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2 E-Mobility for logistic purposes

Hamburg is one of eight model regions for electric mobility in a research project supported by the Bundesministerium für Verkehr, Bauwesen und Stadtentwicklung (federal ministry for traffic, building and urban development). Besides analyzing the application of electric vehicles in public and individual transport, the analysis of e-mobility in economical transports is one objective of this project. As particular project inside the project "Modellregion Elektromobilität Hamburg" (www.elektromobilitaethamburg.de) it is proposed to implement low-emission battery-driven vehicles for logistic purposes. 20 Fiat-E-Fiorino are being tested since February/March 2010 for users in artisanry, logistics and harbour economy. First results are expected in 2011.
Furthermore a charging station infrastructure should be developed. For individual transport eight charging stations were installed in the urban area so far. Until the middle of 2011 50 charging stations are to be installed. Besides testing the charging stations the return of energy into the grid ("vehicle to grid ") will be studied within the project to their specific technical feasibility in order to improve integration of energy from renewable sources (Figure 1).

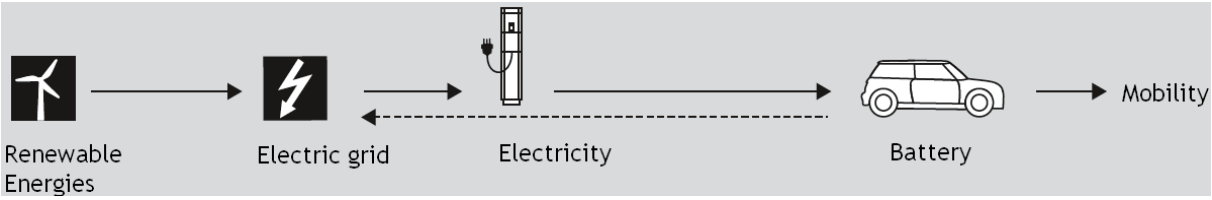

Figure 1: E-Mobility - Scheme "Vehicle - to - Grid" [VATTENFALL2010]

In the project „Flottenversuch Elektromobilität im Wirtschaftsverkehr" (fleet test e-mobility in economical transports) within the framework of the National Development Plan for E-Mobility by the Federal Government and the local climate protection plan, the Hamburger Hafen und Logistik AG (HHLA) is participating in a research project with battery driven container transport vehicles. On the premises of the Container Terminal Altenwerder the HHLA is testing two electrically driven Automated Guided Vehicles (AGV) (Figure 2) in cooperation with the AGV producer Demag Cranes AG, the RWTH Aachen University, the Institute for Energy and Environmental research Heidelberg and the Institute for Vehicles. The Federal Government funds the project with 1.2 Mio. € [www.hhla.de].

Figure 2: Automated Guided Vehicle [www.transportflash.com]

Apart from this research project HHLA is testing hydrogen driven lift trucks in a model project in cooperation with the producer STILL. If the model project is being evaluated positively, HHLA will start to convert the currently operating 100 mainly electrically driven vehicles in hydrogen driven vehicles, like e.g. fork trucks using in intra logistics.
The Hamburg Port Authority, the public institution for all harbour-related issues, is planning research projects analyzing potentials for E-mobility in economic traffic. The first step will be a traffic monitoring in order to [HPA2010]:

- quantify realistic demand potentials for E-mobility in the port of Hamburg,
- identify noise and pollution hot-spots,
- estimate effects of using electrically driven vehicles on Hamburg`s urban area and
- define requirements for infrastructure facilities to be created.

Further steps are not planned yet.
In summary it can be said that testing and implementation of electrically driven vehicles are still in their early stages in Hamburg. Currently, electrically powered vehicles are being used only in the framework of pilot projects, in which private and public transports are the main focus. This circumstance is probably induced by the fact that Hamburg will be “Green Capital” in 2011.
Certainly, in the long term it will be important to convert the economical transports to alternative drive in order to reduce operating costs and achieve the ambitious climate protection aims of the City. But it is still not clear if electrically powered drives will be established due to competing technologies, like e.g. hydrogen powered drives. In this context hydrogen production should be considered as a further opportunity for storing electrical power (Figure 3). In times of high wind energy production and low energy demand the excess energy could be used for hydrogen production.

