TREN/05/FP6EN/S07.53917/019990

HYLIGHTS

HyLights

A Coordination Action to prepare European Hydrogen and Fuel Cell Demonstration Projects

Coordination Action

Priority [6.1/6.2]

Publishable Final Activity Report

Period covered: 1 January 2006 to 31 December 2008	Date of preparation: 14 February 2009
Start date of project: 1 January 2006	Duration: 36 months
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	Revision [0]

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1 HyLights objectives

The European Hydrogen and Fuel Cell Technology Platform (HFP) had identified the importance of joining next generation large-scale demonstration projects and accompanying research projects in a coordinated, coherent, stable and flexible framework. The strategy laid out by HFP was to accelerate the commercialization of hydrogen and fuel cells (HFC) and to engage the industrial supply chain in activities towards attaining this goal. Several strategically important actions have already been undertaken by the European Commission in preparation of this important phase of the transition to hydrogen as fuel and long-term renewable energy carrier.

All these efforts have to be seen in an energy context where oil prices have reached unexpected volatility, where security of supply is a growing concern, and where the first negative impact of climate change is increasingly felt. Since 2008, the Joint Technology Initiative on Hydrogen and Fuel Cells (JTI) has become a program to, among others, kick off the next large-scale demonstration projects on hydrogen for transport as part of the European Commission's 7th Framework Programme (2007-2013) supporting R&D at pan-European level.

HyLights has been part of EC's strategy to assist in the planning of the next HFC demonstration project phase by e.g. analyzing concluded/ongoing demonstration projects, putting a clear focus on hydrogen for transport.

The main objectives of HyLights, also depicted in **Figure 1**, were

A) to support the preparation of a program plan for large-scale demonstration projects[1] to become part of one frequently updated Multi Annual Implementation Plan (MAIP) and several Annual Implementation Plans (AIPs) and

B) to establish and facilitate communication/dissemination activities for demonstration projects on "Hydrogen for Transport" through the platform H2moves.eu.

[1] Also dubbed Lighthouse Projects (LHP)

Figure 1: HyLights objectives (left) and activities (right). Assessment to support the EC and industry (light blue) and dissemination (dark blue)

Project coordination	
Demo project assessment Regions assessment Support the planning of LHPs • Monitoring and assessment framework • H_2 vehicle and supply technology needs • Financing, policy & legal issues of LHPs	• Learn from past / ongoing activities • Learn from and support the European regions • Learn from vehicle fleet operators • Support and harmonise between EC / industry to plan large-scale demo projects in FP7 / JTI • Provide assessment tools
HyLights dissemination H2moves.eu	• Information on demo projects • Create group identity • Facilitation for experts (workshops) • Support wider stakeholder group and regions

2 HyLights tasks

Since its launch in January 2006, HyLights has carried out the following tasks, which, typical for a Coordination Action project, have been adapted to the needs of the relevant stakeholders over time:

- **Assessment of concluded/ongoing demonstration projects on hydrogen for transport:** Establishment of a web-based interactive and searchable demonstration project database.
- **Development of a Monitoring & Assessment Framework (MAF) for the next generation large-scale demonstration projects on hydrogen for road transport under FP7/JTI:** Develop handbooks for project and program level.
- **GAPS analysis[2]:** Assessment of future fleet operator needs for hydrogen and fuel cell vehicles and infrastructure and input to the requirement profile for the next phase demonstration projects.
- **Financial incentives and policy and legal frameworks to support the large-scale commercialization of HFC road transport technology:** Assessment and identification of necessary structures in the early demonstration phase and its smooth transition to a future hydrogen and fuel cell vehicle market.
- **Legal form and management structure of future demonstration projects:** Identification and evaluation of the issues. Provision of initial analysis on the advantages/disadvantages of specific legal forms and management structures (IPRs, State Aid, Safety & Risk Management, Financial and Third Party Liability).
- **Assessment of policy support options and needs for hydrogen vehicles and hydrogen supply including infrastructure**: Consideration of regional framework conditions throughout Europe. Other similar fields of application and challenges (introduction of renewable energies) and other international approaches were analysed for valuable input.
- **Regions' activities and eligibility:** Assessment of status quo and development of a set of criteria to distinguish the more advanced European regions and their degree of readiness for the realization of large-scale demonstration projects to adopt HFC road transport technologies as part of the Demonstration Program Plan. Development of a web-based regions database at www.H2moves.eu. A by-product of this activity was the facilitation of the constitution of the European Regions & Municipalities Partnership on Hydrogen and Fuel Cells (HyRaMP) from October 2007 to April 2008.
- **Dissemination of HyLights project results and demo projects:** Communication of HyLights results and illustration of the coherence of the

[2] In Phase II of the HyLights project the title of work was adapted to better express the task being performed to "*Fleet operators and hydrogen vehicles - Reactions and requirements*"

European demonstration project cluster on hydrogen for transport throughout Europe and the World by relevant means (printed documentation and personal representation at key events).

A prerequisite to obtain useful results and guarantee an efficient process was the link between the different groups involved in the analysis and/or the support of the preparation of the future demonstration projects. The total partnership comprised 21 project partners, 4 institutes carrying out the assessment and planning work, representing technical, socio-economic, regional development and legal expertise at scientific level, and 17 major industry partners (automotive, oil, utilities & industrial gases) supervising and assisting the process.

The extended partnership was larger, including e.g. governments, joining the project via an associate status, and was meant to provide European visibility to hydrogen for transport, as well as to ensure openness and transparency in preparing the large-scale demonstration activities. Industry participation was a key element in shaping the results. The participation in the preparatory work reflected their later commitment in and beyond the demonstration project phase, i.e. as part of the policy support assessment. Cooperation has also been ongoing with expert groups from the U.S. and Japan. HyLights has been awarded the title of a liaison project within the International Partnership for a Hydrogen Economy (IPHE).

Throughout the three years of project duration results from the assessments were first reflected in discussions with a group of high level representatives annually, one from a regional policy background (Nicky Gavron, then Deputy Mayor of the City of London), one representing an international perspective (Prof. Joan Ogden from the Institute for Transportation Studies at the University of California in Davis), one representing industry's view (Prof. Ferdinand Panik from the Fachhochschule Esslingen, former head of DaimlerChrysler fuel cell activities) and one representing the research environment (Prof. Francesco Profumo, Rector of the Politecnico di Torino), all of whom provided valuable guidance for the right focus of activities. Among others, the intensified consideration of technology specific policy support measures, the focus on assessing vehicle fleets in more depth and the relevance of the regions and specifically municipalities to support local industry, i.e. SMEs, were flagged – and taken into consideration by HyLights.

3 HyLights results

A major part of the HyLights assessment and mapping tasks was directed at understanding state-of-the-art in past or ongoing **demonstration projects** on hydrogen for transport on one hand (chapter 3.1) and on the **commitment of regions** in hydrogen for transport on the other hand (chapter 3.2).

3.1 Demonstration projects on hydrogen for transport

3.1.1 European demo projects database

An important first step to understand the variety of approaches to the application of hydrogen as a transport fuel was to assess all past and ongoing demonstration activities across Europe and some of the most relevant international projects.

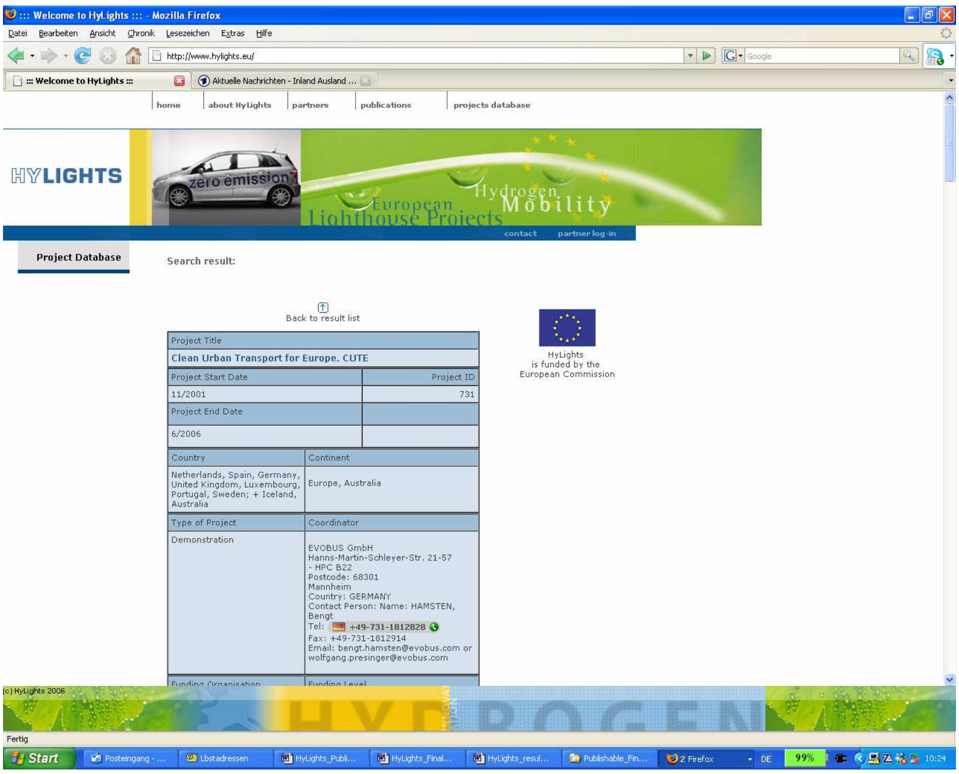
In order to make this information public to a wider group of stakeholders the information and data were incorporated in a searchable web-based database accessible at

http://www.hylights.eu

123 individual projects are listed and information is provided on organizational matters, technical concept, project budgets and results. The database has been updated in the course of work.

Figure 2 shows a screenshot of one of the projects in the database.

Figure 2: Screenshot of the HyLights demonstration project database



3.1.2 Lessons learned from demo projects

The HyLights demo projects database was then assessed for the most relevant demonstration projects providing relevant information in order to plan the next large-scale demonstration projects on hydrogen for transport under FP7/JTI, the so called Lighthouse Projects (LHPs).

The following 10 demonstration projects have been identified and contacted for personal interviews:

- H2argemuc – The hydrogen project at Munich Airport
- ECTOS – Ecological City Transport System: Demonstration, Evaluation and Research Project of Hydrogen Fuel Cell Bus Transportation System of the Future
- CUTE – Clean Urban Transport for Europe
- ZERO REGIO – Lombardia & Rhine-Main towards Zero Emission: Development and Demonstration of Infrastructure Systems for Hydrogen as an Alternative Motor Fuel
- HyFLEET:CUTE – Hydrogen for Clean Urban Transport in Europe
- CEP – The Clean Energy Partnership Berlin
- HYCHAIN-MINITRANS – Deployment of innovative low power fuel cell vehicle fleets to initiate an early market for hydrogen as an alternative fuel in Europe
- HyNor – The Hydrogen Road of Norway
- LHTP – The London Hydrogen Transport Programme
- CaFCP – California Fuel Cell Partnership

Aim was a better understanding of the project organisation, operational experience and lessons learned. The outcome was then used by other HyLights work packages as input for their analyses and preparatory work for e.g. the GAPS analysis and preparation of future LHPs. Furthermore, the information was also offered to other interested stakeholders.

The basis for the interviews was a set of 21 questions structured into 4 topics for personal interviews with responsible individuals from the projects:

– General project information

– Experiences from setting up the project

– Results / lessons learned

– Recommendations

As the most important findings of this exercise can be named the limited availability of vehicles, the necessity to define the project follow-up already during the set-up phase, the need for clear responsibilities for the infrastructure installations, the missing of an integrated long-term funding scheme (EU, Member States, regional) as well as the lack of vehicle and infrastructure performance data due to few vehicles and / or missing assessment and funding frameworks.

One of the most significant findings was that most projects have experienced problems in obtaining sufficient numbers of vehicles. (Early) commitment of vehicle industry and potentially bundling of resources is therefore a key especially for future large-scale demonstration projects.

In case of hydrogen refuelling stations it has been recommended that one partner alone should be made responsible for the approval, erection and operation of a station to lower the complexity of the approval procedure and operations process.

Nearly all projects do some kind of project assessment, but the degree of detail differs significantly. Therefore the utilisation of a common tool, the HyLights Monitoring and Assessment Framework (MAF), may be a practical approach or at least a robust basis for future projects.

Beside the London Hydrogen Transport Programme, funded by 100% from public sources, all projects evaluated were/are various types of public-private-partnerships (PPP), but mostly without an own entity. The only exemption was the H2argemuc project, which operated as a German entity ‘Arbeitsgemeinschaft – ARGE’.

It was recommended to select the project coordinator with particular regard to project management. A criteria catalogue for assisting the selection process became part of the project management assessment activities within HyLights (chapter 3.3).

