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

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

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

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

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

- Executive Summary ........................................................................................................... 9
- Introduction .......................................................................................................................... 15
- Selection of Prioritized Demonstration Projects ................................................................. 17
- Project Coordinators / Managers Interviewed .................................................................... 19
- Results Project Coordinator / Manager Interviews .............................................................. 21
- Region / Municipality Representatives Addressed ............................................................... 37
- Feedback from Region / Municipality Representatives ...................................................... 39
- Annex 1: Interview Protocol H2argemuc ............................................................................. 49
- Annex 2: Interview Protocol ECTOS .................................................................................. 61
- Annex 3: Interview Protocol CUTE .................................................................................... 67
- Annex 4: Interview Protocol ZERO REGIO ........................................................................ 75
- Annex 5: Interview Protocol HyFLEET:CUTE ................................................................. 85
- Annex 6: Interview Protocol CEP ..................................................................................... 93
- Annex 7: Interview Protocol HYCHAIN ........................................................................... 107
- Annex 8: Interview Protocol HyNor .................................................................................. 115
- Annex 9: Interview Protocol LHTP .................................................................................... 123
- Annex 10: Interview Protocol CaFCP .............................................................................. 129
- Annex 11: Interview Protocol CUTE - Stockholm ............................................................. 135
- Annex 12: Interview Protocol CUTE - Amsterdam ............................................................ 137
- Annex 13: Interview Protocol CUTE - Hamburg ............................................................... 139
- Annex 14: Interview Protocol HyFLEET:CUTE - Berlin .................................................. 141
- Annex 15: Interview Protocol argemuc - Bavaria ............................................................... 145
- Annex 16: Interview Protocol ZERO REGIO – Frankfurt Hoechst .................................... 147
- Annex 17: Interview Protocol Hydrogen Link Denmark .................................................... 149
Executive Summary

In the course of the HyLights project WP2 has assessed 9 European and 1 U.S. key demonstration projects on hydrogen for transport. Therefore interviews have been performed and documented in protocols. Aim was a better understanding of the project organisation, operational experience and lessons learned. A presentation showing the results, conclusions and recommendations of the interviews has been prepared. The outcome has then be used by the other WPs as input for their analyses and preparatory work for e.g. the gaps analysis, the establishment of the Demonstration Program Framework, etc., but could be relevant for other interested stakeholders as well.

The basis for the interviews was a set of 21 questions structured into 4 topics:

- General project information
- Experiences from setting up the project
- Results / lessons learned
- Recommendations

These were distributed to the HyLights institute partners prior to the interviews in order to ensure that the expected answers were suitable for doing the analysis work of the other WPs.

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, MS, regional) as well as the lack of vehicle and infrastructure performance data due to few vehicles and / or missing assessment and funding frameworks.

The coordinators of nine leading European demonstration projects and representatives of 1 U.S. demonstration project were interviewed:

- H2argemuc – The hydrogen project at Munich Airport
- CUTE – Clean Urban Transport for Europe
- 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 – The California Fuel Cell Partnership

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 are therefore key especially for future large-scale demonstration projects.

In case of hydrogen refuelling stations it has been recommended that one partner alone should take over the responsibility for the approval, erection and operation of a station in order 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, may be a practical approach or at least a robust basis for future projects.

Beside the London Hydrogen Transport Programme, which is 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 is the H2argemuc project, which operates 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, potentially developed within the preparation of the Demonstration Program Framework, could be a useful tool.

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 and for the hydrogen infrastructure.

For some projects the next steps after their finalisation are unclear. For future large-scale demo projects it should be clarified at the preparation phase as to how the project fits in the overall strategy towards a mass market roll-out.
The hurdles to be overcome during the set up and operation phase of the projects mentioned by the interviewees include financing (no adequate continuous funding available, difficulties in the identification of local funding resources), technology (incident requires redesign of refuelling station), authorisation / regulations, codes and standards issues (difficulties to receive authorisation for refuelling station, certification problems for vehicles) and others (long-lasting contract negotiations, lack of hydrogen vehicles, etc.).

On the project coordinators’ wish list there is also the request for clear, flexible long-term funding schemes reflecting the overall political strategy at all funding levels (EU-wide, national and regional).

A suggested future improvement was that financial support should be already available during the project preparation phase as already this phase is very time consuming and costly.

It was also mentioned that funding organisations should be able to adapt funding to changing project budget requirements during the course of a project.

A common approach to publish status, data, results and ‘lessons learned’ of future projects should be agreed on and each publicly funded project should be obligated to provide respective information.

With regard to performance of vehicles and infrastructure only very limited information could be gathered as either it was already published (CUTE, ECTOS) or it was confidential.

The question on synergies with other fields of technology (e.g. with stationary applications or other alternative fuels at the refuelling station) has been answered very inhomogeneously not allowing to draw any conclusions.

Last but not least some additional ideas for potential incentives could be collected (of course national or local specialties have to be considered) such as decreased or no import taxes for hydrogen vehicles, free parking, free use of toll roads, allowance to use public transport lanes, no VAT, etc.

In general, it can be said that the interview activity was a very successful exercise as a lot of insights into various demo projects were gained. The project coordinators were very proactive and cooperative and have shown huge interest in contributing to the preparation of the next logical step, the large-scale demonstration projects.

In the second phase of the project the focus was no longer on the views of the project coordinators but on the views of the representatives of the municipalities and regions involved in one of the above mentioned demonstration projects. Therefore a short questionnaire was prepared and distributed. Feedback from 7 regions / municipalities could be received and documented.
A presentation showing the results and recommendations of the questionnaire activity has been prepared. The outcome has then been used, together with those of the interviews with the project coordinators / managers, by the other WPs as input for their analyses and preparatory work.

The basis for the questionnaire activity was a small set of questions, which in total comprised 11 single questions, structured in the two topics:

- experiences and lessons learned and
- recommendations

The results: Asked with respect to their decisive motivation and the drivers to participate in the demonstration project most of the answers refer to superordinate issues such as improving energy security, climate and environment protection as well as gaining independence from fossil fuels.

With regard to the political support in one case it was mentioned that the ‘support’ was more a political pressure to deploy alternative fuels within the existing budgetary framework.

Especially the regions / municipalities participating in projects covering buses are very happy with the situation developed. As a result of the CUTE project the Hydrogen Bus Alliance (HBA) was established in which now a common strategy can be developed.

Very inhomogeneous feedback could be collected regarding the questions of next steps. Some answers reflect that no follow up will happen, some will pursue other technologies than hydrogen (e.g. Stockholm: electric hybrid ethanol Diesel buses), but most are clearly dedicated to hydrogen technology and are seeking for large-scale hydrogen demonstration projects.

The regions / municipalities dedicated to hydrogen technology all have a roadmap or strategy plan for the implementation or are currently working on it.

The expected benefit for the regions / municipalities can be summarized as environmental & societal and strategic benefits. The environmental & societal aspects cover emission reduction of public transport, operation in restricted areas, sticking to regulations (e.g. EURO 6), reduction of dependence on imports of fossil fuels. Strategic aspects include the gaining of various expertise in the region and germ cells for developing a hydrogen infrastructure as a basis for future large-scale hydrogen demonstration projects.

The availability of sufficient financial resources was mostly seen as the largest hurdle / showstopper for the various projects. But also missing (European) regulations, codes and standards as well as communication issues were named here. Even mentioned technical issues seemed to play an subordinate role. Here the capacity of the refuelling infrastructure as well as the driving range of the vehicles were in the focus.
Beside the contact person in Berlin, who is interested in buses only (BVG is a public transport organisation), all others would be interested in various vehicle segments (buses, cars, (garbage) trucks, light duty vehicles (vans), scooters, forklifts, specialty vehicles and some also in APUs for ships and aircrafts.

It was recommended for future demonstration projects to enlarge the number of vehicles involved, to enable the up-scaling of the hydrogen refuelling infrastructure, to develop safety issues, to have the long-term focus in mind, improve information exchange and to implement less complex structures with respect to accountability.

Further aspects were the discussion of driving range and liquid hydrogen storage systems (for buses), the improvement of hydrogen compression technology, the addressing of R&D efforts, the mitigation of bureaucracy as well as the implementation of large-scale demonstration projects.

The participating region / municipality representatives ask for framework conditions with regard to safety regulations and standards, political support for hydrogen technologies (like for photovoltaic) as well as for low emission vehicles.

They would propose subsidies for hydrogen production, liquefaction, etc., exemptions for low emission zones, higher support quota for demonstration activities and larger financial support in general.

In general it can be said that the questionnaire activity was a successful exercise as a lot of insights into various demonstration projects and the course of action of the participating regions / municipalities could be gained. Most of the people addressed were very proactive and cooperative and show huge interest in contributing to the preparation of the next logical step, the large-scale demonstration projects.
Introduction

This report documents the activities of WP2 with regard to the assessment of past and ongoing relevant demonstration projects. The projects to be assessed have been defined via a selection process which is described in some detail in the chapter 'Selection of Prioritized Demonstration Projects'.

The exercise of assessing demo projects has not produced final results itself as the findings and the information provided have been used by the other WPs (mainly WP3, WP4 & WP5) for performing their activities (gaps analysis, analysing financial and legal structures, developing the Demonstration Program Framework, etc.).

Therefore WP2 was seen more as a service provider which tried to collect and generate the input for the other WPs. This required that all activities, especially the assessment of the demo projects, were closely linked with those of the relevant activities of the other WPs and the other WPs clearly stated which information they really needed.

The results and recommendations of the interviews have been documented in a MS PowerPoint presentation because of various reasons:

- the author was forced to be short and to the point,
- the material can be efficiently used for further purposes,
- each topic (question) is handled on one slide (except one) and
- the amount of text is limited.

The structure of the presentation correlates with the set of questions which has been used as the basis for performing the interviews.

People requiring more details with regard to the various questions are asked to address the interview protocols annexed to this document.
Selection of Prioritized Demonstration Projects

One of the first activities within WP2 of the HyLights project was the establishment of a structured list of relevant European, regional, member state specific and international hydrogen and fuel cell demonstration projects. The focus was clearly on transport related projects, but synergies with stationary or portable applications have been taken into consideration. The key words for the data collection were ‘hydrogen’, ‘demonstration’ and ‘transportation’. The search for projects took place on a world-wide basis and has included projects since 1990 and also planned activities.

This list has then been transferred to a database which is available at the HyLights website and is part of Deliverable 2.4.

For the selection process a set of criteria has been developed. An EXCEL spreadsheet has been used to enable a transparent and traceable process.

Additional to a pros and cons column the following criteria have been applied in order to assist decision making:

- no or short public demonstration phase planned
- project only thought as proof of concept / principle
- double count in database
- subtask of a larger project

Furthermore, in short phone interviews the HyLights industry partners have been asked for their preferences and if they want to make proposals which projects should be assessed in more detail.

The outcome of this process, a list of 9 key projects, has been presented to the HyLights partnership at a General Assembly Meeting in Brussels on 4th May 2006. After a short discussion it has been agreed that the WP2 assessment activities will start by focusing on these 9 projects.

Details documenting the selection process can be found in Deliverable 2.2 ‘Harmonized list of identified demonstration projects with assessment priorities’ and in the presentations and minutes of the relevant meetings.
Project Coordinators / Managers Interviewed

For the first interviews with the selected demonstration projects in every case its project coordinator respectively the project manager has been addressed. For the names of the persons contacted please refer to chapter ‘Results Project Coordinator / Manager Interviews’ or to the respective interview protocol itself (in the annex of this document).

At some interviews not only the coordinator but also co-workers have participated showing the preparedness and commitment of the various projects to provide their knowledge and their ‘lessons learned’.

The interviews have been performed according to the preferences of the interviewee also taking care of the travel budget. 6 personal interviews have taken place, 1 even with two sessions (travel distance from LBST to the coordinator of the H2argemuc project is only 3 km), 2 coordinators have been interviewed via phone (HyNor and HYCHAIN MINITRANS) and María Maack, coordinator of the ECTOS project, had preferred to fill in the set of questions prepared for the interviews on her own.

Using different methods for getting the set of questions answered (personal interviews / phone interviews / autonomous input) shows clearly that this influences the achievable results. Personal interviews, even if they are the most expensive ones, turned out as the most useful as the interviewee really takes the time it needs, a more intimate relationship can be established, the interview can be performed more as a conversation instead of answering question by question like in an interrogation. Besides saving travel costs phone interviews have the advantage that additional institute partners can join in and participate in some kind of a telephone conference. But in this case the interviewee may feel uncomfortable as he not exactly knows who is listening. In case of filling in the set of questions autonomously the questions have to be drafted very carefully in order to avoid misinterpretation. Even if this seems to be the most comfortable method for the person performing the interviews at the end it turns out as being as time consuming as the phone interviews as additional questioning cannot be avoided.

The interviews have been carried out during the summer months 2006 (mainly in July and August) with additional loops necessary for cross-checking, additional questions, missing input, updating information, etc. lasting till December. In some cases more than one session was already required to do the initial interview as answering the whole set of questions was very time consuming. In the case of the London Hydrogen Transport Programme a phone interview was followed by a personal visit in London which was also used to review the protocol of the phone interview.

After the interviews for each one an interview protocol has been written. The efforts for doing this should not be underestimated as nearly in each case
additional loops were necessary in order to receive promised information, cross checking, etc. The interview protocols are annexed to this document.

At this first stage only non-confidential information has been exchanged. This has had the advantage that there was no need for signing a confidentiality agreement and all information gathered can be used for the further HyLights work.

All interview partners were very open and constructive and one has had the feeling that ‘they have a story to tell’. All contacted persons see the need for further large-scale demonstration projects and are willing to contribute with their experience that these projects will happen.
The European Commission is supporting the Coordination Action “HyLights” and the Integrated Project “Roads2HyCom” in the field of Hydrogen and Fuel Cells. The two projects support the Commission in the monitoring and coordination of ongoing activities of the HFP, and provide input to the HFP for the planning and preparation of future research and demonstration activities within an integrated EU strategy.

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

Further information on the projects and their partners is available on the project web-sites www.roads2hy.com and www.hylights.eu.
Outline

- Projects Overview
- Project Coordinators / Managers Interviewed
- General Learnings from the Projects
- Learnings from Setting up the Projects
- Results / Lessons Learned within Projects
- Recommendations from the Projects

Projects Assessed by HyLights

<table>
<thead>
<tr>
<th>Project</th>
<th>Vehicles</th>
<th>Fuel stations</th>
<th>Hydrogen refuelled</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2-Stormmuc</td>
<td>4 ICE buses, 1 FC bus, 1 ICE car, 1 fork lift</td>
<td>1</td>
<td>138,000 kg</td>
</tr>
<tr>
<td>ECTOS</td>
<td>3 FC buses</td>
<td>1</td>
<td>17,342 kg</td>
</tr>
<tr>
<td></td>
<td>27 FC buses</td>
<td>9</td>
<td>&gt; 192,000 kg</td>
</tr>
<tr>
<td></td>
<td>5 in D &amp; 3 in I FC cars</td>
<td>2</td>
<td>&gt; 500 kg</td>
</tr>
<tr>
<td></td>
<td>9 (+24) FC buses, 14 ICE buses</td>
<td>2 (+8)</td>
<td>227,252 kg</td>
</tr>
<tr>
<td>CEP</td>
<td>17-30 FC and ICE cars, 1 FC bus</td>
<td>2</td>
<td>&gt; 13,557 kg*</td>
</tr>
<tr>
<td></td>
<td>34 wheelchairs, 40 cargobikes, 30 scooters, 44 utility vehicles, 10 midibuses</td>
<td>N.A.</td>
<td>0**</td>
</tr>
<tr>
<td></td>
<td>15 (+30) ICE cars, 0 (+5) FC cars, 0 (+8) H2 buses</td>
<td>2 (+6)</td>
<td>N.A.</td>
</tr>
<tr>
<td></td>
<td>10-12 H2 buses, 60 H2 cars, vans, motor bikes and other vehicle types</td>
<td>tbd.</td>
<td>0**</td>
</tr>
</tbody>
</table>

* passenger cars only  ** hardware in preparation
Project Coordinators / Managers Interviewed

- Judit Mielert, Franz Grafwallner
  ET EnergieTechnologie
  personal interview

- Monika Kentzler
  DaimlerChrysler
  personal interview

- Maria Maack
  Icelandic New Energy INE
  filled in questionnaire by herself

- Nadine Hölzinger, Henning Niemeyer
  MVV Consulting
  personal interview

- Philippe Paulmier
  Axane
  phone interview

- Zoe Jennings
  Greater London Authority
  phone interview (followed by personal interview)

- Achim Boening
  infraserv hoechst
  personal interview

General Learnings from the Projects
Question: What kind of vehicles have been / will be demonstrated and in which numbers?

- Projects, not only those which have no auto manufacturers in their partnership, have experienced problems in gaining sufficient numbers of vehicles for their project

  ➤ *One of the first steps in setting up a project should be to settle binding agreements with car industry (or other vehicle suppliers) on number and type of vehicles and date of delivery*

- In some demo projects the vehicles are used in commercial applications without backup

  ➤ *In the early phase of large-scale demos, there has to be carefully decided if vehicles should be used in real-life value chains, and if so the formal consequences of vehicle failures have to be defined clearly and alternative solutions have to be agreed*

Question: What kind of hydrogen infrastructure has been / will be demonstrated?

- The complexity of the approval procedure for a hydrogen refuelling station increases, if several partners (e.g. component suppliers) are involved

  ➤ *One partner alone should take over the responsibility for the approval, erection and operation of a hydrogen refuelling station*

- Projects using hydrogen refuelling stations with on-site hydrogen generation have experienced that in case of non-performing generation units additional hydrogen has to be purchased

  ➤ *Proper back-up solutions and/or appropriate financial measures should be defined to avoid financial shortfalls*
Question: Did / will you apply an assessment framework?

Nearly all projects do some kind of an assessment, thereby the degree of detail differs strongly.

The projects in FP6 (HYCHAIN-MINTRANS, HyFLEET:CUTE, ZERO REGIO) are obliged to apply an assessment framework (adapted PREMIA).

No project rejected to supply HyLights with the assessment framework itself. However, transfer of sensitive data and information, if possible at all, would require clear procedures including confidentiality agreements, approval of partnerships, etc.

Question: Which legal framework has been / is used for the project?

CUTE, ECTOS*  PPP

HYCHAIN, HyFLEET:CUTE, ZERO REGIO*  PPP

H2argemuc  applies the German legal framework of an ‘Arbeitsgemeinschaft – ArGe’ (receives 50% funding from the Bavarian government)

CEP  For CEP no legal entity has been established. All responsibilities, interfaces, relationships, time lines, etc. are defined in a consortium contract

HyNor  A consortium agreement based on Norwegian law to be signed by all partners provides the legal framework for this project

LHTP  This project will be financed and operated by public organizations only within those legal frameworks

* Each project has its individual Consortium Agreement ruling the project internal legal issues
Question: How did / do you organize your project management?

- Some of the projects investigated have subcontracted the project coordination or parts of it to external organisations. This constellation should enable a neutral and independent project coordination. On the other hand the commitment and a basic knowledge of the coordinator are important factors for a successful project.

  ➤ *Project coordinators should be selected very careful. A criteria catalogue for the selection of a project coordinator may be useful.*

- Most of the projects have more than one location for operating hydrogen refuelling stations and vehicles.

  ➤ *It is important to have local project coordinators in charge reporting to the overall project manager.*

Question: Does your project have a balanced partnership?

- The balance of a project partnership is influenced by the funding schemes. Sometimes vehicles are in favour (e.g. CUTE), sometimes the refuelling stations (e.g. CEP).

  ➤ *Adequate funding should be provided for both the vehicles and the infrastructure in order to lead to a balanced partnership.*

- There is no homogenous opinion if end users should be partner in a project or not. Being partner would improve their commitment, being outside the partnership would better reflect real early market conditions and prove maturity of products.

