Clean Hydrogen In European Cities

Grant agreement No: 256848

Deliverable No. 3.8
Phase 2

# Issues of concern to external stakeholders and critics and pathways to their resolution

## *Reflections on change after 2 years*

**Status: F**

**Dissemination level: PU**

# Authors:

**Simon Whitehouse**; thinkstep AG, Hauptstrasse 115, 70711 Leinfelden-Echterdingen, Germany

Nicole Whitehouse; thinkstep AG, Hauptstrasse 115, 70711 Leinfelden-Echterdingen, Germany

Author printed in bold is the contact person for this document.

# Approvals:

| | |
|---|---|
| WPL | YES |
| Coordinator | YES |
| FCH-JU | YES |

**Acknowledgements:**

The research leading to these results has received funding from the European Union's Seventh Framework Program (FP7/2007–2013) for the Fuel Cells and Hydrogen Joint Technology Initiative, under grant agreement number 256848.



**Date of this document:** 24.09.2015

# 0. Executive Summary

This document reports the findings of a second round of interviews with individuals and organisations who had previously been identified as possible critics and sceptics of a hydrogen powered transport system.

In 2013, a careful and extended engagement with a selection of individuals identified as critics or sceptics of hydrogen in transport was conducted. Subsequently, a Round Table was conducted in Berlin at which a sub group of the interviewees discussed key issues and concerns with selected members of the CHIC consortium along with some influential hydrogen experts. The outcomes were reported in CHIC Deliverable D 3.8. A summary of the clear messages that were distilled from that work can also be found in Appendix D of this document.

Two years on, an opportunity arose to revisit a limited number of the interviewees from the previous round of engagement to once again hear their views, particularly on key issues that they had raised previously. The question of interest was "*has there been discernible change, particularly on addressing perceived negative aspects of hydrogen fuel cell powered transport?*"

In March 2015, thirteen individuals were (re)interviewed, the majority face to face[1] .

The general tenor of these discussions was more positive in the second round than in the first. Some interviewees stated that their attitudes had changed to a more positive one since we last spoke. In another case there had been a significant positive change in the policy of a national Government in relation to the use of hydrogen in transport.

In general, interviewees also appeared better informed about fuel cell technology,

[1] See Appendix C for organisational affiliations of the interviewees

the possible role of hydrogen in transport, and the positive and negative issues. They were aware of more factual information than previously and the views they expressed were more likely to be based on fact than rumour or false or out of date results.

Based on this round of discussions, the researchers felt that the former 'critics and sceptics' might now be more appropriately characterised as 'transport decision makers and influencers outside the hydrogen promoter group'.

The interviewees articulated some additional and very important views on the drivers and issues for Hydrogen use in transport. The most frequently mentioned views were:

- The major driver for hydrogen use in the transport system is de-carbonisation. If hydrogen powered transport cannot completely or very signficantly achieve this then the case for pursuing this technology is not at all strong.
- Government policy has been and will continue to be the most significant influence in future success or otherwise of hydrogen fuel cell vehicles
- The costs of hydrogen production and acquiring the vehicles must be significantly reduced. This will be particularly important if hydrogen fuel cell vehicles are to be competitive with other non-fossil fuel powered vehicles.

Based on these discussions, the following recommendations have been developed:

- Focus funding on decarbonisation – make it real and promote the fact that the chain is 'clean' to all stakeholders, especially the influential Environmental NGOs.
- Focus on different cost models for hydrogen. Include the available data on the considerable external costs to the broader community of continued use of fossil fuels in cost assessments of the various fuel options. Initially this could be by using these costs as a discount factor when calculating the true costs of hydrogen fuel.
- Develop long term relationships with a group of influential Infrastructure

Partners: Consolidating a group of infrastructure partners who have both resources and influence and will act together will no doubt hasten the advent of Hydrogen technology. Putting time into developing these partnerships might be the most important target of “promotion” in the immediate future. Certainly, it could be seen as being on a par with Government policy makers and influential environmental lobby groups.

# Table of Contents

## List of abbreviations

| | |
|---|---|
| CNG | Compressed Natural Gas |
| FCH-JU | Fuel Cells and Hydrogen Joint Undertaking |
| ICCT | International Council for Clean Transportation |
| ICE and ICEs | Internal Combustion Engine (s) |
| $H_2$ | Hydrogen Gas |
| $H_2$FC | Hydrogen Fuel Cell |
| LPG | Liquefied Petroleum Gas |
| NGO(s) | Non Government Organisation(s) |
| US | United States (of America) |
| ZEV | (local) Zero Emission Vehicles |

# 1 Objectives of the report

The objective of this report is to identify any changes in the views of a sample of decision maker and influencers about the future of hydrogen in transport.

