AcceptH2: Public Perception of Hydrogen Buses in Five Countries

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Summary

The international project AcceptH2 aims to understand and measure public perception of hydrogen buses in public transport. Economic preferences are assessed towards the potential and actual use of hydrogen buses. The survey work is performed by means of standardised interviews. The knowledge gained thereof will be used to develop and disseminate recommendations for maximising the positive influence that hydrogen bus demonstration projects can have on public perceptions of hydrogen vehicles and technologies. The project commenced at the beginning of 2003 and is due to be completed by mid-2005.

In the course of AcceptH2, surveys of public perceptions were – respectively will be – undertaken before (ex-ante) and during (ex-post) major hydrogen bus projects in five cities: London (UK), Luxembourg, Berlin (Germany), Perth (Australia) and Oakland (California, USA). The respective ex-ante and ex-post surveys will be compared to ascertain the influence of each project, and the influence of the different projects will be compared against each other. Finally, key factors leading to successful and influential hydrogen bus demonstration projects will be identified and guidelines for future projects will be developed.

Preliminary results of the ex-ante surveys in London, Luxembourg and Perth are:

- The support for hydrogen and fuel cells is generally high.
- The knowledge about hydrogen and fuel cells is rather low.
- Males and people with a higher formal education have a higher knowledge on hydrogen technologies than females and people with lower education.
- Hydrogen is connected to positive (environment, …), negative (bomb, explosive, …) as well as neutral associations (physical properties, …).
- There is practically no opposition to the introduction of hydrogen fuel and hydrogen vehicles. Many people are undecided and need more information.
- In Luxembourg, more than 50% of all respondents would be willing to pay an additional 0.01 Euro to 0.30 Euro per bus fare for hydrogen buses.

The European part of the project is funded by the European Commission.

Project details can be found at www.accepth2.com.

AcceptH2 is the logical next step in a series of acceptance studies in the field. Seven studies on hydrogen acceptance and social implications of hydrogen technology have been carried out so far, six thereof in Germany and one in the UK. Three studies were conducted in the course of demonstration projects. Two essential conclusions may be drawn from the existing studies: Hydrogen acceptance is generally high, and as soon as people experience hydrogen technology in their every-day life they accept and adopt it. This shows the importance of demonstration projects also in this respect. Three reasons dominate people's appraisal of hydrogen vehicles: greatly reduced local emissions, noise reduction and a general perception of hydrogen as being a "clean energy".

1 Introduction

The introduction of hydrogen fuelled vehicles is taking place in selected demonstration cities world-wide, with a view to achieving full commercialisation. However, the successful introduction of these vehicles will depend not only on technical maturity, but especially on public acceptance of this new fuel and of fuel cells and hydrogen internal combustion engines. The work detailed under the international AcceptH2 project contributes strongly to a better understanding of the acceptance of hydrogen technologies, and hence to enable the introduction of hydrogen buses to be carried out with a clear strategy towards public acceptance. The work compares public attitudes in London (United Kingdom), Luxembourg (Luxembourg), Berlin (Germany), Perth (Australia) and Oakland (California, USA), enabling international comparisons of perception to be made and contributing to the international R,D&D co-operation objectives of the European Commission. The work is complementary to many existing EC, national and industry projects.

AcceptH2 addresses a number of gaps in the current literature on perceptions and values of new transport technologies.

It brings together two strands of research: i) investigation of public perceptions to determine broad acceptability and ii) measurement of economic values (measured by willingness to pay) and related demand for hydrogen buses to assess economic viability. Carrying out both types of assessment simultaneously will permit an analysis of how perceptions of hydrogen buses influence their perceived economic value and the public demand for them.

Although, a number of studies have examined the economic value of adopting more environmentally friendly technologies and fuels comparatively little academic work has been directed at valuing the environmental benefits of cleaner transport technologies, such as reduced air quality impacts and noise levels. Broadly, existing research seems to indicate that environmental considerations play a very limited role in the choice of cleaner transport technologies. Not surprisingly, financial considerations and vehicle performance seem to be paramount. However, none of the existing economic valuation work has focused on emissions-free hydrogen vehicles specifically. Most research assessing the potential for hydrogen fuel cell vehicles in the transport market has only looked at the strict technical and financial feasibility of the technology and not at its wider economic impacts. Furthermore, research has typically analysed preferences for private car ownership. This project complements and extends previous economic valuation work by focusing on hydrogen fuel cell buses and their environmental benefits for the public.