  ➤ *It has to be checked case by case (by weighing up advantages and disadvantages) if end users should be included in the partnership.*
Question: Would you shift the focus of the individual tasks in the retrospective?

Some projects are in a very early stage and claimed that it is too early to provide a statement for this question. Shifts proposed from the others:

- **Project management issues***
  - Put higher emphasize to Public Relation activities
  - Handle time-critical issues first (e.g. authorisation, contracts, etc.)
  - Improve internal communication (CUTE has installed a Safety&Security TF)

- **Technical issues***
  - Provide appropriate measures to ensure hydrogen quality
  - Install appropriate maintenance schemes (intervals and procedures)
  - Prepare back-up solutions for component failures

* Only the most important ones are mentioned. Please note that the issues mentioned are not valid for all projects.

Question: What is the follow up of the project?

The answers received concerning the project follow up were inhomogeneous:

- **H2argemuc**: Project will be proceeded with two unfunded stations in Munich
- **CUTE & ECTOS**: Pursued / extended in HyFLEET:CUTE
- **HyFLEET:CUTE**: Not yet decided
- **CEP**: Current contract ends 12/07. Continuation is envisaged
- **HYCHAIN**: Not yet decided
- **HyNor**: After 5 year demo phase possibility of commercial operation will be checked
- **LHTP**: Not yet decided
- **ZERO REGIO**: Hardware operation will proceed. Interest in follow-up projects shown. Negotiations with further vehicle suppliers ongoing
Learnings from Setting up the Projects

Question: Which were / are the decisive motivations / drivers for the realisation of the project?

The decisive motivations / drivers for initiating the demo projects investigated differ significantly. They can be grouped in 4 areas:

- **Politics**: transition from fossil fuels to renewables (ECTOS); improvement of local air quality, reduction of CO₂ emissions and contribute to security of energy supply (LHTP)
- **Technology**: achieve technology leadership, test technology in complex surrounding (H2agemuc) or under various conditions (CUTE)
- **Business**: develop new hydrogen markets (ZERO REGIO), test market for small FC transport applications and related hydrogen infrastructure (HYCHAIN)
- **Public/end-users**: overcome public safety concerns and create public acceptance by showing the benefits & reliability of hydrogen usage to the local environment (HyFLEET:CUTE, HyNor)
Question: Which were / are the largest hurdles / showstoppers for the project?

Most of the hurdles mentioned have caused delays in the project schedules and/or lead to the downsizing of the projects outline

- **Financing:** No adequate continuous funding available during project lifetime; identification of local funding resources
- **Technology:** Incident required partial redesign of refuelling station; technology applied is completely new
- **Authorisation / RCS:** Difficulties to receive authorisation for refuelling stations (partially law changes required); certification problems for vehicles; no adequate regulations in place
- **Others:** Contract negotiations longer than expected; leaving partners during project preparation; lack of hydrogen vehicles; discussions on tax exemptions for \( \text{H}_2 \) and its pricing; strict safety requirements of station operator; balancing stakeholders interests

Question: Which political / financial support was / is available for your project?

- All projects receive funding from regional, national and/or EU resources, but not in each case the funding is well balanced between vehicles, infrastructure and accompanying activities

  ➔ *Find a balanced funding scheme which also enables parallel actions e.g. PR measures, education & training, etc.*

- Some of the projects have to deal with short-term funding schemes not incorporating the follow-up after the end of the (next) funding period

  ➔ *Clear, flexible long-term funding schemes reflecting the overall political strategy should enable the projects not only to keep the project alive but also to implement new developments in order to keep industries commitment and to serve as a test field for cutting edge technology*
Question: Could the project meet the initial cost targets?

- Most of the projects are too premature to answer this question.

- In one case, the change of the industrial design of the hydrogen refuelling station was required after an incident. The project budget did not include allocations for any unforeseeable costs and would have been in real danger if the responsible partner did not step in.

  ➔ Funding schemes should allow a later inclusion of not planable activities and a flexible reaction on unforeseeable incidents.

- Often rising prices for (raw) materials and other resources lead to increased project costs especially if it suffers a delay which not in each case is a fault of the project itself, but the available project funding remains unchanged. If the project partners are either not willing or not able to take over these additional costs the project may face serious problems.

  ➔ Funding organisations should be able to adapt funding to changed project budgets.
Question: Do reports documenting the status, results and ‘lessons learned’ of the project exist?

- Reports documenting the status, results and ‘lessons learned’ exist or are planned to be prepared in all projects in more or less extent, but are often confidential. Detailed material is available for e.g. ECTOS and CUTE. In other projects with national or regional funding obligations to publish such reports hardly exist.

> A common approach to publish on this issues should be agreed on and each publicly funded project should be obliged to provide specified information. Furthermore, an additional level has to be established allowing info exchange between the projects. Hylights is already preparing the instruments for these exercises, the Monitoring & Assessment Framework for documentation on project level as well as the Demonstration Program Framework to a.o. enable the communication and coordination between various projects.

Question: How could / can single partners profit from the project?

- Vehicle manufacturers can collect experiences on
  - homologation & certification processes in various countries,
  - planning & realisation of small series production and can do
  - real-world data & info collection from daily vehicle operation by lay persons
- Infrastructure providers can
  - test the hydrogen infrastructure in real-world applications and
  - contribute to public education on hydrogen as fuel of tomorrow
  - collect experience in hydrogen refuelling stations siting & approval procedures
- All partners
  - Business opportunities can be developed & tested in a ‘protected’ area
Question: How did / do your vehicles perform? How did / do your refuelling infrastructure perform?

- Receipt of performance data on both vehicles and infrastructure has been quite poor because of pre-maturity of projects and / or confidentiality reasons

  The potential obligation of future projects to apply the HyLights Monitoring & Assessment Framework may improve this situation

  In order to receive the required input for the HyLights gaps analysis this issue will be in the focus of the next project phase and may potentially require the signature of confidentiality agreements with the contact persons

- The best data material is available from the projects CUTE and ECTOS published in their respective reports. These reports include information on availabilities, efficiencies, inert gas consumption, hydrogen losses, downtimes of components, fuel consumptions, driving modes, etc.

Recommendations from the Projects
Question: If you had the chance to start from scratch, what would you make different?

- Already the application phase of a project consumes a lot of time and resources
  - It would be desirable to receive financial support already in the application phase. The process could comprise a selection procedure after that the winning consortium already receives direct financial support from the EC for the further set-up of the project. This would especially encourage the participation of SMEs.

- A clear picture of the project partnership as well as of the project itself is already required in the project preparation phase
  - The partners should commit themselves in a very early phase in order to establish clarity and planning reliability and to avoid that partners drop out in the last minute

Question: If you had the chance to start from scratch, what would you make different? (Cont’d)

- Future projects should reach a scale which causes significant momentum and recognition
  - In order to reach this goal it is recommended to work in all areas: technology (contact as many vehicle suppliers as possible), public relations, policy (lobbying for door opening and financial support), social aspects (may be helpful for public acceptance), etc.
  - Combining project ideas may also enlarge the impact, leverage and recognition (e.g. combination of HyNor, Hydrogen Link and HyFuture to the Scandinavian Hydrogen Highway Partnership)

- Specific tasks should be outsourced to specialists from the very beginning
  - It was recommended to sub-contract e.g. PR activities to external experts. Some of the projects have also proposed to outsource the project management
Question: Does your experience support the approach to utilise synergies with other fields of technology?

- Stationary applications may bring additional value to a project as it can improve the utilisation of the hydrogen infrastructure (e.g. usage of LH₂ boil-off gas) and additional experiences can be gathered by operating stationary applications within the complex environment of a hydrogen refuelling station. Furthermore, dissemination possibilities and the project's visibility could be improved.

- If a hydrogen refuelling station can benefit from the distribution of other alternative fuels at the same station is more a philosophic question respectively a question of company politics. One possibility would be the distribution of hydrogen alongside with biofuels and market it as a ‘green’ refuelling station.

- Some projects were initially planned to also implement stationary applications but resigned because of budget cuts (e.g. ZERO REGIO), others have already included them (e.g. HyFLEET:CUTE – 2 fuel cells).

Question: Which framework conditions need to be in place to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

- The approval framework for hydrogen technologies including regulations, codes and standards has to be in place commonly for all over Europe and ideally worldwide.

- It has to be clear to all parties involved that hydrogen technology is still in a premature status and is therefore not yet sustainable without significant support mechanisms (e.g. funding). A lot of project ideas have failed because of missing funding schemes.

- A strong political will must be visible including a long-lasting significant funding scheme which allows long-term and reliable planning.

- In the long run not any kg of hydrogen can be subsidised. Therefore the main focus of the large-scale demonstration projects has to be on the establishment of a commercial market for hydrogen and hydrogen powered vehicles.
Question: Which incentives are necessary to support hydrogen for transport in the future?

- Further incentives (besides e.g. tax exemptions on fuel and / or vehicles, support of hydrogen production from renewables), considering national or local specialties, may be: a) reduced or no import taxes for hydrogen vehicles, b) free parking, c) free use of toll roads, d) allowance to use public transport lanes, e) no VAT, etc.

- Obligations for governmental vehicle fleets or public transport operators may be useful e.g. x% of the vehicles operated must be zero emission vehicles

- A general Europe wide tax exemption is needed for the introductory phase of hydrogen as a fuel

- In some countries e.g. the UK exemptions of congestion charges or exemptions for low emission zones may be the right tools

Acknowledgement

HyLights is financed by funds from the European Commission under **FP6 Contract TREN/05/FP6EN/S07.53917/019990**.
Region / Municipality Representatives Addressed

In the first phase of the project the focus was mainly on the interview activities of the project coordinators / managers of the demonstration projects. In the next phase one of the most important tasks was to also collect the lessons learned and recommendations of representatives of regions and municipalities already involved in relevant completed and ongoing demonstration projects on hydrogen for transport in Europe.

For the names of the persons contacted please refer to chapter ‘Feedback from Region / Municipality Representatives’ or to the respective interview protocol itself (in the annex of this document).

Some participants in the questionnaire activity provided very detailed answers that took them a lot of time showing the preparedness, commitment and willingness of the various regions / municipalities to provide their knowledge and ‘lessons learned’.

The activity has been performed according to the preferences of the contact persons either by answering the questions on the computer or via telephone interviews. Travelling in order to perform personal interviews was not foreseen for this activity because of budgetary reasons. From about 30 region / municipality representatives addressed 7 provided valuable feedback that could be used for the further HyLights work. 6 of them filled in the questionnaire on their computer and sent it per e-mail. One telephone interview has been performed.

Using different methods for getting our questions answered within the two HyLights work package 2 activities (interviews with the project coordinators / managers & questionnaires for region /municipality representatives) in form of personal interviews, phone interviews and the autonomous answering of questionnaires clearly showed that the method chosen clearly influences the achievable results. Please see hereto also chapter ‘Project Coordinators / Managers Interviewed’. Unfortunately the available resources did not allow personal interviews with the region / municipality representatives as already mentioned above.

The questionnaire activity has been performed during March, April and May 2008. Additional loops become necessary for addressing the right persons, cross-checks, additional questions, missing input, updating information, etc.

For the phone interview a protocol has been written. This interview protocol as well as the provided filled questionnaires are annexed to this document.

In this approach only non-confidential information has been collected. This has had the advantage that there was no need for signing a non-disclosure agreement and all information could be used for the further HyLights work.
All region / municipality representatives were very open and constructive and one has had the feeling that ‘they have a story to tell’. All contacted persons see the need for further large-scale demonstration projects and are willing to contribute with their experience that these projects will happen.
Feedback from Region / Municipality Representatives

HyLights
A Coordination Action to Prepare European Hydrogen and Fuel Cell Demonstration Projects

WP2 – Results of the Interviews with Region / Municipality Representatives of the Selected Key Demonstration Projects

Hubert Landinger – WP Leader Work Package 2

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

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

Further information on the projects and their partners is available on the project web-sites www.roads2hy.com and www.hylights.eu.
Outline

- Projects Overview
- Region / Municipality Representatives Contacted
- Experiences and Lessons Learned
- Recommendations

Region / Municipality Representatives Contacted

- Josef Schadl
  Bavarian Ministry for economy, infrastructure, transport & technology
  per e-mail

- Mikael Sloth
  H2Logic
  Denmark
  per e-mail

- Achim Boening
  InfraServ
  Frankfurt-Hoechst
  per e-mail

- Burkhard Eberwein
  Public Transport Berlin
  BVG
  phone interview

- Carola Thimm
  hySOLUTIONS GmbH
  Hamburg
  per e-mail

- Harry van Bergen
  Gemeente Amsterdam
  per e-mail

- Eva Sunnerstedt
  Environment & Health Administration Stockholm
  per e-mail
Experiences and Lessons Learned

Question: Which were the decisive motivations / drivers for the realisation of the project?

The decisive motivations / drivers for initiating the demo projects investigated differ significantly.

- Energy security and independence of fossil fuels
- Environment & climate
- Business development and innovation
- Creation of new markets for hydrogen
- Switch from Diesel to hydrogen buses
- Gain experience with hydrogen and fuel cell technology
- Contribution to development of cleaner vehicles / buses
Question: Which political and financial support was available for the project?

- All projects receive funding from regional, national and/or EU resources
- Political support was provided by the respective local/regional government in most cases at all levels and by all departments
- In some cases the political support was more a political pressure on the public transport to implement the use of clean fuels

Question: Do you have joint activities with other (partner) regions?

- The partner cities in the CUTE respectively in the HyFLEET:CUTE project can/could count on a well-established information exchange and all participants can directly profit from the experiences made within these projects
- As a result of the CUTE project the Hydrogen Bus Alliance (HBA) was founded. Some of the municipalities/regions are partner in the HBA (Amsterdam, Berlin, Hamburg)
- Further cooperations have been established
Question: Will there be any follow up of the project and if so what are the next steps?

- Some of the regions / municipalities do not plan a follow up. Some plan to apply other technologies (e.g. electric hybrid ethanol Diesel buses – Stockholm), others have no concrete plans for alternative fuels at all.
- Some regions / municipalities are very dedicated to hydrogen and / or fuel cell technology and have clear ideas how to proceed after finalisation of the current projects (Amsterdam, Berlin, Hamburg).

Question: Do you have a roadmap / strategy plan for implementing hydrogen and fuel cell technologies?

- Some of the regions / municipalities answered with a clear “NO”
- Amsterdam has a “Hydrogen Vision” and is working on a roadmap / strategy plan
- The city of Hamburg has set up a new climate program. Hydrogen and fuel cells are a core technology in it.
- BVG (Berlin) is currently negotiating its participation in the Clean Energy Partnership (CEP). They are planning to operate up to 50 hydrogen powered buses in the 2010 – 2012 time frame.
- InfraServ (Frankfurt Hoechst) is following the HyWays strategy.
- Hydrogen Link (Denmark) is following a dedicated national roadmap.
Question: How could your region / municipality profit from the project?

- practical technical and logistical experiences
- profit for the local / regional hydrogen network
- example for environmental friendly use of public transport in day-to-day operation
- utilisation of clean buses
- operation of buses possible in restricted areas (German “Umweltzonen”)
- buses are outperforming EURO 6 standards
- infrastructural basis for larger projects
- Economical independence of imports of fossil fuels for transport in the long term

Question: Which were the largest hurdles / showstoppers for the project?

- money (some projects got more expensive than planned)
- securing the various public funding (local, regional, national, European)
- minor technical problems at the project start
- capacity of infrastructure
- driving range of buses
- missing regulations for hydrogen vehicles and infrastructure. Consistent European regulations are required
- information / dissemination / media (local partners wanted to get attention all the time)
Question: Which type of vehicles are you interested in / are relevant for your region / municipality?

- cars
- buses
- (garbage) trucks
- light duty vehicles, vans
- scooters
- fork lifts
- APU (ships, aircrafts)
- specialty vehicles

Recommendations
Question: What are your recommendations for future projects?

- technology needs to be less expensive
- get more vehicles
- possibility of up-scaling the refuelling infrastructure
- development of safety issues
- lower energy consumption of vehicles (hybridisation, braking energy recovery)
- apply long term focus / support
- implement less complex structures with respect to accountability
- better exchange of information between partners (standard reporting procedure)

Question: What are your recommendations for future projects? (cont’d)

- discuss driving range issue open and transparent
- improve hydrogen compression technology
- discuss liquid hydrogen storage systems (for buses)
- address R&D efforts, especially in fuel cell and hydrogen production technology (via FCH JU and national programmes e.g. German NIP)
- less bureaucracy and clearer not changing responsibilities
- large-scale demonstration projects and later deployment projects based on established market frame conditions
Question: Which framework conditions need to be in place to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

- safety regulations and standards
- European regulatory framework for the use of hydrogen in transport (regulations, codes, standards)
- political support for hydrogen like for photovoltaic
- political support for low emission vehicles (e.g. tax exemption)
- long-term support for certain regions, so developments can spread out geographically

Question: Which incentives would you propose to support hydrogen in the future based on today’s situation?

- financial support
- network for joint procurement of hydrogen and vehicles such as the Hydrogen Bus Alliance
- political initiatives (from high ranking EU levels to regional political levels)
- higher support quotas for demonstration activities
- exemptions for low emission zones may be the right tools
- hydrogen available at comparable costs to Diesel
- subsidies for hydrogen production, liquefaction, etc.
Acknowledgement

HyLights is financed by funds from the European Commission under **FP6 Contract TREN/05/FP6EN/S07.53917/019990**.
Annex 1: Interview Protocol H2argemuc

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

H2argemuc – The hydrogen project at Munich Airport

Interview with Judit Mielert and Franz Grafwallner (ET Energie Technologie) 04 JUL 2006 and 10 JUL 2006.
Interviews performed by Hubert Landinger (LBST).

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

**Buses:**
1. Neoplan low-floor articulated bus type Controliner N 4421/hydrogen operated from May 1999 – DEC 2004 on the apron (ICE) by FMG
2. MAN low-floor articulated buses type A 23 (Lion’s City G) in operation since May 1999 on the apron (ICE) by FMG
1. MAN low floor bus type Lion’s City in regular service for public transport (Munich Airport – Hallbergmoos, lane 699) since AUG 2005 (ICE) by bus operator Hagel in a subcontract with Munich Transport and Tariff Association (MVV)
1. MAN low floor bus type Lion’s City in regular service for public transport (Munich Airport – Hallbergmoos, lane 699) since AUG 2005 (ICE) by bus operator Hagel in a subcontract with Munich Transport and Tariff Association (MVV)
The two buses in public transport use are operated rotationally and one bus function as a back-up for the other one.

**Passenger Cars:**
Within the framework of the project only 1 BMW 7-series sedan was foreseen, but in reality up to 15 vehicles have used the hydrogen refuelling station.

**Fork Lift**
In a joint effort of Proton Motor, Linde and the external partner Still (member of the Linde group) a fuel cell fork lift has been developed which started its real world testing at the air cargo company Cargogate (a subsidiary of FMG) in OCT 2003. The vehicle is also frequently used for demonstration at fairs and other events.

Documentation is available at the project’s website [www.h2argemuc.de](http://www.h2argemuc.de).
1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

Two different supply paths for CGH₂ are tested in the H2argemuc project - hydrogen production via electrolysis and via steam methane reforming. As a back-up solution also trucked-in CGH₂ has been used. The electrolyser has been operated from the project start in MAY 1997 until NOV 2004. In NOV 2003 the steam methane reformer (SMR) has been put into operation. During one year (NOV 2003 – NOV 2004) both production paths have been in place and were operated rotationally with a tendency to overweight the operation of the SMR, as its operation turns out to be more reliable and stable. Starting with Phase IV (JAN 2005) funding for the electrolysis was no longer available and therefore it has been taken out of service. For the FC bus a fuel quality of 5.0 must be guaranteed.