Furthermore, some interviewees have recommended subcontracting the project management to an external service provider.

If a project has installations (e.g. refuelling stations) at geographically separated locations, a separate local project coordinator for each location should be assigned.

In order to have a balanced partnership, it was advised to provide adequate funding for both the vehicles <u>and</u> for the hydrogen infrastructure.

3.2 European hydrogen regions

HyLights has spent a large part of its budget on the assessment and mapping of the European regions’ commitment on hydrogen and fuel cells. Part of this was the facilitation of discussions between regions’ representatives and industry in a process which became known as “Expectation Management”.

In addition, HyLights volunteered to support the European regions to set up an own interest body acting towards JTI by coordinating a Task Force finally leading to the establishment of the European Regions & Municipalities Partnership on Hydrogen and Fuel Cells (HyRaMP).

3.2.1 European regions database

Figure 3 shows the European regions which have been identified to be the most active and committed ones in hydrogen and fuel cells for transport. These regions have been assessed in further detail. Furthermore, these data are provided by a hydrogen and fuel cells regions database on the public H2moves.eu website at

www.H2moves.eu.

Figure 3: European regions with strong commitment on hydrogen and fuel cells for transport

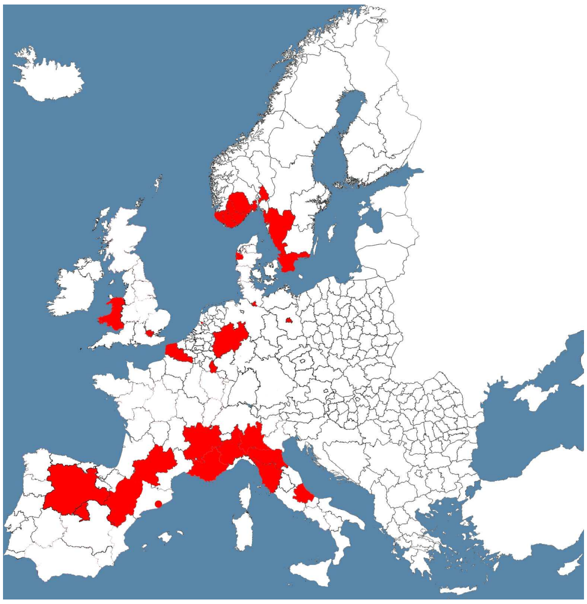
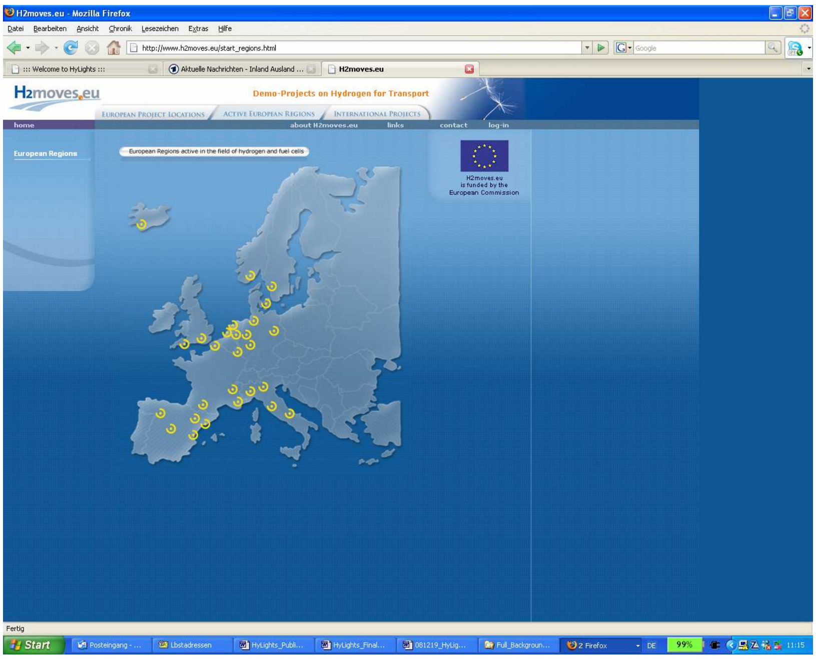


Figure 4 is a screenshot of the European hydrogen and fuel cells website start page.

Figure 4: Screenshot of EU hydrogen regions website



3.2.2 Assessment of regions' commitment

The EU, its Member States and the companies in these states are considered the most relevant players concerning the preparation and implementation of hydrogen in the transport sector. However, the individual regions often are seen as mere locations in which the development and implementation of projects takes place. Under the HyLights project the question was raised how the regions themselves actively contribute to the process and which specific requirements they have as early technology adopters.

A survey was therefore undertaken to assess the regions for their strategies, budgets, stakeholders and drivers for the implementation of hydrogen as a fuel. Criteria were developed as a basis for expert interviews and a questionnaire, and two workshops were organized with attendees from the European Commission, EU Member States, European regions and industry. The objective of the first workshop was to gain insight into and to discuss the regional activities and strategies for the implementation of hydrogen in the transport sector. The objective of the second workshop was to facilitate communication between the regions and industry and to foster the alignment of their interests and strategies. In the course of these activities it became clear that the European regions are in many cases remarkably active in the development of strategies and the realization of projects. They are well organized and cooperate at a regional level (e.g. the Italian regions), a national level (e.g. the German regions) or even at a trans-national level (e.g. the Scandinavian regions) via projects and networks. In some cases, the regions are able to co-finance projects to a significant extent.

In a detailed report HyLights provides a varied picture of the regional contribution to the preparation of hydrogen for use in the transport sector. It also gives detailed insight into related strategies, budgets and the players in each of the 28 European regions - ranging from a few highly committed and active front runners to quite a large group of promising regions with a huge potential to contribute to development. The report is available on the HyLights CD. Below the essentials of the report have been summarised.

<u>General information (regional identification and distribution)</u>

28 regions with a general commitment to or agreements regarding the implementation of hydrogen and fuel cell technologies in the transport sector were identified in the course of the project. In this context a region is considered to be a county, administrative district or geographical area, a municipality or an island. The regional profiles are based on criteria developed beforehand on regional strategies and time frames, project funding and budgets, drivers and obstacles, and regional players in the field of hydrogen demonstration and the implementation of HFC technologies in the transport sector. These criteria were applied from the project level upwards as well as down from a higher programme level. The regions are located all across Western Europe. A few new EU Member States are also interested in the technology, but do not have concrete activities or plans currently targeting the

transportation sector and do not fulfil the identification criteria developed. Activating this hidden potential could be a new challenge for future follow-on project activities.

The majority of the 28 regions identified have detailed plans for HFC applications in transportation. Demonstration projects are ongoing and the development of the new, innovative technology is generally well placed in regional political strategies. In the best cases this has resulted in strategies with concrete timeframes and short, medium and long-term targets. These regions comprise Berlin, Hamburg, North-Rhine Westphalia, London, Piedmont, the Scandinavian regions of South Norway, West Sweden and West Denmark, and Reykjavik. These regions also have well established mechanisms for the allocation of budgets to carry out their plans.

Some of the 28 regions have less detailed strategies, but have identified the potential role of hydrogen as an energy carrier and the importance of integrating HFC technology development into forthcoming regional strategies, a fact which would seem to be a very important target for such regions. Regions focusing on other applications in the hydrogen technology chain first, with plans to start demonstration in transportation at a later strategy stage, also fall into this category, and include Abruzzi, most of the Spanish regions considered (Valencia, Castilla y Leon, Aragon) and the French regions Rhône-Alpes, Nord-Pas de Calais, Provence-Alpes Côte d'Azur and Midi-Pyrénées. The French regions in particular stated that there was a lack of national support for the realization of demonstration projects.

The differences in the situation can be explained to some extent by the diversity of regional conditions such as industrial and economical backgrounds. When asked as to their specific requirements, the regions expressed a need for adapted funding mechanisms and project support. Funding structures should be more specific to regional conditions and there is a need for a better information exchange between industry and the regions to ensure that regional strategies are effective and to avoid misguided developments.

In summary, all of the regions identified plan to extend their activities or – if they are still at the preparation stage – to set up projects. This information is supported by the total number of vehicles and wide infrastructure available in ongoing projects (status 2007/2008: around 70 cars, 50 buses, 16 early market applications, 4 marine applications, 40 refuelling facilities) or planned for the period to 2012 (approximately 150 cars, 125 buses, over 200 early market applications, 5 marine applications, twice the number of refuelling stations) in all identified regions.

<u>Distinction based on regional status and the driving force</u>

It is apparent from the regions identified, that the status and the focus of the projects strongly depends on the regional situation discussed above.

On the one hand, projects at a regional level (e.g. county or geographical area) have a strong regional reference, with ongoing activities linked to the industry of the region in many cases. Project partners at a regional level need to be involved from early project phases onwards. Issues such as job creation and the promotion of local industry are major forces behind commitment, and the showcase function is an important aspect for these regions, which would like to be recognized internationally as locations for HFC applications in which the regional industry is strongly involved in projects and where hydrogen is available and in use (e.g. North-Rhine Westphalia, South Norway, West Denmark, Piedmont, Lombardy, Arnhem). The regions would like to be competitive from the introduction of the technology through to the commencement of mass market production. Strong cooperation networks at a national or even trans-national level are often in place here, and some of the networks are open to further regions (e.g. a Hydrogen and Fuel Cell Initiative to bundle regional competences, the Scandinavian Hydrogen Highway Partnership as a trans-national cooperation with concrete future plans or Italian plans for regional cooperation in the Mediterranean area on the founding of a hydrogen community).

All of the activities identified in such regions are strongly driven by policy aspects, with a strong integration of regional industry and the support of the local authorities and government. Some of these political entities are even direct partners or stakeholders in the projects. Activities are linked to regional environmental policies such as the reduction of greenhouse gas emissions, the lowering of fossil energy consumption, the increased use of renewable energies and an improvement in energy efficiency. But industry policies which strengthen the regional industry's competitiveness (e.g. SMEs) are a very important factor in many of these regions.

On the other hand, there are regions – particularly cities such as Berlin, London and other partner cities within the HyFLEET:CUTE project – with projects which are being or were carried out and fostered by major companies (e.g. the Clean Energy Partnership in Berlin). The main impetus behind these projects is the technology aspect (such as a demonstration of feasibility with an industry reference) or the image enhancement aspect (such as the promotion of the city as an environmentally friendly area with sustainable energy production and clean transport. London is one such example). Several showcase projects in both stationary applications and transport are either ongoing or planned to foster the lighthouse function of these areas (e.g. in Hamburg where stationary applications are planned within the HafenCity project). Most of the projects identified at a city level were realized mainly through private investment from the companies involved and co-financed through public funding from the European Commission or national budgets. Some of these regions were merely locations for projects in the past (e.g. Berlin within the Clean Energy Partnership), to be used as a point of departure for the integration of HFC technologies into regional policies.

These city level projects were often industry driven, with the right environment provided by the city. Extensive public transport systems are in place and the potential to increase the public acceptance of new technologies is high. Bus fleets on ordinary routes can make the new HFC technologies visible and resolve potential doubts as to the safety of hydrogen technologies. The main industry drivers are the promotion and development of the technology and bringing the applications to market readiness. This coincides well with the necessity and plans to commercialise hydrogen in transport for captive fleets.

In summary, the main drivers are energy issues (e.g. the reliability of the energy supply), industrial and social aspects (e.g. local industrial development, promotion of local industry, specifically small and medium enterprises (SME), job creation), environmental aspects (e.g. clean energy production and transport, climate change and air quality) and image enhancement through the application of novel emerging technologies (mostly in metropolises).

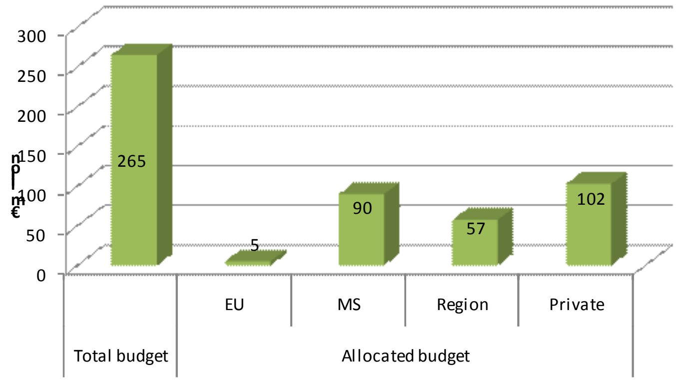
Regional potential

When specific regional conditions are considered, there is considerable potential in the regions to overcome current barriers to the integration of HFC technology and to accelerate the deployment process. The regions are locations for the demonstration of a diversity of applications in the hydrogen value chain, ranging from production through transport and distribution to use in transport and stationary applications. The regions can thus help to increase public acceptance and to demonstrate feasibility. At the same time they are important stakeholders or even early adopters themselves, with a significant potential for the establishment and scale-up of projects. They give the projects a public perspective with corresponding timetables (e.g. plans with a long-term perspective), and some of the regions are even prepared and willing to co-finance projects and aim to extend regional budgets further over the next few years. In some regions (e.g. most of the Spanish regions considered such as Aragon, Valencia and Castilla y Leon) the budget available at a regional level is higher than what can be provided at a national level.

