling stations

Two public hydrogen-filling stations offering both – liquid and gaseous hydrogen – are in operation in Berlin: the Aral/BP-filling station at Messedamm and the TOTAL station in Heerstrasse.

The Aral/BP station (Fig. 1) is worldwide the largest hydrogen-filling station with a capacity of more than 100 cars per day. When taken into operation in 2004 it was the first hydrogen-filling station in Europe fully integrated into a regular public filling station. As part of the most frequented public filling stations in Berlin it is publicly open 24/7 for hydrogen refueling.

The Aral/BP-filling station realizes delivery, storage and fuelling of liquid hydrogen (LH2) together with Linde as well as on-site production and fuelling of gaseous hydrogen (CGH2) at 350 bars. Hydro produces emission-free gaseous hydrogen using water electrolysis. With green certified power, Vattenfall Europe ensures that the electrical energy for the electrolysis and the operation of the service station is provided based on renewable energy sources.

The car manufacturers operate a common workshop for service and maintenance at the filling station at Messedamm.

The second hydrogen-filling station from TOTAL at Heerstraße (Fig. 2) is also fully integrated in a regular station. One part of the hydrogen station is publicly accessible serving passenger cars with LH2 and GH2 (350 bar). The other part provides fuel to hydrogen powered busses with internal combustion engines of BVG as part of the European funded HYFLEET:CUTE project.

Next to a liquid trucked-in path a steam reformer using liquefied petroleum gas (LPG) as feedstock is in operation for the on-site production of hydrogen. Moreover, two stationary fuel cells generating heat and electrical power for the station using

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Fig. 1. Aral/BP hydrogen-filling station at Messedamm, Berlin.


Fig. 2. TOTAL hydrogen-filling station at Heerstraße, Berlin.

the boil-off hydrogen from the liquid hydrogen storage tank are being tested in cooperation with Vattenfall Europe.

Both stations performed very well and were operated without major problems. While the availability of all plants was always higher than 90% the number of vehicles however proved to be to low to test the equipment under full load conditions. Therefore, the partners conducted load tests for both LH2 and CGH2 at the Messedamm filling station in order to better understand and to demonstrate the capacity of the station.

Figs. 3 and 4 show the accumulated filling amounts and frequencies of the hydrogen-filling station at Messedamm and

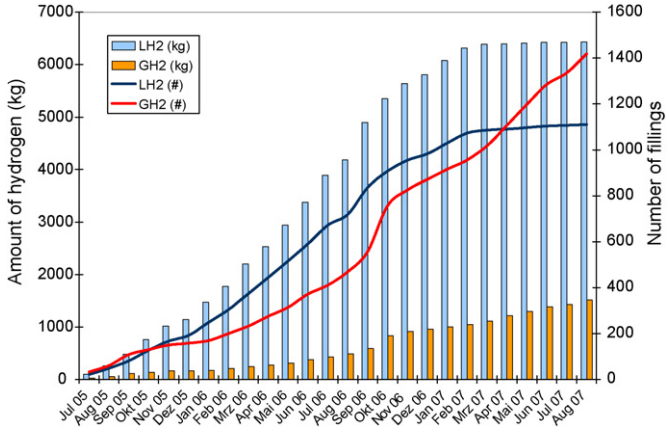


Fig. 3. Filling amounts and frequencies at Messedamm (cumulative).

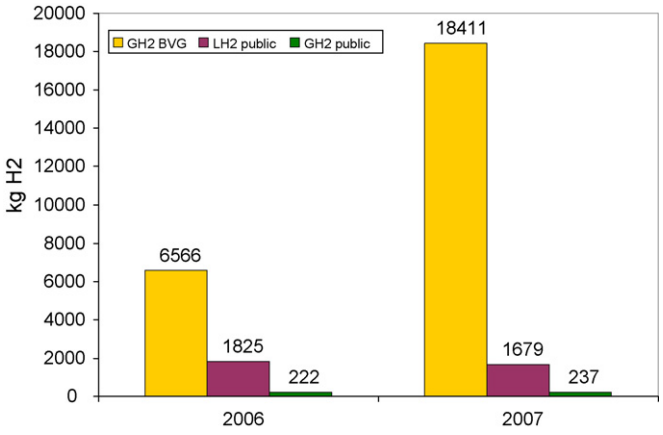


Fig. 4. Filling amounts at Heerstrasse.

