HYLIGHTS

Hydrogen for Transport in Europe

Policy support for hydrogen in transport
From large-scale demonstration phase to early commercialization

Report Status: **Final report**

Report Date: **December 2008**

A Coordination Action to Prepare European and Fuel Cell Demonstration Projects on Transport

Acknowledgement:
HyLights is financed by funds from the European Commission under FP6
Contract: TEN/05/FP6EN/S07.53917/019990.

Disclaimer

This document is the result of a collaborative work between HyLights Industry and Institute partners. The results of the research were subsequently elaborated and presented in a coherent manner, which involved extensive stakeholder consultation in locations around the world as well as feedback from the “HyLights” Industry Partners.

The ideas presented in this document were reviewed by certain "HyLights" project partners to ensure broad general agreement with its principal findings and perspectives. However, while a commendable level of consensus has been achieved, this does not mean that every consulted stakeholder or "HyLights" Industry Partner necessarily endorses or agrees with every finding in the document. The producer of this document is the sole responsible for its content and recommendations.

Introduction

In the framework of the 'HyLights' project, this study presents the summary of recommendations for policy support measures for hydrogen in transport. It specifically focuses on the phase from large scale demonstration towards early commercialisation. The aim of this study is to provide a balanced perspective on the necessary support for hydrogen vehicles, hydrogen as a fuel and refuelling infrastructure. This summary synthesises a number of published reports (Hyways 2007a and HyLights, 2007) and results from stakeholder workshops that took place in the second half of the HyLights project. Major input for the report has been also received through the application of the policy support tool (HyLights 2008a) and the discussion on expectation management (HyLights 2008b) dealing with regional, industry and policy perspectives on hydrogen vehicle demonstrations.

The need for policy support

There is a need for specific support for hydrogen in transport to facilitate the introduction and deployment in the commercial market (HyWays 2007b). Hydrogen technologies are now entering the next phase of innovation leaving the pure R&D phase behind. After a series of large-scale demonstrations jointly financed by industry and government (JTI), hydrogen technology will move towards early commercialisation. Deployment support from the JTI will fade out but the vehicle production needs a quick ramp-up in order to make the step to a higher production level, see Figure 1.

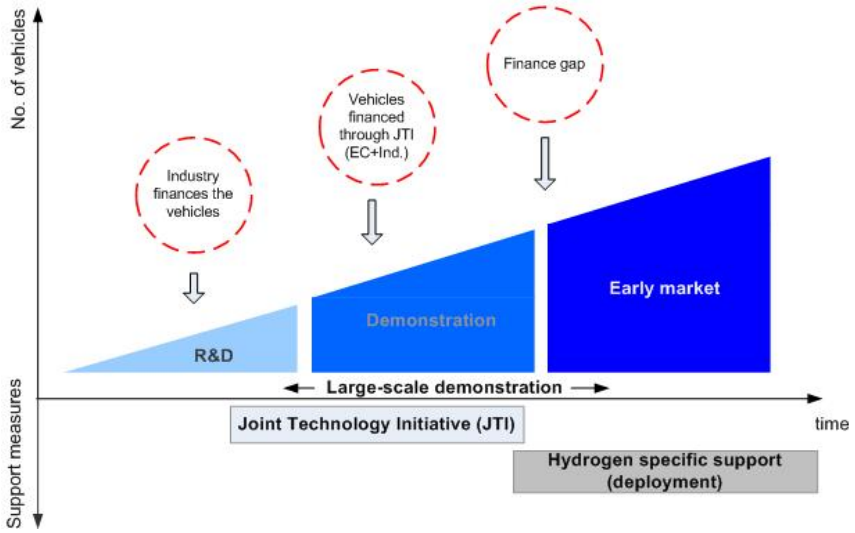

Figure 1: Transition from R&D to early markets

Additional cost per hydrogen vehicle for the end-user will still be substantial. No funding from EU level will be available anymore to cover the extra cost. That means that in this phase, only the member states and regional governments can provide the required incentives to facilitate a quick ramp-up of the deployment of hydrogen applications (HyWays 2007b).

