HYLIGHTS

Hydrogen for Transport in Europe

Policy support for large-scale demonstration projects for hydrogen use in transport

Stakeholder views and preferences, Deliverable 5.1 (Part B)

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

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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.

Executive Summary

Hydrogen specific support measures are necessary to stimulate the introduction of hydrogen in transport. Currently there are no specific support schemes to support large scale demonstration of hydrogen applications. With the Joint Technology Initiative for fuel cells and hydrogen (JTI) in Europe and the National Innovation Programme (NIP) in Germany however, specific policy support schemes are being set up. These support schemes are necessary to tackle the initial barriers for hydrogen and fuel cells in transport which may exist in all parts of the energy chain (production, distribution, refuelling and end-use). Stakeholder experiences with the current support schemes can help identify strong points and drawbacks and as such help policy makers tailor the (future) specific support schemes towards the preferences and needs of the industry. This report summarises the opinions expressed by stakeholders currently involved in hydrogen related demonstration projects and provides some suggestions for future improvement of policy support. However it should be mentioned that the stated opinions reflect upon the individual interests of each interviewee and do not necessarily represent the most effective solution for technological development in the long run.

Experiences with current policy support schemes

Experiences with current policy support schemes for hydrogen demonstration projects in the transport sector are gathered based on a number of dedicated interviews (see Appendix A) and interviews previously carried out within HyLights. It becomes clear that the lack of specific hydrogen support schemes on European, national or local level for (large scale) hydrogen demonstration in transport causes differences in coverage of support (i.e. the eligible cost and the funding rate), duration of the funding and administrative procedures and requirements.

The policy support schemes in place however do provide the possibility to include hydrogen demonstration for transport, despite sometimes long negotiations (with several ministries and/or government layers), sometimes including detailed requirements with respect to technology and site specific conditions. This in general results in lengthy application procedures, during which the budget estimates made during the application did not reflect the actual cost anymore. By the time the project started this resulted in a higher cost burden for the industry, the exclusion of some (mostly stationary) parts of the demonstration project, or even the abandonment of the project as a whole. In some cases the lack of continuity of funding, limited project funding and/or limited project duration set upfront by the (often general renewable energy) support scheme proved to be a barrier to propose a viable demonstration project or to continue an existing (successful) project.

Recommendations based on stakeholder experiences

Hydrogen technology is still in the early deployment phase and thus needs significant policy support. Suggested is to include 50% of the actual cost as a guideline for support in demonstration projects. By limiting the period between application and approval of a project proposal, differences between estimated project budget and actual cost remain small. It should be kept in mind that financial setbacks can be experienced due to all sorts of reasons and only in some cases will the compensated. Compensation of the time and resources spend during the application period can encourage SMEs to participate in demonstration projects, or at least in the proposal.

Reducing the administrative burden for companies, especially those involved in several projects is also mentioned as a priority issue to look into. In addition, also the timing of a call for proposals was put forward. The right timing of a call or clear communication on when a call will be published allows industry to get their internal financing in order enabling them to participate in a project proposal.

Preferred policy support measures for large scale demonstration projects

Investment subsidies and production subsidies are, according to the stakeholders, the preferred policy support measures for large scale demonstration projects. Fiscal reductions and tax exemptions should also be in place. This can be set up for instance as no registration tax on hydrogen fuelled vehicles, no excise duty on hydrogen as a fuel, or tax credits for the purchaser of a hydrogen fuelled vehicle. It should be kept in mind that governments prefer exemptions over subsidies.

For the stimulation of hydrogen production, stakeholders indicate that there should be some distinction in support. Already proven technologies (like steam methane reforming) and readily available hydrogen (by-product hydrogen, sometimes requiring only investments in cleanup and compression) could receive less support compared to renewable hydrogen production. The balance between production cost and fuel price should be kept in mind when answering this question.

Hydrogen distribution and refuelling could benefit (besides investment and production subsidies) from zero or low interest loans. Setting up a hydrogen pipeline is costly, but the option (especially when the large scale production facility is close to the refuelling station) should be kept open. At the refuelling station there are still investments needed in hydrogen refuellers, so some support is needed.

Hydrogen end-use in vehicles need also be supported to cover the additional cost of hydrogen fuelled vehicles. This can be done by subsidies for the producers of vehicles, or by giving the end-user support (like a subsidy or tax exemption).

Preferred policy support measures after the large scale demonstration projects

After large scale demonstration projects the technology moves toward the (pre-) commercial market by entering the early market phase. According to the stakeholders, investment and production subsidies should be kept in place, but slowly shifted towards fiscal reductions and tax exemptions. Here, also public procurement is foreseen. Investment and production subsidies still help industry cover part of their investments in new production facilities (zero or low interest loans could contribute also), while public procurement and fiscal reductions and tax exemptions should create market demand. In the long run, support schemes focussing on sustainability such as emission trading (or CO_2 taxation) could provide incentives for the production of hydrogen as well, but timing is crucial and according to the stakeholders, will not be implemented in the near future.

Non financial support

According to the stakeholders, non-financial support can provide additional incentives and becomes more relevant when hydrogen for transport moves towards the (pre-) commercial market. Some examples of non financial support are (i) an exemption for limited city centre access, (ii) free parking or preferred parking closer to buildings/shops (iii) allowance to use public transport lanes, (iv) free use of toll roads, (v) free use of public transport when using park and ride. Extending the permits of bus operators using hydrogen busses can be useful measures to support hydrogen in transport.