The current project is believed to be unique in that it will carry out two identical surveys in each city, one before and one after major hydrogen bus demonstration projects have been run, in order to assess the level of influence that each project has on public perceptions and economic preferences. The project then extends the analysis a stage further by comparing the level of influence that each of the five demonstration projects has, in order to identify the critical factors that lead to success in introducing the technology. These will be developed into recommendations for how to maximise the positive influence of future demonstration projects. Hence, the results of the study are expected to be valuable for the design and operation of future hydrogen vehicle demonstration projects, and also in the introduction of hydrogen vehicles in mainstream operation.

The use of different cities and geographies will enable an understanding of locally-specific factors that influence the different demonstrations to be developed. Factors influencing these different geographies and cultures will be identified and highlighted for use in future project development.

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In this paper, we describe the international project AccpetH2 and present preliminary results of ex-ante surveys which have already been concluded in London, Luxembourg and Perth. We also present an overview of existing acceptance studies in the field. Finally, we discuss conclusions which can be drawn from the first preliminary project results.

2 Project AcceptH2

2.1 Objective

The objective of the international AcceptH2 project is to assess economic preferences towards the potential and actual use of hydrogen buses by conducting before (ex-ante) and during (ex-post) economic valuation studies within Berlin, London, Luxembourg, Perth and Oakland. In addition, the project will assess the level of influence of the hydrogen bus demonstration projects in these cities on local perceptions of and attitudes towards hydrogen buses by comparing the studies within each city. Factors that explain the degrees of success and influence of each of the five demonstration projects will be analysed, and potential public perception barriers to the introduction of hydrogen buses will be identified. The project allows an important international comparison of public perception and preferences, with a focus on European countries. Recommendations for maximising the positive influence and uptake of demonstration and commercial projects will be developed and widely disseminated.

Specific objectives of the project are:

- To analyse and compare public knowledge and perceptions of fuel cells and hydrogen vehicles in each city before and after the introduction of hydrogen buses (HB) demonstration projects.
- To estimate the perceived economic value of the environmental benefits of HBs in each city, before and after HBs demonstration projects.
- To analyse and compare intended and actual use of HBs in each city by conducting ‘ex-ante’ and ‘ex-post’ surveys.
- To assess how knowledge, perceptions, values and use vary across different population segments within each city and across the populations of the five cities.
- To investigate the factors that determine the effectiveness of HBs demonstration projects in shaping public knowledge, perceptions, values and use.
- To analyse potential barriers to the introduction of HBs in terms of public knowledge, perceptions and values, in five cities.
- To develop recommendations for maximising the positive influence and uptake of future demonstration and commercial projects.
- To disseminate results widely amongst companies and organisations that may in the future run hydrogen vehicle demonstration projects, or that wish to introduce such vehicles into service.

2.2 Methodology

The ACCEPTH2 study involves the collection of survey-based data in five cities world-wide, on public perceptions and preferences for hydrogen fuelled buses. The surveys will be undertaken both before and after the introduction of the buses.

The surveys will contain a large core part used identically in all locations. Only adaptations to local specificities, e.g. for currency or tariff system, are made. In addition, some specific questions of local character are included in the different questionnaires.

The ex-ante Core Survey was/will be administered by telephone in all the partner cities. Respondents are contacted using the random-digit dial approach or the random phone book approach, except in Oakland where people will be contacted face-to-face at bus stops and called at a later date. The survey mode for the ex-post survey has yet to be decided.

2.3 Demonstration projects

The surveys of AcceptH2 are carried out in the cities where the following demonstration projects are or will be carried out:

- AC Transit (Oakland/California/USA)
- CUTE – Clean Urban Transport for Europe (London/United Kingdom and City of Luxembourg/Luxembourg)
- BVG hydrogen bus trial (Berlin/Germany)
- STEP – Sustainable Transport Energy Perth (Perth/Australia).