A support framework should address both the high additional cost for hydrogen vehicles and hydrogen as a fuel. With respect to fuel, the support framework should specifically address high investment risks for hydrogen infrastructure providers (cash flow) as end-users rely on an operating refuelling network. This not only requires a high sense of urgency at policy level, since a policy framework has to be designed and implemented way before the deployment barrier becomes visible (preferably overlapping), but also high commitment, since a substantial and increasing budget is needed for deployment support. It will take years to design and implement new incentives. Although MS-conditions have to be taken into account and can offer country specific advantages, harmonisation between MS needs to be considered whenever possible as well as avoiding gaps between various incentives at different deployment phases. New policies are likely to gradually phase in (or out) in order not to disturb current market conditions.

Given the fact that costs for hydrogen technology are expected to go down significantly over time when deployment goes up, a support scheme is necessary that is flexible enough to adapt to the technological and economical improvements of the technology. Static support schemes bear the risk of severe under or over stimulation of technology that would subsequently lead to an interruption or delay of the technological development.

Level of implementation

Interests for hydrogen differ between European, national and regional level. Each of them has different motives to support the introduction of hydrogen into the energy system. EU research policy is focusing on the early stages of technological development and on medium to long-term benefits. The fact that the EC now finances large-scale demonstrations jointly with the private sector through the JTI shows that the EU has started to hand over R&D to the market and will continue to pull out as the technology moves closer to the market. Deployment support beyond the demonstration phase is not foreseen however.

National governments are concerned to lower CO_2 and other emissions (e.g. particulates) and solve security of supply issues in the most cost-efficient way and on short notice. Yet, cost effectiveness can only be achieved with options that fit well into the current energy system, favouring incremental innovation over disruptive ones such as hydrogen. However, it is not possible to meet ambitious (-50% CO_2) long-term climate goals by means of incremental innovation.

Also up until now there have not yet been large-scale demonstrations projects to convince policy makers about the economic and technological prospects of the technology.

On the regional level hydrogen applications can already contribute to reduce CO2 emissions and noise in city centres. Hydrogen is also received as a local industry and employment factor. Various EU regions are already involved in hydrogen business and small-scale demonstration activities. For those reasons deployment support should be raised through the regions to the national governments where level of awareness is not sufficiently high enough.

Policy support

ECN has developed a straightforward tool that calculates the cost gap between conventional and hydrogen vehicles[1]. Based on the HyWays cost data, a gap of approximately 10€ct/km[2] - taking into account both vehicle and fuel cost – between a gasoline and hydrogen (FC hybrid) vehicle has to be bridged assuming around 100.000 vehicles being built. By using the policy support tool the sensitivity of the €/km gap to a number of factor such as oil price, vehicle price, hydrogen fuel price and several policy support schemes can be reviewed.

The €/km cost is firstly dominated by the vehicle cost (and taxes), followed by the fuel cost. Taxation applies to both vehicle and fuel costs. The current taxation schemes throughout Europe differ substantially. This not only influences the gap (€/km) between gasoline and hydrogen, but also the potential to implement support schemes for hydrogen in transport. In all countries VAT, fuel excise duty and road taxes affect the cost of the vehicle and fuel, but differences in these taxes are minor and influence the cost per kilometre only little (around 0,2 - 0,5€ct/km). The biggest difference in the current taxation schemes is the registration tax on vehicles, see Figure 2 below.

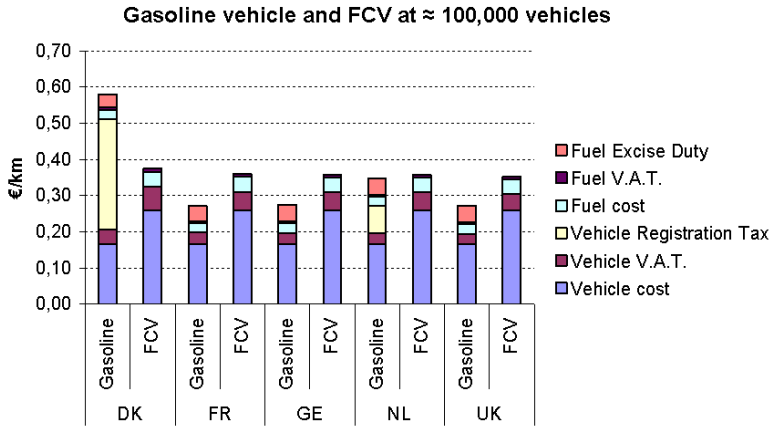

Figure 2: Example: Vehicle cost difference in selected EU countries (based on 2008 support schemes)