Concluding: preferred characteristics of future support scheme

Current policy support schemes primarily aim at technology development (R&D) with limited ability for technology demonstration (of prototypes). The focus of the industry involved in hydrogen and fuel cells is going more towards large scale demonstration (including some small series production). This results in other requirements from a policy support scheme:

- The funding conditions should be known up front. In other words the balance between production, distribution, refuelling and end-use as well as the funding for the different technologies available should be clear.
- The scheme should be long-term, providing the industry certainty about the availability of policy support and allowing them to plan a series of demonstration projects, or apply for an extension of a demonstration project when it is (near its) end. Leaving the project duration open (in the application) allows the industry to determine the preferred and most suitable duration to maximize their learning.

- There should be somewhat flexibility in terms of budget. When unforeseen circumstances occur, a shift in project budget should be an option. Therefore a methodology to quickly apply for a budget shift is crucial. This does not mean every budget shift will be approved. The rules should be clear up front, but the requests should be reviewed on an individual bases.

Table of contents

Introduction

In the European Union (EU) different support schemes are in place (on a national level / level of member states) supporting hydrogen and fuel cell demonstration activities. Primary focus of these kind of support schemes is on technology development (R&D). Technology deployment is only feasible within the context of demonstration of prototypes. Over the past years a lot of experience has been gained with respect to these different kinds of support measures for these type of demonstration projects. However, large scale demonstration projects are needed to be able to make the step from the prototype phase to small scale series production to be applied in early market.

In the Hylights reports (Ros, 2006 and Jeeninga, 2006) – functioning as a background document for this report – a more general study was conducted on possible policy support measures to stimulate hydrogen in the transport sector. The reports concluded that no unique support scheme would be able to tackle the (initial) barriers that may occur in all parts of the energy chain taking into account a fast performance increase of the technology. Various kinds of support measures are possible and necessary to stimulate hydrogen in transport. The choice for a policy support measure should depend on the type of barrier and the maturity of a technology. As technology progresses towards commercialisation the support measures have to change accordingly.

Since the support measures are dependent on the maturity of a technology and since hydrogen in transport is advancing towards the next phase (large scale demonstration projects), needs for policy support change and so should the policy support measures. Building on the stakeholder experience and preferences for certain policy support measures (best practices) should be taken into account while setting up policy support measures for large scale demonstration projects. Therefore, the experiences and needs of stakeholders who want to bring hydrogen technology to the market are collected and analysed in this report.

In this report for the HyLights project – which focuses on the promotion and design of large scale demonstration projects for hydrogen transport applications – the aim is to explore stakeholder experiences with current support measures and their preferences for future support measures. This is done by conducting interviews with stakeholders involved in hydrogen demonstration in the transport sector in Europe. The following two major research questions were addressed:

- What are their experiences with current national and EU policy support for hydrogen demonstration projects?
- What are their ideas on future policy support measures for large scale demonstration projects and the phases after that?

This report outlines the stakeholders experiences and ideas on policy support in the future of and addresses the questions: what are the strong points and draw backs of the current policy support measures for hydrogen demonstration in transport and which support measures are preferred in the future?

First, the stakeholder experiences with current policy support are described in chapter 1. This chapter describes the strong points and draw backs of current policy support measures as well as suggests how the current policy support measures can be improved according to the stakeholders. Chapter 2 takes a closer look at preferences for future policy support for hydrogen in transport. It outlines the stakeholders shared ideas on how to support large scale demonstration projects for hydrogen in transport, but also for the phases after large scale demonstration projects. Since all parts of the energy chain (production, distribution and refuelling, and end-use) and various technologies are involved when implementing hydrogen in transport, this chapter also pays attention to differences of support for certain parts of the energy chain and technologies for future policy support as indicated by the stakeholders. Non-financial support measures are described in this chapter as well. This report ends with a discussion and conclusion in chapter 3, where there will be a reflexion on the stakeholder preferences.

1 Stakeholder experiences with current policy support

This chapter provides an overview of the experiences with current policy support measures for hydrogen demonstration projects in the transport sector based on dedicated interviews (see Appendix A) and other interviews previously done within Hylights (D2.5 - Intermediate Report for all Prioritised Demonstration Projects serving as input for the consecutive gaps analysis and demo project assessment in WP4, 2007). First, an overview of support schemes within recent and ongoing demonstration projects is given (section 1.1), followed by a reflection on the strong points and draw backs (section 1.2), and suggestions how the current funding mechanism can be improved (section 1.3).

1.1 Current support for demonstration projects

Different schemes for financial support for demonstration projects of hydrogen in the transport sector are available. The European Union (EU) provides funding via the Framework Programmes (FPs), some national governments (for example Germany) support the demonstration of hydrogen in the transportation sector and also on local/state level some governments funding is sometimes available. A short overview of current funding sources is presented below.

