

HYLIGHTS

Hydrogen for Transport in Europe

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Methodology to assess stakeholder requirements and interests
The GAPS analysis (Deliverable 4.2)

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

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The European Commission is supporting the Coordination Action “HyLights” and the Integrated Project “Roads2HyCom” in the field of Hydrogen and Fuel Cells. The two projects support the Commission in the monitoring and coordination of ongoing activities of the HFP, and provide input to the HFP for the planning and preparation of future research and demonstration activities within an integrated EU strategy.

The two projects are complementary and are working in close coordination. HyLights focuses on the preparation of the large scale demonstration for transport applications, while Roads2Hycom focuses on identifying opportunities for research activities relative to the needs of industrial stakeholders and Hydrogen Communities that could contribute to the early adoption of hydrogen as a universal energy vector.

Further information on the projects and their partners is available on the project websites www.roads2hy.com and www.hylights.eu.

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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.

Acknowledgement

In the framework of the 'HyLights' project which is funded by the EU 6th framework programme this study presents a methodology developed to assess potential early markets for the application of hydrogen vehicles. The report also describes the validation of the methodology and the results based on interviews that were conducted in the Netherlands. In a later phase of the project more interviews will be conducted and a more extensive assessment of early markets will be performed. Therefore this report should be seen as part of a broader study. The project is registered at ECN under project number 7.7700.

Abstract

This report describes the methodology that has been developed by ECN to assess stakeholder requirements for and interest in large scale demonstration projects and early markets for hydrogen in the transport sector. The methodology has been validated by applying it as test case in the Netherlands. To do so interviews have been conducted with several stakeholders. National governments are seen as key stakeholders in the development and deployment of hydrogen technologies. An analysis of national governments will give insight in the possibilities they have to support hydrogen technologies. In this report the Dutch national government has been analysed regarding purchasing of governmental vehicles and procurement of public (bus) transport. Based on the results recommendations are drawn for further steps in analysing the requirements and interest of stakeholder on a European level.

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Executive summary

In order to define potential early markets for hydrogen in transport, it is necessary to assess the performance level of the current state of technology (vehicles, infrastructure etc) and to compare this with the minimal requirements of potential end-users. To do this, a methodology has been developed: the gaps analysis (Figure S.1). The gaps analysis describes which criteria are important to define the performance levels of current state of technology and of the required technology. An important issue in this is to define potential early markets and discuss the minimal level of the key performance indicators (KPI's). The KPI's describe the performance of the hydrogen vehicle in terms such as maximum driving range, pay load, fuelling time etc.

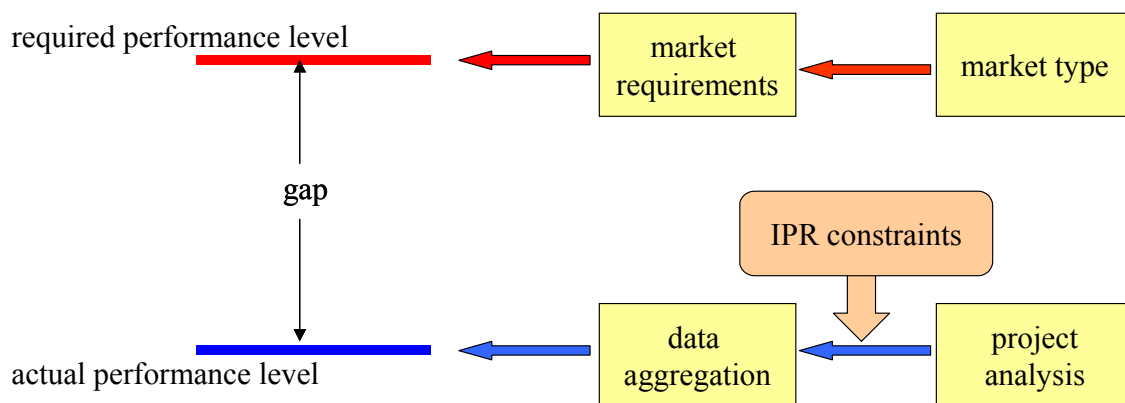


Figure S.1 Schematic representation of the gaps analysis. This report will focus on the upper part (red) of the gap

This report describes the methodology development and validation. The results of the first outcomes of applying the gaps analysis methodology in the Netherlands are included. Based on a theoretical approach, relevant stakeholders have been selected on the level of national government, local government (provinces and cities), bus

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companies and commercial stakeholders. These stakeholders¹ (16 in total) have been interviewed to define their potential interest in participation in demonstration projects and to discuss the minimum performance level hydrogen technologies should comply with. Governments are seen as key stakeholders in the process to come to early market. As a test case, the Dutch government has been analysed to describe the process of acquiring of governmental fleets and to describe the process of public procurement of public transport (buses) in the Netherlands.

The interviews have shown the interest of stakeholders to discuss the potential role of hydrogen technologies in their organisation. Most respondents have expressed their interest but they also indicated that they see important barriers as it comes to the availability of vehicles, the current performance of vehicles, the expected costs of vehicles and the lack of support from the government. Most actors indicate that, though everyone should take his responsibility, in their view, the EU and the national governments should take the leading role when it comes to the introduction of new technologies. Due to these barriers, the discussions with the stakeholders have mainly been based on a hypothetical demonstration project. In practice, it was rather difficult to discuss key technical data as defined by the KPI's. As a consequence, the discussion mainly resulted in qualitative information. Some methodological revisions will be made in order to obtain the required data in the second phase of the project which will have an European broad scope.

Within its guidelines for purchasing governmental vehicles, the Dutch government describes the minimal environmental performance of the vehicles. Enhanced environmental friendly vehicles have also been defined. However, the guidelines focus explicitly on technologies that are commercially available on the market. So demonstration projects cannot be part of the current purchasing procedures. The procurement of public transport bus services is the responsibility of the public transport authorities. Those authorities are focussed on good services for a fair price and so environmental aspects seem to be of minor importance. The national government, however, is developing a new concession format (the innovation concession) which should stimulate the use of innovative technologies.

¹ The interviewed organisations are: ministry of environment (2 divisions), ministry of transport, province of Noord-Holland, province of Friesland, city of Amsterdam, city of Arnhem, city of Nijmegen (2 divisions), city of Leeuwarden, GVB Amsterdam (public bus service Amsterdam), Connexxion (national bus, taxi and ferry company), Berlin Verkehrsbetriebe (bus company of Berlin), Greenwheels (car sharing company), TNT, Green Planet (multi-fuel filling station).

Taking into account the results of the first round of interviews, the next steps are suggested for 2007:

Using the Key Performance Indicators (KPI's) to define the current and future state of technology and the state of technology of conventional vehicles (as reference). This quantitative information will be used to discuss the minimal required performance level in terms of the KPI's with potential users of early market applications. This will result in a graphical presentation of the difference (the gap) between the required performance level and the current and foreseen performance levels. The stakeholders to be interviewed will be selected based on the actor mapping. For each type of actor (e.g. mail delivery company), several companies throughout Europe will be interviewed to define the potential of early markets for their specific application.