3 Existing studies

In the following subchapter, existing studies on the acceptance of hydrogen technologies are presented. In the second subchapter, empirical literature on public preferences for clean vehicles and fuels in general is reviewed including the major studies on hydrogen acceptance.

A detailed overview of existing studies is given by the AcceptH2 report “Analysis and Comparisons of Existing Studies”, which is available on the project website at www.accepth2.com.

3.1 Studies on hydrogen acceptance

Only very few studies exist analysing the acceptance of hydrogen technologies in the general public and in more specific target groups.

Six of the seven studies identified have been carried out in Germany, one in the United Kingdom, so that very little information is available about other countries. Some related work has been carried out in the USA recently, which has not yet been analysed.

In Germany, all studies indicate that in general the level of acceptance of hydrogen vehicles and hydrogen fuel is relatively high. At the same time, the general knowledge about the subject is rather low. This is a rather unusual situation, as generally a low level of general knowledge on a subject results in a rather low level of acceptance or, put in other words, is a reason for uncertainty and fears.

AcceptH2 builds on the results of the seven hydrogen acceptance studies identified. Hydrogen is widely perceived as an environmentally sound energy carrier. When people experience hydrogen technology in their every-day life, they tend to accept and adopt it. This observation emphasises the vital role that demonstration projects play in the course of introducing hydrogen applications to consumer markets.

3.2 Empirical literature on public preferences for clean vehicles and fuels

Most of the relevant literature on public preferences for new environmental transport technologies and fuels focuses on electric vehicles. Of the 24 reviewed articles, 13 deal with electric vehicles, compared with 5 articles dealing with hydrogen-based transport. The remaining 6 articles deal either with generic alternative fuel vehicles, which include electric, methanol, natural gas and gasoline vehicles, or address preferences for different attributes of vehicles in general, in order to identify the key factors influencing demand for low emission vehicles.

The studies reviewed here can be divided into three types according to methodology used (Gould and Golob, 1998) – attitude studies, preference surveys and experimental analyses – although many of them involve a combination of methodologies.

Studies based solely on attitude questions (Lossen et al, 2003; Dinse, 2000; Dinse, 1999; Altmann and Graesel, 1998 – note that these are all studies of acceptance of hydrogen transport), tend to reveal very positive attitudes towards cleaner transport amongst respondents, in contrast with experimental and preference surveys which show lower acceptance levels overall for cleaner transport (Gould and Golob, 1998). The discrepancy between findings from these different methodologies may be due to the fact that attitude surveys reflect ideals rather than actual purchasing intentions (Kurani et al, 1996). As proposed in Fishbein's Theory of Reasoned Action (1977), intended behaviour (i.e. as measured by willingness to pay) is a better indicator of behaviour than attitudes. Attitudes merely guide intentions and, crucially, imply no trade-offs between one's limited budget and securing cleaner transport alternatives.

This discrepancy is highlighted in papers such as Gould and Golob (1998) where positive attitudes towards the environmental benefits of electric vehicles are not complemented by purchasing intentions (78% respondents expressed belief that electric vehicles were the solution to reduced air pollution; 47% expressed intention to purchase an electric vehicle based on the environmental benefits). Similarly, Urban et al (1996) found that electric vehicles were rated highly in terms of environmental attributes, but environment was rated as the least important attribute when purchasing a vehicle. These studies illustrate the fact that, in the absence of questions on purchase intention, results from attitudinal surveys may be misinterpreted and demand for cleaner transport overestimated.

Preference valuation surveys are another approach used to identify potential demand for new technologies. There has been relatively little work to date on valuing the environmental attributes of transport, such as impacts on air quality, noise levels and visual amenity. Most valuation techniques have been used in the valuation of more traditional, non-environmental attributes of transport, such as travel-time savings, alternative route preferences, fare elasticities and public transport preferences (for case studies see Louviere et al, 2000, and Hensher, 2001). For a summary of the historical development of valuation methods in transportation research see Polak and Jones (1996).