European funded projects

Most of the programmes, which fund hydrogen demonstration projects at the moment, are not specifically for hydrogen. In the 6th Framework Programme (FP) hydrogen and fuel cell research cuts across a number of Thematic Priority Areas and could receive funding under:

- Priority 6.1 ‘Sustainable energy systems’
- Priority 6.2 ‘Sustainable surface transport’
- Priority 4 ‘Aeronautics and space’
- Priority 3 ‘Nanotechnologies and nanosciences, knowledge-based multifunctional materials, new production processes and devices’

In general, for medium-to-long term research actions, the European Commission (EC) in FP6 funds up to 50% of the total costs, while for the medium-to-short research (i.e. demonstration projects) actions EC funds up to 35% of the total cost. The stakeholders that were interviewed are (or where) involved in several European funded demonstration projects, like HYFLEET:CUTE and ZERO REGIO, and are also involved in more strategically oriented projects. The strategically oriented

projects involve pathways and socio-economic analysis, and technology validation projects, such as HyWays (www.HyWays.de), Roads2HyCom (www.Roads2Hy.com) and HyLights (www.HyLights.eu).

National and local funded projects

National or local funded demonstration projects often received financial support from the national and/or local government(s). Examples of projects receiving national and local funding are the CEP (Clean Energy Partnership) and ARGEMUC.

As for the 6th FP, there are no specific funding programmes available solely focussing on hydrogen and fuel cells. Most of the national or local funded projects got funding based on negotiations between industry and the government. However, this situation is changing for the case of Germany, where a National Innovation Programme (NIP) on hydrogen and fuel cell technology is set up, with the recent establishment of the National Organisation of Hydrogen and fuel cell technology (NOW, as of February 2008). This programme provides structural funding (for the next 10 years), aligns funding for demonstration projects on hydrogen and fuel cells and will be coordinated on national level (www.bmvbs.de/en/artikel-,1872.960602/National-Hydrogen-and-Fuel-Cel.htm).

1.2 Strong points and draw backs of support

There are several schemes available to support hydrogen in transport (EC, national, state, or local government), however there are not always specific programmes available. This results in differences in coverage of the costs (e.g. which cost are eligible for funding and how high is the funding rate), timeline of the funding (how long does a project get funding), and administrative procedures and requirements. Some demonstration programmes received funding after negotiations with the government (like CEP and ARGEMUC). A more in-depth review shows the following strong points and draw backs of funding hydrogen in transport as indicated by the interviewees.

European funding

As already mentioned in the previous section the amount of funding depends on the type of project. Within the 6th FP, R&D in the field of hydrogen and fuel cell technologies received funding up to 50% as it was considered more long-term research. Demonstration activities however received less (35%), but when the management part of the project (which receives a higher funding rate) is taken into account overall funding comes close to 50%. For the 7th FP (2007 and onwards) the funding rate for demonstration projects is increased to 50%, taking away any differences in support between R&D and demonstration projects.

A strong point mentioned by the stakeholders is the European funding coming from the FPs allows them to co-fund R&D and (small scale) demonstrations. For a technology in a pre-commercial phase joint knowledge build-up (both on technology as on market expectations and deployment strategy and future R&D) is very relevant. For a while, it has been unclear to what extent the next series of demonstration projects for hydrogen in transport could be funded. The conditions of the FP6 framework did not allow to co-fund small series of identical vehicles. With the current FP7 and the Joint Technology Initiative (JTI) for hydrogen and fuel cells underway there will be more clarity where the funding can come from, what will be funded and for how long. The overall opinion of the respondents is that government support for hydrogen and fuel cell demonstration is absolutely necessary.

There are however also some drawbacks mentioned by the stakeholders. This mainly has to do with the administrative burden before and during a project. Applying for FP funding tends to be a lengthy process. The time between submission of a proposal and the approval of the EC to fund the proposal is considered to be too long (in some cases even over a year). This can cause difficulties for the companies involved in the proposal. First of all, the budget estimates which are made for the project proposal may have changed during this period compared to the actual cost when the proposal is approved and the project starts. This causes additional cost for the companies involved. Secondly, companies have to get there internal financing (to fund the other 50%) in-line with the project proposal. The timing of a call for proposals or the time between a project proposal and approval of the proposal sometimes can cause difficulties within the company financing structure.

The application process and paper work during the project (Management reports, Progress reports, periodic activity reports and audits) impose a big burden for companies, especially if they are involved in several projects and have to do the same reports for every project.

The inflexibility of budgets and activities during a project is also a downside mentioned by the stakeholders. It takes quite some time to make changes to a project (as described in the ‘Description of Work’ (DoW)) as it runs, because the EC has to approve which is time consuming.

Another type of drawback mentioned when applying for EC funding is that during the proposal application process the EC sometimes wants to extend project consortia with additional participants. This causes project consortia to become bigger and less effective, even hard to manage. This has implications on how the funding is spent, since more time is needed for management of the project in stead of doing the actual

work. It should be noted that the EC predominantly makes such requests mostly in projects focussing on strategy aspects and not for demonstration projects.

National and local funding

National and local funding schemes differ greatly throughout Europe. In most countries the main funding is focussed on R&D in renewable energy technology and/or general support for renewable energy (more implementation oriented i.e. feed-in tariffs). In regions with the local industry involved in hydrogen and fuel cell technology there is some specific funding available to support R&D and demonstration.