A budget of approximately € 160 million is available in the period 2004 - 2011 for the projects identified in the 28 regions such as HyFLEET:CUTE, Zemships, CEP, HYCHAIN MINI-TRANS, ZERO REGIO, Smart-H2, Althytude and the UltimCar project. This budget is mainly provided by industry (the majority at € 100 million), the European Commission and the states. Regional budgets are typically below € 10 million. Similarly sized regional budgets have also been spent on preliminary studies, technology R&D and first demonstration projects without a transport focus since 2001 (e.g. in North-Rhine Westphalia or West Denmark).

However, the plans of the most active regions for the period to 2015 show remarkable progress (see **Figure 5**): Significant budgets have been allocated to Berlin and Hamburg for the next phases of the CEP to 2015, to the London Hydrogen Partnership until 2015, to the Italian regions under the H2CNG agreement to 2010 and for the SHHP to 2015. The budgets are therefore expected to increase to a level of approximately € 250 million without partial funding from the European Commission, but including around 20% or € 50 million from the regions. What is more, these figures only represent the fixed budgets. There are also a growing number of regions with strategies which are not yet reliable and are more difficult to integrate into the overall picture as funding is part of more general and vague plans without a clear focus on the demonstration of hydrogen for transport. More detailed information on this funding can be found in the detailed report.

Figure 5: Budget allocation for HFC activities for transport (until 2015)



Problems, barriers and obstacles

Despite this background and the regional potential, the integration of HFC technologies is still accompanied by problems and hurdles within the regions.

The regions themselves often cite strong differences in their economical backgrounds and the status of HFC technology realization. A situation has developed in which the individual needs of regional front runners and newcomers are not fully supported. The developing regions in particular expect a more specific funding and project structure. An improvement in the exchange of information between front-running and developing regions and between industries is required to overcome this situation.

In addition, some regions (especially the French ones) stated that the demonstration focus within the strategies and activities was rather weak at a national level. All of the regions highlighted the importance of early project involvement on the part of the stakeholders, the integration of whom is one of the most important factors for the successful realization of a project. This also applies to industrial participation in projects and the development of regional strategies.

On the technology side, aspects such as vehicle availability and the installation of refuelling facilities are very important. A paradoxical situation has arisen in the regions where refuelling stations and cars are concerned. Active regions with ongoing projects in transportation have a number of refuelling stations installed but only a few cars in operation. An increase in the vehicle fleets would appear to pose a great problem which cannot be resolved by the manufacturers. On the other hand, regions able to operate cars are faced with national regulations, codes and standards regarding refuelling facilities, and the erection of such stations is therefore lagging behind the timetables set.

In summary, this report gives a varied picture of the regional contribution to the preparation of hydrogen for use in the transport sector. It also gives detailed insight into related strategies, budgets and the players in each of the 28 European regions - ranging from a few highly committed and active front runners to quite a large group of promising regions with a huge potential to contribute to development.

3.2.3 Regions eligibility self assessment

Based on the insight that the regions' commitment in hydrogen and fuel cell will become a major driver to accelerate the commercialization of these technologies, advance technological excellence also by supporting small and medium enterprises all across Europe, it was decided to develop a tool supporting the regions to assess their own position among the other regions already being active.

The aim of the tool is to facilitate an objective assessment of locations that are willing to establish demonstration projects for hydrogen vehicles. In order to have the most efficient demonstration projects, those locations should be selected first that can contribute most to the further development of the technology. The tool is only developed to assess different locations and benchmark the conditions (favourable/unfavourable) that exist in such locations and it cannot be used to compare or assess the demo projects themselves. As the tool is developed to assess locations, it is not the intention to give a certain "score" (high or low) to a certain location; rather the tool will be used to evaluate the relative advantages or disadvantages of the locations in question. By applying the tool from a regions perspective it would help to identify strengths/weaknesses of the location that could be subsequently further improved towards an optimal competitive position.

Above all, the tool could be used by the regions themselves to evaluate and foster their competitive position. The tool could also be used by decision makers (e.g. within the Joint Technology Initiative on Hydrogen and Fuel Cells) to make an objective comparison between different locations that are planning to establish demonstration projects. The tool could be used as well by project developers as guideline to determine a location for their demonstration project.

3.2.4 Regions Eligibility Self Assessment Tool

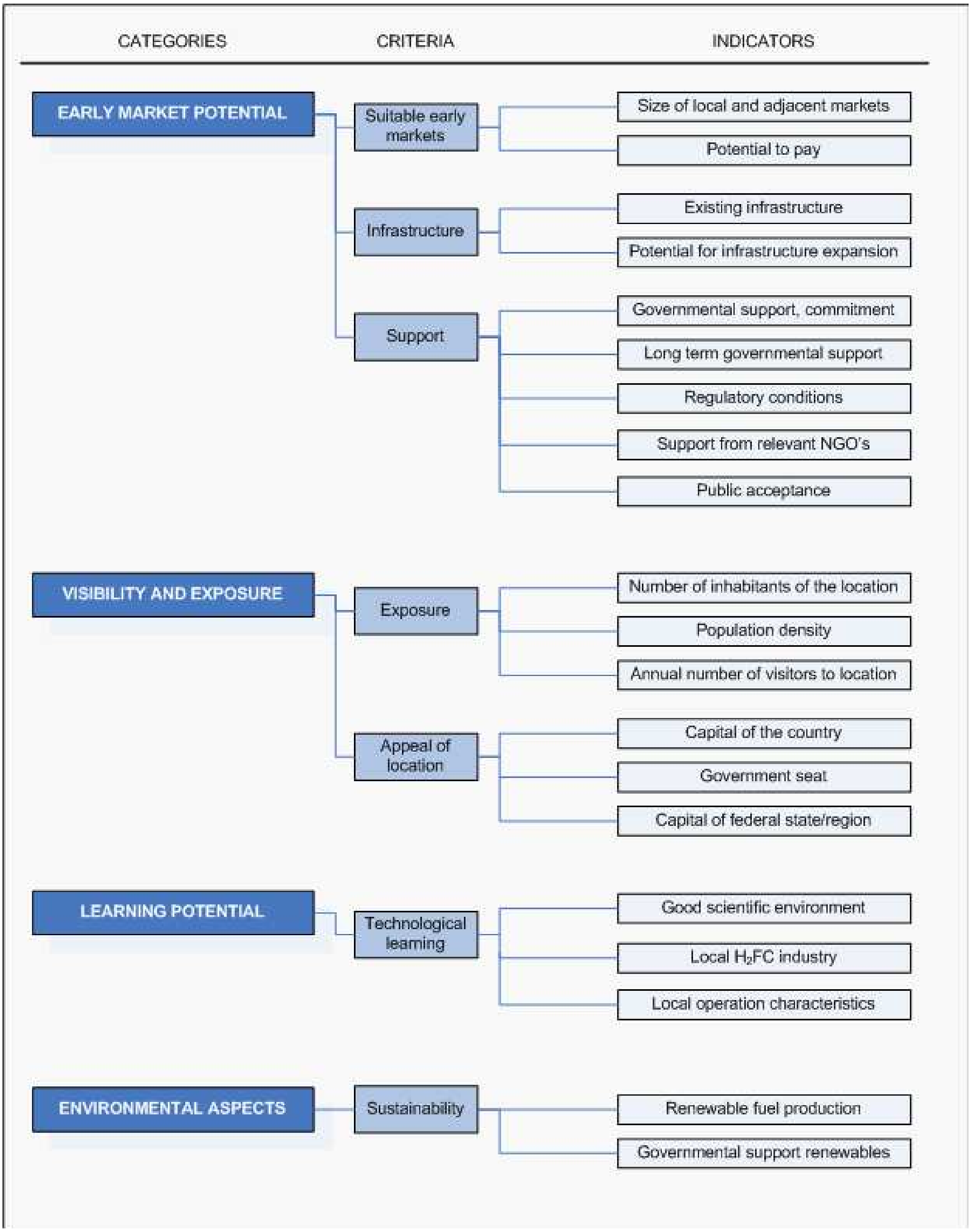
The framework has been dubbed *Regions Eligibility Self Assessment Tool for demonstration projects on hydrogen in transport*.

The tool consists of a set of criteria and indicators and a template that gives guidance on how to apply the tool. The set of criteria has been developed based on literature research. The tool also incorporates feedback from the regions through the European Regions and Municipalities Partnership for Hydrogen and Fuel Cells (HyRaMP).

Figure 6 lists the structure of categories, criteria and indicators decided for use in the tool. In a detailed manual the use of the tool is explained, with background information on how each individual category, criterion, indicator and the weighting factors have to be interpreted. The tool, report and manual are accessible on the H2moves.eu website at:

http://www.h2moves.eu/publications/regions_tool.html

Figure 6: Overview of categories, criteria and indicators



3.3 Monitoring & assessment of demo project performance

3.3.1 Project governance indicators

One objective of HyLights was to identify the key project success factors - from a legal and project management viewpoint - for the undertaking of large-scale hydrogen road transport demo projects at EU (i.e. the Joint Technology Initiative for Hydrogen and Fuel Cells) or national/regional level (i.e. the “Clean Energy Partnership” in Germany or other projects), the so-called “Lighthouse Projects” (LHPs).

Next to giving general advice to the JTI on the success factors of managing future LHPs by helping to structure their planning, the set of “Project Governance Indicators” (PGIs) has also become an intrinsic part of the Monitoring and Assessment Framework (MAF) to assess the organizational performance of demonstration projects and demonstration programs on hydrogen for transport.

The MAF for project level therefore comprises initial “Key Performance Indicators” (KPIs), looking at technical and technological factors, and some “Project Governance Indicators” (PGIs). The PGIs are key factors that could positively or negatively affect the realisation of an LHP and could be key to the efficient and effective organisational success of the projects.

For purposes of analysis the PGIs have been divided according to whether they focus more on the Project Management Functions or the Legal Form that a future LHP may assume. The key functions and forms are first presented in tabular form and then analysed briefly. The analysis demonstrates the importance of each PGI and its consequences on LHPs, and is based on a survey with project partners/managers of concluded and/or on-going demonstration projects, desk-based assessment and research (subsequently validated with different project managers and other project partners/participants), FP6 project management experiences, relevant project management theory (i.e. PRINCE 2), corporate and IPR law, PPP theory, recent JTI related legislative proposals and related EU legislation.

The following factors have been identified, from which 9 PGIs have been derived:

- Steering Group
- Project Manager
- Mobility & Infrastructure Groups
- Quality Assurance Group
- Consortium Agreement
- Confidentiality Agreement
- Risk assessments on both infrastructure and vehicles

- Risk mitigation plans
- Safety training
- Third party liability coverage for infrastructure providers
- Data protection provisions in a contract

The PGIs are grouped into “project management” and “legal” indicators:

Project management

P-1 Project development

P-2 Collaborations

P-3 Budget & financing

Legal

P-4 Contract negotiations

P-5 Liability

P-6 Intellectual property right (IPR)

P-7 Dissemination and public outreach

P-8 Education & training

P-9 Business opportunities

In addition to a detailed description of the PGIs a project developer checklist complements this part of the work (**Figure 7**). This checklist provides the list of all the PGIs that were identified through extensive research before ratings were attached. This list particularly will serve as a “checklist” of options to be considered by project promoters, consortia and/or the European Commission that will undertake and/or be involved in future LHPs.