[1] The policy support tool is publicly available and can be downloaded under www.hylights.eu

[2] With a vehicle cost level cording to HyWays at 100.000 vehicles produced and a H2 fuel price of 6 €/kg

Countries like Denmark and the Netherlands (Energy labels) have high registration tax, on the other hand the countries with automotive industry do not have registration tax. [3] In Denmark and the Netherlands hydrogen vehicles are exempted from registration tax. This provides (already today) an incentive which covers the gap (almost) completely (30€ct/km in Denmark and 5€ct/km in the Netherlands), see Figure 3. On the other hand, countries without registration tax (like Germany) have to implement new specific policy support schemes and cannot build upon current taxation (by giving exemptions on current taxes) to support hydrogen in transport. However, one has to take into account that current (advantageous for hydrogen) tax regimes could change in the future. In the Netherlands, it has been already decided that registration tax will be phased out and replaced by road tax.

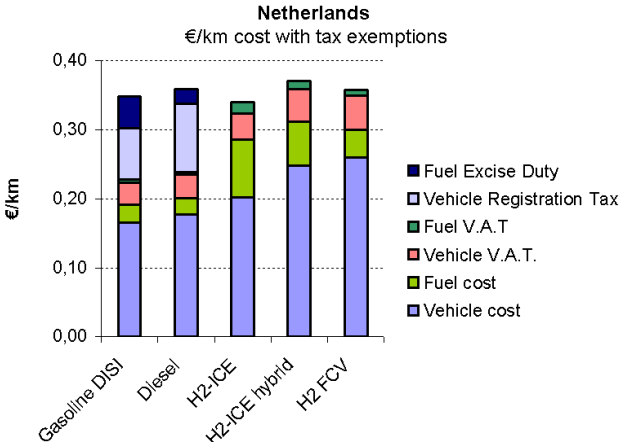

Figure 3: €ct/km cost comparison with tax incentives in NL (based on 2008 support schemes)

Various other policy instruments are suitable to reduce the gap (€/km) between gasoline and hydrogen vehicles. Both registration tax and congestion charge have the highest impact on €/km and can potentially completely cover a cost gap of 10 €ct/km gap. Higher price levels for conventional fuel and lower prices for hydrogen have a much smaller impact (around 1-2 €ct/km). The inclusion of externalities and road transport in CO_2 pricing schemes has only marginal impact (1.4 €ct/km assuming a CO_2 price of 100€/ton) and has moreover the side effect that it only reduces the gap between hydrogen vehicles and conventional technologies but not or less between hydrogen vehicles and other environmental friendly transport options.

[3] One exception in this respect is France. Registration tax is applicable, but for historical reasons it has never been recognized as registration tax on EU level. The tax height is determined on the regional level.

From the perspective of the policy maker

The support schemes need to be stable for a long period of time and investors need to be able to rely on this. Implementation should be done in a way that it is not sensitive to budget cuts in case economy measures need to be taken. Preferably the instruments should be implemented in a budget neutral way, implying that the expenditures equal revenues, and should not be visible on the national account, clearly indicating the total cost of the scheme.[4] From a political point of view, exemptions from existing tax schemes are easier to implement (support politically), whilst increasing taxes or substantial subsidy schemes are politically less favoured. Such schemes are more likely to be terminated from year to year or once in case budgets increase, priorities shift or spending cuts. The schemes should be designed to enjoy support over more than one legislative period.

Also a distinction can be made between incentives playing a role when purchasing the vehicle and incentives during use (on operating cost) of the vehicle. Given the high discount rates of consumers, incentives playing a role when purchasing a vehicle are valued way higher and therefore more effective with respect to influencing purchase behaviour in comparison to future revenues. However, since the full gap has to be bridged at a single moment in time (the purchase), the magnitude of the incentives becomes too big (around 75 m€)[5] to be still favored by policy makers. From a political point of view, incentives on an annual basis but with less substantial payments are much easier to implement compared to an incentive at the amount of purchase, despite the fact that the total budget is equal and the effectiveness is higher at the amount of purchase.

