Enabling the Hydrogen Infrastructure - Waste Hydrogen Utilization in North Rhine-Westphalia

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Enabling the Hydrogen Infrastructure – Waste Hydrogen Utilization in North Rhine-Westphalia

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In the Rhine-Area around Cologne and other parts of NRW, big resources of hydrogen as a by-product from the chemical industry are being produced and not fully utilized [1]. A study conducted by Wuppertal Institute and Research Centre Jülich [2] focussed on assessing likely trajectories of emerging energetic demand for hydrogen in NRW, analysing the current availability of hydrogen from industrial sources, taking stock of exiting infrastructure for distribution of hydrogen and quantifying existing option for setting up a hydrogen infrastructure based on the current situation in NRW. The results of this study, which was conducted in early 2008, has shown that hydrogen which is produced in refineries or during chlorine production is commonly used in four ways: (1) chemically [fed into other chemical processes], (2) thermally [to create heat and steam], (3) sold externally [to gas industry] and (4) vented off [overcapacity which can not be used through (1,2 or 3)]. Hydrogen which is potentially available for applications can be estimated at 350M Nm3 per year. The biggest share (85%) comes from chlorine productions and offers thus a high quality (99% purity) and needs only little treatment for end users.

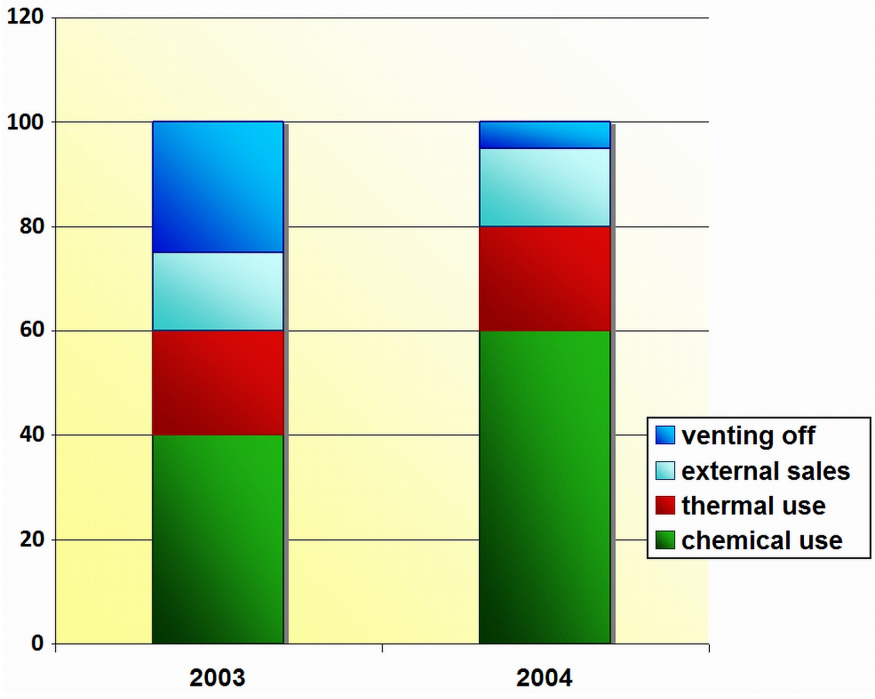

Figure 1: Example of Estimating the Availability of Hydrogen at a Chemicals Plant in NRW.

1 Available Hydrogen Sources

Hydrogen can be produced in various ways and easily be stored. In the near future the main focus will be on the production of hydrogen from renewable energy sources, but today already huge amounts of the valuable gas occur as a side-product in chemical production processes. German and international (GermanHy [3], Roads2HyCom [4]) studies show evidence that these hydrogen amounts could be made available for use in traffic & transport applications at short notice.

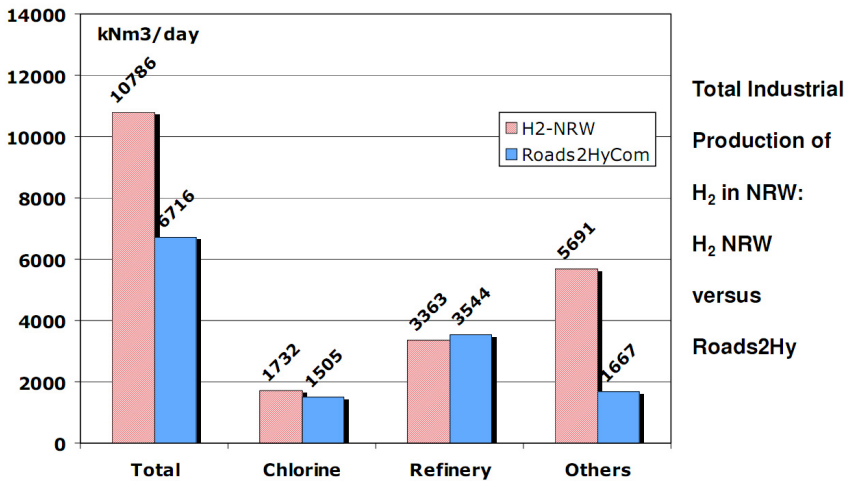

Figure 2: Total industrial Production of hydrogen – H2NRW versus Roads2Hy.