To get more insight in the way governments are organised and how they could play a role in the development and deployment of hydrogen technologies, additional governments will be interviewed and analysed the way the Dutch government has been analysed. First steps have been made for Germany and the United Kingdom. The information on this subtask will be helpful in defining how to set up support mechanisms for governments to foster the development of hydrogen technologies.

In order to define high-potential locations for demonstration projects, a new process will be started to involve regions more actively in HyLights. The result of this process will be multi-purpose. The process should lead to an overview of expectations of different actors and their market development plans over time (what early markets can be established, where and when). Based on these market development plans, a check will be made to define whether the right governments and companies have been interviewed (see first two bullets). If organisations are missing, they will be approached later on in the process.

1 Introduction

An important issue within the HyLights project is to assess the difference between the current performance level of hydrogen technologies and the performance level that is required by potential users of early market applications of hydrogen technologies. Although on some aspects hydrogen technologies do not meet the performance of conventional technologies, there may be several cases where the performance level is sufficient to fulfil the minimum requirements. This specific part of the market is called an 'early market'. The various early markets will have different gaps between current performance and required performance. This gap aims to give insight in necessary technological developments and the timing of the following early markets as well as the potential ways to bridge the gaps.

In order to define how to assess the gap between the current performance level and the minimal required performance level a gaps analysis methodology has been developed by ECN and discussed between the project partners. To validate the methodology, it has been applied to the Netherlands. Chapter 2 describes in more detail the development of the methodology, while Chapter 3 describes the first outcomes (validation process).

During the discussions with key stakeholders on the issue of early markets it became clear that governments are seen as key actors in early market development. This is not only as governmental support will be necessary for hydrogen technologies to become successful but governments could be early users of the technology as well. Chapter 4 gives a general description of how decisions are made within the Dutch government relating to the purchase of governmental vehicles and the procurement of public transport bus services. Chapter 5 describes conclusions and suggested next steps.

2 Methodology development

This chapter starts with a brief description of the gaps analysis method. As the gaps analysis is mainly based on requirements and expectations of potential users of early market applications it is necessary to identify first which actors will be relevant to contact. The second section of this chapter will elaborate on how to map the relevant stakeholders.

2.1 GAPS analysis

The gaps analysis consists of a comparison of the actual performance of the technology and the performance required by potential end-users. The actual performance will be determined by means of an analysis of past and ongoing demonstration projects.² This report will elaborate on the required performance level which is determined by the market type and end-user requirements (Figure 2.1).

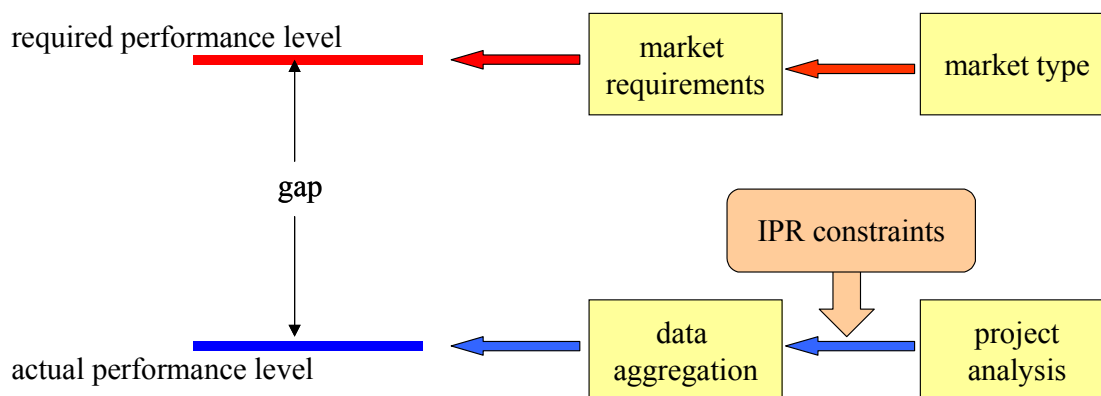


Figure 2.1 Schematic representation of the gaps analysis. This report will focus on the upper part (red) of the gap

² The assessment of the actual performance level is carried out in another part of the project and as such not described in detail in this report.

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The required performance is not only determined by technological characteristics but in general all the requirements ('needs of the end-user') of the specific market are relevant (reliability, investment costs and operational costs, pay load etc.).

2.1.1 The required performance level

The main question is how to determine the required performance level in order to assess the gap between the current state of technology and the requested specifications. The required performance level is determined by the end-user and depends strongly on the type of market (market requirements), see Figure 2.2. For a taxi operating in city centres, a daily driving range of 200 km might be sufficient, even though the vehicle needs heat and power for several hours a day waiting for customers at a taxi stand. Salesman may travel 60,000 km a year, needing a long daily driving range (800 km per tank (or more) as a convenient driving range).

In a number of markets the performance of the conventional ICE-vehicle might exceed (by far) the user requirements. Having the hydrogen vehicle to meet the same specifications as a conventional ICE-vehicle could lead to an unnecessary over-performance (leading to unnecessary high costs). In those markets where the current state of hydrogen technology will be sufficient to fulfil the minimal requirements of the end-user, early markets can be established. These early markets can serve as a bridge towards the mass markets where the hydrogen vehicle has to compete with the conventional vehicle (and its performance) in the end. Further technology development will make more demanding early market applications feasible and so the road to mass market introduction can be gradually paved (evolution of early markets).

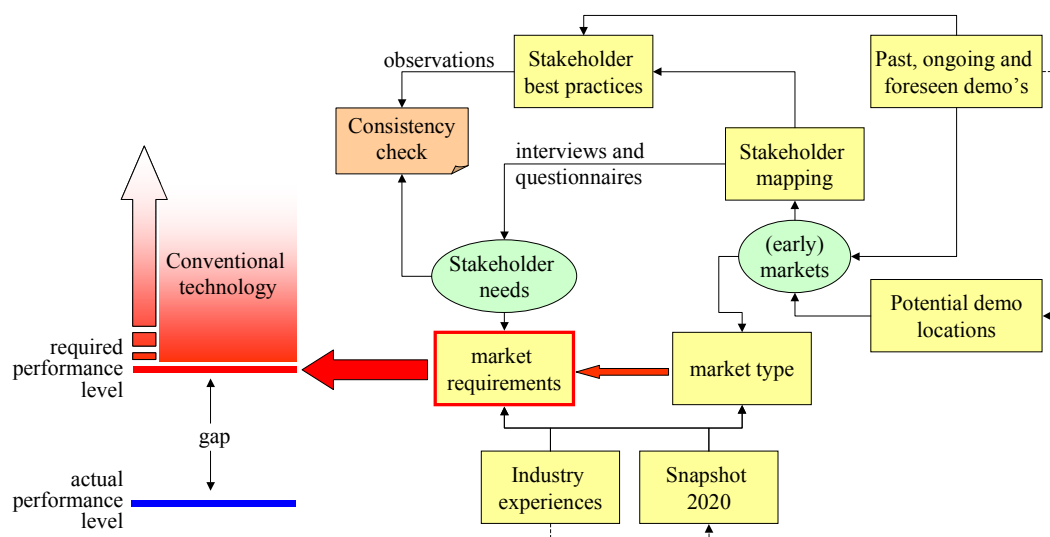


Figure 2.2 Schematic overview of the activities and processes involved in setting the required performance level for the hydrogen vehicle

Figure 2.2 gives a graphical overview of how early market requirements can be defined. This figure will be explained in more detail in the following paragraphs.