1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

Plans to develop an assessment framework and to apply it do exist, but because of cost reasons one has refrained from the realisation of that plans. A reduced version based on a questionnaire activity within the partnership is currently under development but will be for internal use only.

1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

The relationships between the various partners are ruled in a cooperation contract (ARGE MUC contract) and in additional bilateral contracts. The legal form for the H2argemuc partnership is the German ‘Arbeitsgemeinschaft (ARGE)’. The foundation of an ARGE requires at least two partners, which enter into an informal or a written contract. An entry into the Commercial Registry is not required. The contract states that German law will be applied. During the life time of the project respectively the contract various amendments and updates have become necessary. In contrast to the ARGE MUC contract the funding was ruled in bilateral contracts between the individual companies and the funding organisation. The ARGE MUC contract has then become part of the official funding notification. The building authority as well as the commercial regulatory authority have appointed TÜV Süd as an independent expert. As certification body TÜV Süd has accompanied the project in all safety related issues and has answered all general safety related questions. TÜV Süd is not a partner in H2argemuc, but was allowed to apply for funding. Furthermore, the federal aviation authority (Luftfahrtbundesamt LBA) was involved in the project authorisation process because of the proximity to the air traffic.
Each partner has to take care for the certification of the component he supplied and has to take over the full responsibility for this component.

1.5 How did / do you organize your project management?

The project coordinator is an external service provider contracted via a service contract signed by all project partners and the service provider. The service provider receives 100% payment (no own contribution) evenly distributed from the project partners. From the projects point of view the coordinator costs belong to the super ordinate costs. Super ordinate costs structured in

- project management / coordination
- public relations
- others (e.g. additional hydrogen demand)

**PR Council**

Since 2005 a professional PR agency is contracted for the various PR activities (brochures, flyers, website, guided tours at the station, events, etc.). For the steering of the agency a PR council has been installed which consists of representatives from all branches (1 representative mobility, 1 representative infrastructure, 1 representative Munich Airport GmbH (FMG), 1 representative PR agency). Participation at PR council meetings is open to all partners but without any voting rights. Rights and duties of the PR agency are included in a service contract. It is highly recommended to include a professional PR agency from the very beginning of a project in order to have a sound communication strategy in place and to avoid frictions with regard to PR activities because of different views of the partners.

**Timing**

The project is structured in various phases:

- Phase I: JAN 1997 – DEC 2000
- Phase II: JAN 2001 – JUL 2001
- Phase III: JUL 2001 – DEC 2004

In Phase IV funding was only available for operating and maintenance but no longer for additional investments.

**Financing**

The operator of the apron buses, FMG, pays 50% of the Diesel equivalent to the project. The remaining 50% come from funding resources. The calculative fuel consumption of the hydrogen buses has set to be 42 l Diesel equivalent / 100 km. The fuel costs are charged on the basis of kilometres driven. Electricity is purchased from FMG at a price of 6.5 c/kWh.

\[
1 \text{kWh}_{\text{El}} \triangleq 6.5 \text{ ct}; \text{efficiency electrolysis } 66\% \implies 0.66 \text{kWh}_{\text{H}_2} \triangleq 6.5 \text{ ct}; \text{Diesel } 10 \text{kWh/l} \implies 1 \text{l}_{\text{Diesel equivalent}} \triangleq 98.5 \text{ ct } \sim 1 \text{ € (pure energy costs).}
\]

In Phase I Linde has provided LH\(_2\) at a price calculated on the basis of low delivery quantities. The occurring costs have been funded by 50% by the available resources.
Starting from Phase II Linde fully charges the LH\textsubscript{2} deliveries and BMW pays 0.55 €/L\textsubscript{H2} for the fuel consumed, but receives 50% funding for that.

**Reporting**
The project has a reporting obligation towards the Bavarian State Ministry for Economics, Infrastructure, Transport and Technology (StMWIVT). Regular reports (mainly protocols) on the status quo of each single partner serve as the basis for the shipment of funding. Furthermore, an incident reporting procedure has been installed in order to document what has happened and which measures have been taken to solve the problem. The collected information has not been analyzed yet and is kept under confidentiality.

**Internal communication**
Quarterly assemblies of the representative group take place for clarification and agreement on superordinate topics such as financing issues, contractual issues, strategic decisions, etc. This group comprises delegates of each partner, the project coordinator, and the PR council. Head of this group and official spokesman for the H2argemuc project is Rainer Hörl of Munich Airport GmbH (FMG).

In a monthly technology jour fixe (topics are technology and safety) technical representatives (object managers) of each partner meet for an exchange of experiences, the discussion of problems and how to solve them, etc. The protocols of these meetings are not publicly available.

Decisions are taken by silent consent: By not replying by a fixed date, the partner approves the respective proposal.

A very open internal communication within the project partnership was definitely one of the key success factors of the project

**Status of project management**
In case of an ARGE (see 1.4) it is highly recommended to have an external and thereby independent project management as in this comparably loose relationship the interests of the various partners differ strongly.

**Responsibilities**
Each partner has to take over the full responsibility for all components belonging to their part of the facility and each partner is responsible for him/her selves in order to reach the goals set out in the identified and agreed project framework.
1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

In general it can be said that the h2argemuc project has a very balanced partnership. Beside bp/ARAL only Bavarian organisations are involved (in Bavaria there is no oil company). This is adequate as also the funding comes from this region and this also underlines that in the region all relevant branches and competences for the realization of such a project are present. All branches from hydrogen production to end-use (operation of vehicles) are represented.

Some of the partners show great interests in proceeding with the project after 2006. Especially the partner Munich Airport (FMG) would like to proceed with the project at least with the two apron buses but even shows interest in operating two more buses.

The problem was that without public funding there was no solution for covering the additional costs.

With regard to the LH$_2$ path the installation of a new LH$_2$ refuelling nozzle would be required as all new BMW 7-series vehicles are equipped with this new system. The involvement of TÜV Süd turns out as a very useful measure with regard to solve RCS issues as they were very committed and brought the required experience to enable a smooth approval as well as a safe operation of the refuelling station, which was approved by applying German law.

**Philosophy of funding**

On one hand funding should encourage and support industries activities, but on the other hand industry is also asked for showing their commitment (motivation activated via own financial contribution!). The funding organisation does not interfere in the project progress.

The project targets have been set out by the project partners and have been adjusted with the funding organisation.

1.7 Would you shift the focus of the individual tasks in the retrospective?

Public relation activities were underestimated at the beginning of the project. The involvement of a professional PR agency form the very beginning is urgently recommended.

Consequences and fall back positions for deficiencies and failures of components have to be ruled clearly. But in contrast, in this special case the contract would probably never came in place if all possibilities and specialities had been taken under consideration.

Also hydrogen quality and responsibilities and methods to check it should be in the focus especially if fuel cell vehicles demanding higher purities should be refuelled.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?
After finishing its 4th phase the project will terminate at the end of 2006. A press release (in German language only) has been posted in the working docs section of the HyLights website.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for:

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects

within your project?

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2. Experiences from setting up the project

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

Because of transfer of public properties financial resources were available in Bavaria which were dedicated to fund technology development. The largest part of this sources have been made available for the H2argemuc project based on a recommendation of the scientific and technical advisory board of the Bavarian government to initiate hydrogen projects.

One of the most important motivations was the encouragement and the strengthening of the local Bavarian economy in order to bring respectively keep them in the leading position in this field of technology! A further motivation was the sustainment and the creation of jobs in Bavaria.

The decision to initiate and fund this project was based on a feasibility study (100% funded) carried out by Bayernwerk (now E.ON) and DASA (now EADS). A committee comprised of representatives of both companies, the ministry in charge and Munich Airport GmbH (FMG) have prepared a decision-making document based on this study which after its approval leads to the initiation of the project.

The airport has been chosen as the ideal location for the project because of its complex, high-tech and technology oriented nature. At the time of setting up the project this was clearly a unique selling point. In parallel airports are areas of high air pollution often in public critics and are therefore enforced to take measures to improve this situation.
2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

Establishing and adjusting the funding application turned out as a very complicated and complex activity. It comprises
- a general project description
- an organisation chart
- a follow-up chart
- separate funding applications from each single partner
- a detailed cost plan
- a plan showing the distribution of super ordinate costs

The application had to be submitted via a complicated online tool.

But as the most important hurdle the continuity of available funding has to be named. Projects should be established based on clear political targets and should be equipped with substantial long-lasting funding in order to allow a sound and profound execution of the project.

2.3 Which political / financial support was / is available for your project?

In the Phases 1-3 all project relevant costs (investment, operation & maintenance) received a 50% funding by the regional government (Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology-StMWIVT). In the two years of Phase IV (budget € 4.1 million) only operation and maintenance costs (including PR activities, project management, etc.) but not additional investments receive funding (50%). The energy sources electricity and natural gas are funded by 50% during the overall project lifetime.

The overall project budget for the overall project lifetime amounts to € 36 million, whereof € 18 million are funding of the StMWIVT.

2.4 Could the project meet the initial cost targets?

For each of the 4 project phases a detailed cost plan has been developed and agreed on beforehand. Thus, the maximum funding available was fixed. Based on quarterly statements to be checked and approved funding is distributed to the partners.

By applying this procedure it was possible to meet the cost targets.

3. Results / learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?
The Research Institute for Energy Economy (FfE) has performed various analyses for the H2argemuc project mainly on technical but also on economic aspects, but these analyses will not be published. A report on lessons learned is currently under preparation at the press agency in close coordination with the Press Council and is scheduled for being published at the end of 2006. This report will include a final statement with regard to the usefulness and the major outcome of the project as well as an outline of potential future cooperations of the H2argemuc project partners. Furthermore, results and lessons learned are distributed via the projects website www.h2argemuc.de and via press material. For component related experiences it has been recommended to address the respective partners directly.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

By the embedding of their specific component(s) into a complex and highly integrated overall system and its operation in real-world conditions including the coaction of the various components each partner has the possibility to gather an enormous gain in know-how and experience. The operation of the hydrogen refuelling station for the supply of the apron buses, which are in regular service within a given time schedule, requires a high availability of the overall system and thereby of the single components, too. The open internal communication allows that each single partner could build a lot of knowledge with regard to the overall system and its implicit problems. Because of the large number of participants the experiences are numerous and multifaceted. One example documenting the technology progress enabled by experiences collected within the operational phase of the project was the development of a new electrolyser concept by the partner GHW.

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

Performance data of the vehicles should be derived from the vehicle manufacturers directly potentially by signing a non-disclosure agreement.
Performance of refuelling infrastructure

3.4 How do your refuelling infrastructure perform in terms of
- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

Performance data of the hydrogen refuelling station components should be derived from the respective component manufacturer directly potentially by signing a non-disclosure agreement.

The hydrogen refuelling station is in permanent 24h operation and each of the dispensers is equipped with a card reader in order to allow unmanned operation.

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

The partnership comprises a very large number of partners. It is questionable if it is better to work with a lower number of partners accepting not having on board a separate partner for each of the components. This would imply that the components whose suppliers are not partner would have to be reimbursed by 100%, as the components (and potentially further services) would have to be purchased via subcontracts. This approach would potentially increase the overall project costs. Furthermore, if the number of partners sharing the superordinate costs is decreasing, the financial contribution to be covered by each of the remaining partners increases.

On the other hand a smaller partnership could ease agreement procedures significantly.

Nevertheless, the H2argemuc project has shown that even with a large number of partners a successful project is still possible. A detailed and very clear definition of tasks and an agreement on responsibilities including fixed deadlines should be made at the very beginning of the project. Furthermore, also the rights and duties of each of the partners have to be defined clearly.

Reliable instruments for budget follow-up and cost control should be installed and applied.

PR activities should be subcontracted to a professional PR agency.

Project management should be subcontracted to an external neutral service provider.
The political will of the funding body should be communicated clearly. In order to have security for the project planning a long-lasting funding strategy is absolutely necessary. The measurement of the amount of hydrogen refuelled at a refuelling station has to be clarified. The accuracy of the measurement equipment is still unclear and the gauging offices should be involved already in a very early phase of the project.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

Stationary applications may bring additional value to a project as it can improve the utilisation of the hydrogen infrastructure as well as additional experiences can be gathered by operating the stationary application within the complex environment of a hydrogen refuelling station. With regard to other fuels such as CNG, LPG, petrol, diesel, etc. the partnership does not have a common opinion. Therefore here no clear statement can be made.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

It has to be clear to all parties involved that hydrogen technology is still in a premature status and is therefore not yet sustainable without significant support mechanisms (e.g. funding). A lot of project ideas have failed because of missing funding schemes. Financial resources for investments must be available during the overall project period for process and technology optimization, further improvements of existing technology, keeping pace with development in order to demonstrate and evaluate current state-of-the-art technology and not to loose the partners’ commitment. Funding mechanisms for hydrogen technology have to be developed and put in place that starts with significant funding in the beginning and is phased out slowly in parallel to the increasing maturity of the technology. Furthermore, a strong political will must be visible including a long-lasting significant funding scheme which allows a long-term and reliable planning.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

A general petroleum tax exception for hydrogen as fuel is definitely necessary. But also the process to apply to this exception has to be simplified, accelerated and made more transparent. The H2argemuc project could apply to an petroleum tax exception till end of 2004. At that time tax legislation has changed. Although a
request for a prolongation of the tax exception has been filed immediately (spring 2005), it took a whole year until the tax exception has been accepted.
Annex 2: Interview Protocol ECTOS

**Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects**

**Ecological City Transport System: Demonstration, Evaluation and Research Project of Hydrogen Fuel Cell Bus Transportation System of the Future ECTOS**

Set of questions filled in by María Maack (INE) and sent to Hubert Landinger (LBST) by 24 AUG 2006.

1. **General project infos**

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

Three DC Citaro FC buses have been in demonstration in Reykjavik since October 2003, first in the ECTOS project (terminated in AUG 2005) and continued in the HyFLEET:CUTE project. All ECTOS project reports are available at INE’s webpage [www.newenergy.is/en/publication/ectos%5Freports/](http://www.newenergy.is/en/publication/ectos%5Freports/)

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

Onsite hydrogen production, compression and dispensing station, Norsk Hydro’s electrolyser technology for hydrogen production. Electricity from the national grid, which is renewable energy only, 85% from hydro power and 15% from geothermal power. Publications are available at [www.ieahia.org/pdfs/ECTOS.pdf](http://www.ieahia.org/pdfs/ECTOS.pdf)

1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?


1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

German, Icelandic and Norwegian laws and safety standards concerning all aspects of the fuel chain and the vehicle have been applied.
1.5 How did / do you organize your project management?

Icelandic New Energy used international project management procedures in order to organize and implement the project. But the beginning phases (which lasted 5 – 6 years) including discussions, promotion, negotiations, etc. should not be underestimated.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc.)?

A balanced partnership is absolutely necessary. The ECTOS project has involved all necessary partners from industry, academia, municipalities, administration, technical researchers and business partners, car retailers, bus operators, hydrogen retailers, etc. The consortium has been used and can further be used as a blue print for a well balanced partnership.

1.7 Would you shift the focus of the individual tasks in the retrospective?

No.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

The ECTOS project has now been extended into the HyFLEET:CUTE project. The hydrogen station will serve all customers that want to buy hydrogen for whichever applications for as long as it is licensed to do so.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects within your project?
The case study on ECTOS published by the International Energy Agency (IEA) at www.ieahia.org/pdfs/ECTOS.pdf contains all numbers and figures on the technical issues.

2. Experiences from setting up the project

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

ECTOS was the first actual step in realising the transition of the remaining fossil fuel use in Iceland over to hydrogen fuel use. This is presented in the company’s information brochure, page No.3, available at INE’s website: www.newenergy.is/newenergy/upload/files/brochures/newenergy_brochure.pdf

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

All problems were readily dealt with and only minor incidents happened as should be expected. The public was very positive, the technicians very reliable and responsible, the fuel cells and the bus technology performed better than expected. The hydrogen station had one incident and had to be partially redesigned but all these hurdles were overcome and the overall satisfaction with ECTOS is very high from all the participants.

2.3 Which political / financial support was / is available for your project?

The project got high level political and financial support both from local authorities and from EU authorities.

From the overall project budget of € 7.01 million EC has funded the project with an amount of € 2.86 million.

2.4 Could the project meet the initial cost targets?

Yes, except for changes of the industrial design of the hydrogen station which was covered by the responsible partner. Also the fancy look and the PR design for the station was covered from external sources.

3. Results / lessons learned
3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

Yes, at www.newenergy.is/en/publication/ectos%5Freports/ look up ECTOS Deliverable 17. This deliverable includes 3 pages of lessons learned (after the executive summary).

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

The main profit gained by a demonstration project like this is the increased knowledge that could not be achieved without actual testing. The partners take their learnings into all levels of the technological and system development and could not learn those parts except from a monitored testing.

*Performance of vehicles*

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

- driving range
  - As expected in city traffic: 180-220km
  - Higher than expected in long distance driving: up to 280-300km

- fuel consumption
  - Confidential information at the moment as the vehicles are not produced for the open market and will be modified in their next generation

- investment costs
  - Two - three times more expensive as conventional diesel buses, as can be expected for pre-commercial technology

- maintenance costs
  - Higher than for conventional buses but mainly because of preventive maintenance and tests directly related to the project goals and monitoring

- number of passengers / payload per vehicle
  - Comparable to conventional diesel buses, 72

- operating time per day
  - 6 -8 hours

- environmental aspects
  - Totally “clean” technology as hydrogen from renewable sources was used

- ease of use / operational restrictions
general enjoyment by the bus drivers, the buses are more enjoyable to drive

- image
  - clean and promising technology, fuel of the future

Performance of refuelling infrastructure

3.4 How do your refuelling infrastructure perform in terms of

- fuel production
  - Very clean hydrogen, high quality product, reliable operation

- investment costs
  - high

- maintenance costs
  - higher than expected, mainly because of unforeseen incidents in the early stages but dropped to normal after slight redesign in 2004

- refuelling time
  - short, less than 10 min.

- number of subsequent refuellings
  - one per day

- operating time per day
  - 24 hours, 5 days a week

- environmental aspects
  - clean technology, renewable energy transformation

- ease of use / operational restrictions
  - very easy to use, self service

- Image
  - Clean and promising technology, fuel of the future
4. **Recommendations**

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

In Deliverable 17 of the ECTOS project the consortium was asked to write down their lessons learned during the ECTOS project. These comments would be interesting for this question. [www.newenergy.is/newenergy/upload/files/utgfid_efni/ectos_17-total_impact_assessment_.pdf](www.newenergy.is/newenergy/upload/files/utgfid_efni/ectos_17-total_impact_assessment_.pdf)

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

Synergies with other fields of technology could be suitable, obviously if these technologies are using hydrogen as fuel. Stationary fuel cells would be used on board ships and as back-up power, but all grid connected electricity in Iceland is already from renewable resources.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

The approval framework for hydrogen technologies is the most important one. Hydrogen needs to be widely approved as a fuel, ideally worldwide before the hydrogen technology can be used in widespread applications. Other issues like regulations, codes and standards are also important. Projects like HyApproval are therefore very important and will hopefully be successful in bringing us closer to a general approval of hydrogen as a fuel.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

Where fuel and vehicles are taxed “heavily” tax exemptions on hydrogen and hydrogen vehicles would be the most “positive” incentives for the new fuel, at least until it becomes financially competitive.
Annex 3: Interview Protocol CUTE

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

CUTE – Clean Urban Transport for Europe

Interview with Monika Kentzler (DaimlerChrysler AG) 18 JUL 2006.
Interview performed by Hubert Landinger (LBST).