In countries and regions where there is no special programme for hydrogen demonstration projects, funding has to come from programmes with a general aim of stimulating sustainable energy. These however do not take into account the specific needs for hydrogen and fuel cell technologies. As concluded in the HyLights reports (Ros, 2006 and Jeeninga, 2006), generic incentives do not tackle the specific needs to overcome the various barriers in each part of the hydrogen energy chain (production, distribution, refuelling and end-use). Generic support measures are often used to stimulate technologies that are (almost) market mature and compensate (part of) the additional costs. Since hydrogen and fuel cell technologies are still relatively new and high costs are involved since mass manufacturing has not yet started, compensating only part of the additional cost is insufficient as incentive to enable a series of hydrogen and fuel cell demonstration projects.

A difficulty with national or local funding for hydrogen and fuel cell demonstration in transport is the involvement of several ministries and/or levels of the government. Mostly the ministries or local departments responsible for transport, industry or economic affairs are involved and this has to do with the generic character of the support programme and the general decision process concerning policy support (i.e. the responsible ministry/department like transport validates a proposal, while the finance/treasury department has to review the financial aspects). The involvement of several ministries and/or levels of government sometimes may cause difficulties because not all parties involved support hydrogen as much as others. Other shortcomings are a limit on the maximum budget of a project and the duration of a project in some funding programmes in some countries. For example not covering the actual cost, but part of the additional cost may cause difficulties to make the project viable from a financial point of view. By limiting the duration of a project there may not be sufficient time to test and demonstrate equipment since also setting up the equipment needs time.

Most of the respondents referred to Germany's NIP as a good way to stimulate hydrogen and fuel cell demonstrations. The NIP is focussed especially on hydrogen and fuel cells and the programme provides € 500 million support for 10 years with average public funding of 50%. With matching funds from industry this adds up to € 1 billion in support. The focus will be market preparation through (a series of large scale) demonstration projects (approximately two-thirds of the budget) and R&D (one-third).

1.3 Suggestions to improve support

In the previous sections an overview of the support schemes in recent and ongoing demonstration projects for hydrogen in transport is given. Here, also drawbacks mentioned by the stakeholders involved in the demonstration projects were included. It should be kept in mind though that - despite the drawbacks, the interviewees are in general positive about the incentives offered by the existing support schemes for hydrogen and fuel cell R&D and demonstration in transport. However, a number of suggestions were made to improve current schemes as well as future support.

One of the most mentioned shortcomings of the current policy support schemes according to the stakeholders is the lack of continuity of the funding after the project lifetime. Some projects have to deal with short-term funding schemes which can not be used for the follow-up after the end of the funding period. Setting up a long term support scheme is vital for (the acceleration of) the development, demonstration and introduction of hydrogen in transport. A long term support scheme allows a series of demonstration projects to be set-up, or a continuation of successful demonstration projects, instead of having to look for new funding possibilities or spend a lot of time preparing (a proposal for) a demonstration project. With the development of the JTI, potentially a good solution can be provided.

Based on the experiences some stakeholders suggest that long term support scheme ideally should not limit the total budget per project proposal beforehand. Also, the level of support should be raised from covering 50% of the additional cost (as sometimes is the case in national or local generic support schemes) to 50% of the actual cost. Setting a cap for project proposals (for example a project budget maximum of €x million) and only covering the additional cost may cause certain applications to be left out of a project proposal despite their additional value to a project. For example, stationary applications may bring additional value to a project as it can improve the utilisation of the hydrogen infrastructure (e.g. usage of LH_2 boil-

off gas) and additional experiences can be gathered by operating stationary applications within the complex environment of a hydrogen refuelling station. Furthermore, dissemination possibilities and the project's visibility could be improved by including stationary applications. Some projects initially planned to also implement stationary applications but resigned because of budget cuts (e.g. ZERO REGIO), others have already included them (e.g. HyFLEET:CUTE).

According to the stakeholders, the support timeframe for a project should be kept open. Some national or local programmes limit the project timeframe up front. It should be left over to the project partners to determine a sufficient project duration they feel confident with (and see as realistic) to ensure the maximal learning. The possibility to extend a successful project and to implement new technologies allows the project to keep on serving as a test field for cutting edge technology. What the sufficient project duration is remain unanswered, but can differ based on the application (i.e. production facilities, busses, vehicles) and also the technological maturity. Learning for novel technology may profit from longer policy support compared to more mature technology.

To make the project application for support as smooth as possible, the time between project proposal and project approval should be kept as short as possible (for large projects maximum of one year). Currently, contract negotiations take longer then expected. Discussions on the balance of support between vehicle, infrastructure and accompanying activities (PR, education, and training) take up time. It is put forward by some stakeholders that the time between negotiation and approval could be reduced if the policy support scheme clearly outlines this balance. Also, discussion on tax exemptions and the pricing of H_2 as a motor fuel increase the time needed to finalise contract negotiations[1]. Clearly outlining the balance of the supported activities and the taxation of H_2 as a fuel should be included in the support scheme according to the stakeholders. Since there are substantial differences in taxation within Europe, policy support may differ between countries and even regions.

Already in the application phase time and resources are used. According to the stakeholders, it should be considered to provide financial support already in the application phase. The application process could make an initial choice for a few projects which receive funding to further set-up the project proposal. This would especially encourage the participation of SMEs.