Incentives that act upon operating cost of the vehicle are spread over time (the full life time of the vehicle) and do not have to be as substantial since operating cost only account for one-third of the additional vehicle cost. However, vehicle and fuel incentives need to be seen in conjunction since the sum determines the additional cost. From the perspective of the policy maker, an introduction of multiple instruments during both the moment of purchase as well as during operation is therefore most favourable.

Bridging the gap between demonstration and early markets

Analysis of existing and foreseen instruments shows that for most countries a combination of instruments could bridge a gap of, for example, 10 €ct/km. However substantial higher investments are necessary to finance the first 100,000 vehicles that come after the JTI financed large-scale demonstrations that will only comprise of a few thousand vehicles at most. This represents a major hurdle since it is unclear how these vehicles will be financed. The technology is still too expensive to be

[4] Profits (for society) might be substantially higher, but these are not visible on the national account system.

[5] Example for the Netherlands: Assuming a hydrogen vehicle sales share of 1%, total passenger vehicle market size 500,000 in 2007, Source: Statistics Netherland, www.cbs.nl

adopted in the early market and large production volumes cannot be realised due to insufficient demand. Although several thousands of vehicles may be produced, costs will still be high in comparison to the conventional vehicle. Annually about 15 million cars are sold in Europe which means that the market share of 100,000 hydrogen vehicles would be less than one percent of the overall vehicle market. Here, favourable market conditions (early markets) combined with a set of policy instruments comparable to the phase beyond 100,000 vehicles (corresponding to a cost gap of approximately 10 €ct/km or less) need to bridge the gap. Vehicle deployment will be take place at a limited number of locations (e.g. not EU27) that possess favourable conditions and therefore accumulate the majority of the vehicles.

The actual financial gap in the phase up to 100,000 vehicles is difficult to assess since none of the manufacturers has yet publicly announced production volumes together with an indication for sales prices. Research within HyLights has shown that fleet operators could be a starting point for vehicle deployment, but only on a case-by-case decisions basis. Yet, due to the lack of information on price levels, fleet operators are actually not in the position to make informed investment decisions and thus have not started to implement corporate policies supporting hydrogen vehicles In addition, it is unclear if and how a series of early markets could evolve into the mass market and what are the requirements for those vehicles (performance, tolerance to additional costs). (HyLights 2008c)

Regional networking

As indicated in the previous paragraph, specific and concrete information on characteristics of the required evolution of early markets is lacking. On the micro (regional) level, series of early markets are necessary to provide sufficient demand and financial resources as business case for the vehicle manufacturers, ramping up production volumes. The hydrogen committed regions could emerge as early market users with centralised demand from their regional stakeholders. Regions are predestined to absorb a number of vehicles requiring relatively low infrastructure investment. In the accumulated demand of a geographical constrained area lies the key for the early market deployment of a larger number of vehicles. A number of regions have shown high interest to deploy hydrogen vehicles in an early market environment.

Committed “frontrunner” regions should form interest groups and evaluate their vehicle needs and financial opportunities by means of stakeholder workshops. Thus, business plans should be set-up that elaborate on interested fleet operators, total size of demand, vehicle segments and how the supply is going to be financed. The business plans furthermore help to identify the committed regions, which regions have favourable conditions and under which conditions those vehicles can be applied. Currently no more than five to six European regions possess the necessary resources, regulations and characteristics to be a frontrunner. Through the bottom-up activities of the regions interest should be raised within the national government level to start designing national support frameworks.

Infrastructure support

The availability of adequate refuelling infrastructure is directly linked to a successful introduction of hydrogen vehicles. Absence of infrastructure will hamper deployment of vehicles since end-users will be hesitant to switch to hydrogen vehicles. Infrastructure investments bear the risk of negative cash-flows for a long time period due to slow increase in utilisation and competition with conventional and alternative technologies. A policy support framework should therefore also provide incentives to lower the infrastructure investment risk.

In the US, infrastructure incentive schemes have been already introduced on both national and state-level. States as California have also introduced regulatory measures (ZEV) to deploy vehicles. Europe is facing a bigger challenge in order to face comparable market conditions (level playing field). Not only do other incentives need to be implemented to compensate for the absence of regulatory measures, also the existing and potential policy measures vary widely between the EU member states.