1. General project infos

Detailed project information is available via
- the project’s website http://www.fuel-cell-bus-club.com

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

In the project 27 hydrogen-powered fuel cell buses have been operated in everyday public transport services in nine European cities. The operation is documented in the brochure mentioned above.
1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

### Characteristics of the CUTE filling stations

<table>
<thead>
<tr>
<th>Hydrogen production</th>
<th>Hydrogen storage</th>
<th>Dispenser</th>
<th>Max. filling time in min</th>
<th>Interval between x buses in min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam</td>
<td>electrolysis</td>
<td>Blok Loos</td>
<td>hydraulic</td>
<td>490</td>
</tr>
<tr>
<td>Barcelona</td>
<td>electrolysis</td>
<td>Lindé</td>
<td>hydraulic</td>
<td>490</td>
</tr>
<tr>
<td>Hamburg</td>
<td>electrolysis</td>
<td>Nor Hydro Electrolysers</td>
<td>diaphragm</td>
<td>62</td>
</tr>
<tr>
<td>London</td>
<td>external</td>
<td>ROC</td>
<td>cryogenic pump</td>
<td>590</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>external</td>
<td>Air Liquide</td>
<td>diaphragm</td>
<td>60</td>
</tr>
<tr>
<td>Madrid</td>
<td>steam reformer</td>
<td>Air Liquide</td>
<td>diaphragm (two)</td>
<td>50 and 3,400</td>
</tr>
<tr>
<td>Porto</td>
<td>external</td>
<td>Lindé</td>
<td>hydraulic</td>
<td>500</td>
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<td>Stockholm</td>
<td>electrolysis</td>
<td>Hydrogenics Systems</td>
<td>membrane</td>
<td>525</td>
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<tr>
<td>Stuttgart</td>
<td>steam reformer</td>
<td>Mahler KG</td>
<td>hydraulic (two)</td>
<td>350 and 3,400</td>
</tr>
</tbody>
</table>

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3 London: details for storage of liquid hydrogen given, as in operation from May 2005 in Horndelch.  
4 Hamburg: up to 120 min when filling in maximum capacity.  
5 Stockholm: interval between second and third bus 8 hours due to limited storage size.

Source and additional information: CUTE brochure ‘Detailed Summary of Achievements’.  
Problems with regard to hydrogen refuelling stations occurred during the course of the CUTE project are also addressed in the presentation ‘Making sustainable transport a reality – a car maker’s view’


1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

Yes, the assessment framework was developed within CUTE. It gives guidance for the data acquisition forms that have to be filled in by the cities. These are the basis for the analysis done in the Work packages. Each city has had to fill in a template documenting its experiences with fuel cell buses in the CUTE project. This template has been made available for the HyLights project.
1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

CUTE is an Integrated Project within the 5th Framework Programme of the EC and is therefore a Public Private Partnership (PPP). The fuel cell buses are authorised by the German Kraftfahrtbundesamt (KBA) and have received a country certificate for the specific countries, the buses were operated in.

1.5 How did / do you organize your project management?

The project has been coordinated by the main industry partner EvoBus. In the project structure an own workpackage has been dedicated to the project management (see graph).

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

The CUTE project has had a very balanced partnership and during the course of the project a real ‘CUTE-family’ developed. In total the project has comprised 28 partners (project coordinator (EvoBus), city partners (14), industry partner (5), academic and consulting partners (8)).
The meetings were extended to include further companies, like Ballard, AirLiquide, Linde, Hydrogenics, BC Transit and the projects ECTOS, STEP and FCBB.

1.7 Would you shift the focus of the individual tasks in the retrospective?

Frictionless internal communication is the key to a successful project of this size. During the course of the project the task force ‘Safety & Security has been established which has significantly contributed to the information exchange on potential sources of defect.

As many competing hydrogen infrastructure suppliers were involved there was a high pressure to provide reliable hydrogen refuelling stations and to bring the stations quickly online after a disruption.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

The follow-up of the CUTE project is the HyFLEET:CUTE project in which 6 of 9 cities continue the operation of the fuel cell buses for one more year (JAN 2006 – JAN 2007). Hamburg has even enlarged its fuel cell bus fleet from 3 buses to 9 buses. As the buses have been bought by the customers it is their decision what happens with the buses after talking out of operation. Also the refuelling equipment is owned by the transport organisations or the infrastructure suppliers and therefore they will decide if the equipment will be sold or kept for further use.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects

within your project?

As the project is terminated please address the coordinator of the follow-up project Monika Kentzler.
2. **Experiences from setting up the project**

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

From the brochure ‘Detailed Summary of Achievements’: “The vision pursued by CUTE is to develop a totally clean transport system for cities, without reducing modern society mobility standards. In particular, CUTE aims to achieve this vision by replacing diesel and petrol with hydrogen and combustion engines with fuel cells. Hydrogen and fuel cells can introduce a paradigm shift away from the transport sector’s ‘addiction’ to oil. They are at the heart of a zero emissions transport system that would de-couple mobility from climate change and air quality concerns.”

Furthermore, the presentation ‘What is CUTE’ names the following motivations entitled needs for the fuel cell technology:

- Lack of field experience with fuel cell systems and electric engines in mobile applications
- Operability of on-site hydrogen production facilities and referring high pressure filling stations
- Country specific certification of fuel cell systems and high pressure hydrogen storage systems
- Acceptance test of the new technology and of hydrogen as a fuel


2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

- Performance of buses and refuelling stations was very unclear at the very beginning
- Public acceptance was unclear at the beginning
- There was the fear that customer acceptance cannot be reached, if teething troubles cannot be solved quickly
- Legal problems occurred with the authorisation of the hydrogen refuelling station in London
- the first homologation of the buses in the different countries caused some issues, but could be resolved successfully

2.3 Which political / financial support was / is available for your project?

The CUTE project has received very large political support from the EC. From the initially planned total budget of € 52.5 million € 18.55 million have been covered by EC funds. Additional to the EC funding some of the public transport
organisations could receive regional funding for the installation of the hydrogen refuelling infrastructure.

2.4 Could the project meet the initial cost targets?

The initial cost targets could not been met. The total costs of the CUTE demonstration project (including ECTOS) for all participants amount to approximately € 100 million (€ 21.5 million covered by EC sources). See also the presentation ‘What is CUTE’.


3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

In the CUTE brochure ‘Detailed Summary of Achievements’ each topic ends with a dedicated sub-chapter on ‘lessons learned’.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

- Public transport companies: They could collect experiences on public acceptance of fuel cell buses and in the operation and maintenance (only partly, as maintenance has been carried out by the bus manufacturer) of fuel cell buses and hydrogen refuelling stations. Furthermore, they could gather know-how in the safety equipment of maintenance buildings.
- Bus manufacturer: Beside the experiences of the public transport companies the bus manufacturer could furthermore collect information on its drive train concept, the life expectancy of the various components, safety issues and on the behaviour of the single components as well as the overall system under different real world conditions.
- Hydrogen infrastructure suppliers: The partners providing the hydrogen infrastructure could collect technical, economic and safety related experiences of their installations and have been confronted with the need to receive approval for their hydrogen refuelling stations from local authorities. Furthermore, operating concepts such as unmanned operation of production and refuelling units have been discussed intensively.
Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

Detailed information is available in the CUTE brochure “Detailed Summary of Achievements’.

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of

- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

Detailed information is available in the CUTE brochure “Detailed Summary of Achievements’.

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

During the writing of the description of work it should be considered that only realistic and achievable targets are set out. Furthermore, an adequate project management system should be applied from the very beginning of a project. Also the bureaucratic effort has to be lowered e.g. how to handle cost statements, etc. Here a simplification of the processes from EC-side is needed.
4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

With regard to other fuels dispensed at the same refuelling station no project-specific synergies can be recognised. For stationary applications no general statement can be made as it depends on the specific application.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

Europe-wide standardised approval of hydrogen refuelling stations and related components should be possible. Ideally the therefore required activities could receive funding in FP6 & FP7. Furthermore, before hydrogen vehicles can reach private customers an acceptable hydrogen refuelling infrastructure needs to be in place.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

Incentives such as use of public transport lanes, free parking, etc. for hydrogen powered vehicles should be considered very careful as number of vehicles may increase rapidly.
Instead clear goals for emission reductions including a reasonable timeline should be set out.
Tax exemptions might be good option to push technology.
Annex 4: Interview Protocol ZERO REGIO

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

ZERO REGIO - Lombardia & Rhein-Main towards Zero Emission: Development and Demonstration of Infrastructure Systems for Hydrogen as an Alternative Motor Fuel

Interview with Achim Boening (Infraserv Höchst) 12 JUL 2006.
Interview performed by Hubert Landinger (LBST).

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

Frankfurt: 5 DaimlerChrysler F-Cell vehicles (350 bar and at least 1 with 700 bar hydrogen storage technology)
Mantova: 3 Fiat Panda fuel cell vehicles (350 bar)
Documentation may be available via car manufactures.

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

Frankfurt: By-product hydrogen from chlorine electrolysis will be used. A large-scale 200 bar hydrogen infrastructure already exists. The hydrogen refuelling station will be able to serve vehicles equipped with 700 bar hydrogen storage systems. Therefore at the Infraserv Höchst hydrogen centre a newly developed Linde ionic-fluid compressor will be installed pressurizing the hydrogen up to 900 bar. The hydrogen will be delivered to the hydrogen refuelling station over a distance of 1.7 km via a pipeline with the following specifications:
nominal pressure level: PN1000 (tested and certified for 1000 bar)
operating pressure: ~ 900bar
pipe dimension: DN25 (33.7mm outer diameter; 18mm inner diameter)
For the refuelling of vehicles equipped with 350 bar hydrogen storage system a pressure reducing regulator will be installed. Also all equipment (LH2 storage tank, LH2 dispenser, etc.) required to refuel vehicles with liquid hydrogen storage systems will be installed.
Mantova: The hydrogen supply in Mantova is realised by a two step concept:
In the first step hydrogen will be transported for a large production site to the filling station by trailers.
In the second step hydrogen will be produced onsite from natural gas by a newly designed Short Contact Time - Catalytic Partial Oxidation Reformer (SCT-CPO). This reformer, developed by ENI, is specified for small production rates and enables short start-up and shut-down times.
In Mantova hydrogen will be supplied at a pressure level of 350 bar.

Presentations on this issue are available at the ZERO REGIO website (www.zeroregio.com) and at the members section of the HyLights website.

1.3 Did/will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7/JTI?

ZERO REGIO has developed an assessment framework which is partially based on PREMIA mainly referring to technical information.
The assessment framework will undergo a trial run before it is used during the infrastructure and vehicle test phase beginning on 15 November 2005.
IPR will be handled at three different levels:
- public
- selected users (project partners and preferred organisations from other projects e.g. HyLights)
- confidential

1.4 Which legal framework has been/is used for the project? Which authorisation/certification/homologation bodies were/are involved?

ZERO REGIO is an EC funded project (PPP). It receives no further funding. All rights and duties are ruled in a consortium agreement.

Approval procedures in Frankfurt:
The pipeline has been approved according to the German Bundes-Immissionsschutzgesetz (BImSchG) as from a juristic point of view it belongs to the hydrogen production plant, for which an extension of the former BImSchG approval was required then. The BImSchG approval has been granted at the Regierungspräsidium (regional government) Darmstadt.
If the pipeline did not belong to the production plant, it would not have required an approval because of its small nominal diameter.
The refuelling station itself has required a usual building permit. The approval had to be applied at the city of Frankfurt.
The dispensers have to comply to the German Betriebssicherheitsverordnung (operation safety regulation) – certificate is still outstanding, but seems to be
minor issue. The approvals for the refuelling station, the pipeline and the compression system have already been received.

Approval procedures in Mantova:
Prior to the approval of the first public hydrogen refuelling station in Italy a law change had to take place. Before the changed law became effective on 31 AUG 2006 the handling of flammable gases at refuelling stations was allowed only up to a pressure of 200 bar. The changed law allows pressures up to 350 bar. The fire brigades have been strongly involved in the approval process. The certification body TÜV Hessen is partner in ZERO REGIO. Together with Infraserv Höchst they propose to develop a VdTÜV Merkblatt (technical bulletin) for hydrogen refuelling stations compared to the one already available for CNG refuelling stations.
In Italy the Regione Lombardia will buy the vehicles from Centro Ricerche Fiat. They will be operated by the Comune di Mantova.
In Germany the airport operator Fraport will lease the vehicles from DaimlerChrysler. The bilateral leasing contract is carried out bilateral between Fraport and DaimlerChrysler without contribution of the project coordinator. This contract has not been signed yet.

1.5 How did / do you organize your project management?

ZERO REGIO is coordinated by Infraserv Höchst. They are the main contractor with the EC and are responsible for the overall project management (organising general assemblies, coordination of reporting, payment issues, etc.). They are also coordinating the activities in Frankfurt Höchst.
Furthermore, the project has a project coordination committee (PCC) comprising all work package leaders and the scientific officer of the EC which meets quarterly. The PCC reports to the General Assembly (GA).
An external consultant provides assistance to the project management (Becker Technologies). The Regione Lombardia receives external assistance by the Politecnico di Milano (Alberto Rota).
For the activities in Mantova Regione Lombardia is the local coordinator. There a steering committee is in place which meets for local project meetings on demand. For each country (Germany / Italy) a separate Public Relation (PR) strategy has been developed. Project flyers are available in English, German and Italian language.
Brochures and CD-ROMs will be available at the beginning of the demonstration phase (NOV 2006). The activities are based on a common dissemination plan.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

In Italy the authorisation body Regione Lombardia is partner in the project. It turns out that having a relevant authorisation body on board is very useful as this partner can serve as a door opener for all authorisation related issues.
The project progress is supervised by the EC and neutral experts. More intense supervision seems not to be required. The efforts of the coordinator to oversee the activities of the various partners are rather high. The available budget of 7% of the overall budget for coordination and management is definitely too little. Therefore it has been proposed to install a separate package for internal project supervision additionally to the actual project coordination.

1.7 Would you shift the focus of the individual tasks in the retrospective?

The project is structured in a 2 years preparation phase and a three year demonstration phase. This schedule turns out useful and feasible. It is important to tackle time critical issues such as approval procedures, contract negotiations, etc. first and with intense emphasis.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

The project is now preparing the demonstration phase. Hardware installation has begun end of July and the opening of the refuelling station and the start of the demonstration phase will be in mid NOV 2006. It is planned to continue with the operation of the hydrogen refuelling station after the end of the project. Negotiations with auto manufacturers to enlarge the number of vehicles serviced at the station are already in progress.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for
- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects
within your project?
### ZERO REGIO contact persons

<table>
<thead>
<tr>
<th>Coordination</th>
<th>Company</th>
<th>Contact Person</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional Coordination Italy</td>
<td>Consultancy for Regione Lombardia (I)</td>
<td>Alberto Rota</td>
<td>+39-0290659400</td>
<td><a href="mailto:rota.agm@tin.it">rota.agm@tin.it</a></td>
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<tr>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Infrastructure Acquisition (Data)</td>
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</tr>
<tr>
<td>Financing</td>
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</tr>
<tr>
<td></td>
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<td>+39-0290659400</td>
<td><a href="mailto:rota.agm@tin.it">rota.agm@tin.it</a></td>
</tr>
<tr>
<td>Legal Issues</td>
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<td></td>
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<td><a href="mailto:rota.agm@tin.it">rota.agm@tin.it</a></td>
</tr>
<tr>
<td>regulations, codes and standards (RCS)</td>
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<tr>
<td>EniTecnologie (I)</td>
<td>Luca Basini</td>
<td>+39-0252056546</td>
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<td></td>
</tr>
<tr>
<td>public relations (PR)</td>
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<tr>
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<td><a href="mailto:rota.agm@tin.it">rota.agm@tin.it</a></td>
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<tr>
<td>community aspects</td>
<td>Consultancy for Regione Lombardia (I)</td>
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<td>+39-0290659400</td>
<td><a href="mailto:rota.agm@tin.it">rota.agm@tin.it</a></td>
</tr>
</tbody>
</table>
2. **Experiences from setting up the project**

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

In Germany the project was mainly pushed by the Hydrogen and Fuel Cell Initiative Hessen, whose chairman is Dr. Heinrich Lienkamp (Infraserv Höchst). The main drivers were:
- the promotion and the pushing of hydrogen and fuel cell technology
- the development of new markets for available hydrogen (by-product H2)
- the collection of technology experience
- the achievement of technology leadership in dedicated areas e.g. high pressure hydrogen pipelines

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

Some problems emerge of the fact that 900 bar hydrogen compression using an ionic compressor and 1000 bar hydrogen pipelines are definitely new technology! For the time being public acceptance seems not to cause any problems. The approval procedure was hampered by the lack of appropriate rules and regulations for both technical and legislative aspects. In Italy the approval of the hydrogen refuelling station was not possible before a law change has taken place which now allows the distribution of flammable gases up to a pressure of 350 bar (formerly 200 bar / see also 1.4). The Italian fire brigades set out strong requirements with regard to fire protection. Discussions were also required to sort out various problems with regard to IPR issues. For example the composition of the liquid Linde uses in its ionic compressor is confidential Linde internal know-how. On the other hand Infraserv Höchst has to know which substances are in use at its premises in order to act accordingly in a case of emergency. At the end the problem could be solved by providing the information based on signing a confidentiality agreement. Comparable measures had to be taken for handing over the compressor software. In this case Infraserv Höchst has the possibility to rely on its own service personnel.

2.3 Which political / financial support was / is available for your project?

The commitment and contribution of the communities is very intense in Italy (Mantova) and nearly zero in Germany (Frankfurt), but here the project receives political support from the Hessen Agentur (The Hessen Agentur bundles all non-monetary support activities of the Hessian local government with regard to economic development).

In Italy also the Regione Lombardia (project partner) provides massive political support.
Financial support / funding is granted by the EC (30% for demonstration activities, 50% for research activities, 100% for project management).

2.4 Could the project meet the initial cost targets?

It is still too early to answer this question, but the coordinator wants to take the possibility to make a general comment: Often rising prices for (raw) materials and other resources lead to increased project costs especially if it suffers a delay which not in each case is a fault of the project itself, but the project funding remains unchanged. If the project partners are either not willing or not able to take over these additional costs the project may face serious problems.

3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

Regular reports are compiled according to the rules set out in the FP6 guideline documents. Furthermore, quarterly pure technical reports are prepared for documenting and exchanging the project progress. It has still to be clarified if these regular reports can be made available for dedicated people (e.g. HyLights partners) and under which conditions.

Relevant lessons learned can be drawn only during and after the realisation and demonstration phase and will be documented accordingly.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

see drivers / motivation.

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

• driving range
• fuel consumption
• investment costs
• maintenance costs
• number of passengers / payload per vehicle
• operating time per day
• environmental aspects
• ease of use / operational restrictions
• image
To be answered according to the assessment framework during the demonstration phase.

**Performance of refuelling infrastructure**

3.4 How does your refuelling infrastructure perform in terms of

- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

To be answered according to the assessment framework during the demonstration phase.

4. **Recommendations**

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

It would be desirable to get financial support already in the application phase of the project as the required efforts are enormous. The process could comprise a selection procedure after this the winning consortium already receives direct financial support from the EC.

Furthermore, it is important to commit all partners to their participation already in a very early stage in order to establish clarity and planning reliability.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

It was the initial idea of ZERO REGIO to also include stationary applications and their hydrogen supply via pipeline. This topic has been cancelled because of budgetary reasons but would be a preferable case for a project like ZERO REGIO that has the additional advantage of separated hydrogen production and distribution (refuelling).
4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

The framework conditions which have to be in place are that all technical and regulatory issues for the approval of a hydrogen refuelling station have to be solved on a common European basis.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

No additional ideas have been mentioned.
Annex 5: Interview Protocol HyFLEET:CUTE

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

HyFLEET:CUTE – Hydrogen for Clean Urban Transport in Europe

Interview with Monika Kentzler (DaimlerChrysler AG) 18 JUL 2006. Interview performed by Hubert Landinger (LBST).

1. General project infos

Detailed project information is available via the project’s website [www.global-hydrogen-bus-platform.com](http://www.global-hydrogen-bus-platform.com).