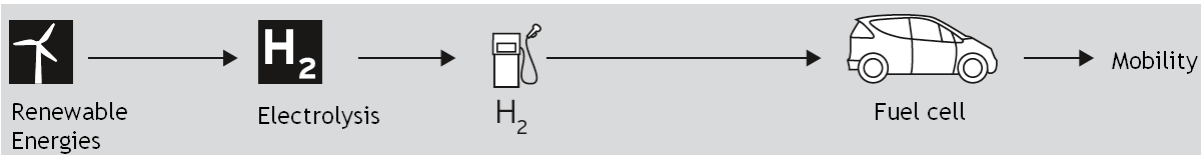

Figure 3: Hydrogen production [VATTENFALL2010]

To what extent electrically operated vehicles are used in intra logistics, such as e.g. lift trucks in the harbour located companies (besides HHLA) is still unclear and has to be researched. Technical equipment for handling cargo and goods, like cranes, dredgers, conveyor belts etc., is usually operated with diesel engines. It also has to be researched if and to what extent electrical drives are used for such facilities. To determine the stock of electrically powered vehicles on-site visits and interviews with responsible persons of the logistic companies are required. These should be conducted in the course of this project.

3 Reefer plugs

The port of Hamburg offers four large container terminals: the HHLA Container Terminals Altenwerder, Burchardkai, Tollerort and the Eurogate Container Terminal. These terminals are equipped with all in all 4.500 reefer plugs [www.hafen-hamburg.de]. The reefer containers are cooled by on-board refrigeration units which are operated electrically. Offshore the electricity is provided by ship. Onshore the containers are powered by the electricity grid of Hamburg. The electric connection power amounts for 20’ container 4 – 8 kW, for 40 feet container 6 – 12 kW, respectively.
In continuative analyses it has to be researched if and to what extent these reefer plugs can be used as manageable load for a Demand Side Management.

4 Onshore power supply

As in other harbor cities onshore power supply for ships is a current and much discussed topic. Onshore power supply is considered as an opportunity to reduce the carbon dioxide, nitrogen dioxide and sulphur dioxide emissions, especially in near residential areas like in the district Hafen City in Hamburg. In this district the Hamburg Cruise Center was created in the past years. With a capacity of 60 cruise liner enters with an energy consumption of nearly 5 GWh the cruise liners caused 3.000 t of CO_2, 54,5 t NO_2 and 29 t SO_2 in 2008. The demand of shipping companies for berths for large ships is rising steadily [BSU2008].
The difficulties caused by ship emissions were revealed by an air pollution report provided during the urban land use planning of the Hafen City. In this report pollution caused by cruise liners is calculated and predicted for the year 2015. The result is that the effective immission limits for the protection of human health according to the Bundesimmissionsschutzverordnung (Federal Immission Control Ordinance) are exceeded [ibid.].
These circumstances cause that residential use is not possible anymore within spitting distance; office buildings are only acceptable with controlled ventilation. So the Municipal of Hamburg started to research the implementation of an onshore power supply for cruise liners. The results are that an onshore power supply is technically feasible. But there are still difficulties and constraints which have to be resolved.
The investment costs are still high. The approximated implementation costs for two cruise liner berths amount around 24 mill. €. Whether and in what period the investment costs for the operation of the system are paid depends on the utilization of the facility. Even with more than 140 cruise liners expected in Hamburg in 2010, the system would not be in operation most of the year. In addition onshore power systems are constructed so that they can provide the demand of the biggest ships. Accordingly, if smaller ships are connected, the facility works in most cases under partial load. This circumstance has the consequence that the fixed costs of such a facility are very high [KALKOWSKY2009].