Rising prices of (raw) materials and other resources may lead to increased project costs while the available project funding remains unchanged. This happens if a project proposal or activity suffers a delay which not in each case is a fault of the project itself (, however also in case of no delay this may happen). If the project partners are either not willing or not able to take over these additional costs the project may face serious problems. Reducing application time for support decreases the risk of actual cost rising beyond budget estimates. Making the support scheme more flexible when unforeseen delays arise can further reduce this risk for the stakeholders. By allowing certain budget changes (or even budget increases) during the project when un-planned activities or unforeseeable incidents arise and by approving project proposals quickly, the project can be managed more smoothly from a financial point of view according to the stakeholders. Setting up a quick procedure how requests for changes in budget should be done or allowing some flexibility in handling project budget greatly increases the projects ability to remain within the total budget and thus the efficiency of the policy support itself.

During a project, the administrative burden for the involved companies should be reduced to a minimum. According to the stakeholders, it should be looked into how and if this burden can be reduced, especially the audit procedure for companies involved in several projects.

The right timing of a call and/or clear indication of when the next call for proposals will be initiated can increase the number as well as the quality of proposals. Stakeholders suggested opening the calls for new project proposals in the first half of the year. This has to do with the internal financing structure of companies. Companies mostly make up their budget for the coming year in the third quarter of the preceding year. If companies have not foreseen the possibility for new project proposal and have not reserved any budget for participation in a project they have to make a lot of effort to get the matching budget if they do want to participate. This however, can also be a reason not to participate in a project proposal at all. It must be said some companies have budgets which cover a period of several years to prevent the problem of obtaining internal financing. They, however, need to have certainty about (future) policy support (in general) for demonstration activities in order to legitimise this budget. And again, when the time between application and approval of a project is too long internal budgets may have shifted already.

[1] Finding the right balance between vehicle and fuel support and the effect of tax exemptions are subject of further study within HyLights.

According to the stakeholders, the policy support scheme should provide long-term support, offering flexibility with respect to project duration and unforeseen circumstances, with short application periods, minimal administration burden and clearly and transparently communications with respect to the date tenders for proposal will be issued.

2 Preferences for future policy support measures

The HyLights reports (Ros, 2006 and Jeeninga, 2006) describe possible policy support measures that stimulate hydrogen in transport. These potential support measures include:

- Investment subsidies (supporting investments in equipment and labour)
- Production subsidies (supporting the running cost and operation of technologies)
- Zero and low interest loans (reducing cost of capital)
- Tendering and bidding (a selection procedure which selects the most cost effective beneficiary that receives support for investments and or operation of a technology)
- Fiscal reductions and exemptions (tax exemptions or credits for use or purchase)
- Quota obligations (obligating use, purchase or sales of a technology)
- Emission trading (creates benefits for external effects like CO_2 emission)
- Regulation (set standards or minimal technological requirement)
- Public and commercial procurement (governments or companies will buy certain technologies when they meat their criteria)
- Voluntary agreements

In section 2.1, first the need for support as indicated by the stakeholders is discussed in relationship to the measures listed above. Section 2.2 specifically focuses of the preference for policy support measures for the large scale demonstration projects, followed by a discussion on preferred policy support measures after this phase and towards commercial market phase (section 2.3). Herewith, the different technologies in the hydrogen energy chain (production, distribution, refuelling, end-use) are taken into account.

2.1 Need for future policy support

Currently, industry is demonstrating their hydrogen vehicles worldwide. There is a need for large scale demonstration projects in order to further develop the technology, see how it performs under real life conditions on a large scale, get a feel for market demand and show to the general public hydrogen and fuel cells are a clean and safe

technology to use. Given the fact that the number of vehicles has to increase substantially in comparison to previous demonstration projects whilst the cost per vehicle are still significant, the total additional costs for these demonstration projects are large and considerably higher in comparison to previous projects where prototypes rather than small series of vehicles were demonstrated. Not only does the automotive industry (OEMs) have to produce hydrogen fuelled vehicles with high additional cost compared to conventional vehicles, oil, energy and chemical companies will have to start working on providing hydrogen at the refuelling stations at comparable prices as gasoline and diesel. As technology develops further towards commercialisation all companies involved have to invest even larger amounts of capital.

Industry has no other option than to transfer the additional cost to the end-user. Government support has to reduce the capital risk and capital requirements but also reduce the additional costs for the end-user to stimulate market demand. It has to be clear that hydrogen technology is still in a premature status and is therefore not yet viable without significant support mechanisms (e.g. funding). A lot of project ideas have failed because of missing funding schemes. A strong political will must be visible including a long-lasting significant funding scheme which allows long-term and reliable planning. In the long run the main focus of the large-scale demonstration projects has to be on the establishment of a commercial market for hydrogen and hydrogen powered vehicles. The following section will describe the industries thoughts on governmental support for large scale demonstration projects, followed by the first thoughts on policy support after large scale demonstration projects. It needs to be mentioned that the expressed opinions are solely the arguments and interests of the interviewees and do not necessarily represent the most effective solutions for future technological development.

2.2 Envisaged policy support measures for large scale demonstration projects

For large scale demonstration projects all parts of the hydrogen energy chain (production, distribution, refuelling and end-use) need to be taken into account for policy support. Investment subsidies, production subsidies and fiscal reductions and exemptions are the most preferred support measures. There are, however, different ideas on the coverage and support of the different technologies in the hydrogen energy chain.