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

- Operation of 33 hydrogen fuel cell powered buses in 9 cities on three continents around the world – Amsterdam, Barcelona, Beijing (China), Hamburg, London, Luxembourg, Madrid, Perth (Western Australia), Reykjavik
- Design, construction and operation of 14 hydrogen powered internal combustion engine buses for Berlin (4 naturally aspirated engines (150 kW), 10 turbo-charged engines (200kW))
- Design, construction and testing of the prototype of the next generation of hydrogen fuel cell bus

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

HyFLEET:CUTE foresees the continuous operation of the CUTE / ECTOS / STEP / China FCB Demonstration Project hydrogen refuelling stations as well as their optimization and improved operational reliability and energy efficiency. In Berlin a new hydrogen refuelling station including an LPG reformer has been designed, constructed and is now in test operation. Its design allows the refuelling of 20 buses.

1.3 Did / will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

Yes, an assessment framework (AF) document has been developed based on the document used in CUTE and adapted to the additional needs of the ICE buses and the hydrogen refuelling station in Berlin. Also this document has been made available to the HyLights project. The AF gives guidance for the data acquisition forms that have to be filled in by the cities. These are the basis for the analysis done in the workpackages. The filled in documents are available for all WP leaders in order to answer the ‘guiding questions’ of the project.

Partially the assessment framework has been adapted to customer specific requirements.

1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

HyFLEET:CUTE is an Integrated Project within the 6th Framework Programme of the EC and is therefore a Public Private Partnership (PPP). The fuel cell buses have received their authorisation already within the CUTE project. The MAN ICE buses have approval for Germany.

1.5 How did / do you organize your project management?

This project is coordinated by the main industry partner DaimlerChrysler. An own workpackage is dedicated to the project management task (see graph).

<table>
<thead>
<tr>
<th>Work Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP 1</td>
<td>Operation and Optimisation of Innovative Hydrogen Infrastructures - Optimisation of the existing H2-Infrastructure at the sites - Set-up of a new infrastructure at a new site incl. LPG-reformer and high-power H2-refueling station</td>
</tr>
<tr>
<td>WP 2</td>
<td>Development, construction and operation of a fleet of hydrogen ICE buses - Construction of 4 H2-nat. asp. ICE buses - Development of a new H2-ICE engine with turbocharger and set up of 9 adv, H2-ICE buses - Integration of an APU into the adv. H2-ICE bus and build-up of one bus</td>
</tr>
<tr>
<td>WP 3</td>
<td>Development, operation and optimisation of a fleet of fuel cell buses - Optimisation of the existing FC buses with regard to energy efficiency - Development of a new type of FC-Hybrid bus and build up of one prototype</td>
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<td>WP 4</td>
<td>Quality, Safety and Training - Analysis of existing H2-safety procedures at the refuelling stations and possible improvements - Certification issues - Training in the framework of workshops of e.g. new European member states, Asia, Australia</td>
</tr>
<tr>
<td>WP 5</td>
<td>Accompanying studies</td>
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<tr>
<td>WP 6</td>
<td>Dissemination through the Global Hydrogen Bus Platform</td>
</tr>
<tr>
<td>WP 7</td>
<td>Project Management</td>
</tr>
</tbody>
</table>
1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was/is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

The follow-up project of CUTE has now opened up to also integrate the non-European projects STEP (Australia) and FCB (China). Also further infrastructure suppliers like Air Liquide and Hydrogenics had the chance to join in. In total the project partnership comprises 31 partners (project coordinator (DaimlerChrysler), government partners (2), public transport companies (7), automotive companies (3), energy companies (10), academic and consulting partners (8)). These partners have signed a consortium agreement. In order to improve and simplify internal communication confidentiality agreements have been signed between the relevant partners. The integration of the new partners into the existing CUTE partnership was a challenging task, but worked out well. Competitiveness between partners has been challenging at times, but as hydrogen buses and infrastructure are still far from commercial market introduction its influence could be minimized. From projects point of view it is rather positive to have two competing technologies and two competing bus manufacturers on board. In order to create a fair balance and mutual trust it is important that the coordinator has a neutral standpoint. HyFLEET:CUTE’s focus is on the operation of hydrogen buses and infrastructure.

1.7 Would you shift the focus of the individual tasks in the retrospective?

It is too early to answer this question.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

DaimlerChrysler: In parallel to the one year extension of the demonstration of the CUTE buses (further operation of these buses is not foreseen in the framework of this project after JAN 2007 as the buses are pre-commercial vehicles) within HyFLEET:CUTE the next generation of fuel cell buses will be developed. It is planned to demonstrate the new prototype in 2009 (at the end of the project) in 3 countries. MAN: 4 buses with naturally aspirated ICEs have already been delivered. 9 buses with turbocharged / direct injection hydrogen ICE will be delivered in 2007 and 1 bus with turbocharged / direct injection hydrogen ICE and fuel cell APU will be delivered in 2008. The buses for Berlin will be purchased by the public transport organisation BVG. The station is owned by the oil company Total. Apart from the hydrogen refuelling stations in Berlin and Reykjavik the stations are located on private premises with limited access for public utilisation.
1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for
- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects
within your project?

We have been asked to address the HyFLEET:CUTE coordinator Monika Kentzler first. She will give advise whom to contact for specific questions.

2. Experiences from setting up the project

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

The 31 project partners have very different interests in the realisation of the project. Therefore the complete answer to this question is rather complex. Some examples from a general perspective: for the bus manufacturers and the refuelling station providers it is the development of the technology and the testing of different concepts. For the public transport companies one main driver is to (further) document their commitment to the new technology both for vehicles and fuel infrastructure.

For the research organisations/consultants it is the data evaluation and the development of their tools. These mentioned drivers will not be the only ones though.

Speaking as a DaimlerChrysler employee, not as the coordinator: Some of the customers of the CUTE fuel cell buses had shown great interest in continuing the operation of the buses as the components did not have reached the end of their lifetime. In parallel DaimlerChrysler wanted to directly utilize the experiences and ‘lessons learned’ in developing the next generation of fuel cell buses.

For the other bus manufacturer MAN: MAN’s motivation to participate in HyFLEET:CUTE was the possibility to continue the ICE development and leave the level of small-scale demonstration of hydrogen buses by an extended ICE bus fleet at a so far unseen scale. ICEs from MAN have repeatedly proven their enhanced maturity in several demonstration activities e.g. in the H2argemuc project at Munich Airport. In view of this situation MAN decided to develop, build and demonstrate a fleet of 14 low-floor buses powered by the next generation of 150 kW natural aspirated ICEs (4 buses) and more powerful 200 kW turbo-charged ICEs (10 buses). These buses will undergo an extended field trial on BVG’s routes in Berlin, which will increase the depth of testing, so that in the next step further bus operators can be supplied with vehicles of this kind. The operators of the buses could gain (further) experience with the buses and use the project for further dissemination of the hydrogen technologies.

For all others please contact the respective companies to define their drivers.
2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

No comments have been made hereto.

2.3 Which political / financial support was / is available for your project?

Based on the success of CUTE also HyFLEET:CUTE receives enormous political backing. The contribution to the overall budget of € 43.16 million amounts to € 19 million from EC funding resources.

2.4 Could the project meet the initial cost targets?

It is still too early to answer this question.

3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

Comparable to those of CUTE also HyFLEET:CUTE will provide reports documenting the project’s status and its results and ‘lessons learned’.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

Technological push for hydrogen powered buses and hydrogen infrastructure and public visibility.

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of
- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image
Information will be made available later in the course of the project.

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of
- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

Information will be made available later in the course of the project.

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

Not many improvements could be experienced with regard to the efforts required to fulfil the EC rules in comparison with the CUTE project. Furthermore, it seems that the critical size of a partnership seems to be reached with a number of about 30 partners, this will have to be discussed at a later stage of the project again. The smooth coordination of larger partnerships seems to be very difficult. Reporting for the project has been simplified, but is still too excessive for a project size like this.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

With regard to other fuels dispensed at the same refuelling station no project-specific synergies can be recognised. For stationary applications, synergies between stationary & transport applications will be studied through the setting-up of stationary fuel cells at the Berlin HRS in 2007.
4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

Europe-wide standardised approval of hydrogen refuelling stations and related components should be possible. Ideally the therefore required activities could receive funding in FP6 & FP7.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

Incentives such as use of public transport lanes, free parking, etc., for hydrogen powered vehicles should be considered very careful as the number of vehicles may increase rapidly.
Instead clear goals for emission reductions including a reasonable timeline should be set out.
Tax exemptions might be a good option to push this technology both for vehicles and hydrogen distribution (e.g. from renewables).
Annex 6: Interview Protocol CEP

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

The Clean Energy Partnership CEP

Interview with Henning Niemeyer and Nadine Hölzinger (MVV Consulting) 20 JUL 2006 and phone interview with Henning Niemeyer 24 JUL 2006. Interviews performed by Hubert Landinger (LBST).

1. General project infos

CEP is the demonstration project of the German Transport Energy Strategy (“VES”), but the partnerships are not totally congruent. The CEP contract has been signed in autumn 2003, but preparation work has started already in spring 2002.

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

- 10 DaimlerChrysler A-Class F-Cell vehicles FC CGH₂ in operation
- 3 Ford Focus FCEV Hybrid FC CGH₂ in operation
- 2 BMW 7-series ICE LH₂ in operation
- 1 GM/Opel HydroGen3 FC LH₂ in operation
- 1 VW Touran HyMotion FC CGH₂ in operation since 1 JUL 2006
- 1 VW Caddy FC CGH₂ operation start planned for mid 2007
- 1 MAN 12m standard bus ICE LH₂ temporarily between May 2004 and June 2006
- 1 Bus converted by BVG FC LH₂ operation start planned for end of 2006

Some more vehicle data are available at www.cep-berlin.de.

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

CEP has the possibility to access two hydrogen refuelling stations. The first one (opened in Nov 2004) is the BP / Aral hydrogen refuelling station at Messedamm 8-10, 14057 Berlin-Charlottenburg. This refuelling station is used as the main station within CEP as the installation of the hydrogen related
infrastructure components is funded with resources from the German National Sustainability Strategy.

The hydrogen supply for this station is twofold: LH\textsubscript{2} is provided by the partner Linde from its liquefaction plant in Ingolstadt, for which the electricity for the liquefaction process stems from renewable energy sources. Linde is currently building a further liquefaction plant in Leuna which will significantly reduce the transporting distance to Berlin. For the handling of boil-off gas the system is equipped with a re-liquefaction system, the so called LOPEX system. This system has been developed in the framework of the CEP project and currently undergoes an optimisation process. CGH\textsubscript{2} (35 MPa) is supplied from a Norsk Hydro electrolyser, which uses 100% certified electricity from a newly constructed Swiss hydropower plant. Redundancy for the CGH\textsubscript{2} path can be realised by a LH\textsubscript{2} evaporation system, which is installed but not always in stand-by mode.

At the BP / Aral station a refuelling of buses is currently not possible, but an upgrade is under discussions. Hurdles to be taken before a refuelling of buses will be possible comprise on-site operational aspects, safety aspects, costs, etc. For incident notification the TSG (Tankstellen Support GmbH) has been involved. There is the possibility of transferring failure codes (special failure code lists have been developed) or clear text messages. After each incident notification TSG requires a feedback answering questions such as ‘What has happened?’, etc. TSG provides a monthly report on the incidents registered.

The second one (opened in MAR 2006) is the Total hydrogen refuelling station at Heerstraße 324, 13593 Berlin-Spandau. The construction of the major parts of the hydrogen infrastructure at this site is funded by the European Commission under the 6\textsuperscript{th} Framework Programme in course of the HyFLEET:CUTE project. Within CEP funding is available for soft measures such as project coordination, dissemination, safety studies and scientific support. While the station was implemented mainly to refuel BVG’s buses funded under HyFLEET:CUTE it also serves as a backup for the vehicles operated in the CEP project. Linde is also the provider of LH\textsubscript{2} for this refuelling station using the same pathway. CGH\textsubscript{2} will be produced via an LPG reformer starting operation in SEP 2006. The reformer will be designed to allow the substitution of LPG through Bio-DME. The capacity of this reformer will be sufficient to supply at least 7 buses in daily operation. The missing amount of hydrogen will be supplied via evaporation of LH\textsubscript{2}. CGH\textsubscript{2} is supplied at a pressure of 35 MPa.

It is planned to install an SMS notification system (“DAISY”) to inform the vehicle users in case the station is out of service.

Some more details concerning the hydrogen refuelling stations are available at www.cep-berlin.de.

1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

Yes,

a) It includes the following vehicle data collected on a monthly reporting basis:
   - number of refuellings
   - amount of hydrogen refuelled
• driving range (can only be estimated as vehicles are temporarily also operated and refuelled in other locations)
• presence of vehicles
• utilization days of the common workshop
• incidents

This data will be reported only internally. A regularly publication of operational data is not foreseen in the project. Aggregated data are so far available for project partners only. A publication of data has not yet been considered.

b) The reporting formats of the infrastructure side that are used for the monthly CEP reporting have been made available to HyLights already in FEB 2006. This version is still valid.

Within the framework of the project the following data are collected for the Messedamm station (a comparable set of data will be collected for the Heerstrasse station starting from 1 JUL 2006):

**LH₂ refuelling facilities**

- Basic data
  - number of refuelling procedures
  - amount of LH₂ refuelled (kg)
  - provided amount of H₂ for back-up (kg)
  - total LH₂ consumption (kg)
  - LH₂ quantity delivered to storage tank (kg)
  - number of storage tank refuellings
  - operation time LH₂ cryo pump (h)
  - operation time LH₂ cryo pump for backup reasons (h)
  - number of pump start-ups
  - operation time LOPEX (h)
  - number of LOPEX start-ups
  - amount of re-liquefied H₂ by LOPEX system (kg)
  - operation / availability days of overall system
  - number of days without operation
  - electricity consumption cryo pump, Lopex system(kWh)

- Refuelling incidents
  - number of incidents (technical reasons)
  - number of incidents (user reasons)
  - incidents with material damage
  - incidents with personal injuries
  - number of interrupted refuelling processes

- Technical information / HSSE / general
  - total number of alarms
  - number of emergency alarms
  - number of alarms with production interruption
  - number of reported accidents
  - number of reported incidents
  - description of required interventions

**CGH₂ compression and refuelling facilities**

- Basic data
1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

There has no legal organization been established for the CEP project. All responsibilities, interfaces, relationships, time lines, etc. are arranged in a consortium contract. TÜV Berlin-Brandenburg, a subsidiary of the TÜV Rheinland Holding, involved as authorisation assessor has requested an operating contract between the concerned partners BP / ARAL, Linde and Norsk Hydro which names an overall responsible organisation for the operation of the Messedamm station and rules the definitions of the interfaces between the various components. BP / Aral has taken over this role, while the responsibility for the operation of the single plants...
has been delegated back to the Linde and Norsk Hydro. The infrastructure partner agree that this constellation is not ideal as a future model for the operation of refuelling stations as it requires additional organisational efforts that can be avoided if the station is owned and operated by only one partner (possibly with technical support from further partners). The land where the refuelling station is located is owned by a public authority and leased to BP / Aral for 15 years.
For the second hydrogen refuelling station, Total is the single owner and single responsible operator.

1.5 How did / do you organize your project management?

The highest decision level within the project is the Steering Committee. It consists of representatives of all partners, of three working groups, of the federal ministries involved (Federal Ministry of Transport, Building and Urban Development, Federal Ministry for Economics and Labour, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) and of the project coordinator (contracted by the partnership). The Steering Committee elects a chairman from among its members.
Below the Steering Committee, the project is structured into three working groups:
  * Mobility
  * Infrastructure
  * Public Relations

Depending on actual needs further working groups may temporarily be established. E.g. a working group on “Safety in Hydrogen Workshops” was established in close cooperation with Berufsgenossenschaft Bahnen (Professional Association “Railways”) and non-CEP vehicle manufacturers.
As contract partner to the funding organisation, BP / Aral is responsible with regard to the funding resources. They hold in trust the funding resources on behalf of the funding organisation (the three ministries) and the project partners. dena as an associate partner of CEP accompanies the project with lobbying and scientific support activities in the field of sustainable energy policy.
The consortium contract states that if an external organisation should be contracted for the project coordination, the organisation chosen should not only have general experience in project management but also particular experience in hydrogen and/or fuel cell related projects. Furthermore, a strong commitment with regard to the project may be very useful. In CEP, the external, subcontracted coordinator MVV Consulting GmbH is well accepted by the partnership (mainly industry) as they take over this role in an independent, responsible and reliable manner.
Overall costs such as project management, scientific support and monitoring, public relations, costs for the convention centre at Berlin Messedamm, etc. are distributed evenly among the project partners and are funded by the ministries involved.
For the handling of information and know-how gained from the project a special database for knowledge management purposes has been developed on MS ACCESS basis. This system is able to handle all kinds of project related documents e.g. protocols, minutes of meetings, authorisation documents,
presentations, press releases, interviews, etc. This database enables various search functions such as search for a person, a date, a keyword, etc. Based on the database a number of useful “lessons learned” will be elaborated. The relationship between the users of the vehicles and the OEMs is ruled in bilateral leasing contracts outside the framework of the project.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was/is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

Even if there is no funding for vehicles available within the ongoing phase of the project (neither for development nor for demonstration) there is a sufficient and even growing number of participating automotive partners in CEP (VW became consortium member on 1 JUL 2006). The participating OEMs are highly committed to the project. It may be questioned if component suppliers (of hydrogen refuelling station and vehicle components such as fuel cell manufacturers) should be represented to a higher extend. It should however be considered that the more partners are in a project the more complex the project handling and management turns out while an added value with regard to the successful implementation of the project is not clear, whereas a larger number of vehicle manufacturers and oil companies would enlarge the impact as well as the international recognition of the project and could enable common problem solving for problems that occur or may occur at all hydrogen refuelling stations. A higher refuelling frequency for example would considerably improve the performance of the refuelling stations with regard to efficiency and reduction of losses. Also the exchange of information on common problems can be improved. It is in the nature of the matter that the end users of the vehicles (passenger cars) are not partner in the project. Users being independent from the project are more unbiased, critical and independent test persons for the new technology than users being committed to the project. Vehicle operators are interviewed in the framework of the implementation of a knowledge management system. Herewith experiences and know-how gained by the vehicle operators become direct part of the project know-how. Obtaining and securing this knowledge is sufficient for the project The operators therefore do not require to be a partners in the project.

In general it can be said that the CEP partnership is well balanced.

Future partnerships to be considered could however comprise:
- Organisations working in the field of regulations, codes and standards (e.g. TÜV)
- Scientific bodies (universities, institutes)
- Institutions in the field of vocational training
- Additional OEMs (incl. bus manufacturers)
- Additional refuelling station operators (only if additional OEMs can be attracted or additional vehicles can be implemented)
1.7 Would you shift the focus of the individual tasks in the retrospective?

Very much in the focus should be the hydrogen refuelling station layout with regard to the dimensioning of the components and the number of vehicles to be serviced.

It has been a learning from the CEP project that adequate production, storage and demand alignments together with a certain flexibility reduces the H2 losses of the total system.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

The current project phase (Phase I) i.e. the current funding contract will terminate on 31 DEC 2007. It is anticipated to proceed with the (extended) operation of the hydrogen refuelling stations and the vehicles after Phase I, presumably in the framework of and with funding from the National Hydrogen and Fuel Cell Technology Innovation Programme launched by the German Government.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects

within your project?

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<td>Henning Niemeyer</td>
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2. **Experiences from setting up the project**

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

The main drivers pushing forward the CEP project idea was the German Transport Energy Strategy (VES) group. The motivation was to realize the first-ever hydrogen refuelling station integrated into a public gasoline retail station site and to test the suitability of hydrogen as a vehicle fuel.