There are several sources to identify the early market requirements. First of all, it can be based on the values given in the 'Snapshot 2020' as provided by the Deployment Strategy group of the Hydrogen and Fuel cell Partnership (HFP) combined with experiences within automotive industry. In addition, a parallel approach is based on mapping the relevant stakeholders. The theoretical potential early markets are the basic input for this stakeholder mapping. The mapping of the stakeholder network serves as the basis for the assessment of the stakeholders' best practices and, by means of interviews and questionnaires, the specific stakeholder needs are assessed (e.g. the needs of the end-user³ in terms of technological, economic requirements as well as social and environmental).

The figure also shows the link between various tasks within the HyLights project. For example the assessment of high potential locations for future large scale demonstration projects as well as the characteristics of past, ongoing and foreseen demonstration projects will provide information with respect to early markets.

2.1.2 The assessment framework

To determine the gap between the actual performance level of the technology and the minimal required performance level by the end-user, it is essential that both performance levels are defined by the same set of indicators. These indicators, the assessment framework, have been determined by means of an iterative top-down and bottom-up approach. For the top-down approach, a list of key performance indicators is compiled on a theoretical basis. The bottom-up approach investigates the existing assessment frameworks (including their aim!) and builds upon that.

In order to test which indicators are useful to get insight into the gaps, the Netherlands was taken as a test case. By conducting several interviews (the top-

³ The end-user can be a company or a governmental organisation, it is not necessarily a consumer (in this case: it is likely not to be a consumer).

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down approach) insight is gathered in the validity of the indicators. Indicators used in the interviews are:

Opportunities

For own fleet

For public transport

Drivers

Local air quality

Global climate change

Political will

Company image

Barriers

Cost

Technological performance

Availability of technology

Support of management/politics

Resources

Financial resources to purchase/stimulate hydrogen

(Policy) Initiatives

Demonstration project

Parking license

Public transport (purchase) obligation

Responsibilities to promote hydrogen

European Union

National government

Local government

Industry

Alternatives to attain goals

Biofuels

Natural Gas

Hybrids

Renewable hydrogen

Renewable production in 20xx

The indicators used in the interviews are a mixture of technological, economic requirements as well as social and environmental. Actors approached for the interview were selected based on the stakeholder mapping.

2.2 Stakeholder mapping

Within the field of hydrogen numerous actors interact with each other. On the one hand manufacturers of hydrogen technology systems (vehicle and fuel cell stack manufacturers) and producers of hydrogen are developing new technologies and products with the aim to develop a mass-market product. On the other hand governments try to stimulate the development of technologies that can help to attain their policy goals. While (potential) users weigh carefully the pro's and cons of a certain product before they will buy or use one. As all actors are operating more or less within their own framework, it is likely that they will have different expectations and prerequisites. However, early markets should be established in those cases where different actors can cooperate in a way that all interests are served. That is why it is very important to map the relevant stakeholders and to get a clear view on their considerations in order to find common ground (see Figure 2.3).

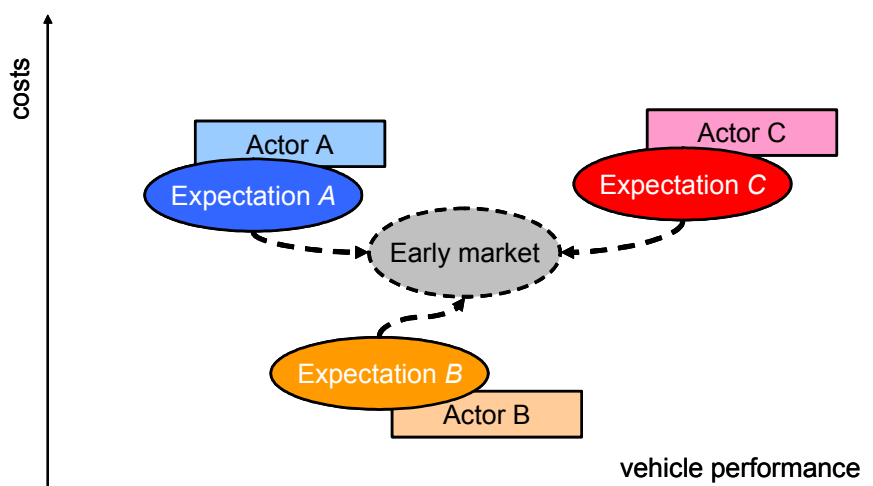


Figure 2.3 Expectations and requirements concerning for instance cost of different actors

The first step while mapping the actors is to define those actors that might have an important role in the deployment of the first early markets. By conducting interviews, insight into the different expectations is gathered. In addition, insight into the relationship and interdependence between actors is obtained.

2.2.1 Selection of key stakeholders

In general two types of end-users can be identified 1) actors that are focussed on solving societal problems (mainly governments) and 2) actors that are mainly

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focussed on bringing down their costs (mainly companies and private car owners). Governments might be users in the way that they can use hydrogen technologies themselves (governmental fleets) or that they provide incentives to enable the use of hydrogen in other parts of the transport sector (e.g. public transport). The government is responsible for solving problems related to climate change, local air quality and security of supply. In theory, they operate under suitable market conditions (protected monopolistic market) to act as early market. In a competitive economy commercial companies try to minimise costs in order to maximise profits and they are probably only willing to invest in new and more expensive technologies if it will give them a competitive advantage (e.g. more appreciated by clients - image) or if governmental law forces them to do so (emission caps, limited city centre access for polluting vehicles, etc - level playing field).

To identify actors' expectations and requirement levels, potential users (governments and private companies) have been interviewed. These users have been selected on the basis of expected interest, potential key locations for hydrogen technology applications or contribution to ongoing, past or foreseen demonstration projects. Specific attention has been paid to the local and national governments as key actor in this process. The interviews bring forward the prerequisites of potential users to switch to hydrogen technologies in the (nearby) future. Suppliers of hydrogen technologies or hydrogen itself are part of the HyLights consortium and have been asked to share their views on early markets in terms of expectations and foreseen performance levels during a workshop organised in September 2006.

3 Validation: first results for the Netherlands

Concerning the development of hydrogen technologies, different actors might have their own perspectives and expectations on how these technologies should be developed and deployed and how early markets should be planned. Often those perspectives include assumptions on the role other actors should play. If expectations are not made explicit the risk exists that expectations and reality do not correspond. If this is the case development and deployment of the new technology might be hampered. This chapter will give an overview of perspectives of relevant actor groups. In addition actors' expectations and minimal requirements for new hydrogen technologies are discussed. After all, demonstration projects will only be feasible if the performance of a technology matches the minimal required performance level of the actors. The information is collected by means of interviews (so far mainly conducted in the Netherlands)⁴. Questions asked during the interviews are included in Appendix A for policy makers and Appendix B for industry stakeholders.