The report is based on the information gained from 13 interviews undertaken with influential individuals/organisations external to the Hydrogen world. The majority of the interviewees had previously been personally interviewed or participated in the Round Table discussions which were reported in *D 3.8: Issues of concern to external stakeholders and critics and pathways to their resolution*. The interviewees were characterised as being in positions of influence over Government or industry decision makers. In many instances they were also in organisations which had expressed views which were not supportive of hydrogen fuel cell powered transport. The detailed rationale for the original approach and stakeholder selection can be found in the report of D 3.8, page 8.

The intention of this follow-up work is to see if the views of these influential opinion formers had changed.

# 2 Who were interviewed and what were they asked?

The researchers' intention was to re-engage with a sub-set of those people who had been interviewed in the first round of interviews reported in D 3.8. The major aim in selecting the original cohort was to talk to people who were outside the hydrogen world and were in positions of influence in relation to transport policy. In addition the focus was on speaking to individuals and organisations who had expressed views that were critical or sceptical about the future potential of hydrogen in transport. The cohort were loosely characterised as 'critics and sceptics'.

While most of the second round of interviews were with people who had previously participated, in some instances, for a variety of reasons, individuals were no longer available. In these instances an alternative person from the same organisation was interviewed. On one occasion, an opportunity was taken to engage with a new organisation of some influence in the alternative energy sphere.

The number of interviewees in the sub group represented just over one quarter (26%) of the number of interviewees in the first round of interviewees. In choosing the individuals to be re-interviewed, the researchers looked to ensure representation from Environmental Groups; influential Policy Makers and Technical Experts. Several people approached were unavailable due to having moved from their previous role (in two cases a substitute was interviewed) and one person refused a request for re-interview.

| Category | No of Interviewees |
|---|---|
| Government Policy Groups (International, Pan-European, National, Elected Representative) | 6 |
| Lobby Groups: Environment; (Clean) Transport | 4 |
| Research Groups (Private & Public) | 3 |

The affiliations of the interviewees are shown in Appendix C.

The interview schedule was framed around a reduced version of the Round 1 interview

schedule. Some additional questions were developed for each person based on any singular sceptical view they had expressed in their first interview. The questionnaires developed are provided in Appendix A. The discussions were open ended with each question acting as the starting focus for discussion around the issue.

# 3. The key question - Is there a role for hydrogen in transport?

The overwhelming view of the interviewees to this question was positive.

The supportive responses were spread across Government, National and Pan-National policy groups, environmental NGOs, a transport lobby group and a research organisation. This is entirely consistent with the outcomes from the first round of interviews.

One transport lobby group was hesitant about the future they saw, suggesting that the role for Hydrogen would be very limited.

The reasons for the positive views resulted from the wide range of capabilities generally attributed to hydrogen fuel cell powered transport. The summary list of these reasons as well as the negative views are summarised in Appendix B.

These views are broadly similar to those expressed in the first round of interviews. However there are some very significant differences.

The general tenor of the discussions was more positive in the second round than in the first. Some clearly stated that their attitudes had changed to a more positive one since the first round of interviews. In one case there had been a significant positive change in the policy of a national Government in relation to the use of hydrogen in transport.

In general, interviewees also appeared better informed about fuel cell technology, the possible role of hydrogen in transport, and the positive and negative issues. They were aware of more factual information than previously and the views they expressed were more likely to be based on fact than rumour or false or out of date results.

It was not possible to conclude whether this was due to the information they had

gained in the previous round of interactions, or whether the interactions themselves had prompted them to take a closer interest. However it is clear that the previous interactions had resulted in a positive effect on their knowledge and understanding.

Based on this round of discussions, the researchers felt that the former 'critics and sceptics' might now be more appropriately characterised as 'transport decision makers and influencers outside the hydrogen promoter group'.

## 3.1 The major issues arising from the interviews: A Discussion

The three major issues reported below were commonly raised by the interviewees and are viewed to have the most significance for the future of hydrogen fuel cell vehicles. It should be noted that the issues were also prominent in the first round of interviews. However in this round they were raised more prominently and clearly, and flagged by the interviewees as being very important. The discussion around them also showed that the interviewees were generally better informed about the issues than was evident in the first round.