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

- There were long discussions, if the land, on which the station is erected, will be available for this purpose as different plans how to develop this area in another way had existed in parallel.
- Also the contract negotiations concerning the consortium contract took more time as initially expected. It is therefore recommended not to enlarge consortia of future project phases substantially.
- Tax exemption (petroleum tax) for hydrogen had to be obtained. This tax exemption is not (yet) based on a general tax exemption for hydrogen as a vehicle fuel but is an exception from the general rule. A general tax exemption has however to be fostered in order to enable the market introduction of hydrogen.
• Differences in internal safety and security standards of the partners.
• The decision of the infrastructure partners to commonly operate the Messedamm station led to problems during process of obtaining the operation permission, as a common responsibility without a main responsible was not accepted by the authorities.

2.3 Which political / financial support was / is available for your project?

Funding is available for the hydrogen infrastructure build-up (BP / Aral station) and its operation as well as for the build-up and operation of the service station (workshop) for the hydrogen cars and the workshop for hydrogen buses located at Usedomer Strasse. For the implementation and operation of the vehicles no funding is available.

The German funding mechanisms applied in this case are very flexible. The rules how the funding resources have to be spent in the framework of the project are relatively flexible. That provides the possibility to react on unforeseen events (e.g. upcoming of unexpected R&D results) and learnings. Experiences from the project can be implemented directly within the project duration. But resources made available by the funding agency are strictly limited to a total funding of € 5 million over the whole project duration (Phase I). Uneven annual down payments take place, reflecting the uneven cost structure during the project life time. The ministries transfer the funding directly to BP / Aral, as they are the single contractor in the funding contract. On the other hand, the consortium contract rules the transfer of the funding money to the other project partners on the basis of their semi-annual cost statements.

Besides the financial support the project also receives a lot of political and moral support enabling a fruitful alliance between policy and economy.

2.4 Could the project meet the initial cost targets?

Not by 100%, but surprisingly well. Costs at some infrastructure partners were slightly higher than expected.

3. Results / lessons learned

3.1 Do reports documenting the status, results and 'lessons learned' of the project exist?

• Bi-annual progress reports are regularly compiled (confidential)
• A knowledge management database has been set up which includes all information relevant for the project (see question 1.5; confidential). Within CEP, interviews in order to developed lessons learned have been performed. These activities will result in a report including about 20 – 22 lessons. The lessons will include e.g. questions on authorisation, project coordination, public relation, knowledge management, petroleum tax exemption, component interfaces, safety, certified green electricity, etc.
The report will be ready in autumn but it has still to be defined if it will be for internal use only (confidential) or publicly available. There is also the option to prepare two reports – one confidential and one public.

- A brochure containing detailed information about the various components and about the partners as well as the current status of the project is under development. It will be made available electronically only and will be published on the projects website by the end of 2006.
- Furthermore, there is the CEP website www.cep-berlin.de.
- For internal information and communication, the project maintains an extranet:

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

From a technical point of view: The component suppliers can learn how their specific component performs in collaboration with components of other suppliers, how the interfaces have to be defined, how the overall control system has to be implemented, how the communication interfaces between the various components can be realized, how different safety philosophies can be brought together, etc.

Furthermore, the usage of the technology by (nearly) lay people can be tested. (So far the users of the refuelling station have to undergo a training before their first refuelling and participate in an annual refreshing course.)

Given the two hydrogen refuelling stations operated within the context of the CEP project, there is the possibility to compare both stations for various topics. The Total refuelling station for example is owned and operated by Total solely. This very much simplifies the authorisation, the build-up as well as the operation of the refuelling station. Component suppliers such as Linde are just contractors of Total (technology partners). Furthermore, different ways of hydrogen onsite production can be compared.

Beside the technical learnings and experiences, the partners of course can profit from the cooperation by establishing a strong network and building confidence on a personal basis.

**Performance of vehicles**

3.3 How do your vehicles (buses, cars, etc.) perform in terms of
- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image
The vehicle manufacturers do not receive any funding neither for vehicle development nor for the vehicle operation within the project. Therefore, only aggregated data and only for project internal use are provided. It can however be stated, that the vehicles perform very well with regard to reliability, availability and customer satisfaction.

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of

- fuel production
- investment costs
- maintenance costs
- refuelling time
  The refuelling times are satisfying for all users.
- number of subsequent refuellings
  Subsequent refuellings are not a problem for the CEP station because of the generous dimensioning of the station. The electrolysis has an output of 60 Nm$^3$/h allowing 2-3 refuellings/h. With regard to LH$_2$, there are no limitations at all.
- operating time per day
  CGH$_2$: 24h/d, but during LH$_2$ delivery, the whole refuelling station (including petrol refuelling and shop) has to be closed according to the BP / Aral HSSE requirements. Therefore, it has been agreed that LH$_2$ deliveries take place only during late night hours.
  LH$_2$: Because of the limited number of refuellings during nighttimes it has been agreed that the LH$_2$ refuelling facilities will be switched to stand-by mode during night times and weekends. While refuelling remains possible in principle refuelling may take substantially longer than during daytimes as the facilities have first to be switched back to standard mode and have to be cooled down. Hereby a permanent cooling of various components (cryogenic pump, refuelling nozzle, pipes, etc.) can be avoided and LH$_2$ losses can be lowered. But there are no technical or other restrictions to operate the LH$_2$ refuelling station in a 24h/d modus. Furthermore, the LH$_2$ path is equipped with a re-liquefaction system in order to minimize the evaporation losses from the storage tank.
- environmental aspects
  The whole CGH$_2$ pathway as well as the energy for the liquefaction process is based on certified renewable energy (electricity) (see also 1.3).
  Noise measurements have not yet taken place.
- ease of use / operational restrictions
  BP / Aral estimates the operational availability of the overall hydrogen refuelling station to about 95%.
  Even if the station respectively the dispensers are easy to use and detailed information boards are explaining the refuelling procedure a dedicated initial training for users of the refuelling station is obligatory before their first refuelling. Furthermore, users are encouraged to participate in annual refreshing courses. Project attendant observations are done to prove whether initial and in particular refreshing trainings can be avoided in the future.
Of course, some teething problems had to be solved e.g. frequent alarms caused by operating errors and there is still optimisation potential for a smoother and more convenient utilization.

- image

For the pricing of the hydrogen it is intended to aim at the prices of conventional fuels. Currently, the price is set to € 8/kg for both LH₂ and CGH₂. The price was negotiated between the working groups infrastructure and mobility. Once in a year, the hydrogen pricing is revised and adapted in case of necessity. So far no adjustments were necessary.

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

At the first large-scale hydrogen refuelling stations, a contact person should be available directly at the station responsible for all belongings of the station operation.

The ease of operation for the customers (end-users) has to be in the focus.

The interfaces between the various components involved have to be improved.

On-line controlling, servicing and solving of minor problems should be possible for all components.

As today normally no alternate hydrogen station is nearby, the information flow from the station operator to the customers has to be well established (e.g. message if station is out of service).

From a political/funding point of view: In this project, funding is only available for the infrastructure part, the mobility part does not receive funding. In future projects, all relevant parties (infrastructure partners & mobility partners) should receive funding in a balanced distribution in order to ensure that with regard to capacity, the station is in balance with the fleet to be refuelled. The refuelling of buses is currently not foreseen and possible. In order to make good use of available capacities, it should be foreseen in the future. Reasons why a refuelling of buses is currently not possible are:

- The hydrogen storage system is too small
- A compatible coupling is not installed (but manufacturers of hydrogen powered buses show a tendency to prefer the use of the smaller refuelling nozzle (TK 16) initially thought for passenger cars only)
- The hydrogen refuelling point is not designed for refuelling of heavy duty vehicles from an operational point of view.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

Synergies with stationary applications can be definitely seen, e.g. usage of LH₂ boil off gases (even if there is the possibility of re-liquefaction). This concept is
tested at the refuelling station Heerstrasse where two fuel cells are installed, funded within HyFLEET:CUTE.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

First of all, the technology must be developed to a stage which allows a market introduction. That means that the technology must be as reliable as the technology in use today. In the case of fuel cells, durability has to be improved and costs have to decrease. Furthermore, a wide-spread network of hydrogen refuelling stations and an attractive portfolio of hydrogen powered vehicles must be in place. Here one should learn from the CNG market in order to avoid that the same mistakes will be repeated. Analyses of what can be learned from the mistakes of the CNG market should be performed. Both vehicle costs and fuel costs must be comparable with conventional vehicles and fuels. In the long term, the production of hydrogen from others than fossile fuel resources is inevitable.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today's situation / point of view?

A long-lasting (15-20 years) petroleum tax exemption for hydrogen as a fuel is required. Only at a later stage, the phasing-in of a tax on hydrogen can be considered and will depend on the production costs and sales prices for hydrogen as a fuel. In Berlin, there are currently no plans to open public transport lanes for hydrogen powered vehicles. Both for technology development, for demonstration and for market introduction, a long-lasting funding scheme is required. The number of suppliers of storage systems for CGH$_2$ are quite limited which may lead to bottle-necks. Furthermore, there is still a large demand for technology development in case of LH$_2$ storage systems. For market preparation, the creation of public awareness is key and public awareness will be a substantial momentum for the establishment of a functioning market for hydrogen vehicles. The larger a project the larger the recognition effect will be. But market development must take place hand in hand with the technology development. An example for a successful project is the TUT project in Berlin, where 1,000 CNG taxis have been put in operation. As now a substantial share of Berlin’s taxis is powered by CNG, this technology receives noteworthy recognition. But CNG technology faces other problems e.g. with the authorized dealerships: There engagement in selling CNG vehicles is quite limited because of
• low profit margins
• no or limited special marketing concepts (e.g. one-day registrations, special editions, etc.)
• distribution only by application of the general price lists

Furthermore, also the engagement of the car industry is limited as even for them, the margins are limited and the vehicle production requires a lot of manual labour at single workstations. Marketing topics and problems have to be tackled. But EC is not working on this issue.
Annex 7: Interview Protocol HYCHAIN

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

The HYCHAIN-MINITRANS Project

Telephone interview with Philippe Paulmier (Air Liquide) 05 JUL 2006
Additional information is taken from HYCHAIN-MINITRANS presentations held at the Hydrogen for Transport Seminar
and from the document “Practically speaking, what is the HYCHAIN Project?”
Interview performed and document prepared by Hubert Landinger (LBST)

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

HYCHAIN-MINITRANS is a 5 year project structured in a 2 years preparation phase and a 3 year demonstration phase. Starting date of the project was 15 JAN 2006.
The project will demonstrate 158 vehicles in 4 European regions:
• 10 Fuel Cell Midibuses
• 30 Fuel Cell Scooters
• 34 Fuel Cell Wheelchairs
• 44 Fuel Cell Utility Vehicles
• 40 Fuel Cell Cargobikes
Detailed information is available at the HYCHAIN-MINITRANS website at the ‘Vehicle showroom section’.

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

As HYCHAIN-MINITRANS vehicle demonstrations will take place in 4 European regions each of these regions needs to have an appropriate infrastructure in place. These hydrogen infrastructures look slightly different:
Emscher-Lippe-Region (Germany):
Hydrogen will be derived from an existing natural gas reformer.
700 bar H2 clip-on bottles will be refuelled in Marl and distributed to the other 3 regions.
Hydrogen refuelling stations for the midibuses will be installed on demand. 300 & 700 bar bottles will be distributed via automatic dispensers (vending machines) within an area of 25 km² making them available for 1,000,000 inhabitants in 12 cities.

Castilla y León Region (Spain):
Hydrogen will be derived from renewable electrolysis (50%) and natural gas reforming (50%).
A hydrogen refuelling station for the midibuses will be installed on demand (presumably in Soria for two buses). 300 & 700 bar bottles will be distributed via automatic dispensers (vending machines) within an area of 300 km² making them available for 500,000 inhabitants in Soria, Valladolid and León.

Rhone Alpes Region (France):
Hydrogen will be derived from renewable electrolysis and natural gas reforming. 300 & 700 bar bottles will be distributed via automatic dispensers (vending machines) within an area of 44,798 km² making them available for 5,608,200 inhabitants.

Emilia Romagna (Italy):
Hydrogen will be derived from natural gas reforming. 300 & 700 bar bottles will be distributed via automatic dispensers (vending machines) within an area of 300 km² making them available for 150,000 inhabitants in Modena.

Detailed information is available at the HyLights website at www.hylights.org/publications/hyseminar/Hychain_EC_Hydrogen_Transport25-01-06.pdf

1.3 Did/will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7/JTI?

According to the EC contract HYCHAIN-MINITRANS is obliged to apply an assessment framework which has been mainly derived from the PREMIA activities. The information to be provided will include operational data on e.g. availability and maintenance efforts of the vehicles. Details which data have to be provided to whom are laid down in the contract with the EC.

1.4 Which legal framework has been/is used for the project? Which authorisation/certification/homologation bodies were/are involved?

HYCHAIN-MINITRANS is a Public Private Partnership (PPP) funded within the 6th Framework Programme of the EC. A Consortium Agreement constitutes the liaison of the 24 partners. A number of homologation/certification bodies are involved in each of the 4 countries. Each of the vehicles should receive homologation for public use in the country it is applied.
1.5 How did / do you organize your project management?

For each of the 4 countries a regional coordinator has been identified. General decisions concerning the overall project are drawn from an Executive Board. The company Besel provides staff to assist the coordinator in the reporting and other project management activities. Furthermore, the project is structured in workpackages with a workpackage leader taking the responsibility. The overall project management structure is complex and is laid down in a matrix.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

It seems to be an advantage to have one strong player on board covering all issues with regard to hydrogen infrastructure. All partners appreciate this constellation. No end-users are on board the partnership. If end-users are on board the real market conditions could not be tested. On the other hand it would ease the efforts to identify application possibilities for the vehicles. In general it seems that the project has a balanced partnership, but it is too early to provide a final statement.

1.7 Would you shift the focus of the individual tasks in the retrospective?

It is too early to answer this question.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

Besides the midibuses the vehicles will be leased to the end-users. The midibuses will be sold to the end-users. The decision on the further use and ownership of the vehicles will be made at the end of the project.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
• regulations, codes and standards (RCS)
• public relations (PR)
• community aspects
within your project?

Not available yet.

2. Experiences from setting up the project

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

There are a number of various motivations and drivers.

Application related:
• Deploy and develop further fuel cell technology and its applications
• Test (early) markets

Infrastructure related:
• Test hydrogen infrastructure
• Develop easy to use exchange system ➔ "Clip-On Concept" and test market for concepts of this kind
• Finding partners and establish partnerships for concepts of this kind

In the first phase of hydrogen energy deployment, the lack of refuelling stations and the public acceptance of the new fuel represent two of the major obstacles to the development in the future public domain. By participating in this project the partners show their commitment to contribute to overcome these obstacles. They will provide user-friendly solutions that can address challenges in terms of autonomy, safety, simplicity, quickness and availability issues. Captive fleets allow the vehicle manufacturers demonstration and testing of the technology in a controlled environment. Continuous monitoring and assessment allow obtaining operational feedback to improve technology and lower entry hurdles.

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

Balancing the interests of the various partners turned out as a problem. Financing problems occurred as a major partner dropped out during the contract preparation phase. Acquisition of regional funding was also a problem. Initially a much larger project was planned. Downsizing caused a lot of troubles and efforts. Regulations, Codes and Standards issues took a lot of time but turned out as solvable at the end. In the case of the buses it is difficult to receive a commitment of the end-users to buy the buses. Initially it was planned to sell 8 buses to end-users in the Emscher Lippe Region. As it turned out to be difficult to find customers for all partners, it is
currently discussed to enlarge the area in which a potential operation of the buses could be accepted as part of the project. It is planned to have contracts with end-users for all buses by the end of 2006.

The city of Soria / Spain has committed itself to buy two of the buses (but no contract has been signed yet). Here Air Liquide will provide a hydrogen refuelling station.

Potential cities for the operation of buses in NRW are Herten and Marl (no official statement available) and Gladbeck (where at least a hydrogen refuelling station would exist established in a project funded by regional sources).

2.3 Which political / financial support was / is available for your project?

HYCHAIN-MINITRANS is funded by the Directorate-General Energy and Transport of the European Commission for € 17 million (out of a total budget of € 37.6 million).

Receiving political and financial support from regional governments was a big challenge and has required talking a lot.

Big differences in the four participating countries could be experienced, but mostly positive results could be achieved.

In France several levels of government got involved.

In Italy responsibilities are not very clear.

The regional support of the (local) governments is very important and of great relevance for the success of the project.

Regional governments are contributing to the project by their financial commitment.

It is important to include the local governments into a transparent communication strategy.

2.4 Could the project meet the initial cost targets?

It is too early to answer this question.

3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

It is planned to write documents on lessons learned.

Furthermore, interim reports have to be prepared as in all EC funded FP6 projects.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

The manufacturers of the various vehicles could learn a lot with regard to the homologation and certification processes in the 4 countries.
The vehicle manufacturers can learn about the planning and realisation of small serious production.
As soon as the vehicles are in daily operation real-world data and information can be gathered by having hydrogen powered fuel cell vehicles in the hand of common people.
Furthermore, it can be learned which maintenance issues can arise and how they can be solved.
The hydrogen supply company (Air Liquide) can test the handling of the hydrogen cartridges and evaluate their technical performance.
As both the vehicles and the cartridge vending machines will be used in public surroundings public and political acceptance can be pushed forward.
In this way, the project will lay the foundations of a preliminary economic model to prepare for the large-scale industrialization of vehicles powered by hydrogen as an alternative energy source.

There are also a set of questions that are expected to be answered during the lifetime of the project:
- Can HYCHAIN help accelerate the further development of codes and standards?
- What is the public acceptance level of mini vehicles based on fuel cells?
- How reliable can the vehicles be in the hands of end users from the general public?
- What other design issues will arise that will require solving?

The objectives of the fuel cell developers are to market fuel cells to OEMs and system integrators in early adopting / near term markets and strategic demonstration markets. They want to accelerate the commercialisation of fuel cell technology.

HYCHAIN supports the strategy of fuel cell developers in the following ways:
- Validates fuel cell technology in wider geographic, climactic and cultural markets
- Demonstrates fuel cell technology to wider general public to build acceptance and market pull
- Demonstrates fuel cell technology to OEM clients to build acceptance for integrating into wider products and market introduction
- Wider number of vehicles helps reduce cost and accelerates statistical validation

The main activities of each partner in the project and how each partner can thereby profit from the project are described in detail in the document “Practically speaking, what is the HYCHAIN Project?”

Performance of vehicles
3.3 How do your vehicles (buses, cars, etc.) perform in terms of
- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

No vehicles in operation yet. First vehicles will be implemented in 2007, deployment will take place in 2008.
At the beginning of the project (JAN 2006) the “Shortcomings” – obstacles to market introduction have been described as follows:

<table>
<thead>
<tr>
<th>Obstacles to hydrogen fuel cell market introduction:</th>
<th>Hydrogenics current status for early test markets:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>Suitable for early niches</td>
</tr>
<tr>
<td>Durability</td>
<td>Suitable for early niches</td>
</tr>
<tr>
<td>Reliability</td>
<td>Suitable for early niches</td>
</tr>
<tr>
<td>Unknowns requiring experience for the end user and manufacturer alike</td>
<td></td>
</tr>
<tr>
<td>- long-term operation</td>
<td>Requires demonstrations</td>
</tr>
<tr>
<td>- long-term maintenance</td>
<td></td>
</tr>
<tr>
<td>Availability of refuelling infrastructure</td>
<td>Requires demonstrations and market introduction</td>
</tr>
<tr>
<td>Approvals and certifications</td>
<td>Depends on market demand, developing regulations, codes and standards</td>
</tr>
<tr>
<td>Costs (system, operation, maintenance, spare parts)</td>
<td>Costs still to high due to raw material costs, lack of automated high volume production</td>
</tr>
</tbody>
</table>

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of
- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

No infrastructure in operation yet. Infrastructure build-up will start in 2007.
4. **Recommendations**

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

One of the focal points has to be the effort to implement large volumes of vehicles in order to generate the critical mass. As currently there is no sufficient market for fuel cell vehicles and applications, larger projects are necessary to close the gap between vehicle performance and customer needs. Furthermore, widespread activities to increase public acceptance are urgently required.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)?