Production of hydrogen

Hydrogen can be produced using several technologies. Some of these are already used today, like steam reforming of methane (SMR), while others are still under development and thus have high cost (for example hydrogen production using sustainable energy). This 'green' hydrogen production is the ultimate (long term) goal and should be demonstrated as well. Some interviewees suggested that the support of hydrogen production should be based on the sustainability and should be in-line with the EC sustainability goals (meaning if the EC wants 20% sustainability, 20% of the hydrogen production for the demonstration projects should be produced sustainable).

The difficulty with subsidising production of hydrogen is the link between production cost and fuel cost for the end user. Ultimately, the end user does not want to pay more for hydrogen as a fuel as he or she is used to pay for gasoline or diesel. But the cost of hydrogen as a fuel is dependent on how it is produced (and over what distance it has to be transported). According to the stakeholders there should be a distinction in support for hydrogen production based on the technology used. This does not mean that, taking into account that the fact that we are dealing with the (large scale) demonstration phase and early markets, hydrogen from fossil resources should not get support.

By-product hydrogen seems a readily available source of hydrogen. This however is not entirely true. By-product hydrogen is not always fuel cell grade quality according to stakeholder experiences. Depending on the source of the by-product hydrogen (e.g. by-product hydrogen from chemical plants is cleaner compared to by-product hydrogen from refineries). Investments have to be made for clean-up and compression in some cases. If by-product hydrogen is foreseen in large scale demonstration projects some stakeholders are of the opinion that support may be needed.

Renewable hydrogen production is (at the moment) the most expensive way to produce hydrogen. There are different ways to produce sustainable hydrogen, for instance by using wind, solar, biomass. According to the stakeholders, the amount of subsidy should depend on the technology used, resulting in an acceptable hydrogen production price and end-user cost. Clarity must be created on which (parts of the) production routes are included in the support scheme and which are not. For example, should the support of hydrogen production (with electrolysis) using renewable electricity include the wind turbines itself, or not? It seems unlikely to

include wind turbines in a hydrogen support scheme, since there are different support schemes focusing on wind electricity generation.

Also, green certificates can be bought to 'green' the production of hydrogen via electrolysis. From a marketing point of view however, the presence of wind turbines near the hydrogen production facility sends out a 'sustainable/green' signal to the general public and may be worth subsidizing after all.

Concluding, in order to provide clarity to the industry the stakeholders feel there should be a clear outline of which technology receives which amount of support. In the end the end user has to pay the price he or she is used to when purchasing gasoline or diesel. A distinction should be made between hydrogen production technologies using fossil fuels, by-product hydrogen sources, sustainable (including nuclear) and renewable hydrogen sources. For all these technologies it should be clear how big the incentive will be. For example, the amount of funding for the renewable energy sources could even depend on the location.

Hydrogen distribution and refuelling

If hydrogen is not produced on-site, it has to be transported from the production location to the refuelling station (using a truck or pipeline). The build-up of a hydrogen pipeline network requires large investments which will make only sense in the large scale demonstration phase if the hydrogen source is near the refuelling station and the demand is high (enough). Even than a pipeline is costly since the utilisation of a refuelling station can be low. Investment subsidies on pipelines need to be available, but also zero interest loans are favoured by the stakeholders. However, the solution of providing hydrogen by truck can also be chosen for the large scale demonstration phase. Trucks transporting hydrogen are available and need little subsidy according to the stakeholders.

For the large scale demonstration project, also an incentive is needed to compensate (e.g. subsidy) the investments in the refuelling station itself. Here also the (initially) low utilisation pays a role, because it is likely there are a couple of refuelling stations for a limit amount of vehicles. The subsidy for the refuelling station (including storage and refueller) should be dependent on the size of the installation.

Hydrogen end-use applications

The cost of hydrogen vehicles will still be high in the large scale demonstration project phase. During this phase the attention should be focussed on reducing this capital burden for the end-user. This can be done by providing the end-user with an

incentive (like tax exemptions), but also by reducing the cost for the OEMs. Both these incentive will lower the risk for the OEMs since it increases the likelihood that there will be a market. The OEMs can be supported by increasing the funding percentage (compared to current funding levels) and providing subsidies that cover more eligible expenses. For example the development cost (or part of it) of the vehicle up to now can be included, the in-kind contributions can be taken into account, or maintenance and spare part cost can be included for the demonstration phase.

Both hydrogen ICE and FC vehicles are being developed. Simply making a distinction based on the 'engine' used is not favoured by the stakeholders. The total cost of the vehicle has to be taken into account when considering support. The EUCAR, Concawe, JRC (2007) and HyWays studies show there is a difference in cost depending on if it uses a hydrogen ICE or fuel cell. By the stakeholders it is suggested to stimulate hydrogen ICE and FC vehicles based on the (additional) cost of the new technologies used in the vehicle (engine, FC, storage tank, etc.).

Fiscal reductions and exemptions mainly on purchase tax (or tax credits) on the vehicle and exemption of excise duty for hydrogen as a motor fuel are also mentioned by the stakeholders as important policy support measures that have to be in place. Although the contribution for the industry of these instruments is limited in the large scale demonstration phase, it is good for public perception and PR and paves the way for introduction of hydrogen in transport in the long run.

2.3 Policy support after large scale demonstration projects

After the phase of large scale demonstration projects the pre-commercial market phase will start. During the pre-commercial market phase there are still additional cost for the hydrogen fuelled vehicle and fuel compared to the reference vehicle and fuel. In this phase the focus is more on creating a favourable market for hydrogen in transport and setting up even bigger production facilities. The demand for policy support in this phase is even bigger than for the large scale demonstration projects phase, even though the additional costs per vehicles rapidly go down.