### *3.1.1 The major driver for hydrogen in the transport system is de-carbonisation.*

The interviewees were very clear that they saw de-carbonisation of the transport system as the major, and perhaps only significant, driver for the potential future role of hydrogen in the transport system. No de-carbonisation → no use in pursuing hydrogen. The issue of local air quality was raised by some, but battery electric vehicles were commonly seen as a more imminent technology to address this.

This message was very strong and clear across all interest groups from government officials, research organisations, environmental groups and transport lobby groups.

This is a very important message, particularly in the light of the range of hydrogen production methods currently in use in the various hydrogen fuel cell vehicle trials, and their relative efficiency. Experiences to date would suggest that steam reformation of natural gas is still the cheapest and most reliable production path, but with the highest carbon outputs. Electrolysis using renewable energy is the lowest carbon output but the least efficient, most costly and can be unreliable.

This issue is closely linked to the broader issues surrounding efficient and effective hydrogen production and refuelling infrastructure. While the sceptical views held by those outside the hydrogen promoter group of this aspect of a hydrogen transport system appear to have lessened, it is clear that changing this to garnering support and allies will rely to a large extent on the progress made in the infrastructure elements of the system i.e. progress in producing clean, low to zero carbon hydrogen efficiently and reliably.

It is unclear how long the tolerance expressed in the first round of interviews for the production of 'grey' hydrogen as long as it was on a clear path to 'clean' hydrogen will persist.

### *3.1.2. Government policy has been and will continue to be a major driver of future success or otherwise of hydrogen fuel cell vehicles.*

While Governments and their officials frequently talk of their policies being 'technologically neutral', the outcomes that they are seeking are commonly anything but. For example, many policies, while not requiring or overtly supporting specific solutions or technologies, can only be successfully implemented if a particular, or at the very least one of a limited number of solutions, are utilised. The Californian Government's Clean Air and Pollution Control laws supported by the Zero Emission Vehicle Programme provide one such example.

As has been outlined above, the de-carbonisation policies of Governments, the detailed objectives and the timelines for achievement will be crucial to any future uptake of hydrogen fuel cell vehicles. Equally, the longevity and stability of these policies will be important in providing industry with certainty for their investment decisions and future planning. Developing and implementing a different form of the transport system requires time, money, a long term horizon and certainty. Only Governments can provide the pre-conditions for this.

### *3.1.3. The costs of hydrogen production and acquiring the vehicles must be significantly reduced. This will be particularly important if hydrogen fuel cell vehicles are to be competitive with other non-fossil fuel powered vehicles.*

Along with producing the hydrogen cleanly, the cost of production and dispensing needs to be at least comparable with alternatives. Because the current infrastructure is generally designed, built and operated for relatively small numbers of vehicles, it is unsurprising that the costs are high. However modelling done within CHIC shows that, at least for electrolytic production, the cost is unlikely to be reduced significantly while energy costs remain at their current level. Reducing the costs of hydrogen production will require changing some of the input costs and perhaps the basic charging paradigm.

One interviewee highlighted the relative lack of industry energy partners as a major impediment to tackling this issue. In general terms, ICEs have fossil fuel suppliers as major partners, supporters and lobbyists – LPG, CNG and oil suppliers. They are large companies with major vested interests and links into decision makers.

Similarly battery electric and the various forms of hybrid electric vehicles have electricity supply companies as their ‘natural’ allies. Recent studies by the ICCT in a number of US cities have shown how uptake of these vehicles has been strongly supported and facilitated by a range of financial and non-financial incentives, including the installation of refuelling infrastructure, from the energy companies and Governments. And in those jurisdictions where an element of Government funding comes from either the ownership of or royalties from energy production and distribution facilities, it is not unexpected that there is a limited appetite in these Governments for framing policies to support alternatives.

Currently the cost of acquiring a hydrogen fuel cell vehicle is still much higher than for other alternative energy vehicles. Moreover, other forms of vehicles are much more readily available and in greater numbers than hydrogen fuel cell vehicles. This presents a significant current barrier to hydrogen fuel cell vehicles.