A benefit from combining hydrogen projects with other alternative fuels can not be seen. Whereas by combining stationary and transport hydrogen applications including other vehicles (than in HYCHAIN-MINITRANS) e.g. passenger cars and buses various synergy effects may show up e.g. better utilisation of hydrogen infrastructure, wider dissemination possibilities, broader visibility, etc.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

Hydrogen must be recognized as a clean fuel. Incentives to encourage purchase decisions are necessary. A broad promotion for this kind of technology is required.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

A strong political commitment to support the activities of the industry should be a matter of course. HYCHAIN-MINITRANS is a test if regions are willing to give financial support to the end-users of the hydrogen applications. The results of this exercise should be used for the setup of further hydrogen projects.
Annex 8: Interview Protocol HyNor

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

The HyNor Project

Telephone interview (phone conference) with Ulf Hafseled (Hydro) 06 JUL 2006
Participating from HyLights: Hubert Landinger (LBST), Ellas Papadopoulou (Kellen), Per Godfroij (ECN), Menno Ros (ECN)

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

15 Toyota Prius hybrid vehicles converted to hydrogen (ICE) have been ordered at Quantum. The first 4 will be finished and delivered in August 2006. The remaining 11 vehicles will be delivered in early 2007.

A first prototype of a Think fuel cell vehicle will be available for testing in autumn 2006, a series of 5 vehicles are planned to be in operation in 2007. It is planned to operate buses in Oslo (4), Grenland (2) and Stavanger (1-2). The buses may be ordered after a joint bidding process, possibly joining an international buyer’s pool. It has not yet been decided whether ICE or FC buses will be ordered.

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

The first of HyNor’s hydrogen refuelling stations will open in Stavanger in August 2006. The next station to commence operation is Grenland (around Easter 2007). It is planned to have all 6 refuelling stations in full operation by 2009, each with a different method of delivering the hydrogen.

1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

As there is no major car industry in Norway, there is no special interest in gathering vehicle specific data. No assessment framework will be applied. Of course, data which are of general interest and easily to gather will be documented (e.g. fuel consumption, refuelling time, driving range, incident reporting, etc). The availability of this information for stakeholders outside HyNor has still to be clarified.

The measurement of specific data is not in the focus of HyNor.
Emission testing and exact measurement of fuel consumption (dyno test) will be organised by the vehicle suppliers on their own behalf (to be determined in the purchasing order).

1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?
The passenger cars have been ordered by a Grenland car company dealing with electric cars. The cars will be leased to the end-users by 5-year leasing contracts. The calculatory worth of the cars will be zero after the five years.
End users will be local communities, a utility (Hydro: 2 Prius vehicles in Hydro’s car pool → changing users; Statoil: the same), a university, a hotel chain, local agencies, a.o.
Authorisation bodies are not partner in HyNor.
Authorisation will be applied based on the local rules in Norway.
Each node is responsible for receiving its permits from the local building authority and the local fire department as well as the central body “The Directorate for Civil Protection and Emergency Planning”.
For the passenger cars type approval will be applied for according to EIHP2.

1.5 How did / do you organize your project management?

HyNor is structured in two levels:

Level 1: The HyNor Steering Group. It functions as an umbrella for the partnership. Each of the 6 nodes is represented in the Steering Group by its node leader. The leadership of the Steering Group is organised as a rotating system.
Level 1 currently includes 2 working groups
- working group vehicle acquisition
- working group infrastructure
Further working groups will be established on demand.
Furthermore, the Steering Group is assisted by
- a media coordinator and a
- secretariat

Level 2: Each node is structured in working groups like the example from the Grenland node
- working group vehicles
- working group station
- working group hydrogen competence
All nodes have more or less the same structure.
It is very important and useful to have this structure (local nodes and overall project management) as the project management provides the framework and rules and the real work has to be done at the node’s level.
The working group on hydrogen competence are also responsible for public awareness. For example an NGO has published an article in a local newspaper answering 10 FAQs (Frequently Asked Questions) related to hydrogen safety (no direct response requested).
A consortium agreement based on Norwegian law has to be signed by all partners. Although this Consortium Agreement includes confidentiality clauses,
most of the HyNor knowledge will be open to public. The handling of IPR issues is also determined in the Consortium Agreement.

There were discussions on installing a permanent project manager. It has been agreed that there is no real need for a permanent project manager in the early phase. This may change during the project duration and there is still the option to install a project manager.

If a project manager is installed from the very beginning it would be preferable to have an internal person in charge. Later in the course of the project an external project manager would be the better option, but also an internal person with certain qualifications and an adequate standing can do this job. Even if the project has separate financing schemes for the various nodes, there is also a central budget in place.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was/is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

The HyNor partnership includes representatives of all relevant stakeholder groups (industry, NGOs, research institutes, local governments, etc.). The HyNor partnership is open for anyone. Additional partners can be easily included. Authorisation organisations are not included in the partnership in order to remain their independency. Not all end-users are partners in the project. In various nodes (where buses will be applied) the bus operators are project partner. Other end-users are not partner in the project. For the time being the partnership seems to work properly.

1.7 Would you shift the focus of the individual tasks in the retrospective?

The kick-off of the project took place at the end of 2003. As it is really difficult to get vehicles, the partnership early realises the need to have a working group on vehicles.

Concerning the financing issues one can say, that one can always do more. Contacting both, Members of Parliaments and local governments turned out to be successful at the end.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to/used by others?

The goal of the project is market penetration of hydrogen, therefore after the 5-years demonstration phase it will be checked if the stations can be operated commercially. The general idea is to keep all hydrogen refuelling stations in operation after the finalisation of the project; this also was envisaged with the site selection. Therefore all stations have public access.

For the passenger cars: Norwegian law do not allow the purchase of the vehicles after the termination of the leasing contracts.
2. **Experiences from setting up the project**

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

Besides the security of supply, climate change and local air quality, there are some other economic and political drivers. Even if Norway is not a car producing country, especially the energy related industry is very much interested in establishing know-how and gaining experience in hydrogen infrastructure solutions in order to provide products and services on a global market.

A further motivation is to show the public, that hydrogen can contribute to the improvement of local environmental conditions (e.g. air quality).

NGO's are very positive, supportive and with clear goals. They show comparable interest as industry does, they also assist in performing workshops targeted to tackle safety concerns. The same message coming from both the industry and NGOs sends a strong signal to the authorities.

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

Automakers are difficult to win for participating in demo activities. They want to operate their vehicles in limited and concentrated demonstration projects. Hydrogen powered vehicles will now be derived from Quantum Technologies (USA). The price for the converted Toyota Prius vehicles will be three times the price of the ordinary vehicle. Costs for a fuel cell vehicle would be higher about a tenfold of the H2ICE.

Attracting sufficient traffic (= hydrogen consumption) may turn out as the largest hurdle as soon as it comes to a commercial operation. During the demonstration phase hydrogen will be sold at the price of petrol (related to energy content). The costs for the energy source will be taken by the refuelling station operator.

EU-wide approval routes for vehicles also applied in Norway would help to motivate car industry to participate in demo projects.

In order to save money the hydrogen refuelling stations will be built without redundancy options. As a 100% fail free operation of the refuelling stations cannot be guaranteed, a common understanding that an uninterrupted use of the hydrogen cars will potentially not be possible, has been established. What happens if a hydrogen refuelling station does not work has to be determined in the leasing contracts of the vehicles.
2.3 Which political / financial support was / is available for your project?

For the operation of each of the nodes an own financing scheme including local funding has been developed. The nodes directly apply for funding for their activities. For establishing the central budget the Steering Group applied for national funding at the Ministry of Transport. This authority will fund the central HyNor activities as well as the initial investment costs by a contribution of 50%.

In general the funding scheme is quite OK. In 2007 a number of funding requests will be handed in accompanied by a lobbying campaign. The funding requests for the first two nodes have already received green light.

Norway has financial support mechanisms in place for electric vehicles, which also apply for the hydrogen vehicles. The vehicles do not have to pay import tax, toll or parking fees. They may even use the public transport lanes. Currently Norway is looking into an exemption of VAT for electric and hydrogen vehicles.

2.4 Could the project meet the initial cost targets?

It is too early for a statement.

3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

A ‘lessons learned’ report will be available later in the project based on the results of workshops on this issue.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

Partners learn how to build a hydrogen refuelling station. They can position and prepare themselves for the future hydrogen fuel markets. They can develop business cases (e.g. the car leasing company, hydrogen infrastructure providers).

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

- driving range
  Two versions of the Toyota Prius converted by Quantum Technologies will be used:
  - with two hydrogen tanks ==> 120 km
  - with three hydrogen tanks ==> 200 km
- fuel consumption
- investment costs ==> 3 times as expensive as normal version of Prius
- maintenance costs
Past and Ongoing Demonstration Projects

FINAL REPORT

- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

You have to take what you can get!!!

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of
- fuel production
  Fuel quality (purity) will be specified according to FC vehicle requirements
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
  The Grenland refuelling station, one of the first to be opened, will be able to
  refuel 15 cars and 2 buses per day
- operating time per day
  All 6 refuelling stations will be in service 24h/day (unmanned operation).
- environmental aspects
- ease of use / operational restrictions
- image

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make
different? What are your recommendations for future projects?

It’s quite early to answer this question. From today’s point of view the project set
up seems to be OK.
It is recommended to work in all areas: technology (contact as many vehicle
suppliers as possible), public relations, policy (lobbying for door opening and
financial support), social aspects (may be helpful for public acceptance), etc.
The scale of a project is very important. Combining six hydrogen refuelling
stations in one project causes significant momentum and recognition.
If the end-users should be partners in the partnership or not depends on the
application and should be decided case by case.
A GPS system (integrated in the vehicles navigation system) may assist early
adopters in finding and approaching hydrogen refuelling stations.
4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

At the hydrogen refuelling station in Stavanger also Hythane and natural gas will be available. If it is a benefit for the hydrogen refuelling station or not is hardly to measure. It is more a philosophic question respectively a question of company politics. One possibility would be to distribute hydrogen alongside with biofuels and market the whole thing as 'green' refuelling station. There is no reason not to implement not transport related applications at the refuelling station, but the driving force should be the transport sector.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

In the long run not any kg of hydrogen supplied can be subsidised. For both sectors, for the vehicles but also for the hydrogen infrastructure, a commercial market has to be established. This has to be the main focus of the large-scale demonstration projects. It has to be clarified where the hydrogen will come from and that renewable resources have to be applied.

In future financial (fiscal) support should be more generous than today’s biofuels incentives, that is, hydrogen prices should be lower than prices of conventional fuels in order to attract people. Project size is very important for an economic or near-economic operation of the hydrogen infrastructure (including the hydrogen refuelling station). The only chance to improve economics of the infrastructure is the implementation of larger numbers of vehicles.

Proposed numbers of vehicles:
- 50 – 100 in case of passenger cars
- 20 – 30 in case of buses

There is also the need to work on public recognition. The way of thinking must change. “Environment should benefit, but not on my own costs”. The trick is to make them pay for it, but not recognizing it.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

Further incentives (beside those mentioned as examples in the question) may be decreased or no import taxes for hydrogen vehicles, free parking, free use of toll roads, allowance to use public transport lanes, no VAT, etc. Also obligations for government vehicle fleets or public transport operators may be useful e.g. x % of vehicles have to be zero emission vehicles.
Annex 9: Interview Protocol LHTP

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

The London Hydrogen Transport Programme

Telephone interview with Zoe Jennings (Greater London Authority) on 27 JUL 2006 and personal interview with Zoe Jennings and Ben Madden (element energy) on 23 OCT 2006.

Interview performed and document prepared by Hubert Landinger (LBST)

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

It is planned to have 70 hydrogen powered vehicles in operation by 2010. They will be operated by Transport for London, the Metropolitan Police Authority, the London Fire and Emergency Planning Authority and other public sector fleets in London.

The first tender has been opened for 9 – 11 buses. Responses have been accepted till end of September. The contract is intended to be signed at the beginning of 2007. The buses are expected to be put in operation by 2008 and will be in operation for 5 years with the option to proceed operation for 2 additional years. For the qualification of potential suppliers a qualification system is applied. The notice of the existence of a qualification system is posted at the working docs section of the HyLights website.

End of July a competitive dialog process has been opened for the remaining 60 vehicles (no buses). The notice on this has been placed in the EU Journal. It is planned to order the vehicles from more than one bidder. These 60 vehicles are planned to be operated for 3 years.

The competitive dialog document lists the following objects:
- Lifting trucks
- Generator units
- Fuel cells
- Motor vehicles, trailers and vehicle parts
- Motor vehicles
- Engines and engine parts
- Motorcycles, bicycles and sidecars
- Ships and boats
- Repair and maintenance services of motor vehicles and associated equipment

The competitive dialog documents are posted at the working docs section of the HyLights website. Responses have been accepted till 22 SEP 2006.
1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

Both the planning permission and the technical design of the hydrogen refuelling station in Hornchurch (erected within the CUTE project) foresee the refuelling of 3 buses only. Therefore further hydrogen refuelling infrastructure will be built, but there is not yet a decision on a location. Presumably, a larger hydrogen refuelling station will be built in Eastern London at a bus depot and further smaller ones for central London fleets.

1.3 Did / will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

If possible and deemed useful, the HyLights MAF will be applied. Currently, a procurement process is in use and will be publicly available in January 2007. It includes assessment criteria for the procurement process.

1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

No new special legal entity will be needed for the project, but a new structure will be set up within Transport for London for managing the programme. Also the London Hydrogen Partnership has no legal entity. Funding will come from the Mayor of London and Transport for London will do the project management. The London Hydrogen Partnership has developed the Hydrogen Transport Plan. This plan has been presented to the mayor and has been further developed to the London Hydrogen Transport Programme. Transport for London is now implementing the programme, which is based principally on public money.

1.5 How did / do you organize your project management?

The London Hydrogen Transport Programme is governed by the Hydrogen Project Board. The Project Board has prepared a project business plan dealing with all relevant project topics such as procurement procedures, risk handling, criteria for the project approach, board meetings, etc. The Project Board is led by Transport for London and includes representatives from the Greater London Authority, the London Hydrogen Partnership and from legal and financing departments of Transport for London. Furthermore, the Project Board is structured in various subgroups.
1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was/is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

Transport for London is the lead partner in the project and brings much of the balance through its various departments involved (legal, financing, health & safety, insurance, etc.). Other partners included are the Metropolitan Police Authority and the London Fire and Emergency Planning Authority. All other things will be contracted. Also technical consultants will be subcontracted.

1.7 Would you shift the focus of the individual tasks in the retrospective?

The public procurement rules are very strict. The procurement process should be as flexible as possible.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to/used by others?

First of all, the programme is much focused to receive and operate the 70 vehicles. The next stage will be to enlarge the programme in preparation of the Olympics in 2012 and is aiming towards the EC Lighthouse Project activities. London (GLA) is committed to work towards the Implementation Panel targets of 2015.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects
within your project?

Contacts are not yet available.
2. Experiences from setting up the project

2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

The driving force behind the programme is the Mayor of London. Worries about air quality, greenhouse gas emissions and security of energy supply as well as branding for the city and the region are providing the arguments.

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc.?

Initially one was worried about the availability of vehicles. But as now a more flexible approach with regard to the procurement process has been applied problems seem to be solved. It is a quite new process, also for the 60 further vehicles, which on one hand has to be competitive, and on the other hand must be based on the basis of available vehicles. It turns out, that initial discussions with potential vehicle suppliers may be the best approach for a successful procurement process. Therefore the competitive dialog process has been applied. Reliability is a very critical issue. The more reliability you want, the more you have to pay. This goes for the vehicles in the same way as for the hydrogen infrastructure.

As the hydrogen infrastructure will not be purchased by TfL but all infrastructure costs will be covered in the sales price of hydrogen (GBP/kgH2) this is a very critical value.

Also warranties because of durability problems are causing problems.

A further problem is capital costs.

2.3 Which political / financial support was / is available for your project?

The programme lives principally from financial support by the Mayor of London. Therefore also the political support is for sure.

2.4 Could the project meet the initial cost targets?

For the being the project is roughly within the budget.
3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

It is planned to write documents on lessons learned. Some parts of these reports will be publicly available. The procurement documentation can be shared with other interested cities in JAN 2007.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

In bringing hydrogen forward the city of London has the opportunity to upgrade its image (branding).

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of
- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

It is too early to answer this question.

Performance of refuelling infrastructure

3.4 How does your refuelling infrastructure perform in terms of
- fuel production
- investment costs
- maintenance costs
- refuelling time
- number of subsequent refuellings
- operating time per day
- environmental aspects
- ease of use / operational restrictions
- image

It is too early to answer this question.

4. Recommendations
4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

Planning security should be based on the evidence of future technology development.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

It is not the role of the project as it is focused on transport by 100%.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

No comments have been made hereto.

4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

E.g. exemptions of congestion charge, exemptions for low emission zones, etc. The London development plan should include clauses for the establishment of a hydrogen refuelling infrastructure.
Annex 10: Interview Protocol CaFCP

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

The California Fuel Cell Partnership

Interview with Catherine Dunwoody (Executive Director CaFCP) on 27 JUL 2006
Interview performed and document prepared by Dr. Ulrich Bünger (LBST)

1. General project infos

1.1 What kind of vehicles have been / will be demonstrated and in which numbers? Is there documentation available?

This question has not been answered during the interview session as there is sufficient information available in the Internet.

1.2 What kind of hydrogen infrastructure (hydrogen production pathway, dispensing pressures, etc.) has been / will be demonstrated? Is there documentation available?

This question has not been answered during the interview session as there is sufficient information available in the Internet.

1.3 Did /will you apply an assessment framework for this task and is it available for HyLights for evaluation in order to contribute to FP7 / JTI?

No MAF has been developed as the purpose of the CaFCP was not to push technology development in the vehicles or at the hydrogen refuelling stations (HRS), but to test hardware under every day conditions and showcase vehicles and infrastructure to the public, i.e. a networking and facilitation exercise, with a strong focus to create an interface between technology development and decision makers, stakeholders and the public.

1.4 Which legal framework has been / is used for the project? Which authorisation / certification / homologation bodies were / are involved?

CaFCP is no legal entity. Hence all HRS are self-insured by separate insurance companies. Concerning the vehicles, the OEMs bear all risks. In contrast to the “calculation” of the risks by analysing possible failure modes in the EU, the U.S. takes another approach. The expert on the issue is Steve Weiner at Pacific Northwest National Laboratory (PNNL). He should be approached for further information.
1.5 How did / do you organize your project management?

CaFCP is project based (CaFCP being the “project”) with special task forces for upcoming tasks.

1.6 Does the project have a balanced partnership? Do you feel that a relevant branch or expertise was / is not represented in the project? What should be considered to bring together the most adequate partnership (e.g. neutral body to control project progress, task responsibilities, RCS issues, etc)?

Through the task forces (see Q 1.5) CaFCP can react very flexibly on changes in the industrial and political environment. CaFCP is neither a lobby activity (industry representation) nor a research project (assessment of results and preparation / initialization of next development steps to improve H2&FC), instead its purpose is testing under real life conditions, facilitation of stakeholder coherence and public appearance.

1.7 Would you shift the focus of the individual tasks in the retrospective?

As CaFCP is a flexible project it never had a fixed task structure. The focus has been adapted to upcoming necessities constantly.

1.8 What is the follow up of the project? Will the demonstration activities stop? Will the hardware sold to /used by others?

For the time being there are no plans to cease the activities or sell hardware. On the contrary, CaFCP is going ahead with considerations concerning infrastructure build-up and a growing refuelling network as in the wake of the ZEV more hydrogen cars will come to California.