3.1 About the interviews

Fifteen interviews have been conducted (of which 14 in the Netherlands) with representatives from cities, provinces, national governments, bus companies and commercial stakeholders⁵. The interviewed organizations are chosen because of their potential role of participation in future early markets and/or large scale demonstration projects. During the interviews people are asked to describe their interest in and the possibilities they foresee to become active in demonstration projects for hydrogen technologies. The interviews were focussed on acquiring quantitative information on the minimal performance level (see Chapter 2). In those cases that actors were not as such interested in hydrogen or if they had little know-

⁴ This version of the document has been sent to the respondents of the interviews for comments though not all have given their approval yet and so no conclusions may be drawn about *formal* views of governments or other organisations.

⁵ The interviewed organisations are: ministry of environment (two divisions), ministry of transport, province of Noord-Holland, province of Friesland, city of Amsterdam, city of Arnhem, city of Nijmegen (two divisions), city of Leeuwarden, GVB Amsterdam (public bus service Amsterdam), Connexxion (national bus, taxi and ferry company), Berlin Verkehrsbetriebe (bus company of Berlin), Greenwheels (car sharing company), TNT, Green Planet (multi-fuel filling station).

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how on the issue, the interviews have been focused on the development of sustainable transportation in general. An overview of the outcomes of the interviews ordered by stakeholder group is presented in Appendices C till G.

The cities that have been interviewed are Amsterdam, Arnhem, Nijmegen and Leeuwarden. These cities have been selected based on their interest in either hydrogen technologies or their policies in relation to clean and sustainable transport. One of the cities (Amsterdam) is already involved in hydrogen projects within the transportation sector (CUTE and HyFleet CUTE projects). The city of Leeuwarden is actively promoting demonstration projects with different kinds of alternative energy sources, like hydrogen applications for housing, natural gas busses and cars, bio-ethanol and biodiesel use and it was one of the organizers of the Frisian Nuon Solar Challenge (a race for boats powered by solar energy). Arnhem and Nijmegen, as neighbouring cities, have been contacted as Arnhem has a relatively large number of hydrogen technology industrial players (like Nedstack, HyGear and KEMA) whereas Nijmegen is known for its interest in standards for clean vehicles entering the city centre. The HAN University of Arnhem and Nijmegen educates a.o. automobile technology. With stationary applications of hydrogen technologies Arnhem is one of the most active regions in the Netherlands. For example they have established the Arnhem Hydrogen Network Netherlands.

On the level of provinces two out of the twelve Dutch provinces have been contacted to interview: the province of Noord-Holland and the province of Friesland. In general provinces are responsible for procurement of public bus services within their own region (see also Chapter 4; the government as key stakeholder). As public busses are seen as an important early market application for hydrogen technologies, the provinces are of interest to consult. The province of Noord-Holland has been chosen to interview as they have recently given a concession to a bus company that was offering to operate natural gas busses in the capital of the province, Haarlem. Nowadays all city busses in Haarlem run on natural gas. The interview was held with a representative of the department of transport which is responsible for procurement of public bus services. The province of Friesland is, like its capital Leeuwarden, active in developing and supporting renewable energy applications. The contact person for Friesland was responsible for environmental issues and was also representing the city of Leeuwarden.

On the level of national government different interviews have been conducted with the representatives of the Dutch ministry of environment (VROM) and with the Dutch ministry of transport (Verkeer en Waterstaat). In the Netherlands the ministry of environment is responsible for issues relating to climate change and for reduction of emissions (including emissions from transport). VROM is also the leading department concerning issues related to sustainable purchasing of the national government. In the Netherlands, six ministries have jointly decided to work on sustainable development. In the 'energy transition' programme the ministries aim at encouraging and speeding up the shift to new energy sources. The programme consists of six themes. One of these themes is sustainable mobility, an issue the ministry of

transport is responsible for. Besides, this ministry is responsible for achieving the national ambition level regarding the emission of carbon dioxide within the transportation sector. The ministry is also responsible for allocating budgets for procurement of public transport and for granting licenses to taxi companies.

Three bus companies have been interviewed; the private company Connexxion and the municipal bus companies GVB (Amsterdam) and BVG (Berlin). These companies have been contacted as they are either already involved in hydrogen projects (GVB - HyFleet CUTE, BVG - Clean Energy Partnership Berlin). Or have announced to start a feasibility study for realisation of a demonstration project with approximately 20 hydrogen busses (Connexxion).

In the private sector four commercial actors have been approached for an interview. One of them, a car sharing company, was explicitly not interested in hydrogen technologies and so no interview was carried out. One of the private actors is bus company Connexxion (see the previous paragraph). The remaining two actors are TNT and Green Planet. TNT (a global mail delivery company) has been approached as they have a large vehicle fleet with potential for early market application and because of their Driving Clean Strategy (an initiative to support environmental friendly transport, which has resulted so far in the use of a.o. soot filters and biodiesel). Green Planet is developing a new concept for refuelling stations. They plan to sell different kinds of alternative fuels (natural gas and biofuels), and the electricity necessary to operate the fuelling station will be generated by own wind mills.

3.2 Assessment of expectation and requirement - the Netherlands

The interviews have been conducted to define potential commitment and interest of relevant stakeholders to participate in future demonstration projects. The outcomes of the interviews will give an impression of expectations and requirements of different kinds of stakeholders concerning the role of hydrogen technologies in the future. As the stakeholders have been chosen based on a theoretical determination of potential early markets, it has been no surprise that many of them indicate that, theoretically, they see good possibilities to support hydrogen or to start using hydrogen technologies within their organisation as kind of a demonstration. The possibilities vary from (more) hydrogen busses, to hydrogen vans for mail delivery, passenger cars for civil servants and special applications for e.g. road construction work.

While contacting the respondents most of them seemed to be very interested to discuss hydrogen technologies and the potentials thereof for their organisation. Interest of stakeholders has been related to a kind of curiosity to learn more about the current state of technology. As the kind of stakeholders is very different it is not remarkable that they have very diverse motives. In general the cities and provinces are interested in innovative technologies as it could solve the problems they are

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facing regarding local air quality, besides new technologies can give an impulse to local industry and may benefit the image of the region or the local politicians. In general, the interviewed bus companies are interested to use new technologies as they have to meet emission standards that are becoming more and more stringent. As they expect hydrogen will be the fuel for the future they prefer to invest in this technology instead of, for example, the natural gas technology. The interviewed commercial actors have different motifs to be interested in the technologies. For them practicing business on a social responsible way may be important. Besides they expect to be able to profit from new developments, though customers are not expected to be willing to pay for it.

Despite the possibilities the actors see and their positive attitude towards the technology, there are some serious barriers that have limited their actions so far and which may limit also their interest in future. Obvious barriers are the availability, the costs and performance of hydrogen vehicles. Although many actors are enthusiastic to participate in demonstration projects, the additional costs should be limited or be covered by others (e.g. the government) as they will not be able to transfer these costs to their customers. Uncertainty about the future role of the new technology and the speed of further developments weakens the enthusiasm of some actors. Another important barrier that is mentioned is related to the role they assign to the national government. Most actors indicate that, though everyone should be held responsible, to their views, the EU and the national governments should take the leading role as it comes to the introduction of new technologies. As long as the national government does not have a clear vision and strategy on sustainable transport, the other actors feel a bit directionless. Actors are reluctant to choose for a certain technology as long as they have no back up from the government. The same holds for financing of projects as financiers are hesitant to loan money for projects that possibly might not be the technology of the future. Besides commercial actors will only be able to calculate the additional costs of the new technology to their customers with a supporting policy framework in place.