As with the infrastructure, to a large extent this cost and availability difference can be explained given the still developmental nature of the fuel cell technology and

infrastructure. The fuel cell technology also has higher complexity and therefore higher costs than alternatives that rely on the ICE, or fully battery electric vehicles. However, while conversely the fuel cell vehicle potentially offers greater range and perhaps flexibility than other alternatives, these 'fine distinctions' do not differentiate them at present to the potential purchaser.

Nevertheless these costs are private costs i.e. the cost as seen immediately by the individual vehicle owner. Some interviewees pointed to the large global costs to the community of not de-carbonising the transport system. This differential between private and community costs was seen as the responsibility of Governments to address. Policy initiatives aimed at reducing the community costs for now and the long term clearly have the capacity to significantly change the relative private costs.

In summary the interviewees see the cost competitiveness of hydrogen fuel cell vehicles as a major current barrier to their greater penetration into the market.

## 3.2 Other issues arising from the interviews

### *3.2.1 Hydrogen production*

Apart from the importance of 'clean' hydrogen and the reduction of costs discussed above, the interviewees raised a number of other issues related to the production of hydrogen. Once again the discussions generally reflected sound knowledge of the interviewees.

Second order concerns about hydrogen production and utilisation included

- Hydrogen had to be considered as part of the broader energy system and not in isolation in the transport system. Indeed, some saw the best (and most likely) mode of producing Hydrogen for use in transport as a by-product of excess stationary renewable energy management.
- Being able to extract revenue from the production and sale of hydrogen would be important for Governments as well as industry and there were a number of critical issues that were yet to be addressed.

- A number of technological issues such as metering, compression and other engineering problems still needed to be resolved
- Hydrogen production in Europe was already at capacity and so using it in transport would create additional demand and competition resulting in price increases. There were other uses such as heating and buffering in the energy system that were more rational uses for hydrogen.

.

### *3.2.2 Lack of Availability/Visibility of Hydrogen Fuel Cell Cars*

A number of interviewees pointed to the availability and visibility of BEVs and Plug-in hybrids which led them to ask where are the $H_2$FC cars? As one interviewee put it "If I wanted to go out and buy a fuel cell car, even if I had the money, I couldn't". Of course cost is a factor in this as indicated above. However, this lack of 'visibility' is an issue for people considering hydrogen as a serious contender in the personal transport energy area. Most interviewees were aware of the Toyota Mirai[2] announcements and were interested to see where this led.

### *3.2.3 Sources of information about hydrogen*

Hydrogen specific extension and information sources were not a major source of information to the interviewees. While nearly half of the interviewees said that they were on mailing lists for alternative energy newsletters, very few mentioned hydrogen specific information sources.

The table below shows the various information sources that were mentioned.

| Medium | No of times mentioned |
|---|---|
| Personal professional communication | 5 |
| On mailing list for alternative energy (some hydrogen specific) newsletters | 5 |
| Involved in committees to do with alternative energies | 4 |
| Generalist magazines (including Auto advertising/bulletins) | 4 |
| Other: National Hydrogen Assoc; internet searches; specialised events (conferences etc) | 3 |

[2] The Toyota Mirai is a H2FC vehicle which Toyota has announced will be sold commercially http://www.toyota.com/mirai/fcv.html

One important issue raised by an environmental group was the huge quantity of information they were receiving and their preferred way of receiving information on hydrogen based transport would be a succinct (1-2 pages) update on:

- Status technically
- Status politically
- Status of Research & Development
- Status of implementation

This information has already been relayed to and implemented by the CHIC dissemination partner.

### *3.2.4 The drive train and energy arrangements envisioned by 2025*

The responses from the interviewees when asked to envision what they saw as the likely drive train and energy arrangements for different modes of transport by 2025 are shown below. The interviewers deliberately kept the time frame short in order to base the responses on something a little more "real" than crystal ball gazing.

All foresaw more and more efficient ICEs as the likely most dominant drive train for all forms of transport in the next ten years. They saw this being commonly achieved through various forms of hybridisation. While to a large extent these views came out of the interviewees' understanding of the time frame required to bring new technology to market, they were also influenced by the recent improvements in ICE efficiency, along with the beliefs about the capacity for further improvements.