1.9 HyLights is doing detail analyses on specific topics. Can you provide us with the names (and contact details) of the relevant contact persons for

- end-use applications / vehicles (data acquisition)
- infrastructure (data acquisition)
- financing
- legal issues
- regulations, codes and standards (RCS)
- public relations (PR)
- community aspects
within your project?

Jaquelyn Birdsall (safety), Nico Bouwkamp (senior technology expert, 4 years with CaFCP), Catherine Dunwoody (management), Bill Elrick (junior technology expert, recently joined CaFCP), Jennifer Hamilton (hydrogen purity)

2. Experiences from setting up the project
2.1 Which were / are the decisive motivations / drivers for the realisation of the project?

Motivation was to develop a showcase for hydrogen fuel cell vehicles as a follow-up to the preceding and scrapped battery electric vehicle strategy.

2.2 Which were / are the largest hurdles / showstoppers for the project with regard to technology, financing (economy, etc.), safety, society (public acceptance, image), legal issues, etc. ?

None so far (again, as no fixed goals were set)

2.3 Which political / financial support was / is available for your project?

CaFCP is financed by its partners from the private and public sector. The financing scheme, i.e. the shares of the individual partners, is not open to the public.

2.4 Could the project meet the initial cost targets?

N.A.

3. Results / lessons learned

3.1 Do reports documenting the status, results and ‘lessons learned’ of the project exist?

Ample documentation exists on the work carried out by CaFCP such as reports and presentations as well as regular events with own PR material. Yet, the documentation is not project but case specific or in other words, CaFCP acts “in the background”.

3.2 How could / can the single partners profit from the project (technological, economical, safety related, public acceptance, etc.)?

Individual project partners learn (a) technically through participation in meetings, work of CaFCP on specific technical issues (e.g. hydrogen purity) and (b) in relation to public relation through various CaFCP PR events.

Performance of vehicles

3.3 How do your vehicles (buses, cars, etc.) perform in terms of

- driving range
- fuel consumption
- investment costs
- maintenance costs
- number of passengers / payload per vehicle
- operating time per day
• environmental aspects
• ease of use / operational restrictions
• image

N.A.

Performance of refuelling infrastructure

3.4 How do your refuelling infrastructure perform in terms of
• fuel production
• investment costs
• maintenance costs
• refuelling time
• number of subsequent refuellings
• operating time per day
• environmental aspects
• ease of use / operational restrictions
• image

N.A.

4. Recommendations

4.1 If you had the chance to start from scratch once again, what would you make different? What are your recommendations for future projects?

Practically speaking, if starting from scratch was an opportunity, CaFCP would consider more ride&drive space as driving the vehicles in the backyard, i.e. in front of the maintenance bays, poses safety problems to the personnel or guests (Yet, no accident has occurred). If CaFCP could be re-established the status of a legal entity would be preferred.

4.2 Does your experience support the approach to utilise synergies with other fields of technology (e.g. stationary applications, other fuels, etc.)

N.A.

4.3 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure (policy goal) and a widespread use of hydrogen powered vehicles?

See therefore CaFCP vision document available at http://www.cafcp.org/
4.4 Which incentives are necessary to support hydrogen in the future (tax exemptions on fuel and/or vehicles, hydrogen production support from renewables, environmental standards for vehicle emissions, etc.) based on today’s situation / point of view?

See therefore CaFCP vision document available at http://www.cafcp.org/
Annex 11: Interview Protocol CUTE - Stockholm

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

CUTE Partner City Stockholm

Input received from Eva Sunnerstedt (Environment and Health Administration Stockholm – responsible for clean vehicles in Stockholm) on 11 APR 2008
Document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

Environment. Stockholm transport are to use 25 % renewable fuels by 2006 (achieved), 50 % by 2012 and 100 % by 2020.

1.2 Which political and financial support was available for the project?

Political support by City of Stockholm and Count Council of Stockholm and the Board of Stockholm Transport. Financial support from the above but also from the National Energy Agency and Vinnova (another national authority). Also support from the EC of course. And from Fortum, a energy utility company that participated in the project locally in Stockholm.

1.3 Do you have joint activities with other (partner) regions?

Fortum (see above), Royal Institute of Technology (KTH) helped with evaluation. Also we had a cooperation with a fuel cell bus project on Gotland, Sweden’s largest island – however that project never started due to lack of finance. CUTE, STEP and ECTOS partners of course.

1.4 Will there be any follow up of the project and if so what are the next steps?

Nothing planned at the moment. Next step is electric hybrid ethanol diesel buses.

1.5 Do you have a roadmap / strategy plan for implementing hydrogen and fuel cell technologies?

No
1.6 How could your region / municipality profit from the project?

Good experiences, good cooperation within Stockholm but also with partners in CUTE, etc. Better fit for future trials, etc.

1.7 Which were the largest hurdles / showstoppers for the project?

Money (it got more expensive than planned). Information / dissemination / media – everyone wanted to get attention all the time - all local partners!!

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

Cars, buses, trucks, light duty vehicles, airport ground vehicles.

2. Recommendations

2.1 What are your recommendations for future projects?

Technology needs to be less expensive. Possible to get more vehicles (a whole bus fleet, a whole waste truck fleet) not only a few demo vehicles. Up-scaling of refuelling station possible without being too expensive. Safety issues need to be developed. Lower energy consumption in vehicles – electric hybrid hydrogen fuel cells for instance. Needs to be a battery onboard to store braking energy for instance, etc.

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

Safety regulations and standards.

2.3 Which incentives would you propose to support hydrogen in the future based on today's situation?

N.A.
Annex 12: Interview Protocol CUTE - Amsterdam

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

CUTE Partner City Amsterdam

Input received from Harry van Bergen on 08 APR 2008
Document prepared by Hubert Landinger (LBST)

1. **Experiences and Lessons Learned**

1.1 Which were the decisive motivations / drivers for the realisation of the project?

- Contributing to development of cleaner vehicles / buses.
- Cleaner air, less noise.

1.2 Which political and financial support was available for the project?

- political support of the municipality (economic department, environmental department, public transport).
- financial support: EU, national government, local government, local public transport enterprise.

1.3 Do you have joint activities with other (partner) regions?

- the CUTE-project was held in circa 10 European cities.

1.4 Will there be any follow up of the project and if so what are the next steps?

- we are working on a follow up project, again with hydrogen busses.

1.5 Do you have a roadmap /strategy plan for implementing hydrogen and fuel cell technologies?

- we have a “Hydrogen Vision” and we are working on a roadmap / strategy plan.

1.6 How could your region / municipality profit from the project?

- practical technical and logistical experience
- the local / regional hydrogen network profits a lot from a project like CUTE.
1.7 Which were the largest hurdles / showstoppers for the project?

- Money
- A few minor technical problems when the project started.

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

- Buses, vans, cars, scooters, vehicles that collect waste.

2. Recommendations Amsterdam

2.1 What are your recommendations for future projects?

- apply a long term focus / support
- implement less complex structures with respect to accountability.

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

- large scale production (in industrial areas) and large scale distribution of hydrogen.
- hydrogen tanks with more capacity.
- long term support for certain regions, so developments can spread out geographically.

2.3 Which incentives would you propose to support hydrogen in the future based on today’s situation?

Money?
Annex 13: Interview Protocol CUTE - Hamburg

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

CUTE Partner City Hamburg

Input received from Carola Thimm (hySOLUTIONS GmbH, Hamburgs Antrieb Wasserstoff) on 07 APR 2008
Document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

To gain experience with hydrogen and fuel cell technology and evaluate the hydrogen buses as a solution for clean transport for future use

1.2 Which political and financial support was available for the project?

Additional support to EU by German Federal Ministry of Economy (15%)

1.3 Do you have joint activities with other (partner) regions?

Yes. As a result of the CUTE project the Hydrogen Bus Alliance was funded. The aim of the Alliance is to bundle the demand for hydrogen buses and thus reduce the costs of the buses.

1.4 Will there be any follow up of the project and if so what are the next steps?

HOCHBAHN plans to buy additional 20 fuel cell hybrid buses from EvoBus between 2010 and 2013. Negotiations are already in preparation. Also a new refuelling infrastructure for up to 40 buses will be installed in 2010.

1.5 Do you have a roadmap /strategy plan for implementing hydrogen and fuel cell technologies?

Yes. The City government of Hamburg has set up a new climate program. Hydrogen and fuel cells are a core technology in it.
1.6 How could your region / municipality profit from the project?

The hydrogen buses have become a very lively example for the environmental friendly use of public transport. Therefore there has been a very relevant success in the marketing for public transport. Also the buses have shown that the support of the city of Hamburg for hydrogen and fuel cell technology is adequate and can help bring environmentally friendly technology in day-to-day-operation.

1.7 Which were the largest hurdles / showstoppers for the project?

There have only been minor hurdles e.g. capacity of infrastructure. For the future the main focus should be to realise sufficient supply of hydrogen for the applications to support larger demonstration activities which are necessary to initiate the optimisations that are still necessary in the technology.

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

Buses, cars and fork lifters. New projects to install more buses and cars (CEPII) as well as fork lifters are under way. Additional projects are for APUs in ships and aircrafts.

2. Recommendations

2.1 What are your recommendations for future projects?

Better exchange of information between the partners and a standard reporting with exchange procedure.

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

European regulatory framework for the use of hydrogen in transport (rules, codes, standards)

2.3 Which incentives would you propose to support hydrogen in the future based on today’s situation?

Network for the joint procurement of hydrogen and vehicles such as the Hydrogen Bus Alliance.
Political initiatives (from high ranking EU level towards regional political level)
Annex 14: Interview Protocol HyFLEET:CUTE - Berlin

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

HyFLEET:CUTE Partner City Berlin

Telephone interview with Burkhard Eberwein (Public Transport Berlin BVG) on 18 APR 2008.
Interview performed and document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

- BVG is Germany’s largest public transport organisation
- the Berlin government (Senat) puts permanent political pressure onto BVG in order to apply as much sustainable fuels as possible
- BVG already made positive experiences in EC co-funded projects
- BVG has decided not to apply CNG technology
- In BVG’s opinion hydrogen is the most seminal fuel
- BVG’s approach is to switch from clean Diesel buses to hydrogen buses
- BVG initially submitted a separate project proposal which was then merged with the extension of the CUTE project to the common HyFLEET:CUTE project
- BVG has its own technology development where hydrogen internal combustion engines (ICE) perfectly fit
- In BVG’s opinion market introduction of fuel cells is still far away; hydrogen internal combustion engines can be realised earlier

1.2 Which political and financial support was available for the project?

Financial support was provided by the European Commission (EC co-funded project).
As already mentioned above the Berlin government (Senat) puts political pressure onto BVG to apply cleaner fuels. Nevertheless, various technologies are promoted by the government. While some groups are in favour of natural gas technology, the senator for economy is in favour of hydrogen technology and provides verbal support.
Being a public body (the senator is supervisory board chairman) BVG is forced to implement tight cost saving programs.
In total it can be said that the political influence is neutral.
1.3 Do you have joint activities with other (partner) regions?

Cooperation with other regions interested in hydrogen technology is automatically given by the participation in the project HyFLEET:CUTE. Furthermore, BVG is formal partner of the Hydrogen Bus Alliance (HBA). Contacts are established with the cities of Bolzano, Cologne and Hürth, as these cities are also envisaging hydrogen ICE buses.

1.4 Will there be any follow up of the project and if so what are the next steps?

HyFLEET:CUTE will be terminated in autumn 2009. A participation in CEP II is under negotiation. The cooperation contract is currently under juridical verification. In the time frame 2010 – 2012 up to 50 buses may be applied. This would be economically feasible if 50% funding is available. Suppliers of hydrogen ICE buses may be MAN (management reluctant) as well as Solaris.

1.5 Do you have a roadmap /strategy plan for implementing hydrogen and fuel cell technologies?

see 1.4

1.6 How could your region / municipality profit from the project?

- utilisation of clean buses
- operation in restricted area possible (“Umweltzone”)
- outperforming EURO 6 standards
- hydrogen buses may contribute to fulfil the European NO\textsubscript{x} directive for fleet operators to be implemented as from 2009
- as soon as fleet emission will be taken into account, hydrogen would be the optimal fuel

1.7 Which were the largest hurdles / showstoppers for the project?

Because of the limited driving range, the hydrogen buses can only be used for shorter routes. This would be a problem, if larger number of hydrogen buses should be integrated in the fleet. Currently 14 hydrogen buses are in operation at a depot together with 220 Diesel buses – that is not significant. The Diesel buses allow a driving range of 350 km, whereas hydrogen buses are limited to a driving range of 200 km. Therefore the longer routes cannot be serviced by the hydrogen buses.

It has already been decided, that the buses for the CEP II project will be equipped with liquid hydrogen storage systems. BVG do not believe in 70 MPa technology to be applied in buses. Currently the refuelling process lasts 12 minutes which in fact is to long. The targets for the CEP II buses is to decrease
the time required for the refuelling process to 5 minutes and to enlarge the driving range to 400 km. A first prototype with a hydrogen storage capacity of 80 kg is already under development. One option also comprises the integration of a fuel cell (0.5 kW) to use the boil-off gas which will serve the internal power supply. An air exchange rate of 3/h is standard for all garages. This is sufficient for general maintenance and repair works of the hydrogen buses. For special tasks regarding the hydrogen system a smaller garage equipped with the required safety equipment will be available.

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

buses only

2. Recommendations

2.1 What are your recommendations for future projects?

- discuss the driving range issue open and transparent
- the bottle neck is the hydrogen refuelling station and here is especially the hydrogen compression technology (current experience: in average compressor is down for one week every two months). If buses are fully integrated into the fleet, a redundant system would be required
- no significant issues with the hydrogen buses
- the size of the refuelling system is significant and may cause an integration problem for some bus depots
- LH₂ systems are smaller and more reliable

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

BVG sees no problems for fleet operators

2.3 Which incentives would you propose to support hydrogen in the future based on today’s situation?

The hydrogen should be available at comparable costs of the Diesel fuel. Therefore subsidizing is required for hydrogen production, liquefaction, etc.
Annex 15: Interview Protocol argemuc - Bavaria

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

argemuc Partner Region Bavaria

Input received from Josef Schadl (Bavarian Ministry for economy, infrastructure, transport and technology) on 16 APR 2008
Document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

Motivation for the argemuc project was the Hydrogen Initiative Bavaria (WIBA)

1.2 Which political and financial support was available for the project?

The project receives co-funding from the Bavarian government amounting to € 18 million (50% of total project budget). Furthermore, the project receives massive political backing.

1.3 Do you have joint activities with other (partner) regions?

N.A.

1.4 Will there be any follow up of the project and if so what are the next steps?

N.A.

1.5 Do you have a roadmap /strategy plan for implementing hydrogen and fuel cell technologies?

N.A.

1.6 How could your region / municipality profit from the project?

N.A.
1.7 Which were the largest hurdles / showstoppers for the project?

N.A.

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

Passenger cars, buses and forklifts were tested within the project.

2. Recommendations

2.1 What are your recommendations for future projects?

Before hydrogen can be introduced as a transportation fuel, it seems that substantial R&D efforts, especially in fuel cell technology and hydrogen production, is required (basic research via JTI and the German National Innovation Programme for Hydrogen and Fuel Cells (NIP)).

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

N.A.

2.3 Which incentives would you propose to support hydrogen in the future based on today’s situation?

See 2.1
Annex 16: Interview Protocol ZERO REGIO – Frankfurt Hoechst

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

ZERO REGIO Partner Industry Area Frankfurt Hoechst

Input received from Achim Boening (InfraServ) on 25 APR 2008
Document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

The motivation was based on our existing hydrogen sources. We want to create new markets for hydrogen as a fuel and we want to establish hydrogen technology in the Rhine-Main area.

1.2 Which political and financial support was available for the project?

The project is supported by the EU within FP6.

1.3 Do you have joint activities with other (partner) regions?

The project ZERO REGIO has joint activities with Regione Lombardia, Italy

1.4 Will there be any follow up of the project and if so what are the next steps?

Different large scale concepts in the area of public transportation were checked. Realisation would be possible except of the availability of vehicles.

1.5 Do you have a roadmap / strategy plan for implementing hydrogen and fuel cell technologies?

Yes, we were partner of the project HyWays and the strategies of HyWays are also the strategies that we follow.
1.6 How could your region / municipality profit from the project?

With ZERO REGIO we provided the infrastructural basis for much larger projects in the field of public transportation in the Rhine-Main area.

1.7 Which were the largest hurdles / showstoppers for the project?

The largest hurdles in ZERO REGIO were the missing regulations for hydrogen vehicles and infrastructure. Especially in Italy that caused delays. Consistent European regulations are needed.

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheelchairs, airport ground support equipment (GSE), small delivery vehicles, etc.

For further projects large numbers auf buses and GSE are needed.

2. Recommendations

2.1 What are your recommendations for future projects?

Less bureaucracy and clear responsibilities in Brussels that are not changing during the project.

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

Consistent EU-wide regulations and political support for hydrogen like for photovoltaic.
Political requirements for vehicles that support low emission vehicles.

2.3 Which incentives would you propose to support hydrogen in the future based on today’s situation?

see 2.1 and higher support quota (35% for demonstration activities is too low)
Annex 17: Interview Protocol Hydrogen Link Denmark

Evaluation of past / ongoing hydrogen demo projects for transport to prepare the coming large-scale demo projects

Questions towards Regions / Municipalities Representatives

Hydrogen Link Denmark

Input received from Mikael Sloth (H2Logic) on 28 APR 2008
Document prepared by Hubert Landinger (LBST)

1. Experiences and Lessons Learned

1.1 Which were the decisive motivations / drivers for the realisation of the project?

1) Energy security and independence of fossil fuels
2) Environment & Climate
3) Business development and innovation

1.2 Which political and financial support was available for the project?

Local (municipality)
Regional
National
Private/companies

1.3 Do you have joint activities with other (partner) regions?

All 5 regions in Denmark are part of Hydrogen Link and through Scandinavian Hydrogen Highway Partnership collaboration is secured with regions in Norway and Sweden.

1.4 Will there be any follow up of the project and if so what are the next steps?

Yes. Hydrogen Link is now organised as an association (legal entity) and several more activities both in terms of R/D/D and network projects are already ongoing and under planning.

1.5 Do you have a roadmap /strategy plan for implementing hydrogen and fuel cell technologies?
Yes. Hydrogen Link follows a national roadmap for “Hydrogen transport onwards 2025” developed by a working group beneath the “Danish Hydrogen and Fuel Cell Partnership” www.hydrogennet.dk

1.6 How could your region / municipality profit from the project?

Economical independence of import of fossil fuels for transport in long term
Economical savings from climate change effects
Economical profit from business growth, innovation and export of hydrogen fuel cell technologies

1.7 Which were the largest hurdles / showstoppers for the project?

Securing the various public funding (local, regional and national)

1.8 Which type of vehicles are you interested in / are relevant for your region / municipality? (buses, vans, cars, scooters, forklifts, specialty vehicles such as wheel chairs, airport ground support equipment (GSE), small delivery vehicles, etc.)

In prioritised order:
Forklifts
Cars
Buses
Speciality vehicles

2. Recommendations

2.1 What are your recommendations for future projects?

Large-scale demonstration projects and later deployment projects based on established market frame conditions

2.2 Which framework conditions need to be in place in order to develop a sustainable hydrogen refuelling infrastructure and a widespread use of hydrogen powered vehicles?

- Tax exemption on hydrogen powered vehicles & production of hydrogen fuel onwards 2020
- Subsidy amount (e.g. € 2.500 – 4.000) to end-users buying the first 10.000 hydrogen vehicles
- Banning or heavy tax on all sale of new fossil powered combustion engine person vehicles from 2030 and onwards
2.3 Which incentives would you propose to support hydrogen in the future based on today's situation?

See part 2.2.