Figure 7: Project Governance Indicators checklist for LHP project developers

PROJECT MANAGEMENT FACTORS	LEGAL FACTORS
GENERAL MANAGEMENT	*LEGAL FORM*
Steering Group / Steering Committee (decision making body)	Public-Private Partnership
Project Management team vs. one person coordinator	Incorporated legal form (i.e. Ltd, unlimited, EEIG, etc.)
External Project Management company non-project partner	Public shareholder majority of shares
Managing Director vs. team (company structure)	Private shareholder majority of shares
Decision Making Board (company structure)	Unincorporated (simple collaboration, other)
Executive Expert/Consulting Group (not part of decision making process just providing opinion)	Consortium Agreement
Local/sub-management structures/nodes	Confidentiality Agreements
Local training / education body	Sub-contracting Agreements
	Vehicles/buses/infrastructure leasing agreements
	Vehicles/buses/infrastructure purchase agreements
	Fleet operator contracts
OPERATIONS	*FINANCE*
Dedicated Administrative body – Secretariat	EU Funded
Mobility/Vehicle Group	National funds
Infrastructure Group	Regional/local funds
Ad hoc Working Groups	Risk financing/Venture Capital
Safety Team	Project financing agreements
Quality assurance/efficiency body	Public Procurement
Monitoring & assessment body	Competitive Dialogue
Project Coordination Committee (between work packages and the European Commission)	Calls for tenders
Finance body (Treasurer)	Call for project proposals
Separate financial management between nodes and central budget	
RCS External Monitoring body	*SAFETY AND RISK*
RCS Intra-project Monitoring body	
RCS monitored by project partners	Risk assessment - infrastructure
Stationary Applications Body	Risk assessment - vehicles/buses
Efficiency Analysis Body	Risk mitigation plans
Technology Team meetings	Safety training
	Safety plans
	"Third party" liability OEMs
	"Third party" liability infrastructure provider
	"Third party" liability special project consortium/group provisions
	External insurance provider (infrastructure)
	External insurance provider (vehicles)
OTHER	*OTHER*
Forum (including external/non-contracted stakeholders)	State aid rules
PR bodies in nodes/local management structures	Anti-trust
PR team consisting of Project Partners	Merger control
External PR firm (subcontractor)	IPR protection rules & procedures in the contract
	Data protection provisions in consultation with certification/authorisation organisation
	Partnership with certification/authorisation
	organisation
	Memorandum of understanding (MoU) with other projects/regions

The main lessons learnt were derived from past/ongoing hydrogen road transport demonstration projects for the establishment of future LHPs. The feedback received from project partners/managers demonstrated that the PGIs that were useful for past and current demonstration projects might not be applicable for future LHPs. The methodology used for the analysis is explained in more detail in the full report on the HyLights results CD.

3.3.2 Handbook I for demonstration projects

An important outcome of the HyLights project is the Monitoring & Assessment Framework (MAF), a tool to be used to assess the performance of the coming large-scale demonstration projects on hydrogen for transport at project and program level. The handbook which has been developed jointly with industry and the European Commission is suggested to be used already in the negotiation phase of the projects. Projects such as HYCHAIN MINI-TRANS and CEP II have already decided to apply Handbook I.

The HyLights MAF Handbook I comprises a set of 8 "Project Governance Indicators" (PGI), 17 "Vehicle Performance Indicators" (VPI) and 16 "Infrastructure Performance Indicators" (IPI). Both for the VPIs and IPIs "technical specifications" and "cumulative performance data" indicators have been defined. **Figure 8**. provides an overview.

Figure 8: Project Governance Indicators (PGI) and Hydrogen & Vehicle and Infrastructure Performance Indicators (VPI & IPI) in the HyLights MAF Handbook I

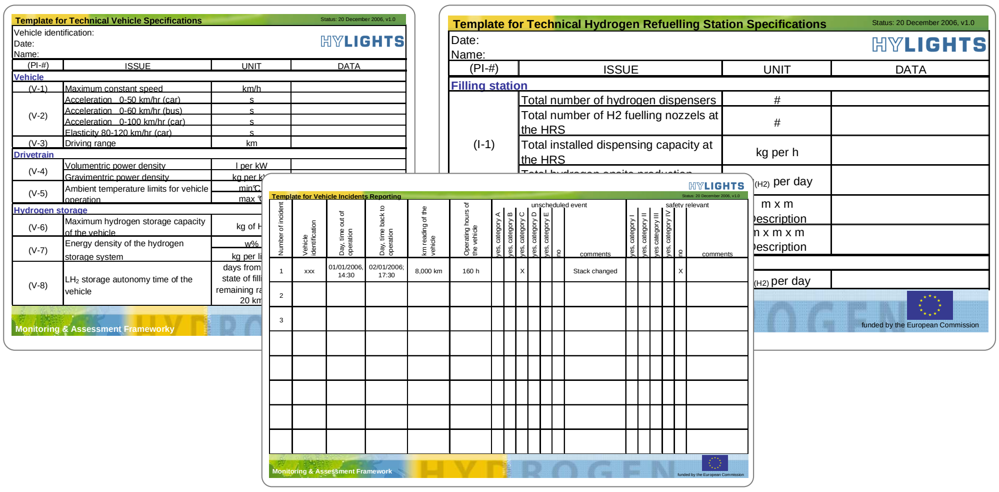
Project Governance Indicators	Hydrogen Vehicle Performance Indicators	Hydrogen Infrastructure Performance Indicators
Project management scheduled development collaborations financing & budgeting quality assurance **Legal** contract negotiations liability Intellectual Property Rights **Socio-economics** dissemination and visibility education and training business opportunities	**Technical specifications** maximum speed acceleration and elasticity driving range drivetrain power density ambient temperature limits for vehicle operation maximum hydrogen storage capacity of the vehicle energy density of the hydrogen storage LH2 storage autonomy time of the vehicle **Cumulative performance data** total travelled distance hydrogen refuelled and consumed vehicle availability safety incidents reporting vehicle efficiency / fuel consumption vehicle emissions – regulated emissions customer satisfaction approval and operational hurdles of the vehicle	**Technical specifications** fuel dispensing capacity refuelling station siting boil-off rate of the stationary LH_2 storage (at HRS) **Cumulative performance data** refuelling quantity refuelling time utilisation rate of the refuelling station availability of the refuelling station safety incidents reporting fuel quality and composition hydrogen losses at the refuelling station quantity of delivered H_2 (central H_2 production) produced H_2 (onsite H_2 production) utilisation rate of fuel production unit (onsite H_2 production) specific energy demand customer satisfaction of the refuelling station handling and opening hours of the station approval and operational hurdles of the HRS

Figure 9 shows some of the templates to be used for collecting project specific information and data on vehicles and refuelling infrastructure.

Figure 9: Examples of templates to be used to collect data for the HyLights Monitoring & Assessment Framework (MAF)

Technical vehicle specs

Technical hydrogen refuelling station specs



Vehicle incidents reporting

Another important learning from the assessment of demonstration projects in e.g. the U.S. program was that Intellectual Property Rights issues (IPR) have to be taken seriously within the project partnerships. For that reason an organizational approach involving a Neutral Body to collect and accumulate the data as well as proposal for handling of confidentiality on several levels have been proposed. Together with the other methodologies they are described in Handbook I.

3.3.3 Handbook II for demonstration program

In the course of work towards Handbook I, the HyLights partners have identified a number of issues which cannot be handled at individual demonstration project level. These issues comprise

- environmental impacts and benefits, especially emissions,
- hydrogen fuel and vehicle costs,
- public acceptance and perception and
- safety.

It was found that the demonstration program performance is less explicitly to be assessed. Instead of developing a detailed methodology with indicators and criteria, a general approach was proposed in the HyLights MAF Handbook II specifically for the assessment of environmental performance and hydrogen fuel and vehicle costs.

Furthermore, Handbook II proposes that this work is undertaken by a Neutral Body, preferably the JTI Programme Board itself, supported by neutral experts in the field.

3.4 Planning of Lighthouse Projects

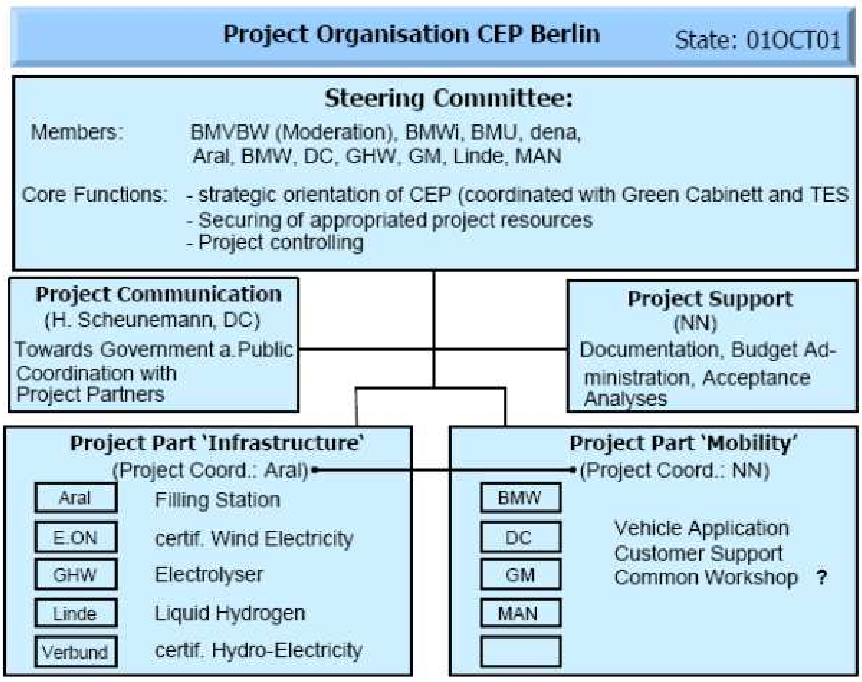
3.4.1 Organisational project factsheets

In order to provide advice on demonstration project management structures to JTI, a sound analysis of past and ongoing demonstration projects specifically on hydrogen and fuel cells for transport has been undertaken. The projects have been screened for the following aspects:

- General information,
- Contractual issues,
- Financing issues,
- Managerial issues,
- Utilisation,
- Permits – standards & regulations,
- Safety – standards & regulations,
- Intellectual property and
- Regulatory issues.

A detailed report explains the characteristics of all projects assessed (e.g. **Figure 10** shows the organizational chart of the CEP project in Berlin) and is accessible on the HyLights CD.

Figure 10: Project organization CEP Berlin



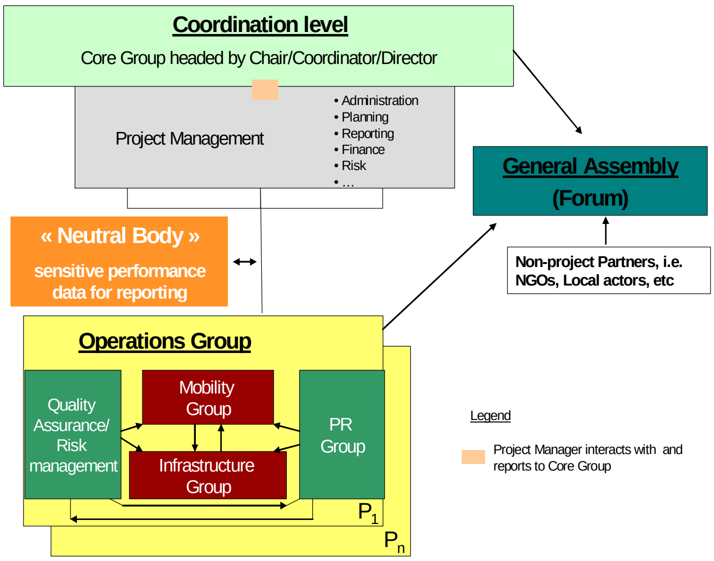
3.4.2 Legal forms and management structure

An important part of the preparation of the next large-scale Lighthouse demonstration Projects on hydrogen for transport under FP7 and JTI will be the project management structures. Programme Management is fundamental to the coordination of the activities undertaken by project partners. Programme Management also ensures that the envisaged outcomes of projects can be achieved and that those outcomes are in line with the main targets of the programme. Therefore a good structure is needed whereby the aspirations of the leaders and the realities of the work ahead are communicated and a common approach be developed and monitored.

Using the selection of projects undertaken in another HyLights work package, past and ongoing demonstration projects on hydrogen for 9 demo projects were assessed for the management structures and experience collected.

Based on this structured assessment and using the previously defined Project Governance Indicators the most advantageous management structures have been identified and discussed. As a result the generic organizational structure shown in **Figure 11** has been identified as most appropriate.

Figure 11: Generic organizational structure for future LHPs under JTI



3.4.3 IPR rules and processes

Through a separate subcontract to the companies Faasen&Partners and Brinkhof the special topic of IPR issues was assessed with the necessary competence. The objective of this part of work was to identify and elaborate on the key issues pertinent to the protection of Intellectual Property Rights (IPR) of the entities/project promoters participating in large-scale hydrogen road transport demonstration projects, the so-called “Lighthouse Projects” (LHPs) within the context of the future FCH JTI.

Within the framework of the LHPs, HFC technologies are further developed, tested, evaluated and validated. These activities are based on technologies and technical knowledge of the project partners/promoters and will generate technologies and large amounts of relevant data (henceforth referred to cumulatively as “IP”). This IP may comprise information that represents a competitive advantage for the project partner/promoter concerned. Nonetheless, the sharing of this IP among the partners is essential for the efficient execution of the projects and will speed up development of the technologies involved enhancing the potential of large-scale commercialization of these technologies and facilitating the design of a harmonized set of Regulations, Codes and Standards (henceforth referred to as “RCS”). To resolve this issue, a balance must be struck between protecting and sharing of IP by rules and processes that serve all project participants/ promoters´ interests. At the same time these rules and processes should take into account that

- joint development of technologies, giving rise to joint IP ownership issues, is likely to occur within these projects, and
- the projects might be executed in various member states, subject to national (mandatory) IP rules.

