

Hydrogen Refuelling Station Hamburg HafenCity

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1 Project Concept and Objectives

Decoupling the growing road traffic and the related greenhouse gas emissions demand a major effort by research, OEMs as well as oil and energy companies. Above all the reduction of CO₂-emissions is a growing need for climate protection. Bio fuels can help to reach those targets, however the available sources are not sufficient to guarantee a sustainable supply. Battery Electric Vehicles are today limited technically with regards to range and weight and will most likely be used in metropolitan regions.

In this project the necessary infrastructure to refuel buses and cars of a bigger fleet will be installed. Doing so the prerequisite for using fuel cell based cars and buses as an alternative way of mobility is developed. The capability of new components for the productions, storage and distribution of larger amounts of hydrogen is shown. Additionally still existing potential optimizing on a technical and operational level shall be made available. Ultimately the possibilities of using electrolyzers for levelling alternating feed in from wind power will be looked at in a first step.

2 Description of the Project

The project Hydrogen Refuelling Station HafenCity Hamburg is a joint project between Vattenfall Europe and a competent partner with knowledge on the field of hydrogen refuelling and retailing. Being part of the lighthouse project Clean Energy Partnership (CEP) this station has been granted funding within the National Innovation Program hydrogen and Fuel Cell Technology (NIP).

The HafenCity Hamburg is one of the biggest inner city development projects in Europe. Already today the HafenCity project is internationally recognized with regards to urban development and quite popular with tourists. The planning standards to be fulfilled by the constructors conform to highest standards and the energetic concept of the area is unique. Amongst others Vattenfall operates the district heating plant and a molten carbonate fuel cell in the heart of HafenCity Hamburg.

The Hydrogen Refuelling Station will be located at the east entry of the HafenCity Hamburg and face to face with the new headquarter of the publisher Spiegel. This place guarantees a high visibility and attractiveness for the relatively new hydrogen application for transport purposes. Also the place is a good choice, because of the good accessibility for third users within the city centre.

The project is divided into two phases. In phase one it is projected to service 10 buses and 10 cars. In the second phase from 2013 onwards the number of buses will be increased to 20 and the number of cars to more than 20.

The main properties of the new supply infrastructure are the following components and services:

- A daily capacity of max. 750kg
- At least 50% of the hydrogen will be produced by on-site electrolysis. The electrolyzers will produce hydrogen in a high purity to be consumed in the vehicle's fuel cells. The used electricity is from proven renewable sources provided by Vattenfall. In this case it is possible to service the cars and buses of the first phase only with the hydrogen produced by the electrolysis.
- A special challenge is the fact that the station is located at a highly frequented place and in an urban zone. The station is a part of a small group of public stations in the world. To have a supply guarantee the production plant is build on in a modular structure with multiple electrolyzers and two state of the art compressors. This system allows servicing a part of the bus fleet during a malfunction of a component.
- The rest of the hydrogen demand will be delivered from external sources yet to be determined by tendering. This could be by-product hydrogen or green hydrogen from wind-power in dedicated projects. The demand for delivered hydrogen is about approx. 120,000 kg annually when reaching peak load in 2013. The mixture between on-site electrolysis and delivered hydrogen ensures high flexibility and also test the daily delivery of hydrogen to a station.
- A special feature of this pure hydrogen refuelling station is location of the production and conditioning of the hydrogen. It will be located in a two story building covering all the existing ground area. Future hydrogen refuelling stations which will be integrated stations might benefit from the experiences gained at this project. A technical challenge is the interacting of the components in a limited space.
- A major aim is to adjust the hydrogen production according to a certain level of power production from wind. For this purpose, the hydrogen refuelling station will be applied with wind power profiles to gain experiences from the alternating production properties of the electrolyzers and the whole system. The electrolyser will have to follow a wind power profile of generated electricity by wind power in dedicated tests. This feature plays a big role in integrating fluctuating wind power in the energy system. Through this regulation the transmission net can be relieved and more wind power can be integrated. For this purpose the control system of the plant is designed in a way so it is possible to upload real wind profiles into the system and adjust the performance of the electrolyser.

Table 1: Technical data.

Hydrogen production by electrolysis	Approx. 355 kg/day (equal with 14,8 kg/ hour)
Delivered hydrogen	Approx. 355 kg/day when fully expanded (20 buses 2013)
Total hydrogen demand	Max. 750 kg/day
Storage capacity tanks (gaseous)	Medium pressure tanks: max. 500 kg, High pressure tanks: max. 300 kg: Σ : max. 800 kg
Production hydrogen	3 electrolyzers with 60 Nm ³ /h each
Compression on storage pressure	2 ionic compressors from Linde
Number of buses Beginning from end of 2010	10
Number of buses 2013	20
Number of cars 2011	20+
Number of cars 2013	40+
Planned operating time	2010 to 2017

- The storage of hydrogen for the refuelling of the buses takes place in pressure vessels in several pressure stages. The highest pressure stage works at around 900 MPa. This pressure allows that the hydrogen can overflow to the buses. The same applies for cars which can be refuelled at 35 or 70 MPa.
- The station will be one of the first stations offering the SAE standard for refuelling of 70 MPa-vehicles. A -40° C precooling will be available for the 70 MPa-refuelling of passenger cars.
- The hydrogen refuelling station is designed as a self service station. A card-reader-system allows that all CEP-members can use the station. The station has a video monitoring and a remote monitoring system to guarantee the technical and operational safety.
- The cost of total € 7.5 Mio are funded with 48% within the NIP program.
- The commissioning of the hydrogen station HafenCity is planned for the second quarter of 2011.



Figure 1: Artist view of the hydrogen station HafenCity Hamburg.
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