**Views of drive train and energy arrangements in order of dominance envisaged for different modes of transport by 2025***

| **Personal Transport** | **Commercial Vehicles (delivery vans; buses)** | **Heavy Duty (trucks)** |
|---|---|---|
| 1. Efficient ICEs<br>2. Hybrid ICEs<br>3. Plug In Hybrids<br>4. Battery Electric (<20% of the market)<br>5. $H_2$FC (~1% of the market)) | 1. Efficient ICEs**<br>2. Battery Electric<br>3. $H_2$FC<br>4. Natural Gas<br>5. Bio-Gas<br>- | 1. Efficient ICEs (>90% of the market)<br>2. Hybrid ICEs<br>3. Natural Gas |

*Based on views relating to new registrations in 2025. ICEs will still be very dominant due also to changeover times

**Some query the success of hybrid buses – efficiency gains not worth the extra cost

# 4. Conclusions and Recommendations

## 4.1 Conclusions

Hydrogen was clearly seen as having significant potential to be part of the future menu of transport energy options.

As with the first round of interviews, it remains hard to find 'hard line' critics of a future hydrogen based transport system. Significantly, it was clear that the views of the majority of interviewees had moved to be more positive than in the first round of interviews. This second round of interviews could more correctly be characterised as having been undertaken with transport decision makers and lobbyists who have an interest in and some questions about hydrogen and its potential future role in transport. None of the interviewees could be described as 'hard line' critics or sceptics.

Importantly it was evident that

- The views of the interviewees were based on factual information. They were mostly aware of up to date information and progress in the technology and systems, although the information did not appear to have been obtained directly from CHIC. Hydrogen powered transport options were clearly part of their thinking; and
- There was no mention of the 'hype' – over-promising and under-achieving - that was quite prominent in the first round of discussions; however
- Efficient ICEs were seen as the dominant form of drive train in the medium term (2025).

De-carbonisation was seen as the dominant, and perhaps the only, driver for the further development and implementation of a hydrogen based transport system. Simply put – no de-carbonisation of the hydrogen production system → no incentive for hydrogen fuel cell transport to be on the menu of alternative energy options. Other drivers frequently mentioned in the first round of interviews such as oil

depletion and city air pollution were noticeable in their absence. The exploitation of new sources of oil and the progress in battery technology were presented as proximal solutions for these issues.

This is a particularly important issue and relevant to future funding placement and investment. There is a perception that production of hydrogen by way of low, or preferably zero, carbon emissions is the weak point in developing a future hydrogen transport system, and there is keen interest in how it will be overcome and when. Tolerance for the use of fossil fuel inputs expressed in the first round of interviews is not likely to be long lasting particularly as international pressure increases to reduce greenhouse emissions sooner rather than later.

The linking issue here is the role of Government policy. Interviewees expressed strong views about the key role Government could have with its policy settings. The impetus being given to various forms of battery electric vehicles by a range of Government financial and non-financial incentives provides strong evidence for this.

The issue of the costs of the hydrogen powered vehicles and the hydrogen being dispensed should partly be addressed as production volumes increase. However the modelling undertaken within CHIC on possible future electrolytic hydrogen production costs suggests that some fundamental paradigm shift may be needed if these are to approach the target costs of the FCH-JU.

When taken as a whole, these findings suggest that funding bodies should focus more strongly on quite targeted and perhaps personal, dissemination efforts, rather than broadscale. While the broadscale dissemination is important to bring the community along with the development of the technology, it will be the decision makers in Governments, and the decision influencers in various lobby groups that are likely to be the most influential in creating an environment that will accelerate the commercialisation of hydrogen based transport. Creating and building networks of these influential people and organisations is likely to bring a bigger and faster payoff than other forms of dissemination. However this approach will no doubt be resource intensive.

Allied to the above is the need to provide personal experience and "visibility" of the technology to these decision-makers.

## 4.2 Recommendations

It is significant that the *"Important Findings for Hydrogen Energy Futures"* reported in D 3.8 are consistent with the findings from this follow up study. These are shown in Appendix D of this report.

However there are some particular findings from this study which could be considered when framing future projects and making funding decisions.

- Developing and implementing a very low, and preferably de-carbonised hydrogen infrastructure or at least one with a very clear pathway and relatively short time line to de-carbonisation is critical and should be a focus for funding.

  This should be key part of all future hydrogen transport projects, and the priority that is being given to this issue should be strongly communicated to environmental NGOs as part of a concerted effort to 'enrol' them as hydrogen based transport supporters.

- Developing an identifiable Alliance of Energy and Infrastructure Hydrogen Partners has the potential to establish a strong support group and 'cheer squad' for hydrogen powered transport.