The projects in most cases are and will be co-funded by the EC under the Framework Programme (“FP”) 7 and private and local public entities. FP 7 imposes general IP rules on the project partners. These rules leave the regulation of several important issues to the project partners. Among these issues are the access to (confidential) IP and the way in which joint ownership of newly developed IP, known as foreground, is regulated.

The analysis of Faasen and Brinkhoff has addressed several possibilities to handle IPR produced throughout the demonstration projects´ lifetime. One possibility is the establishment of a simple consortium agreement wherein the stipulations on IPR, access and use rights will be detailed and another one is the establishment of a separate legal entity (SLE).

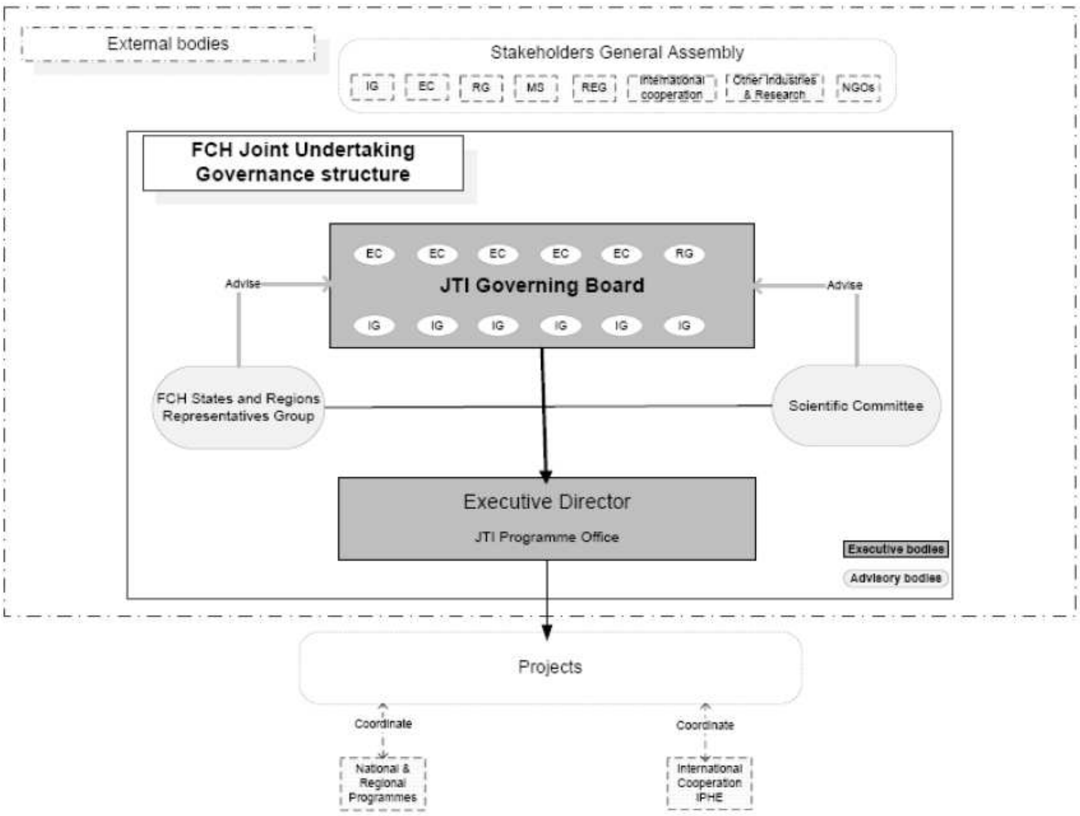
In the case of LHPs the strategic relevance of the partnerships undertaking the projects is limited to the timeframe of technology development and demonstration until the beginning of first full-scale commercial activities. This chronological dimension needs to be reflected when legal structures for LHPs with a focus on technology validation are discussed.

Based on existing industry experience a lean structure without a single legal entity (SLE) governed by a consortium agreement (CA) to address the aforementioned timeframe and that will be regulating the relevant management, operational and data protection/ IP issues is to be favoured for the majority of LHPs also due to the reduced complexity that such a lean structure presents vs. a more complex SLE structure. The latter would be more suitable should competing companies decide to undertake joint development activities of new hydrogen technologies with the strategic intent to continue this partnership following conclusion of the LHP demonstration phase, if a positive business case could be achieved. In addition, such a venture is likely to deliver a significant amount of patents and other rights on IP, which require higher protection levels over a longer period of time.

3.4.4 Analysis of other JTI management structures and U.S. benchmarking

In a second step, the management structures of the Joint Technology Initiative on Hydrogen and Fuel Cells (JTI Hydrogen) (see **Figure 12**) has been assessed in comparison to the one of other JTIs which are being or have been established and to the DoE Hydrogen Program structure.

Figure 12: FCH JTI Program Management Structure



A program is a major undertaking for most organisations, meaning significant funding and substantial change for the organisations and individuals involved. The work performed by HyLights considers the comparative program management practices in both similar JTI projects as well as in other hydrogen-based programmes such as that of the U.S. DoE's Hydrogen Programme.

The analysis undertaken here only deals with Programme Management and the bodies that will implement the Program. Programme Management bodies and the data that they will monitor from project level are considered. Certain characteristics of each JTI are identified which helps in the understanding of the composition and purpose of each JTI. Their programme management structures have been benchmarked against that of the FCH JTI. The same approach was undertaken when comparing the U.S. DoE Hydrogen Program with FCH JTI.

It was found that while the JTI structures are fairly similar in their structures and operations there are different structures in place mainly with regard to research and regions' representation. The difference is largely due to the composition of the Industry Grouping as there does not seem to be a link between the complexity of the program management structure and the amount of funding available. Compared with the U.S. the European JTI structure is composed of many similar bodies as the current ongoing U.S. approach. However, the JTIs appear to be more open to the regions' representation than the U.S. model and there is a more formalised approach in the U.S. allowing for coherent work across the 300 million people nation despite the program receiving less funding.

3.5 Policy support measures

3.5.1 General conclusions

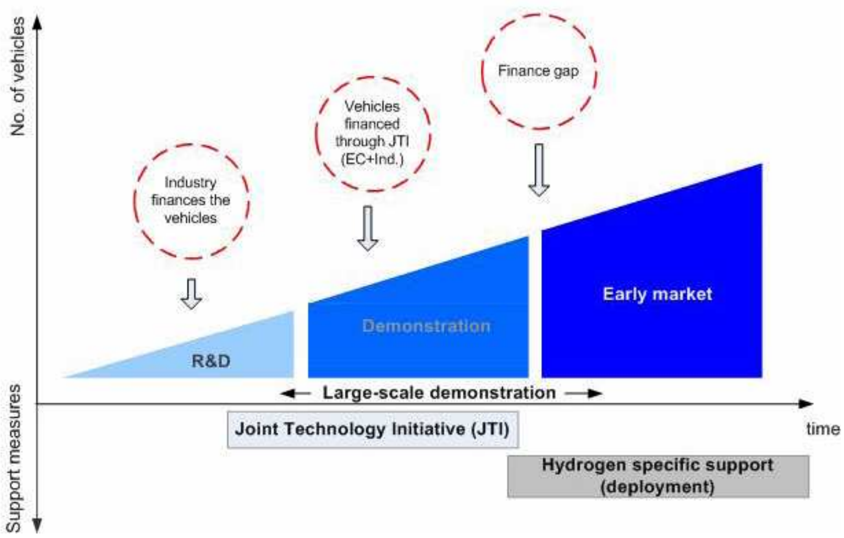
Introduction

In the framework of the HyLights recommendations for policy support measures for hydrogen in transport have been derived from a thorough assessment. The assessment specifically focused on the phase from large-scale demonstration towards early commercialisation. The aim is to provide a balanced perspective on the necessary support for hydrogen vehicles, hydrogen as a fuel and refuelling infrastructure. The assessment results have been reviewed in several stakeholder workshops and synthesised in a number of published reports. Major input has been also gained through the application of a spread sheet based policy support tool and the discussion on 'expectation management' dealing with regional, industry and policy perspectives on hydrogen vehicle demonstrations.

The need for policy support

There is a need for specific support for hydrogen in transport to facilitate the introduction and deployment in the commercial market. Hydrogen technologies are now entering the next phase of innovation leaving the pure R&D phase behind. After a series of large-scale demonstrations jointly financed by industry and government (JTI), hydrogen technology will move towards early commercialisation. Deployment support from the JTI will fade out but the vehicle production needs a quick ramp-up in order to make the step to a higher production level, see **Figure 13**.

Figure 13: Transition from R&D to early markets



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

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

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

Level of implementation

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

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

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

On the regional level hydrogen applications can already contribute to reduce CO_2 emissions and noise in city centres. Hydrogen is also received as a local industry and employment factor. Various EU regions are already involved in hydrogen business and small-scale demonstration activities. For those reasons deployment support should be raised through the regions to the national governments where level of awareness is not sufficiently high enough.

Policy support

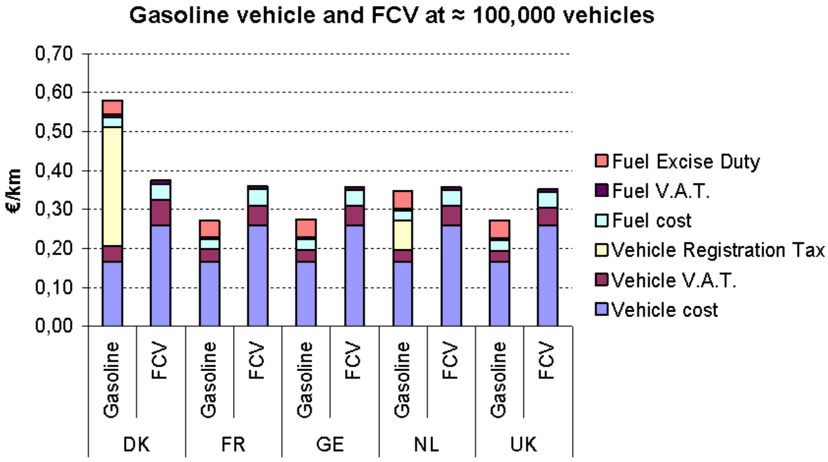
HyLights has developed a straightforward tool that calculates the cost gap between conventional and hydrogen vehicles[3]. Based on the HyWays cost data, a gap of approximately 10 €ct/km[4] - taking into account both vehicle and fuel cost – between a gasoline and hydrogen (FC hybrid) vehicle has to be bridged assuming around 100,000 vehicles being built. By using the policy support tool the sensitivity of the €/km gap to a number of factors such as oil price, vehicle price, hydrogen fuel price and several policy support schemes can be reviewed.

The €/km cost is firstly dominated by the vehicle cost (and taxes), followed by the fuel cost. Taxation applies to both vehicle and fuel costs. The current taxation schemes throughout Europe differ substantially. This not only influences the gap (€/km) between gasoline and hydrogen, but also the potential to implement support schemes for hydrogen in transport. In all countries VAT, fuel excise duty and road taxes affect the cost of the vehicle and fuel, but differences in these taxes are minor and influence the cost per kilometre only little (around 0.2 – 0.5 €ct/km). The biggest difference in the current taxation schemes is the registration tax on vehicles, see **Figure 14** below.

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

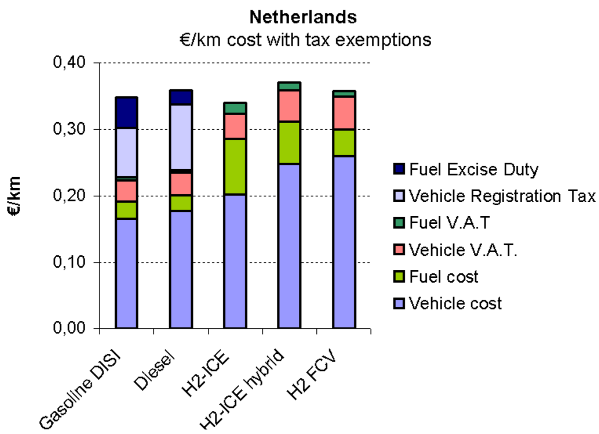
[4] With a vehicle cost level according to HyWays at 100.000 vehicles produced and a H_2 fuel price of 6 €/kg

Figure 14: Example – vehicle cost difference (€/km) in selected EU countries (based on 2008 support schemes)



Countries like Denmark and the Netherlands (energy labels) have high registration tax, on the other hand the countries with automotive industry do not have registration tax[5]. In Denmark and the Netherlands hydrogen vehicles are exempted from registration tax. This provides (already today) an incentive which covers the gap (almost) completely (30 €ct/km in Denmark and 5 €ct/km in the Netherlands), see Figure 15. On the other hand, countries without registration tax (like Germany) have to implement new specific policy support schemes and cannot build upon current taxation (by giving exemptions on current taxes) to support hydrogen in transport. However, one has to take into account that current (advantageous for hydrogen) tax regimes could change in the future. In the Netherlands, it has been already decided that registration tax will be phased out and replaced by road tax.