Most preference surveys reviewed here address the potential demand for electric vehicles and make used of stated preference techniques. Stated preferences are survey-based methods commonly used to measure, in monetary terms, the welfare impacts of changes in products, policies or projects: by means of a questionnaire, respondents are asked for their willingness to pay to secure an improvement or, alternatively, to avoid an undesirable change (Bateman et al, 2002). The values elicited are contingent on the scenario and information provided in the survey. Specific stated preference techniques used in the transport studies reviewed include choice modelling methods (Bennett and Blamey, 2001; Louviere et al, 2000) and the contingent valuation method (Mitchell and Carson, 1989; Bateman et al, 2002). Although specific results vary widely, there is general agreement across all studies that environmental concerns are not important for vehicle choice.

To date, the only study to estimate the economic value of hydrogen fuel cell vehicles is Mourato et al (2003), which uses contingent valuation method to evaluate the economic benefits of hydrogen fuel cell taxis to professional taxi drivers in London. Taxi driver willingness to pay for participation in a fuel cell taxi pilot project was found to be considerably less than the reductions in running costs associated with participation in the pilot project. Thus willingness to pay was determined mainly by financial considerations (i.e. the expectation of financial gains), and not environmental factors. However, longer term willingness to pay for purchasing a production line fuel cell taxi, in an optimistic future scenario of mass introduction, was found to be positively influenced by environmental concerns (as well as by financial and performance considerations).

There has been criticism of the use of stated preference techniques in evaluating potential demand for new technologies, as a new technology may have attributes that the consumer has little experience of, and hence no preferences for (Kurani et al, 1996). An example might be the home recharging attribute of electric vehicles. One way of dealing with this issue involves providing respondents with direct experience of the technology, as in the experimental studies (Kurani et al, 1996; Urban et al, 1996; Kurani et al, 1995). These experiments combine different methodologies – attitudinal questions with choice modelling and contingent valuation method, as well as a variety of innovative techniques (e.g. videos, simulated information and vehicle trials) – in order to obtain values for potential demand for cleaner transport technologies. The general theme behind experimental approaches is experience of the technology, whether it is through direct experience or virtual simulation.

It appears, from the above studies on public acceptance and preferences for new environmental technologies, that in the short run, environmental concern will not be the key influence on decisions to purchase cleaner vehicles. The key concerns will be price and performance. If alternative fuel vehicles are able to compete with internal combustion fuel vehicles in terms of price and performance, then environmental concern may indeed act as a predictor of consumer choice.

4 Preliminary results of AcceptH2 surveys

In the course of AcceptH2, ex-ante interviews have been finalised in London, Luxembourg and Perth so far. The Berlin ex-ante interviews will be completed by January 2004. The schedule of the AC Transit (Oakland) bus trial is not yet finally fixed.

The results presented are based on preliminary data as analyses are still on-going. In the London ex-ante survey 414 people were interviewed, 300 in Luxembourg and 300 in Perth. The Perth assessment is not yet fully completed at this time, thus the number of assessed interviews is n=100. The interviews were conducted by telephone, though additional open interviews are held in Perth with focus groups (decision makers and stake holders, such as bus driver, mechanics etc.). The bus operator in Luxembourg will conduct a small-scale survey involving people such as drivers, mechanics etc.. Though not of statistical significance in the framework of AcceptH2, the open interviews in Perth and the small-scale survey in Luxembourg may deliver additional qualitative information at a later project stage.

The broadest set of currently available survey data comes from Luxembourg. Thus, in depth discussions of preliminary results and the presentation of background data are focused on Luxembourg in this paper. In Luxembourg several correlations were found, e.g. between sex and knowledge. Yet, correlations do not necessarily imply any causality.

In Luxembourg, only bus users were interviewed. In London, 74% stated to be bus users. This number was lower in Perth (45%). London and Luxembourg bus users take the bus more frequently than Perth bus users.