The Dutch national government seems to be keen on the development of new low carbon technologies that could help to solve the problems that are caused by the emission of CO₂. So far, however, they do not take for granted that hydrogen will be indispensable in the future. They wonder whether hydrogen technologies will develop sufficient to become (nearly) competitive with conventional technologies regarding to performance and costs and whether hydrogen will be the most efficient renewable (or low carbon) fuel. To their view main competitors for hydrogen are biofuels. All EU member states are already actively supporting biofuels as they are forced to by the European directive on biofuels. In their opinion, biofuels can have a significant contribution to reduce greenhouse gas emissions. The underlying assumption (made by the government) is that biofuels can have an emission reduction potential of up to 90% compared to fossil fuels (well-to-wheel). If hydrogen will be produced from sustainable fossil sources (so including CCS) or from renewables it will further reduce greenhouse gas emissions. If biofuel production potentials are sufficient to cover the energy demand in the transportation sector, the Dutch government wonders whether investments in hydrogen technologies are necessary. Nevertheless other alternatives

might be interesting, for example, hydrogen produced from fossil fuels combined with carbon dioxide capture and storage or technical benefits of fuel cells compared to internal combustion engines.

Although it is relevant to know which technologies might contribute to solving (future) policy goals, to the view of the government industry has to decide on which technologies to develop. The government itself should define a policy framework with boundary conditions and goals. Within this framework it is up to the industry to find the suitable technological solutions (technology neutral policies). For the short term technologies that have a convincing outlook should get support within their current development stage.

While discussing the development and deployment of hydrogen technologies a relevant question is whether there is a need to invest in hydrogen technologies or whether (better) alternatives exist. The respondents have indicated their views on potential alternatives and they seem to be related to their own drivers and main goals. In general one could say that for local actors the drivers are also more focused on the local level and here mainly environmental issues (air quality and noise) and innovation are important. Alternatives to contribute to tackle these problems could be alternative fuels, like natural gas, and enhanced conventional technologies, like particle filters and catalysers. For commercial actors the alternatives depend mainly on the policy framework of the government, though some of them strive to be a social responsible company themselves.

The respondents from the national government indicated that they expect that most short term policy goals (local air quality) could be solved by using advanced conventional technologies and so for the medium to longer term their main focus is on solving the problem of climate change and security of supply.

4 The government as key stakeholder

Compared to conventional vehicle technologies (i.e. the internal combustion engine running on fossil fuels) hydrogen technologies will mainly have benefits for the environment due to their ability to reduce emissions and to decrease the dependency of fossil energy sources. More benefits are expected (less maintenance and more electricity on board) but those benefits are estimated to be small compared to the current costs of the technology.

As mainly society in general will benefit from the new technology and as the costs of the technology might be far from competitive on the short term (compared to conventional technologies) it is to say that governments are a very important stakeholder within the development and deployment of this new technology.

If governments recognise the potential of hydrogen technologies to contribute to sustainable development they could take a leading role in supporting it. In general new technologies can be supported by financially stimulating research, development and deployment or by creating market opportunities, see also (Ros, 2006). In order to make environmental friendly technologies viable environmental costs should be internalised or emission standards should be set in the end. This will give a negative incentive to the reference technology. It is however insufficient to overcome the initial barriers that a disruptive technology such as hydrogen faces. To support the first small markets, the early markets, governments could be very supportive by applying the technologies themselves or by trying to create early markets in the semi-public (like public transport), or even the private sector. This section will elaborate on the way the Dutch government has organised the purchase of its own vehicles and the public procurement of public transport. By exploring this, conclusions can be drawn about under what conditions it will be possible for the government to switch towards new, innovative and sustainable technologies. A distinction will be made between purchase of own vehicles and the procurement of public transport. Information in this chapter is based on interviews and literature research.

4.1 Governmental fleets

The Dutch national government owns approximately 10.000 vehicles varying from passenger cars, to vans and lorries. This number does not include the vehicles owned by cities, provinces (12) and governmental organisations. In the Netherlands all ministries, provinces, cities and other organisations are responsible themselves for the purchase of their own vehicles, however on the national level guidelines have been formulated to describe the minimal performance level of the vehicles. Within these guidelines (which are in place for the period 2006-2010) environmental aspects are covered as well. Minimal requirements are: comply with Euro 4 emission standard; diesel vehicles should be equipped with particle filters; fuel efficiency

should correspond with the energy labels A, B or C⁶, ministers are allowed to use cars with label D and all vehicles should be equipped with fuel consumption indicators.

Beside the guidelines that apply for all vehicles a specific section of the guideline has been devoted to innovative vehicles. This section describes the requirements an environmental friendly vehicle should comply with. The main issues in this are that the vehicles should be able to use alternative fuels (defined as: for example natural gas or hydrogen) or it should be equipped with an alternative power drive like hybrid technologies. An interesting issue is that maintenance should be feasible without specific technological know-how.

The guidelines (VROM, 2006) actually describe which vehicles could be purchased by the government for the case these vehicles are available on the market. Purchasing does not take into account using vehicles as kind of demonstration project. The guideline for environmental friendly vehicles will be revised in 2008. Every two years each ministry has to report to parliament what kind of vehicles they have purchased. The national government has announced the ambition to be zero carbon from 2012. Governmental vehicles are subject to this ambition as well and so in the next years guidelines will be developed to formulate how to achieve this.

Recently (December 2006) the department Rijkswaterstaat (responsible for national road and water management) of the ministry of Transport has announced to start a feasibility study on the possibilities to use hydrogen vehicles for road maintenance work (e.g. mobile road barriers, small ships, mowing machines, cranes and tractors) (Rijkswaterstaat, 2006).

4.2 Procurement of public transport

In the Netherlands procurement of public transport is, with exception of rail transport and taxi services, the responsibility of the 19 public transport authorities (PT

⁶ Dutch system, based on a European directive, to indicate fuel efficiency of vehicles. Saling is from label A to label G. C is 0-10% more efficient than average, A and B are respectively >20% and 10-20% more efficient; efficiency is based on size of vehicle and absolute fuel consumption

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authorities) (see Figure 4.1). These authorities (the 12 provinces and 7 large city regions) are responsible for (mainly) bus transport in their own region. The national government, by the ministry of Transport, assigns money to the regions for executing the bus services. The budget is based on parameters like the number of inhabitants of a certain region and the empirical tested number of users of the bus services. A federal law describes the prerequisites for public procurement, but the requirements for the bus services itself are set by the PT authorities (independently from each other). The federal law, for example, describes the maximum procurement period, which has recently been extended from 6 to 8 years.

The PT authority defines the minimal requirements and puts it out to tender. The bus company that scores the most points based on the different criteria is rewarded with the concession. The bus company is paid for the agreed service and additional income (40% in total) comes from the gains of the purchase of tickets. Ticket prices are set by the national government and tickets can be used for all bus services in the country) The PT authority might allocate additional money for the bus service if they prefer to have alternative vehicles (like natural gas or hydrogen busses).