Creating market demand and a favourable market for hydrogen in transport can be stimulated by giving support in such a way that the end-user has no (or limited) additional cost. Fiscal reductions and tax exemptions - like exemption of fuel excise duty, no circulation tax, and no registration tax - are still a good support measure in this phase according to the stakeholders. Creating market demand by public procurement (together with regulation) is also seen as important. Nevertheless,

investment and production subsidies still need to be in place to allow the industry to set-up production facilities and so on. Suggestions made by the respondents for other policy support measures which help the industry ramp up their production and relieve the end-user from any additional cost are:

Production of hydrogen; Renewable hydrogen production technologies still require investment subsidies or production subsidies. Emission trading also helps these technologies and, together with zero and low interest loans (reducing cost of capital), will help the build-up of the production of hydrogen.

Hydrogen distribution and refuelling; Initial investments in a hydrogen pipeline network and refuelling stations are very high and will require additional investment support from the government. This can be done by investment subsidies or zero interest loans which reduce the cost of capital for these large investments with long payback time. The support can be made dependent on the network density according to the stakeholders, meaning support goes down when the network expands.

Hydrogen end-use; Public procurement will be a possibility to start market demand. For example government demand for a certain percentage of alternative fuelled vehicles, of which a certain percentage is zero-emission is a good way to stimulate market demand. To increase market demand regulation (fleet mandates) can later be set up to do the same for commercial fleets.

For the end-user, incentives must also be applied in order to reduce the additional cost of both fuel and vehicle compared to gasoline and diesel vehicles. With respect to hydrogen as a fuel, providing tax exemption on excise duty reduces the cost for the end-user.

Tax exemptions on the vehicles can also be given, for instance by setting the registration tax to zero. This only has effect in countries where there actually is a registration tax. Countries without registration tax can provide subsidies or tax credits (i.e. a reduction on income tax) to reduce the vehicle cost for end-users. Some of these measures are already in place in Europe (like in the Netherlands, Denmark and Norway where there is no registration tax on hydrogen vehicles) and the US (tax credits in several States) and these examples should be followed by other countries.

2.4 Non-financial support

From a public perception point of view and from a marketing point of view non-financial support is important to have in place (as soon as possible). The user will value these advantages in addition to driving a hydrogen fuelled vehicle. Examples of

non-financial support measures for hydrogen fuelled vehicles (and/or zero-emission vehicles) are:

- Limited city centre access exemption
- Free parking or preferred parking closer to buildings/shops
- Allowance to use public transport lanes
- Free use of toll roads
- Free use of public transport when using park and ride

For the use of hydrogen fuelled vehicles in early markets, some non-financial support measures have also be suggested. Companies who exploit busses for public transport based on tendering may exploit their services longer if they use hydrogen busses, or one can also include a minimum share of ZEV or a minimum average emission level (gram CO_2 / km) in the terms of reference for the bid. Fleets using hydrogen may deliver their goods also during the day in the inner-city.

Often mentioned by the stakeholders are the uniform regulation codes and standards (RCS) for hydrogen refuelling and vehicles as non-financial support. This is a necessity (removal of a market deficiency) in stead of a possible support mechanism. Also clarity on how to get permission to install hydrogen at a refuelling station is needed. This now differs per member state and even within member states, depending on the region.

Including hydrogen in education and training of engineers is also needed. To further promote hydrogen a public ad campaign can inform the general public about hydrogen as a future fuel.

3 Discussion and conclusion

It becomes clear there is a need for a specific scheme to stimulate demonstration of hydrogen and fuel cells for transport. The scheme has to be able to shift the current stimulation of prototype demonstration to demonstration of small scale series production (of both hydrogen as a fuel and hydrogen vehicles). This implies the following:

- The funding conditions need to be known upfront so it will be clear to the industry that when they meet these conditions they can get financial support. Lengthy application procedures for project support can be avoided this way.

- The scheme should allow some flexibility in the project budgets in case of unforeseen circumstances. By setting up a method to handle budget shift request quickly, delays can be decreased (further). This does not mean the projects will have full flexibility in their budget, it merely points out the change in budget request will be handled quickly and when not approved the project partners can look for alternatives.

- The scheme should allow continual funding, allowing (successful) projects to extend their running time (with additional funding). This can increase the learning of the industry, but an eye must be kept on the optimal learning period.

- The scheme should be long term allowing industry to plan a series of demonstration projects in stead of having to do the whole negotiation and administrative procedure all over again after a single project ended.

A difficulty with setting up a good support scheme for hydrogen and fuel cell demonstration projects is finding the right balance between support of production, distribution, refuelling and end-use. For each of these parts of the hydrogen energy chain several technologies are available and these are all in different states of technological maturity. Clarifying the support conditions upfront for the different technologies is preferred by stakeholders. The stakeholders deemed a technology specific approach necessary and preferred:

- The support for the production of hydrogen to depends on the technology used in relation with the end-user cost for the fuel. For example existing technologies (SMR) and sources (by-product) of hydrogen could receive limited investment subsidy compared to sustainable production technologies of hydrogen. Although not mentioned by the stakeholders this sounds more like a feed-in tariff.