Roads2HyCom shows that German centres of activity are - among others - the Rhine-Ruhr region in Northern-Rhine-Westphalia. To keep cost for an initial infrastructure low, the existing hydrogen production could be utilized to demonstrate sustainability and provide a basis for a larger transition in the energy system.

To give a more specific example the situation in the Cologne region should illustrate the existing potential: alone in the Cologne are 6,7 billion Nm3 of hydrogen are being produced per year. Despite the fact that big parts of this hydrogen is used by various customers a share of 203.000 Nm3 per day [~18 tons H_2 per day] has been classified “available” by the producers of hydrogen [5] Available hydrogen was defined as volumes which were vented off or used for thermal applications und thus could be replaced by natural gas. The availably amount equals the energy needed to power 56.000 passenger cars (12.000 km/a, 3,5 l gasoline [eq] or 120 MJ per 100 km) or 1010 hydrogen busses (55km per year, 4kWh H2 per km or 12KG H2 per 100km). As there are approximately 1000 diesel busses being operated in the Cologne area the latter findings show clearly that (based on the available energy amount) the complete bus fleet could be replaced by hydrogen busses.

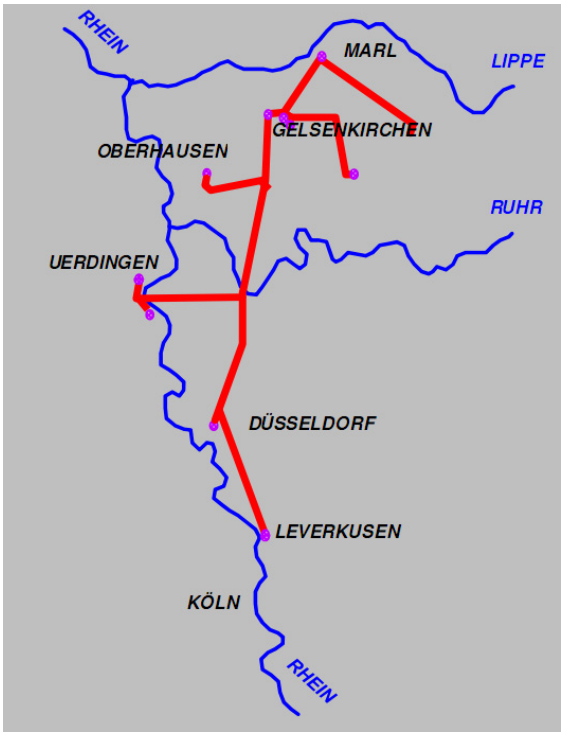

Figure 3: Pipeline-Network in NRW operated by AirLiquide.

Since 1998 the French gas company AirLiquide operates a hydrogen pipeline network in NRW which has a total length of 240 km and connects 14 production sites [6]. The total transmission capacity of the pipeline network is estimated at 250M Nm3 / year. This pipeline could be a complementary part allowing NRW to keep initial setup costs low. Depending on the level of political commitment and industry willingness the potentially available hydrogen is estimated to be sufficient for vehicle applications until 2020.

2 HyCologne as Local Network of Innovation

HyCologne focuses on using these resources and is building up a local network of innovation for hydrogen related technologies. Currently there are twenty partners organised in a cluster and two main projects initiated. Starting early 2010 HyCologne will establish a hydrogen bus fleet and built up a hydrogen powered fuel cell power plant in industrial size. Therefore a project has been set up to use the availably by-product hydrogen. The project called “Chemergy” will demonstrate clean energy solutions that make use of an existing but currently untapped source of hydrogen fuel – hydrogen emitted as the by-product of a sodium chlorate manufacturing plants. The purified hydrogen could be used to greatly reducing greenhouse gas emissions, local air pollutants, and the use of fossil fuels.

3 Utilizing Waste Hydrogen – The CHEMERGY Project

The demonstration project “Chemergy” will involve the operation of hydrogen hybrid busses and a number of fuelling stations. By making use of an existing by-product stream, the plant

significantly reduces the financial cost and energy required to provide 99.99% pure hydrogen.

The „Chemergy“ project has the purpose to open up the infrastructure of the chemical industry, which has so far been closed in, and to provide public access, so that hydrogen can be used as energy carrier. This constitutes a necessary condition to establish an optimal starting position for the commercially reasonable operation of hydrogen applications in the future.

The development of the infrastructure is clearly beneficial for the location’s and the region’s competitiveness. In parallel to the local activities the project partners examine how the findings of the Chemergy project can be transferred to other locations and how the potential resources of the industrial by-product hydrogen can be put to use in the region, in NRW and in Germany as a whole to ensure optimal results in efficiency.

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