Figure 15: €ct/km cost comparison with tax incentives in NL (based on 2008 support schemes)



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

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

From the perspective of the policy maker

The support schemes need to be stable for a long period of time and investors need to be able to rely on this. Implementation should be done in a way that is not sensitive to budget cuts in case economy measures need to be taken. Preferably the instruments should be implemented in a budget neutral way, implying that the expenditures equal revenues, and should not be visible on the national account, clearly indicating the total cost of the scheme[6]. From a political point of view, exemptions from existing tax schemes are easier to implement (support politically), whilst increasing taxes or substantial subsidy schemes are politically less favoured.

Such schemes are more likely to be terminated from year to year or once in case budgets increase, priorities shift or spending cuts become necessary. The schemes should be designed to enjoy support over more than one legislative period. Also a distinction can be made between incentives playing a role when purchasing the vehicle and incentives during use (on operating cost) of the vehicle. Given the high discount rates of consumer products, incentives playing a role when purchasing a vehicle are valued much higher and are therefore more effective with respect to influencing purchase behaviour in comparison to future revenues. However, since the full gap has to be bridged at a single moment in time (the purchase), the magnitude of the incentives becomes too big (around 75 m€)[7] to be still favoured by policy makers.

From a political point of view, incentives on an annual basis but with less substantial payments are much easier to implement compared to an incentive at the moment of purchase, despite the fact that the total budget is equal and the effectiveness is higher at the moment of purchase.

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

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

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

instruments during both the moment of purchase as well as during operation is therefore most favourable.

Bridging the gap between demonstration and early markets

Analysis of existing and foreseen instruments shows that for most countries a combination of instruments could bridge a gap of, for example, 10 €ct/km. However, substantial higher investments are necessary to finance the first 100,000 vehicles that come after the JTI financed large-scale demonstrations that will only comprise a few thousand vehicles at most. This represents a major hurdle since it is unclear how these vehicles will be financed. The technology is still too expensive to be adopted in the early market and large production volumes cannot be realised due to insufficient demand. Although several thousands of vehicles may be produced, costs will still be high in comparison to conventional vehicles. Annually about 15 million cars are sold in Europe which means that the market share of 100,000 hydrogen vehicles would be less than one percent of the overall vehicle market. Here, favourable market conditions (early markets) combined with a set of policy instruments comparable to the phase beyond 100,000 vehicles (corresponding to a cost gap of approximately 10 €ct/km or less) need to bridge the gap. Vehicle deployment will take place at a limited number of locations (e.g. not EU27) that provide favourable conditions and therefore accumulate the majority of the vehicles.

The actual financial gap in the phase up to 100,000 vehicles is difficult to assess since none of the manufacturers has yet publicly announced production volumes together with an indication for sales prices. Research within HyLights has shown that fleet operators could be a starting point for vehicle deployment, but only on a case-by-case decision basis. Yet, due to the lack of information on price levels, fleet operators are actually not in a position to make informed investment decisions and thus have not started to implement corporate policies supporting hydrogen vehicles.

In addition, it is unclear if and how a series of early markets could evolve into the mass market and what the requirements for those vehicles are (performance, tolerance to additional costs).

Regional networking

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

Committed “frontrunner” regions should form interest groups and evaluate their vehicle needs and financial opportunities by means of stakeholder workshops. Thus, business plans should be set-up that elaborate on interested fleet operators, total size of demand, vehicle segments and how the supply is going to be financed. The business plans furthermore help to identify the committed regions, which regions have favourable conditions and under which conditions those vehicles can be applied.

Currently no more than five to six European regions possess the necessary resources, regulations and characteristics to be a frontrunner. Through the bottom-up activities of the regions interest should be raised within the national government level to start designing national support frameworks.

Infrastructure support

The availability of adequate refuelling infrastructure is directly linked to a successful introduction of hydrogen vehicles. Absence of infrastructure will hamper deployment of vehicles since end-users will be hesitant to switch to hydrogen vehicles. Infrastructure investments bear the risk of negative cash-flows for a long time period due to slow increase in utilisation and competition with conventional and alternative technologies. A policy support framework should therefore also provide incentives to lower the infrastructure investment risk. In the U.S., infrastructure incentive schemes have been already introduced on both national and state-level. States as California have also introduced regulatory measures (ZEV Requirement) to deploy vehicles. Europe is facing a bigger challenge in order to provide comparable market conditions (level playing field). Not only do other incentives need to be implemented to compensate for the absence of regulatory measures, also the existing and potential policy measures vary widely between the EU member states.

Since EU infrastructure support is out of scope as of today, support has to be provided at the member state or regional level. There is already a tendency to provide infrastructure support through national programmes e.g. in Germany.

However, there is still a general lack of interest on the member state level, partly because vehicle numbers are not regulated and thus difficult to estimate. Again, regions committed to hydrogen should become active and either include infrastructure in their business plans or raise interest at the member state level. Eventually infrastructure support needs also to be synchronized with fuel and vehicle support which is only possible on national level.

Conclusions

This part of the report summarises the research carried out within the HyLights project in the field of financing large-scale demonstration projects and beyond. Studies have been completed on early markets for hydrogen vehicles, on existing and future policy support schemes and on expectations of different stakeholders towards the deployment of vehicles. Through HyLights, now a more detailed picture has been provided e.g. regarding the effectiveness of a policy support framework and on the necessary steps that need to be taken in the future concerning early markets. However, the analyses also show that further analysis is needed building upon the work performed in HyLights to quantify in more detail the evolution of early markets.

The interviews with potential early users of hydrogen vehicles basically showed that fleet operators have not started thinking about support schemes for hydrogen or zero-emission vehicles. They are, however, keen on supporting energy efficient vehicles and have for example implemented incentives for vehicles with energy label A and B. Comparable support schemes for zero-emission vehicles can only be implemented if (additional) costs are known. Further analysis on early markets for hydrogen vehicles just based on the evaluation of stakeholder requirements, existing and foreseen support schemes and lessons learned from recent and ongoing demonstration projects is expected not to provide any relevant results on top of what has been found in the context of the HyLights project. As a next step, regions should develop concrete business plans, stating how many vehicles can be deployed at what conditions. This should include tolerance of additional costs and performance requirements.

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

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

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

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

3.5.2 Assessment of policy support mechanisms

The need for a comprehensive policy support measure assessment had already been pinpointed by the European hydrogen energy roadmap project HyWays. For that reason HyLights continued this work and addressed the issue from an industrial and policy maker perspective.

Instead of deriving advice in favour or against individual policy support measures or bundles of measures, the HyLights partners decided to address the major issues, assess possible measures and compare their impact taking regional and structural considerations into account and discuss policy support measures from other topically related market introduction strategies such as for PV and wind energy in Europe or zero emissions vehicles in California.

Instead of going into all results of the assessment in detail, it is advised here to use chapter 3.5.1 of this report to understand the major conclusions and to refer to the full background report on the HyLights results CD.

3.5.3 Stakeholder views and preferences

In addition to the assessment of policy support measures supporting an accelerated introduction of hydrogen and fuel cell vehicles, a discussion among the HyLights industry partners (automobile and energy) was facilitated. Also, discussions were fostered between industry and the European Commission.

It turned out that the issues of “technology specific support” and “regionally specific support packages” were of specific interest to the participants in the discussions.

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. The work performed by HyLights 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 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 be 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 exemption from registration tax for hydrogen fuelled vehicles, exemption from excise duty for 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 directly supporting the end-user (by e.g. 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, 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 buses can be useful measures to support hydrogen in transport.

Concluding: preferred characteristics of future support scheme

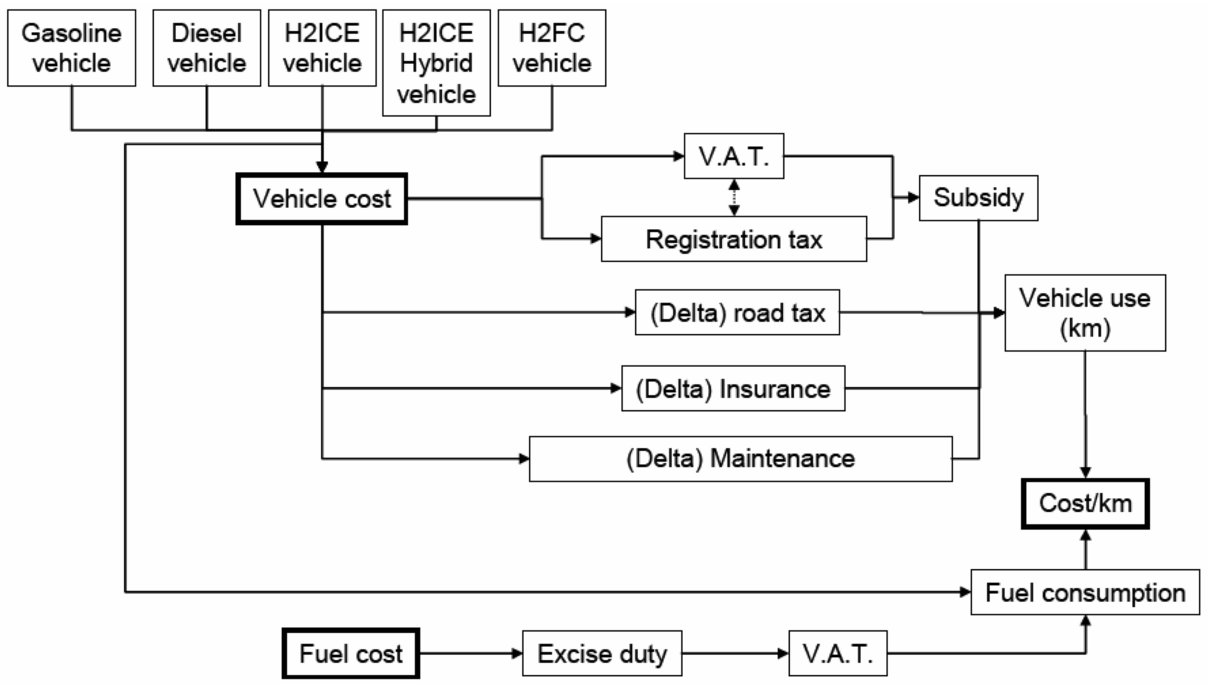
Current policy support schemes primarily aim at technology development (R&D) with limited ability for technology demonstration (of prototypes). The focus of industry involved in hydrogen and fuel cells is going more towards large-scale demonstration (including some small series production). This results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

3.5.4 Calculation tool

HyLights provides a calculation tool to assess the impact of various policy measures and their vehicle or infrastructure specific combinations on the costs of driving or to calculate allowable extra alternative vehicle costs. The possible policy support regimes are depicted in Figure 16.

Figure 16: Overview of possible policy support regimes for private cars



The tool is downloadable from the HyLights website at:

www.HyLights.eu

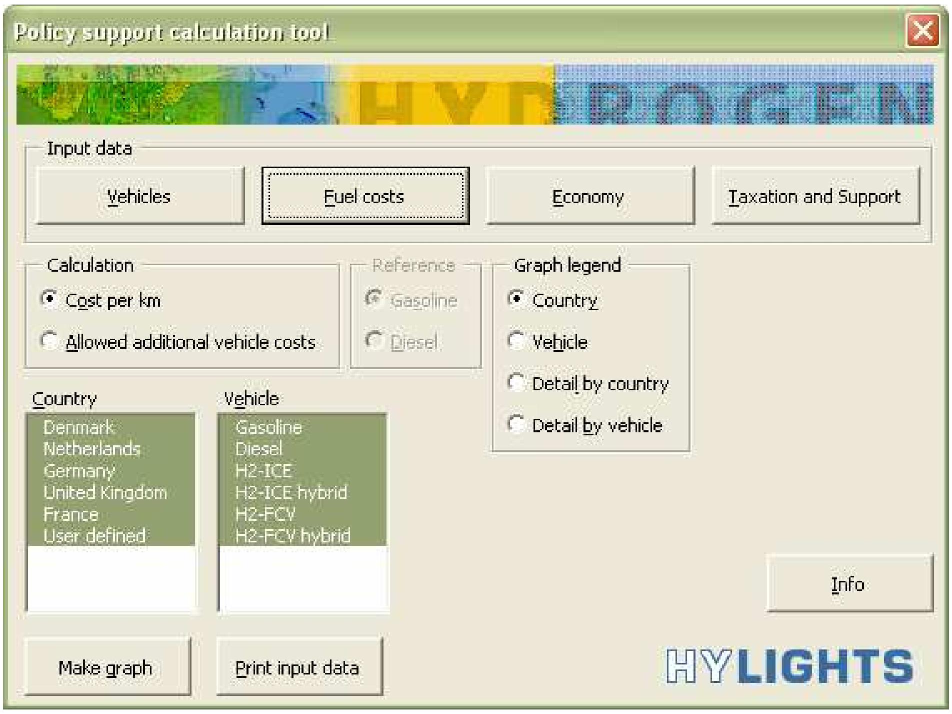
<u>Methodology and manual</u>

The overall purpose of the tool is to calculate:

1. The cost per kilometre for a vehicle in a certain country
2. The allowed additional cost of a vehicle compared to a reference vehicle

A manual has been written explaining the details of how to use the tool and all its available options. The methodology behind the tool is also explained. Default values have been incorporated in order to allow a quick-start for using the tool. An annex contains detailed data on the current taxation schemes for private cars in various countries. **Figure 17** shows the entry menu to the policy support calculation tool.