  Hydrogen powered transport would likely benefit from having a 'natural ally' to advocate alongside the traditional hydrogen stakeholders, in a similar way to the fossil fuel and electricity interests do for ICEs and battery powered transport. Putting time into developing these partnerships, alongside developing understanding and support from Government and NGOs outlined above, might be the most important target of "promotion" in the immediate future.

- Developing and evaluating different cost models for hydrogen production and utilisation is likely to be critical to developing electrolytic hydrogen production.

  While the input costs remain around their current level it will be difficult, and perhaps unlikely, for this method of hydrogen production to meet the cost targets of the FCH-JU. On the other hand the factors included in the costs inputs into many other fuels are incomplete. Reputable studies have shown that current mainstream fuels have a significant impact on health and the broader economy. A low carbon world is good for the economy by reducing the cost associated with these impacts[3].

  While it may be unrealistic to expect the price of fossil fuels to be increased to take account of these environmental/societal impacts (although Governments do have instruments to do this should they choose to use them), it is quite appropriate for these impacts to be used as a discount in studies examining costs of hydrogen. This practice should be explored and utilised as much as possible.

- Targeted, personal and, where possible, experiential dissemination is likely to be the most productive way to produce the appropriate policy environment to facilitate commercialisation of hydrogen powered transport.

  While broad scale dissemination and extension activities can be cost effective in informing the community about issues, it is unlikely to be successful in reaching the key decision makers and opinion formers. To make positive progress with these stakeholders takes personal contact. While this is resource hungry, it is clear that getting support from this group will be a key to providing the right policy environment that will facilitate a future hydrogen powered transport system.

[3] Better Growth: Better Climate – Charting a new path for low-carbon growth and a safer climate; September 2014, The Global Commission on the Climate and Economy, www.newclimateeconomy.report

-

# 5. Appendices

## 5.1 Appendix A: Interview Questionnaire

The interviews were framed around the key views expressed in the first round. An additional question was developed for each person based on their general views expressed in their first interview. The discussions were open ended with the questions acting as the focus for discussion around the issue.

**The focus questions similar to Round 1 interviews were:**

- Do you see a role for hydrogen in Transport?
    - If yes
        - What role?
        - Why?
        - When
    - If no
        - Why
        - Is there a 'fatal flaw' or not?

- What do you think are the significant issues in relation to hydrogen production?

**New questions for this round were:**

- In the last 6 months can you recall seeing or receiving any information on hydrogen in transport? If so where did that come from?

- Realistically, by 2025, what do you see as being the drive train and energy arrangements for
    - Passenger vehicles?
    - Urban public transport?
    - Commercial freight?

**Specific questions put to Individuals based on their comments during Interviews: 2011-2012**

| Question |
|---|
| 1. $H_2$ has a niche market –is your attitude still the same?<br>2. Do you still think battery electric vehicles will be the choice in the medium term? |
| You mentioned in your last interview (quote) "(there was) a tendency of hydrogen groups to over - promote and that leads to a backlash."<br><br>Do you see any change in this approach more recently? More measured realistic information? |
| Previously you said that a very influential factor in the growth of $H_2$FC in transport in (your country) was the regulatory environment e.g. the significant and difficult authorisations required for hydrogen production. Has this situation changed at all since we last spoke? If so why/ If not – why not? |
| In discussions with *(previous colleague)* he noted that there appeared to be more of a sense that fuel cell challenges can be overcome when compared with the battery challenges. Would you concur that this is still the case? |
| In your previous interview you noted that policy makers in Transport Energy Policy are wary of creating subsidy 'addicts'. At that time you were suggesting that hydrogen promoters were put in this category. Do you feel that hydrogen based transport is still seen as a subsidy dependent for many years to come? |
| When we interviewed *(previous colleague)*, he was highly optimistic about the future of $H_2$ in Transport (especially given the statements of Honda and Toyota at the time). What is <u>your</u> response to the proposition that:<br><br>*"Both now and in the foreseeable future (say 2025), the $H_2$FC system is more a technological success than a commercial proposition."* |
| In our previous interview you noted that you felt the transport sector would struggle to de-carbonise. Has your opinion changed? |
| In our first interview you identified $H_2$ storage; clean sourcing of $H_2$ and decreasing cost as the areas most in need of breakthroughs.<br><br>Is this still accurate? Do you see substantial progress in any of these areas? |
| Previously you were sceptical of the use $H_2$FC in light (passenger) vehicles and saw its application in other areas (e.g. heavy transport, air, marine) as probably post 2030.You also made a point of saying that there is a need to consider possible future role of hydrogen from a systems perspective and not a sectoral one.<br><br><u>In this context you stated that the best role for hydrogen may not be in transport.</u> |