Since EU infrastructure support is out of scope as of today, support has to be provided at the Member State or regional level. There is already a tendency to provide infrastructure support through national programmes in for e.g. Germany. However there is still a general lack of interest on the member state level, partly because vehicle numbers are not regulated and thus difficult to estimate. Again, hydrogen committed regions should become active and either include infrastructure in their business plans or raise interest at the member state level. Eventually infrastructure support needs also to be synchronized with fuel and vehicle support which is only possible on national level.

Conclusions

This report summarises the research carried out within the HyLights project in the field of financing large scale demonstration projects and beyond. Studies have been completed on early markets for hydrogen vehicles, on existing and future policy support schemes and on expectations of different stakeholders towards the deployment of vehicles. Through HyLights, now a more detailed picture has been provided e.g. regarding the effectiveness of a policy support framework and on the necessary steps that need to be taken in the future concerning early markets. However, the analyses also shows that further analysis is needed building upon the work performed in HyLights to quantify in more detail the evolution of early markets. The interviews with potential early users of hydrogen vehicles basically showed that fleet operators have not started thinking about support schemes for hydrogen or zero-emission vehicles. They are however keen on supporting energy efficient vehicles and have for example implemented incentives for vehicles with energy label A and B. Comparable support schemes for zero-emission vehicles can only be implemented if (additional) costs are know. Further analysis on early markets for hydrogen vehicles just based on the evaluation of stakeholder requirements, existing and foreseen support schemes and lessons learned from recent and ongoing demonstration projects is expected not to provide any relevant results on top of what

has been found in the context of the HyLights project. As a next step, regions should develop concrete business plans, stating how many vehicles can be deployed at what conditions. This should include tolerance of additional costs and performance requirements.

Hydrogen specific policy support is indispensable to facilitate the market commercialization of hydrogen vehicles. Beyond about 100,000 produced vehicles, price levels will come down to a level where they can be compensated through a set of existing policy incentives. End-users might still have to pay a premium in comparison to conventional vehicles unless those extra costs are completely allocated by means of policies. Both hydrogen vehicles and hydrogen as a fuel need to be addressed by a policy framework. However, the expected cost gap of 10 €ct/km can be tackled by means of various existing policy instruments. Countries that already feature high taxation on conventional vehicles are in a better position to introduce or extend tax exemptions for hydrogen vehicles.

Attention on the member state level needs to be raised urgently to start with the design and implementation of support frameworks to be in place when the JTI financed demonstrations phase out and deployment could face an abrupt halt. Gaps between policy incentives covering different deployment phases need to be avoided. Stable support frameworks are necessary from an industry perspective to demonstrate long-term commitment for the technology, implying that preferably incentives should be budget neutral and designed in a way that they are little vulnerable to economy measures.

The challenge is to bridge the financial gap between the large-scale demonstrations and early market phase where the cost gap is too large to be covered by means of policy support. In order to deploy the first 100,000 vehicles, hydrogen committed regions need to emerge as early market for vehicles with the accumulated demand within a constraint area that can be supplied by limited infrastructure. Therefore regions or municipalities in liaison with relevant industry stakeholders have to position themselves and come up with a viable plan on how to introduce numbers of vehicles, which segments and how to cover finance over a period in time.

Infrastructure is a serious problem since Europe has not regulated its supply. In the absence of national infrastructure support, regions should account for necessary infrastructure in their business plans. Finally, the regional activities should raise attention at national governments to implement complex support schemes for vehicles, fuel and infrastructure.

References

HyWays 2007a, The European Hydrogen Energy Roadmap, www.hyways.de

HyWays 2007b, Action Plan – Policy Measures for the Introduction of Hydrogen Energy in Europe, www.hyways.de

HyLights 2007, Summary report HyLights Phase I, Deliverable 5.1A, www.hylights.eu

HyLights, 2008a, Policy support tool, www.hylights.eu

HyLights 2008b, Entering the next phase towards commercialization of hydrogen vehicles – role and expectations of various stakeholders, www.hylights.eu

HyLights 2008c, Gaps analysis – minimal user requirements for hydrogen vehicles, Deliverable 4.3, www.HyLights.eu