Figure 17: Screenshot of start page for HyLights policy support calculation tool



The tool includes data for 5 countries (Denmark, Germany, France, UK and the Netherlands). By comparing the outcomes (for both cost per km and additional vehicle costs) an insight will be possible to the impact of different taxation schemes. Since not all EU countries are included a user defined “COUNTRY” can be specified allowing the user to incorporate a policy scheme of the preferred country to carry out an analysis of the impact and effect of other policy support schemes.

A comparison of current different policy support schemes on costs per km and allowed additional costs have been documented in a separate HyLights report.

3.6 Performance of future hydrogen vehicles (GAPS analysis)

The so called GAPS analysis was planned by HyLights initially to assess the “gaps“ between current vehicle performance and the performance of the fuel cell and hydrogen vehicles to be used in the next large-scale European demonstration projects (Lighthouse Projects).

Based on interviews in the Netherlands (and Germany) it rapidly became obvious that the perception of fleet operators, being the key target group of the next demonstration project, had little or no perception of what the performance of this new type of vehicles should be, except that they should “have similar or better performance than today’s vehicles” and at “comparable costs”. The results from this analysis are briefly presented in chapter 3.6.1.

From that it was concluded that too little information is available yet on fuel cell and hydrogen cars, making it necessary for the automobile manufacturers to put more immediate emphasis on informing their future early customers.

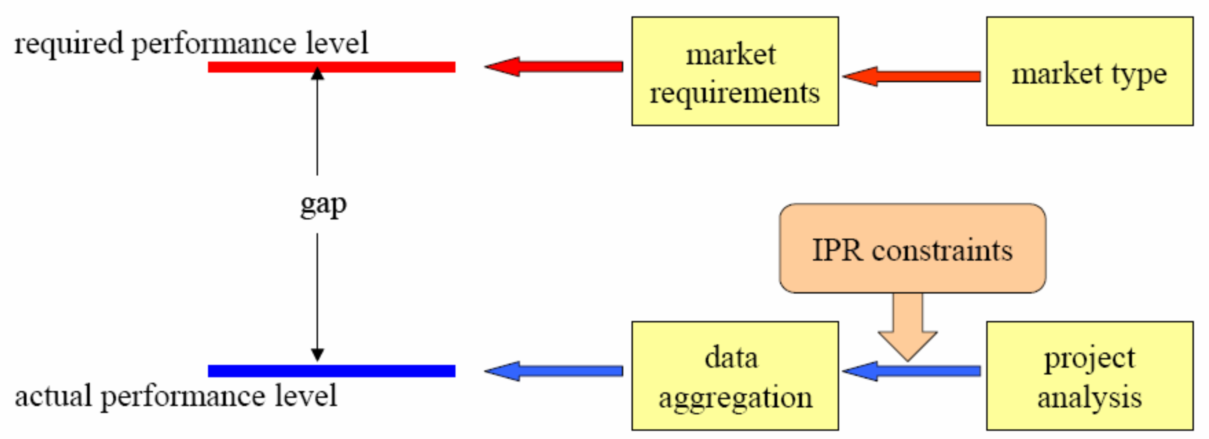
As also the HyLights Executive Advisory Board members had warned that the results from the GAPS analysis in Phase I did not provide enough information for policy makers or industry to be better prepared for the Lighthouse Projects, it was decided to refocus the effort in HyLights Phase II. Instead on focusing on the identification of the future operators’ minimum performance requirements for the demonstration phase only, the new task now became to analyse the real performance requirements of early vehicle fleet operators on vehicles (i.e. on road with licence plates) and to a lesser extent on the refuelling stations for the time immediately following the large-scale demonstration projects and irrespective of the technology being used.

To achieve a more complete picture of the situation in Europe, the assessment was extended to then also incorporate France, Norway, Spain and the UK. The results from the second part of the assessment are presented in chapter 3.6.2.

3.6.1 Minimal user requirements for hydrogen vehicles

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 18**). 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 to 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 18: Schematic presentation of the GAPS analysis in Phase I of HyLights – Focus is on the upper (red) part of the gap



The first results of applying the GAPS analysis methodology in the Netherlands have been documented in a separate report and were discussed with stakeholders from industry, research and the policy sector. Based on a theoretical approach, relevant stakeholders have been selected on the level of national government, local government (provinces and cities), bus companies and commercial stakeholders. These stakeholders[8] (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 were seen as key stakeholders in the process to come to early market. As a test case, the Dutch government has been asked to describe the process of acquiring 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 indicated 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.

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

[8] 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 Verkerhsbetriebe (bus company of Berlin), Greenwheels (car sharing company), TNT, Green Planet (multi-fuel filling station).

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.

3.6.2 Assessment of fleet operator requirements

The aim of the second part of the GAPS analysis was to gain insight about customer opinions and perspectives on the adoption of hydrogen vehicles once the large-scale demonstration phase has been finished and mature vehicles are available on the market. High interest persists on which exact customer groups are interested in hydrogen vehicles and what is their motivation to adopt the technology.

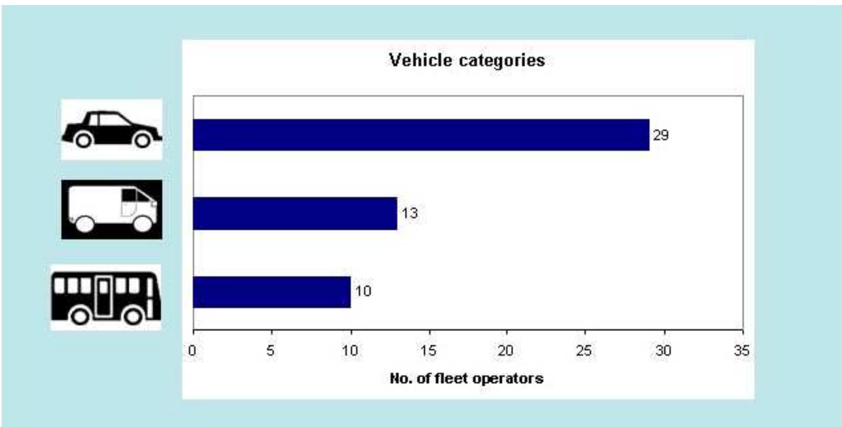
<u>Research approach</u>

The study has been carried out based on a number of interviews with fleet operators in ten European focus regions. The interviews were conducted based on a questionnaire with a twofold aim. First, it aimed to understand the general opinions and motivations for the introduction of hydrogen in their fleet. Secondly, a quantitative part was focussing on technical performance requirements of the current vehicles and to identify the future demand for vehicles.

Different fleet operators also utilize their vehicles in a different way. Therefore a separate part of the questionnaire was seeking information on daily utilization, routines and practices. In each of the focus regions interviewees were identified from a wide cross-section of potentially interesting users from the public and private sector. Vehicle categories taken into account for the study are mainly road certified passenger cars, delivery vans, buses and specialty vehicles such as scooters and four-wheeler (

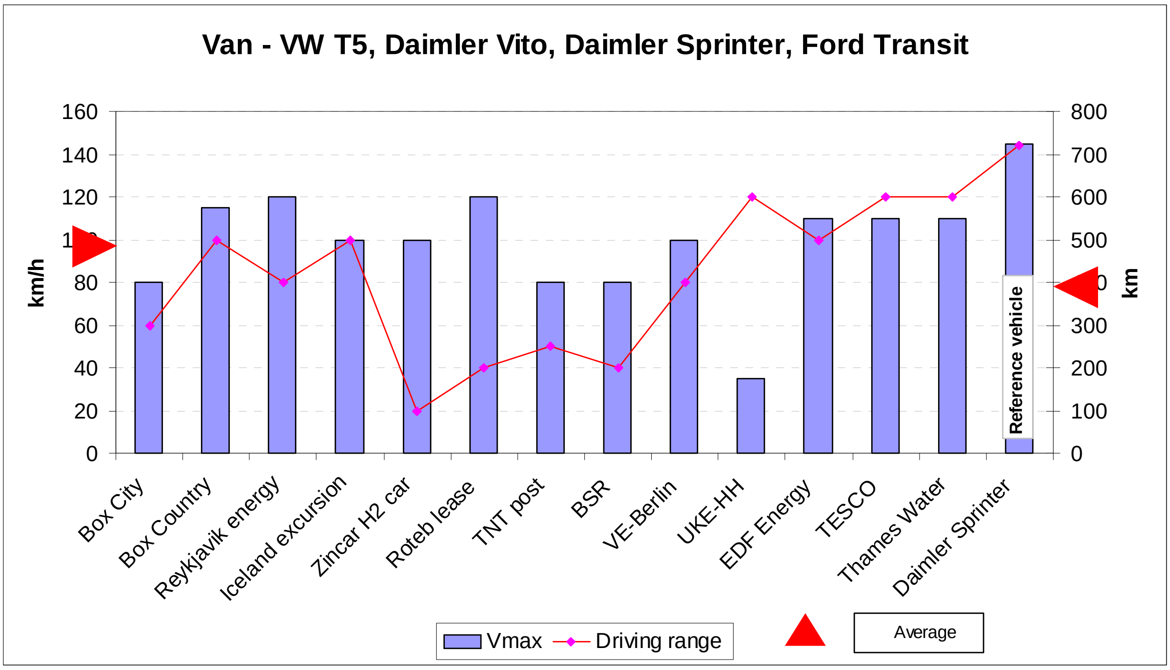
Figure 19). In total, 63 interviews were conducted with selected individuals, which play major roles in the strategy, vehicle or purchase department of their organizations.

Figure 19: Vehicle category distribution



For all vehicle classes the performance profile for Key Performance Indicators (KPI) was analysed across the relevant vehicle fleets. E.g. for the required maximum speed and driving range of vans the results are depicted in **Figure 20**.

Figure 20: European fleet operators requirements for “driving range” and “max. speed” performance for vans (individual and average data)



Motivations for hydrogen

As yet, a number of operators have introduced corporate policies that can drive hydrogen deployment faster than elsewhere. E.g. these are policies on low-emission fleet vehicles, fossil free energy plans or becoming the technological leader. Public transport companies have been identified as the main group for the last internal driver. Reason for this is that hydrogen for bus applications is perceived as the necessary next technological step and alternatives such as hybrid diesel buses would not be cost-effective on the long-term. However, this business case assumes the availability of reasonably priced hydrogen and only slightly higher priced hydrogen buses.

Commercial operators tend to purely focus on cost effectiveness of vehicles if no other internal policy on alternative transport exists within the company. Those operators carefully watch the political developments and prefer to choose second-best alternative sources of energy (biofuels, other low-emission vehicles) before turning to hydrogen.

In general, large commercial operators tend to be hesitant towards hydrogen, partly caused by the need for very high reliability of the vehicles in the business process. Another reason is often their dependence on leasing companies and being fixated on an offered vehicle portfolio. Some small and innovative operators such as the public transport in Soria (Spain) as well as RVK and the Vestische Strassenbahn in NRW (Germany) have signalled high interest on purchasing hydrogen vehicles. Without significant ‘external’ policy pressure (for e.g. on purchase obligations) it is not expected that the majority of commercial companies will turn to the early market adopters of hydrogen.

The by far two largest customer groups identified in the HyLights interview activities are Municipal Services and Public Bus Operators. In the municipal services group some 13 operators mainly using vans and cars are comprised and in the public bus operator group some 12 bus operators are included. All other groups consist of 6 or less users.