| Is this a view you still hold? |
| --- |
| In our last interview with the *(your organisation)* it was noted that "politicians have lost interest in hydrogen because of the apparent lack of progress - expectations were too high". Would you say this is still an accurate assessment? |
| One of the conundrums of hydrogen in Transport is that while it offers (at its best) an alternative to fossil fuels free of harmful emissions, it does not enjoy even qualified support from the Environmental groups, even when it is about the use of hydrogen in public transport and for freight. Why do you think this is the case? |

## 5.2 Appendix B: Summary of the General Views expressed in Interviews

**Reasons given for positive views about a future role for hydrogen in transport**

- The technology is impressive and it works.
- EU policy directives on $CO_2$ reduction in transport are very influential
- Energy storage properties of $H_2$ make it a very useful potential adjunct to other forms of energy generation for buffering
- Works well for fleet applications and is local pollution free
- Only solution for heavier vehicles and to give greater range

**Reasons given for uncertainty or negative views about the future role for hydrogen in transport**

- Given that transport must de-carbonise quickly, electric cars and high efficiency ICEs are here and now and relatively inexpensive. History shows that 'economics rules'. This may only leave a relatively small niche for hydrogen powered vehicles – fleets or in some self-determining large cities that may opt to deploy hydrogen powered vehicles for local political or perhaps air quality reasons.
- hydrogen production remains an issue. Unless hydrogen can be produced cleanly and cheaply there is no (or very little) advantage.
- $H_2$ has an energy density problem.
- Hydrogen powered vehicles have lost ground in recent years due to the lack of vehicle availability and the very high cost.

## 5.3 Appendix C: Organisational Affiliations of Interviewees.

| |
|---|
| International Council on Clean Transportation, USA |
| Institut National de l'Environnement Industriel et des Risques (INERIS) |
| IEA (OECD) |
| ITF (OECD) |
| WWF International |
| European Commission |
| MEP Greens Party |
| Transport and Environment |
| Greenpeace |
| Ricardo |
| UK Committee on Climate Change (Committee) |
| UK Committee on Climate Change (Executive) |

## 5.4 Appendix D: Clear Messages from First Round Interviews (D 3.8)

### *5.4.1 Hydrogen will be part of the energy future*

It is hard to find 'hard line' critics of a future hydrogen transport system However, it is easy to find sceptics – especially on issues of

- Timeframe
- Cost
- Performance

Hydrogen is seen by many as having the potential to be part of the future menu of options

- But it is no silver bullet and we must stop the "Hydrogen hype".
- And there are some very significant conflicting views among key groups with important spheres of influence

### *5.4.2 Developers of Hydrogen energy solutions can do things better*

- ***Hydrogen based Transport Planning must be for green hydrogen*** in short to medium term and show a clear path and timeline how this will be achieved.
- ***Hydrogen based Transport Planning must work to the strengths of hydrogen*** (heavy duty/long range/regional economics) and show how it fits into a broad system of alternative energies (not just in transport), rather than competing with them.
- ***Hydrogen based Transport Policies should not ignore efficiency arguments*** but make a case for why conversion efficiency is less important in certain circumstances.
- ***Hydrogen based Transport business cases are of paramount importance*** but must
    - be credible (independently refereed as a possibility)

- show phasing out of Government support towards profitable returns to industry & State (monetising)
- make useful comparisons e.g. light rail initiatives, bike rental, trolley buses

- ***Hydrogen based Transport projects and technological activity should focus on the "have to" advances*** e.g. green hydrogen; accurate metering; independently refereed cost and technological reviews.
- ***Hydrogen based Transport projects must tailor communications for acceptance.***
  - Visibility of the hydrogen product is too narrow at present
  - Stay credible and deliver on promises
  - Targeting audiences and delivering accurate, current information outside the hydrogen sympathetic groups
  - Ensuring and promoting the hydrogen 'fit' with values and behaviours of influential community groups (e.g. Environmental NGOs, Government Ministries)
  - Letting the broader public know what's "in it" for them. This needs to be done where the technology is actually in use or being thought about.