The main criteria which the PT authority sets are derived from the basic function public transport should fulfil (accessibility and affordable fares). That is why costs and quality (in terms of passenger capacity) are the main issues. Environmental issues are taken into consideration but have yet still a low priority. Some PT authorities and passenger interest groups even plea for low environmental requirements as this may negatively influence service quality (money can be spend only once).

Sometimes modern busses are required by the PT authorities (for example busses complying with the Euro 4 standards) or requirements are set for the average age of the bus fleet. Requirements based on average fleet properties can increase costs significant for the bus companies as the depreciation should be earned back in a shorter period of time. This issue is also relevant if a new bus company (or in the case of Amsterdam water taxi service) will be granted the concession while the current bus company has invested in new equipment. This problem can be solved by obliging the new owner of the concession to take over the equipment.

In the case of Haarlem (capital of the province of Noord-Holland) the PT authority has ascribed points for clean engines (technology neutral approach). Connexion, the winner of the tender, had offered natural gas busses including the fuel infrastructure. In that way the PT authority does not take any responsibility for the infrastructure or the alternative technology; Connexion will be judged on the service they provide.

Although the national government is responsible for targets relating to avoiding climate change and increasing security of energy supply, so far they do not have implemented a direct instrument to influence the procurement of public bus transport

in the provinces. Recently industrial partners from the Dutch transition platform have advised the government to start with innovation concessions. The aim of such a concession should be to overcome barriers that exist in current legislation and budgets and which should enable the possibilities to apply innovative technologies. The response of the government on this advice has been positive and they are willing to work out the idea. A main issue in this will be how to overcome the financial barriers (like investment costs and depreciation time related to concession time).



Figure 4.1 Overview of public transport authorities in the Netherlands

Note: in green are the twelve provinces and in purple are the larger city regions.

5 Conclusions and further steps

As the first interviews in the Netherlands will be used among others to validate the methodology and the approach of how to define the gap between current performance level of hydrogen technologies and the minimal requirement level of potential users, a reflection will be given on the outcomes (Section 5.1). As the assessment of end-user requirements as part of the gaps analysis will be extended in 2007 to cover more organisations in more EU countries, Section 5.2 will elaborate on how to approach this process.

5.1 Conclusions

As the gaps analysis will mainly be based on the key performance indicators that describe the performance of a technology on a technical basis (driving range in kilometres for example), the focus in the interviews was to define the minimal performance level of the respondents in terms of KPI's as well. However, during the interviews it became clear that for several reasons the discussions had a more qualitative character. It is assumed that this is mainly due to the fact that most respondents were not already actively involved in demonstration projects for hydrogen and so the details (the minimal performance level) had not yet been considered profoundly. Besides due to a lack of experience with the new hydrogen technology, respondents might not have been interested in such details. This assumption seems to be supported by the fact that the interviews with those respondents that are already actively involved in a demonstration project (CUTE) had a more qualitative focus.

In a more qualitative way, the interviews have given insight in general thoughts and expectations of the stakeholders. Bus companies and commercial actors have varying views on hydrogen technologies: some are explicitly favouring it; others also consider other alternative fuels; while some have put their efforts on fuels like natural gas or biofuels. Main issues for these actors are reliability of the technology and additional costs. For these actors main drivers can be summarised as taking social responsibility and gaining a competitive advantage (by improving the image of the organisation). Barriers that are foreseen are the current performance and availability of demonstration vehicles, while costs should be on a comparative level as conventional vehicles. Asked why organisations are not already actively participating in demonstration projects they point out that the availability and the costs of vehicles make it less attractive or even impossible. Before more demonstration projects can be established bus companies and commercial stakeholders expect a more guiding role from the government.

Local governments, cities and provinces, indicate that their vision on hydrogen technologies will depend on the vision of the national government. Today some of the

local governments lack information on suitable solutions to come to sustainable transportation and that makes it difficult for them to make the right decisions when discussing the use of particle filters, natural gas, biofuels, hybrid technologies and hydrogen. The main drivers for this actor group are focussed on the local level and are related to improving local air quality and stimulating local industry. Main barriers are the additional costs, availability and the technical performance of the (demonstration) vehicles. Besides, it is claimed that a clearer vision and more money would be necessary from the national and European government. The local governments are not participating or supporting demonstration projects (exception for the city of Amsterdam) as the sense of urgency is missing and efforts are focussing on solving current local policy goals (like improving air quality) with available technologies (like natural gas, particle filters). Some local governments never considered the use of hydrogen technologies while others indicate that the lack of the vehicles is a very clear reason for no action. To increase the use of hydrogen technologies the local governments suggest developing a clear vision and an adequate supporting framework.

The Dutch national government seems to focus on attaining the national targets set for air quality and the emission of greenhouse gasses. These targets are relatively short term and thus have to be met by using technologies that can be deployed in mass markets within the next few years. For the medium term further emission reduction targets are expected also for the transportation sector. However the role hydrogen technologies could play to contribute to achieving the expected reduction targets is not yet clear for the government. In the end the government favours a policy framework that does not specifically support a certain technology but that sets a policy framework wherein new technologies have to prove themselves (competition based). Those technologies that might have a good prospective might get a technology specific support in an early phase of market introduction.

Governmental fleets are seen as a potential early market for hydrogen technologies. However, as it has become clear by analysing the way governmental vehicles are purchased in the Netherlands the purchase guidelines do not take into account new technologies that are still in a development and demonstration phase. So, first this phase has to be passed in order to enter the major governmental early markets. In the case of public procurement the main obstacles seem to be funding of the additional costs and lack of sense of urgency. With the new concept of an innovation concession procedure demonstration of new innovative technologies within the sector of public transport busses might be facilitated.

5.2 Further steps

One of the main conclusions concerning how to approach potential early market stakeholders and defining their minimal required performance level is that it seems to be very difficult to obtain quantitative information even though it was specifically asked for. An explanation for this could be that interested actors might not be familiar

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with detailed information relating to the performance of hydrogen vehicles. Such information would become really interesting at the moment the actors are seriously working out the minimal requirements for participating in a demonstration project, whereas during the interviews only a hypothetical case has been discussed. Therefore further steps for the next phase in determining interest of stakeholders and their minimal requirement level have to deal with this issue. That's why the following steps, in more or less chronological order, are suggested:

Using the Key Performance Indicators (KPI's) to define the current state of technology, the expected state of technology in future and the state of technology of conventional vehicles (as reference). This quantitative information will be used to discuss with potential users of early market applications their minimal required performance level in terms of the KPI's. The quantitative information provides the basis to visualize the proven difference (the gap) between the required performance level and the current and foreseen performance levels. The interview partners will be selected based on the actor mapping and for each type of actor (e.g. mail delivery company) different companies within Europe will be interviewed to define the potential of early markets for this specific application.

To get more insight in the way governments are organised and how they could play a role in the development and deployment of hydrogen technologies, more governments will be analysed the way the Dutch government has been analysed. Work on this going on already to analyse Germany and the United Kingdom. More countries will be selected after validation of the methodology. The information on this subtask will be helpful in defining how to set up support mechanisms for governments to support the development of hydrogen.