It seems to be misunderstood by the operators that lowering fleet CO_2 emissions cannot be achieved by forcing vehicle use to fulfil higher emission standards. CO_2 emissions are not part of the emission standards and are currently only subject to voluntary agreements between the EU and car manufacturers. In fact, the carbon footprint is not reduced by switching to a higher emission standard (e.g. from Euro III to Euro IV)

<u>Technical performance and daily operational characteristics</u>

Technical performance requirements of fleet operators do not seem to represent a barrier for hydrogen vehicle deployment. In the relevant vehicle categories (small and medium sized passenger cars, delivery vans and buses) the average performance requirements are significantly lower than the maximum values by the conventional reference vehicle. From the analysis of the data it becomes clear that hydrogen vehicles which fulfil the requirements are absolutely sufficient and do not have to match necessarily the maximum performance levels of today’s conventional vehicles.

Research into driving patterns and refuelling behaviour revealed that only certain fleet vehicles return back to their home base every day or use only a small number of refuelling stations in the base’s vicinity. However, this analysis needed to distinguish between company cars, vehicles for sales personnel and maintenance vehicles. In particular commercial operators maintain increasingly ‘dynamic’ fleets that do not return to their home base every day. E.g. drivers of maintenance vehicles in the telecom and energy sector receive their daily driving tasks by means of wireless communication and start directly from their home. In this case a wide refuelling network is utilized on a national or regional scale and does only experience limitations in the choice of the tank card.

Operators that refuel their vehicles every day at the same station or return every day to their base are limited: public transport operators and municipalities in the first place. On the other hand company cars handed out to the employees often travel the same route every day to their workplace and back so that installation of infrastructure in proximity of the company could supply those vehicles with hydrogen. As in the early introduction phase hydrogen infrastructure will only become available in the major cities and along major highways, the driving characteristics have implications for the first users. A trend to establish an early refuelling station network (2009/2010) is to be expected for Germany, Scandinavia and Spain.

Policy

Hydrogen vehicles will not be anywhere close to cost parity to conventional vehicles unless a number of vehicles are produced on mass-scale and economies of scale come into effect. The lack of financial support is one of the most frequently mentioned obstacles by organizations for further procurement of vehicles for demonstration and first use. Hydrogen vehicle funding opportunities provided by governments thus play a vital role for technology deployment. Germany is the only country that offers national level funding for demonstration projects, but other countries are in preparation such as Norway and small funding possibilities in Spain. Regional funding is provided in NRW, Aragon and Rhône-Alpes.

Conclusions

Unsurprisingly, nobody is willing to pay more for clean and advanced hydrogen vehicles as long as fossil based fuels continue to be cheap. These considerations indicate that two policy support components might be necessary in order to lead to a successful introduction in this segment: support programs for vehicle purchase subsidies and for infrastructure build-up respectively medium to long-term preferential pricing of hydrogen as vehicular fuel.

Mass-manufacturing and economies of scale will bring down the cost of hydrogen vehicles over time. However, until this stage is reached a number of vehicles need to be deployed first in the market that will still be substantially more expensive. Vehicles in large numbers are supposed to be absorbed by commercial fleet operators that maintain a larger fleet than their public counterparts. The research has now shown that this is not feasible except for buses since most commercial operators have higher infrastructure demands than what will be feasible at the early stages of hydrogen infrastructure build-up. Deployment focus for volume vehicles (passenger cars, vans) should therefore be on city/regional logistics and mail & courier collection/delivery in larger cities and urban agglomerations. These operator groups typically return to their home depot and/or distribution centres daily. More research on the potential opportunities offered by regional fleet operators might be worthwhile to be performed.

Commercial fleet operators that lack internal drivers for deployment of low and zero-emission vehicles will not start considering hydrogen unless political motivation (e.g. purchase obligations) or regulatory requirements facilitate or demand such technology introduction.

A further driver for the implementation of clean hydrogen propulsion technologies is the increasing requirement for conventional pollution abatement measures reflected in the EURO IV, V and VI emission standards which unfortunately also lead to significant increases in fuel consumption. Already for the switch from EURO III to EURO IV, they are between 12% and 18% (reported by EMT-Madrid and RVK Cologne respectively) and thus increase the carbon footprint at a similar rate. The continuously growing requirements in reducing pollutants will lead to rising investment costs and complexity of technology and sooner or later might force a technology switch anyhow to intrinsically cleaner propulsion concepts.

Currently it is mainly major cities in Scandinavia and in Germany which are becoming active in the field of hydrogen, the procurement of hydrogen and fuel cell vehicles and the opening of hydrogen refuelling stations. In the South of Europe it is rather the small and medium-sized cities that want to take a pioneering position in new technologies. In general the southern European countries of France, Italy and Spain have a large number of public operators being major drivers for hydrogen while during the enquiries for this study a virtual absence of interest from the private sector could be observed.

3.7 H2moves.eu – The European demonstration project family

3.7.1 Background

HyLights had been asked by the European Commission to integrate a work package to strengthen and to support PR and dissemination efforts of the EC funded demonstration projects on hydrogen for transport. Due to the nature of the project-oriented funding schemes each single demonstration project has organised its own dissemination and PR activity, mostly by emphasising only the efforts of the consortium partners. However, this inevitably led to a shortfall regarding the presentation of the coherence of the ove

rarching EC approach and the strategy behind the selection of demonstration projects. To contribute to the effort to display the broader picture of the EC funding strategy and its demonstration projects HyLights has established a joint initiative towards more and equal visibility of all individual projects.

HyLights established an initiative branded *H2moves.eu* which invited all publicly supported demonstration projects on hydrogen for transport in Europe to benefit from becoming part of the so called “project family on hydrogen for transport”. Right from the beginning especially industry argued that all demonstration activities should become part of the initiative which was fully supported by the European Commission. A set of rules for participation in the project family was provided by HyLights by which it was agreed that generally all demonstration activities with any kind of public funding could join the initiative. Privately funded projects supporting and strengthening the European approach should not be excluded, the final decision of membership being in the hands of HyLights. This open approach led to a committed group of European demonstration projects which joined in the H2moves.eu initiative.

Together with the industry involved in HyLights and the various demo projects a communication strategy was developed. Three major tasks were identified:

- To communicate (to stakeholders, the EC, industry and regions),
- to facilitate workshops (for the demo project family) and
- to support (all stakeholders from above but not explicitely the public).

The communication task covers all information and dissemination activities about "hydrogen for transport" towards specific target groups. The facilitation task is to support and to offer services to ongoing and emerging demonstration projects within the genuine scope of H2moves.eu. This task is directly targeted towards the various partners of the demonstration projects and should firstly increase and support the information flow in between the projects. The third task is to provide support and assistance to coming or planned demonstration projects and towards the European regions. This also includes fostering the information flow towards and between the regions and increasing the visibility of the regional activities.

3.7.2 Communication

The primary assignment of the H2moves.eu communication task was to provide an overview and an easy access to information about ongoing demonstration projects on hydrogen for transport in Europe. Various dissemination channels were used to achieve this goal. The basis was provided by the H2moves.eu website which does not only link all the specific project websites but also provides an easy and pictorial introduction to all projects at a consistent level of complexity. The coherent perspective of the website creates a very powerful first impression of the European landscape of demonstration projects.

The first step of the H2moves.eu initiative was to create a brand and a corporate identity for the project family with a specific and self-explanatory logo design for the selected "H2moves.eu" brand:

H2moves.eu

With the logo a corporate identity was created and established. To promote the logo a couple of "give aways" were developed. Pins, stickers and well accepted hydrogen data cards in 6 European languages were developed and distributed at different events. About 30,000 hydrogen datacards were distributed in Europe, in the USA and in Australia. In addition a poster flyer showing all European demo projects at a glance was printed of which 5,000 copies were distributed (**Figure 21, Figure 22**).

Figure 21 Hydrogen datacards in 6 languages and demo project poster/flyer

Figure 22 Poster of the European demo projects on hydrogen for transport

As first step an overview of all European hydrogen demo projects was provided on the website. In a second step all regional activities were added to the website to jointly display information on active and committed regions serving as examples for other interested regions (**Figure 23**).

Figure 23 H2moves.eu website – Regions activities overview

Internet activities were complemented by the presence of H2moves.eu at various stakeholder events, trade fairs and conferences. A joint booth concept was developed to display the EC funded projects with coherent appearance and design. But also nationally funded projects were invited and most of them participated on a basis of shared costs. About 6 to 8 projects frequently participated in the joint booth (**Figure 24**).

Figure 24 Joint H2moves.eu booth at the H2 Congress in Essen in April 2008

The booth concept turned out to be an efficient means to jointly present the projects. With modest financial funds the booth was presented at 14 European events, at 2 consecutive National Hydrogen Association events in the U.S. (2007, 2008) and at the World Hydrogen Energy Conference in Australia in 2008. The H2moves.eu booth staff was briefed about the projects' latest status. More specific requests were forwarded to responsible individuals of the respective demo projects. The impact created by the joint appearance was significantly higher than the impact single projects could have achieved at the same events, specifically as the coherent European approach could be displayed and emphasised.

At most conferences the exhibition was complemented by presentations in the conference program. The presentations provided an overview on European demonstration activities and in 2008 also on regional activities. The H2moves.eu presentations were focused at providing a coherent European strategy while the single projects would typically concentrate on their specific ambitions. Figure 25 gives an impression of the H2moves.eu booth concept and appearance.

In the course of the H2moves.eu activity several additional promotional items were designed. They comprised paper cuts of all 10 HyFLEET:CUTE buses, educational fuel cell vehicles with solar hydrogen filling station and a display of scale models of European hydrogen and fuel cell vehicles.

Figure 25 H2moves.eu booth at the NHA conference in Sacramento, USA, 2008

Figure 26 Hydrogen vehicle scale model exhibit at the H2moves.eu booth

In total the H2moves.eu booth was presented three times in Brussels, once in Italy, four times in Germany, once in Sweden, twice in The USA, in Australia.

3.7.3 Facilitation

The European Commission realised that the information exchange between the independently operating demonstration activities could be improved. Due to a lack of topical meetings on a regular basis with experts from the various projects also real cooperation between the projects was limited. To meet the demand of more information exchange and to facilitate and to foster the "project family" idea a second task of H2moves.eu was defined. This task comprises the invitation of experts from the projects and external experts to topical workshops on cross cutting issues or on issues of specific interest.

Three workshops have been organised and facilitated by HyLights under the H2moves.eu brand on 'regulatory issues', 'review of the HyLights Monitoring &

Assessment Framework (MAF)' and 'project dissemination issues'. A fourth workshop on 'hydrogen purity' could not be organised due to missing interest of the projects. Each topical workshop aimed at the identification of best practices, at the avoidance of a duplication of work, the use of benefits from "lessons learned" and to pave the way towards successful and efficient demonstration activities.

The H2moves.eu workshops were complemented by two regions workshops (in the "support" task) to which representatives of the demo project family were invited.

3.7.4 Support

At present the European landscape of demonstration projects on hydrogen for transport is characterised by many incoherent activities. Projects funded by the European Commission coexist with projects funded by national governments and by regional authorities or initiatives. Therefore the lack of information flow and missing cooperation between individual projects funded by the European Commission can also be explained by the naturally scattered national or regional strategies, i.e. the many less visible regionally or nationally funded projects or initiatives and the – up to now – missing body to cluster these activities by information gathering and display.

In order to support the EC and regions jointly HyLights volunteered to support the establishment of the European Regions & Municipalities Partnership on Hydrogen and Fuel Cells (HyRaMP). HyLights, supported by Roads2HyCOM, Fuel Cell Europe and the European Hydrogen Association, coordinated the enabling Task Force on behalf of the EC which had kicked off the activity on the 3rd Regions Workshop at the Technical Review Days in Brussels on 11 October 2007. Even though widely unknown, this additional and not-planned-for support became an important element of HyLights's facilitation to improve the coordination of Europe's regional approaches on hydrogen for transport with the European one.

The aim of H2moves.eu in the framework of HyLights was to offer services also to the regions' group of actors by providing an overview on active and committed regions, by inviting regions to workshops and by providing a platform for information exchange. Networking and advice are provided to add new partners, to refer to existing expertise and to identify areas for cooperation. Both tasks – facilitation and support – have aimed at strengthening the "Project Family" idea and increasing the impact of each single demonstration activity by providing transparent information.

H2moves.eu became a first contact point for regions aiming to receive information about opportunities to get involved in demo projects or whom to contact in industry to present themselves as possible locations for a demonstration project. Resulting from the many individual requests it had been decided to carry out a series of regions workshops. These workshops turned out to be beneficial for both parties. Regions learned about industries´ perspective and strategies and the regions could present their approaches and opportunities as well as already existing programmes and projects. H2moves.eu did not act as an active player in this context but as facilitator provided the communication platform and moderated between the involved parties.