- The support for the transportation and refuelling, since it is likely there will be under utilization on the pipeline and refuelling station, should be on the investments made. Subsidizing a hydrogen pipeline infrastructure in this phase of technology development makes only sense if the production plant is close to the refuelling site. By providing zero or low interest loans the industry would also be stimulated to take hydrogen pipelines into account already in this phase.

- The hydrogen vehicles in the large scale demonstration phase are still costly and not only need investment subsidies (reducing the additional cost for the end-user), the capital burden for the OEMs need further support as well.

Support after large scale demonstration projects

There are still additional costs which require support after the large scale demonstration projects. Preferences for policy support measures shift more towards fiscal reductions and tax exemptions and public procurement, however investment and production subsidies need to be kept in place. Creating favourable market conditions by tax exemptions (for instance, no purchase tax and excise duty) and public procurement are ways to stimulate market demand. Production of hydrogen can be increased by production and investment subsidies and in the long run inclusion in the emission trading scheme. For pipeline networks investment subsidies (maybe dependent on the network density) should be kept in place as well as providing zero-interest loans. OEMs need to make further (and larger) investment in production plants and would benefit from zero-interest loans as well.

Non-financial support

For the large scale demonstration projects non-financial support is beneficial to have in place but not a necessity. On the other hand, the public perception and marketing of hydrogen in transport would benefit if there were non-financial support measures in place.

The phase after the large scale demonstration projects would benefit greatly from having non-financial support in place. Some examples are (i) an exemption for limited city centre access exemption, (ii) free parking or preferred parking closer to buildings/shops (iii) allowance to use public transport lanes, (iv) free use of toll roads, (v) free use of public transport when using park and ride. Extending the permits of bus operators using hydrogen busses can be useful measures to support hydrogen in transport.

References

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HyLights (2007) Intermediate Report for all Prioritised Demonstration Projects serving as input for the consecutive gaps analysis and demo project assessment in WP4, D2.5, March 2007

EUCAR, CONCAWE, JRC (2007b) Well-to-wheels analysis of future automotive fuels and powertrains in the European Context - Tank-to-Wheels Appendix 1 – Vehicle retail price estimates, Version 2c, March 2007

Appendix A Interview list

ET Energie Technologie
Shell Hydrogen
Total
Linde gas AG
Opel/GM
BMW
New Iceland Energy
BP
ENI Tecnologi

Deliverable 2.5:
ARGEMUC (ET Energie Technologie)
ECTOS (New Iceland Energy)
CUTE (Daimler)
ZERO REGIO (Infraserve Höchst)
HyFLEET: CUTE (Daimler)
Clean Energy Partnership (MVV Consulting)
HYCHAIN (Air Liquide)
HyNor (Hydro)
London Hydrogen Transport Programme (Greater London Authority)

Appendix B Interview questions

Policy support for demonstration projects and early markets

HyLights is an EU funded project assisting all stakeholders in the preparation of the next important phase for the transition to hydrogen as a fuel and long-term renewable energy carriers in the transport sector. This next phase will comprise large scale demonstration projects ("Lighthouse projects"), leading to an acceleration of the commercialization of hydrogen and fuel cells in the field of transport in Europe.

Goal of the questionnaire

One of the aims of the project is to gain insight in the instruments that currently support the demonstration projects. What are the strong and weak points of the current supporting schemes? Furthermore, can these instruments also be applied when entering the next phase of demonstration projects? Is it for example necessary to implement tailor made support mechanisms for production, infrastructure development and hydrogen vehicles individually?

More information on the HyLights project can be obtained from www.hylights.eu or by contacting Menno Ros (+31 224 56 4423, ros@ecn.nl) or Per Godfroij (+31 224 56 8258, godfroij@ecn.nl) of ECN Policy Studies.

Introduction

There are several possibilities for governments to support hydrogen and fuel cell demonstration and early market deployment. In the past, the various parts of the energy chain have been subsidised by a 35% subsidy on investments in the EU. In future, different parts of the chain (production, distribution, end-use) might need different kinds of instruments. Instruments that can be used are:

1. Investment subsidies
2. Subsidising the production of hydrogen
3. Zero or low interest loans
4. Tendering and bidding
5. Fiscal reduction or exemptions

6. Quota obligations
7. Emission trading
8. Emission standards
9. Regulation
10. Public procurement
11. Voluntary agreements

Questions

1. Which policy support do you get/provide for current projects? (type of instrument, funding rate)
2. What are the main draw backs, what are the strong points?
3. How do you regard the funding level? Is it adequate? What are your expectations with respect to the development of future funding levels (i.e. the upcoming series of lighthouse projects and beyond that).
4. Are there any other (practical) observations with respect to the current financing scheme that you want to share with us?
5. For future projects which financial instruments (mix) would in your opinion be most suited for the upcoming lighthouse projects?
6. Should/Can there be a difference in support amounts between production, distribution and end-use of hydrogen or do all the parts of the chain have to be supported equally?
7. Why? Can you explain your preferences?
8. Are there any non-financial support mechanisms that would have been very helpful (i.e. limited city centre access etc.)?
9. Which other (non-financial) instruments would in your opinion be most suited for the upcoming lighthouse projects?
10. Should/Can there be a difference in support amounts between production, distribution and end-use of hydrogen or do all the parts of the chain have to be supported equally?
11. Why? Can you explain your preferences?