In order to define high potential locations for demonstration projects a new process will be started to involve regions more actively within HyLights. The result of this process will be multi-purpose. The process should lead to an overview of expectations of different actors and to market development plans for certain regions in time (what early markets can be established, where and when). Based on this market development plans a check will be made to define whether the right governments and companies have been interviewed (see first 2 bullets). If organisations are missing they will be approached after all.

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Appendix A Interview questions for policy makers

HyLights - Early markets for hydrogen and fuel cells in the transport sector

Introduction

HyLights is an EU funded project consisting of 4 research institutes and 17 industry partners (of which most EU car manufacturers, oil and chemical companies) preparing 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') at various locations throughout the EU, leading to an acceleration of the commercialization of hydrogen and fuel cells in the field of transport in Europe.

For this purpose ECN is assessing the minimal requirements (technological, financial and socio-economic) stakeholders have for using hydrogen technologies and compare these with the current hydrogen and fuel cell related technology performance. This comparison provides insight into the preconditions for possible introduction markets, or early markets for hydrogen and fuel cell technologies. These early markets bridge the gap between pre-commercialization and mass-market introduction.

For an exploration of possible early markets the following questions provide a guideline for the interviewee.

More information on the HyLights project can be obtained from www.hylights.eu or by contacting Per Godfroij (0224-568258) or Menno Ros (0224-564423) of ECN Policy Studies.

Questions

1. Are you familiar with hydrogen and fuel cell technology?
2. Are you involved in any projects on hydrogen and fuel cells and if so, in what way?
3. What are your ideas on the usage of hydrogen and fuel cells in the transport sector? Is further development necessary?
4. Are you active in the field of hydrogen in transport?
 - a. If not, why? (no interest, no knowledge, other vision)
 - b. If so, what is your vision, goal, planning, role, incentives?
5. Which policy goals does hydrogen contribute to? (local air quality, GHG emission reduction)
6. Is policy or financial support available for hydrogen and fuel cells? Which incentives are available (or necessary) to support hydrogen? (EU legislation, national programs, or local initiatives)
7. Who is responsible for the introduction of sustainable technology development and introduction? (EU, national governments, municipalities, industry, consumers, other)
 - a. If it is not your responsibility, is this a reason not to participate in the demonstration of hydrogen and fuel cell technology?

8. What could be a reason for you to start promoting hydrogen and fuel cells?
9. Which barriers and opportunities (technological, social, financial) do you see?
10. Does your organization have a captive fleet where hydrogen and fuel cell cars/busses can (or are going to) be used? What are the preconditions to start using this technology?
11. What is your vision of limited city centre access? What could be the role of hydrogen in limited city centre access?
12. How does hydrogen and fuel cell technology relate to other solutions, like biofuels, catalysts, or other alternative fuels, on the short term and far future?

Appendix B Interview questions for industry

HyLights - Early markets for hydrogen and fuel cells in the transport sector

Introduction

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') at various locations throughout the EU, leading to an acceleration of the commercialization of hydrogen and fuel cells in the field of transport in Europe.

For this purpose ECN is assessing the minimal requirements (technological, financial and socio-economic) stakeholders have for using hydrogen technologies to compare these with the current and expected hydrogen and fuel cell related technology performance. This comparison provides insight into the preconditions of possible introduction markets, or early markets for hydrogen and fuel cell technologies.

For an exploration of possible early markets the following questions provide a guideline for the interviewee.

More information on the HyLights project can be obtained from www.hylights.eu or by contacting Per Godfroij (0224-568258) or Menno Ros (0224-564423) of ECN Policy Studies.

1. Are you involved in any projects on hydrogen and fuel cells and if so, in what way?
2. What is your view on the use of hydrogen and fuel cells in the transportation sector? Why should these hydrogen technologies be used?
3. What kind of vehicle fleet does your organization have?
 - a. How many vehicles?
 - b. Kind of vehicles?
 - c. Fuel filling locations? (number, privately owned, public?)
 - d. What is, in general, the relation between the investments costs of your fleet and the costs of the service you sell? E.g. relation between investment costs and labor costs.
4. Can you describe how your vehicles are used in general? What are the prerequisites in terms of:
 - a. Driving range
 - b. Fuel consumption
 - c. Possibilities for fueling
 - d. Investment costs
 - e. Maintenance costs
 - f. Number of passengers (weight of cargo) per vehicle
 - g. Operating time per day

- h. Environmental performances
 - i. Ease of use
 - j. Image
5. In what case will you be interested in the usage of hydrogen technologies (as an early market)? What are your preconditions?
 6. What are the main drivers to use of hydrogen technologies (why)?
 7. What are the main barriers /obstacles?
 - a. Technical
 - b. Societal
 - c. Legal
 - d. Financial
 - e. Social/Acceptance
 - f. Image

Appendix C Cities

Opportunities	Opportunities to apply hydrogen technologies differ from city to city. Amsterdam is already using hydrogen busses (HyFleet CUTE project) and considers zero emission standards for canal boat companies. Other cities see potential opportunities to use hydrogen in governmental fleets, public transport, city centre delivery vans or rental boats.
Drivers	Though all cities are interested in sustainable energy solutions, they all seem to have their own motives, goals and instruments. While in some cities support for local industry is very important other cities are mainly driven by the issues like ‘creating a good atmosphere in cities’. Hydrogen technologies could support the improvement of local air quality. Though cities are formerly not directly responsible for solving the climate change program (as the national government is) they try to contribute as much as possible.
Barriers	All cities are interested to use hydrogen technologies, though the limited performance and the relatively high costs are barriers. Also the availability of hydrogen vehicles is seen as a downside (some cities are really interested to buy hydrogen vehicles but are not able to). The uncertainty regarding future technological development (will technology develop in time?) combined with the increasing potential of alternative solutions (for sustainable transportation) could take away their interests. Some cities mentioned that they are interested to use hydrogen technologies, but only if technology has been proven.
Resources	Most cities do have resources to support clean vehicles, though these budgets seem to be limited in relation to huge costs associated with demonstration projects for hydrogen technologies.
Initiatives	Most cities are involved in several hydrogen activities, varying from CUTE hydrogen busses, to feasibility studies for hydrogen canal boats and hydrogen for households.
Responsibilities	Demonstration projects or early markets could be started at the level of local governments. However, in many cases local governments do not know the views and strategy of the national government or the European Commission. Cities do not only hold responsible the higher levels of government (national government and European Commission) for

developing strategies, but without strategies they feel less secure to chose for certain technologies. Technological solutions cities might chose, could be rejected by the national government in a later phase.

Cities would like to see the European Commission and national governments to develop their strategies and to give guidance in sustainable development.

Cities seem to develop their strategies for sustainable transport more or less by their own. Sometimes they lack information (sources) and clear strategies from the national government. This might result in an unfocussed development of technologies (not to say good or bad). For example some cities in the Netherlands have chosen to start using natural gas as a clean and alternative fuel, whilst other cities have rejected natural gas as not being a fuel of the future.

Alternatives
to attain goals

Environmental problems which cities are facing are mainly related to (short term) local air quality and noise. The potential role of hydrogen in solving these problems seems to be limited. Not only because of alternative technologies as soot filters and de NO_x catalysers, but also because of the time scale. Problems with local air quality can't wait until hydrogen technologies can be applied on large scale.