Compared with the prices for oil and diesel with 8 Ct/kWh, the onshore power costs are still high with 13 Ct/kWh. The main reason is that onshore power is taxed in Germany. Furthermore it is not clear who will operate such facilities and assume liability.
At least the realization of onshore energy supply facilities depends particularly on the political intention. The mentioned pollution report will put pressure on politicians, but until now there are no signs for political action which provoke the implementation of an onshore power supply connection. With the construction of another cruise terminal in the district Hamburg-Altona no provisions are made for an onshore power supply again. The BSU would like to wait until a final international standard for onshore power supply connections is available [KALKOWSKY2009].
The opponents of an onshore power supply instead argue for a natural gas or high efficient ship diesel onshore supply in order to reduce air pollution. Especially the ship companies fear competitive disadvantages because of high investments and onshore power costs.
Besides the discussion of an onshore power supply for cruise liners the onshore supply of ships for inland water transport is already installed. The harbor carries all in all five berths for inland water vessels [Figure 1].

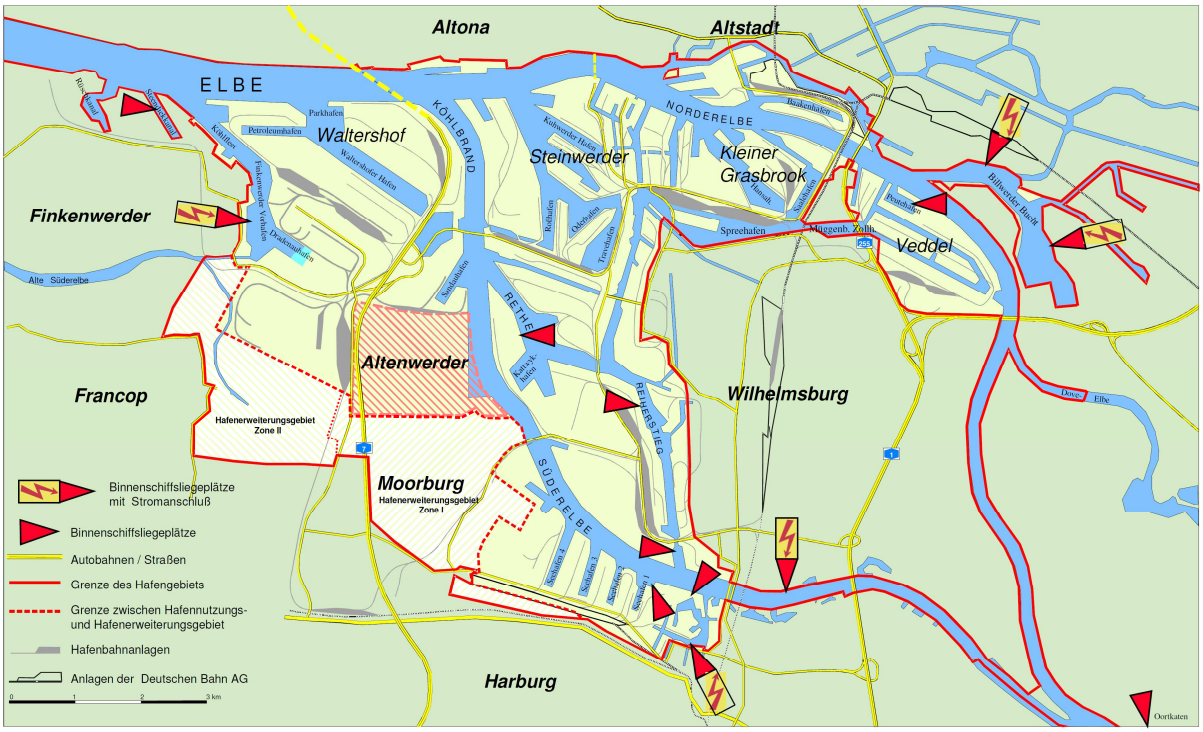

Figure 4: inland water vessel berths in the port of Hamburg [HPA 2008]

In the early 1990ies a couple of landing stages were already equipped with onshore power supply facilities. These facilities enable inland water vessels to obtain their complete power onshore during their landing time. Additionally, onshore power supply facilities are available for small passenger liners.

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