Heerstraße, respectively. The number of refillings was continuously increased during the course of the project. Due to the exchange of the LH2 coupling on all BMW vehicles by the end of 2006 the filling amounts for LH2 at Messedamm decreased substantially. The figures show the continuous growth in demand while the slightly higher values for the second half of 2006 were caused by the load tests in September and October 2006.

The filling amounts at Heerstrasse filling station are very much dominated by the busses operated by BVG.

## 3. Hydrogen vehicles

BMW, Daimler, Ford, GM/Opel and Volkswagen together provide hydrogen-powered vehicles for the CEP demonstration project. This fleet consists of 17 hydrogen powered passenger cars using either internal combustion engines or fuel cell systems for the drive trains and either gaseous or liquid hydrogen on the side of the on-board hydrogen storage. BMW operates two 7-series hydrogen-powered vehicles, Daimler 10 type A-class F-Cell vehicles, Ford three Focus FCEV Hybrid, GM/Opel one HydroGen3 and Volkswagen one Touran HyMotion (Fig. 5).

Most of the vehicles are being driven by customers on a daily basis. Overall, the experiences operating the hydrogen-powered vehicles were very positive. The customers' increasing passion for using these vehicles instead of conventional ones is very visible after 2 years of operation experience. Most drivers use the vehicles daily within their regular working routine (Fig. 6).

Fig. 5. CEP hydrogen powered vehicles.

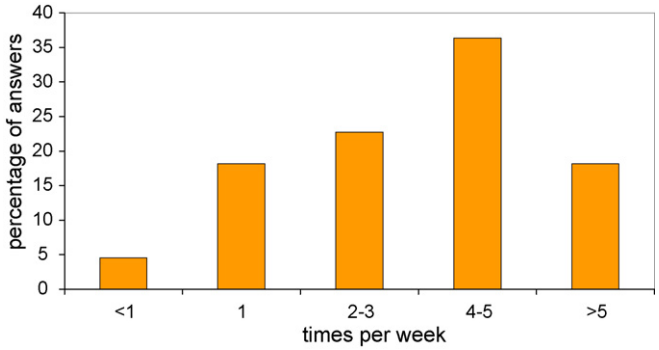


Fig. 6. Frequencies of use of hydrogen powered vehicles by customers in the CEP.

To date the hydrogen vehicles accumulated a total mileage of about 400,000 km.

A study carried out in 2007 examined the customer acceptance of the fuel cell powered vehicles. While 60% already had a positive attitude towards hydrogen powered vehicles prior to the project 32% of the drivers that were skeptical to begin with became positive based on their experiences during the project. Eighty-six percent would recommend their friends and colleagues to participate in the project. The main reasons for their recommendations were "good thing – environmental friendly" and "driving fun – vehicle performance".

## 4. Outlook

The current phase 1 of the CEP will be finalized at the end of 2007. The partners are committed to continue the partnership and they have started to prepare future activities. It is intended to enlarge the CEP to become the major lighthouse for transportation applications regarding fuel cell and hydrogen technologies in Europe including more hydrogen-filling stations and larger fleets of hydrogen powered passenger cars and busses. The CEP will be part of the 10 year "National Innovation Program for Hydrogen and Fuel Cell Technology (NIP)" funded by the German government.

The objective for the hydrogen production is to meet a hydrogen demand of more than 3 t per day after 2011 at least five hydrogen-filling stations in Berlin and Hamburg. Concerning the increase of renewable energy sources to produce hydrogen targets were set to a share of 20% renewable hydrogen in 2010 and 50% in 2016.

Activities on the hydrogen station side include the deployment of state of the art refueling technology, including upgrading of existing filling stations (700 bar CGH2 filling capability, next generation LH2 filling) as well as the expansion of the mini-network. While the focus until 2010 is still technology validation this will shift towards market preparation for hydrogen road transport applications in the period 2010–2016.

Hydrogen powered passenger cars will continue to operate to demonstrate everyday customer usability. This includes an increased number of next generation hydrogen powered vehicles to further develop and validate hydrogen and fuel cell vehicle technologies. The objective is to achieve full customer acceptance in terms of handling, performance and cost as a prerequisite for mass-market commercialization.

Moreover, the CEP lighthouse as part of the German National Innovation Program and as part of the European Joint Technology Initiative activities will also address crosscutting issues including hydrogen safety, education and public outreach. Experiences from the CEP will be shared with the broader stakeholder community.

## Acknowledgements

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