Renewable H₂

Cities have varying views on whether hydrogen should be produced from renewable sources or not. While in the end it should be the case, some cities see hydrogen from fossil sources as intermediate solution. Amsterdam and the GVB have conducted a study to the potentials of producing hydrogen in waste incineration plants.

Appendix D Provinces

Opportunities	As provinces (a.o.) are responsible for the procurement of public transport in the Netherlands, they theoretically have a large potential for application of hydrogen busses. Though early markets should be established in those regions with maximum of visibility.
Drivers	No information.
Barriers	<p>Main goals of public transport are to provide a good service in terms of accessibility, availability and social factors. Environmental issues are relevant but not crucial. Choices for environmental friendly options could even compete with main goals as they are usually more expensive. That's why actors are reluctant in choosing for environmental friendly options.</p> <p>Further state of technology, costs, reliability and availability are serious barriers to overcome.</p>
Resources	Budgets for procurement of public transport are determined by national government (based on aspects like number of inhabitants of a certain region). Budgets for environmental friendly vehicles should be allocated by the national government as well.
Initiatives	Initiatives with natural gas busses and the intention to start running busses on biodiesel.
Responsibilities	The national government is hold responsible for funding and explicit choices.
Alternatives to attain goals	Depending of the policy goals alternatives for hydrogen are biofuels and natural gas. Instead of choosing certain technologies explicitly, the province of Noord-Holland prefers defining policy goals and setting boundary conditions.
Renewable H ₂	No information.

Appendix E National government

Opportunities	Potential early markets are abundant.
Drivers	Hydrogen technologies should be able to contribute efficiently to national policy goals (emission reduction, noise reduction, improvement of security of energy supply, improvement of Dutch economic/knowledge position).
Barriers	Availability of hydrogen vehicles and the speed of technological development combined with the uncertainty of the potential future role of hydrogen technologies are seen as big hurdles.
Resources	No specific funds available.
Initiatives	The Dutch government is supporter of the CUTE project in Amsterdam. The ministry of transport and its department Rijkswaterstaat are discussing applications of hydrogen technologies at road repair activities.
Responsibilities	Concerning the development of technologies that could contribute to a sustainable transportation sector a coherent vision and strategy of the European Commission is necessary.
Alternatives to attain goals	<p>Theoretically hydrogen technologies could help solving two main policy goals of the Dutch national government that is: reduction of polluting emissions like NO_x and PM₁₀ to improve air quality and to reduce emissions of greenhouse gasses to combat climate change. The use of hydrogen might also improve security of energy supply but a national goal for this has not been set yet (besides this is beyond the responsibilities of the two interviewed ministries).</p> <p>However objectives to improve local air quality are short term goals (2010); a time frame wherein hydrogen technologies are not expected to be able to contribute significantly. For the short and medium term it is expected that improvement of conventional technologies could solve the problem with polluting emissions. Possible technologies for this could be end-of-pipe technologies like soot filters and NO_x catalysers and the use of cleaner fuels. So far there are no binding objectives for greenhouse gas emission reduction beyond 2012 (Kyoto-protocol), though the Dutch government has the ambition to reduce greenhouse gas emissions drastically. While they see an important role for biofuels, the government favors to set boundary conditions and targets instead of choosing to develop a specific technology. Though different technologies (biofuels, hydrogen and electricity) can coexist,</p>

Renewable H ₂	<p>they have to compete with each other in some way.</p> <p>Hydrogen technologies are mainly seen as a potential solution for curbing greenhouse gas emissions in the transportation sector, therefore hydrogen should be a climate neutral fuel in the end. Fossil hydrogen could be an intermediate solution if its role in contributing to a sustainable use of hydrogen in the future will be clear. Hydrogen produced from coal (e.g.) combined with carbon capture and storage, might be a good solution as well.</p>
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Appendix F Bus companies

Opportunities	Theoretically there are many opportunities within the sector of public busses, though quality and reliability of the technology is a prerequisite, while costs should be covered by the national government.
Drivers	Bus companies are facing an increasing demand for clean busses and future emission level limits are expected to be more stringent than today's. That's why they expect that new clean technologies will be necessary to comply with the future emission standards. In principle the bus companies are willing to support the technology development by supporting demonstration projects.
Barriers	In the Netherlands most bus companies are privatized. Only some bigger cities still have their own municipal bus company, however those companies will be privatized in nearby future as well. Although the companies attach importance to innovation and environmental issues, they state that they can only sell those services that their customer will pay for. Beside costs another major barrier is the availability of hydrogen busses (although BVG is buying several hydrogen internal combustion engine busses).
Resources	In general resources are very limited. New technologies that are more expensive than conventional technologies seem to be feasible only when governments (national, local or EU) are willing to fund it. Bus companies are not able to transfer the costs to (e.g.) the end user (passenger) as ticket prices are fixed and mainly determined by the government.
Initiatives	GVB is running 3 hydrogen busses as part of the HyFleet CUTE project. Connexion has announced to start a feasibility study to start to run hydrogen busses in nearby future (in cooperation with Shell). BVG is member of the Clean Energy Partnership in Berlin and has planned to buy up to 100 ICE hydrogen busses in the coming years.
Responsibilities	The Dutch bus companies mention that they expect a more active role of the national government. A clear vision and strategy on clean and sustainable public transport is missed. The European Commission should spend more money on R&D in relation to hydrogen technologies.
Alternatives to attain goals	Hydrogen busses with an internal combustion engine are seen as a good / reasonable intermediate solution. The bus companies are not interested to invest in natural gas busses, as natural gas is not seen as a final solution. In that

Renewable H₂

way they prefer to invest in hydrogen technologies. According to BVG hydrogen technologies (ICE) might become competitive with natural gas busses in several years.

In the end hydrogen should be produced from renewable energy sources.

Appendix G Commercial actors

Opportunities	As TNT has a large fleet of vehicles they could be a good partner for a demonstration project.
Drivers	<p>Environmental issues are important for TNT, that's why the CEO and board have decided to develop the Driving Clean Strategy. Although clean vehicle fleets might give a competitive advantage, most TNT customers are not asking for it and in the end they are not willing to pay for it (if they would it would be much easier).</p> <p>Green Planet is developing a green refueling station which should be commercially viable. Green Planet expects that people will be attracted by and interested in fueling their cars at an environmentally 'friendly' refueling station. So far, no plans exist to sell hydrogen.</p>
Barriers	<p>TNT would be interested in using new vehicle technologies, though reliability should be secured and costs have to be reasonable (compared with conventional technologies).</p> <p>For Green Planet no real market exists as no hydrogen vehicles are on the road.</p>
Resources	<p>Financial resources are limited. According to TNT demonstration projects should be organized within a strategic partnership whereby a win-win situation will be created. TNT can offer a good testing fleet while other partners can offer innovative technologies.</p>
Initiatives	<p>TNT: Driving Clean Strategy, though no focus yet on hydrogen technologies.</p> <p>Green Planet: selling alternative fuels, though no plans for hydrogen yet.</p>
Responsibilities	<p>As most customers are not likely to pay for environmental friendly products support from the government is needed. A clear strategy from the (national) government is missing and would be very helpful.</p>
Alternatives to attain goals	<p>No specific goals defined yet.</p>
Renewable H ₂	<p>No information.</p>