4.1 Knowledge about hydrogen

When asked whether the interviewees knew that the automobile industry is developing hydrogen vehicles, around 50% answered 'yes' (London: 45%, Luxembourg: 51%, Perth: 47%). Around 50% answered 'no'. A small percentage wasn't sure whether they had heard about hydrogen vehicles.

In Luxembourg, significantly more male interviewees (71%) had heard about hydrogen vehicles than females (40%). Male persons commonly tend to be more interested in technology matters. Furthermore, women tend to understate their own knowledge especially on topics which are usually attributed to males. The knowledge of hydrogen powered vehicles is higher among people with higher formal education (55% passed at least secondary school year 12).

Many people from Luxembourg are curious towards hydrogen powered buses. 25% of the respondents would – at least once – wait for a longer time to catch the hydrogen bus rather than the conventional one.

4.2 Attitude towards hydrogen

To examine the general perception of hydrogen, interviewees were asked to state free associations regarding the word 'hydrogen'.

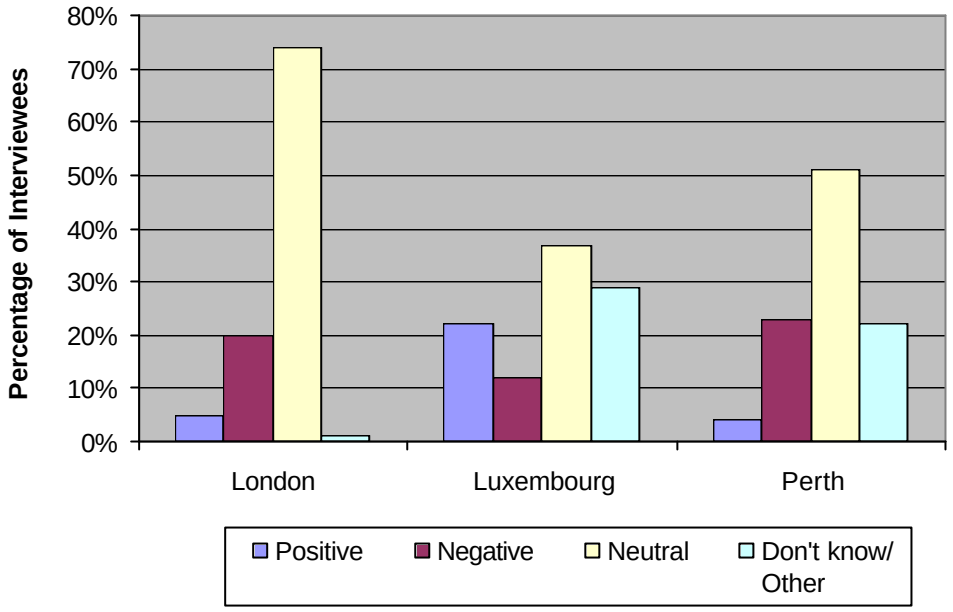

Fig. 1: Free associations to hydrogen

The free associations to hydrogen are dominated by neutral associations (between 37% and 74% of all respondents) and a strong fraction of 'don't know' statements in the case of Luxembourg and Perth. Except Luxembourg, there are by far more negative associations than positive ones. In Luxembourg the number of positive associations is higher compared to negative associations and shows the highest overall percentage of positive associations of all three cities. Of those people having stated negative associations in Luxembourg, one fourth also mentioned positive associations.

One could have expected that the word 'Hindenburg' would be an issue recalling the severe dirigible incident at Lakehurst/USA in 1937. Yet, survey data do not prove this assumption. The word 'Hindenburg' was sporadically mentioned in Perth (3%). In Luxembourg it didn't show up at all (London data not available).

4.3 Support for the introduction of hydrogen vehicles

A vast majority of 83% (Luxembourg) and 94% (Perth) think it is a good idea to trial hydrogen fuel cell buses. Less than approximately 1% object to trial hydrogen fuel cell busses in Luxembourg and Perth. The fraction of people who support the demonstration of hydrogen fuel cell buses is greater in Perth than in Luxembourg even though only 45% of Perth respondents are bus users (in Luxembourg only bus users were interviewed).

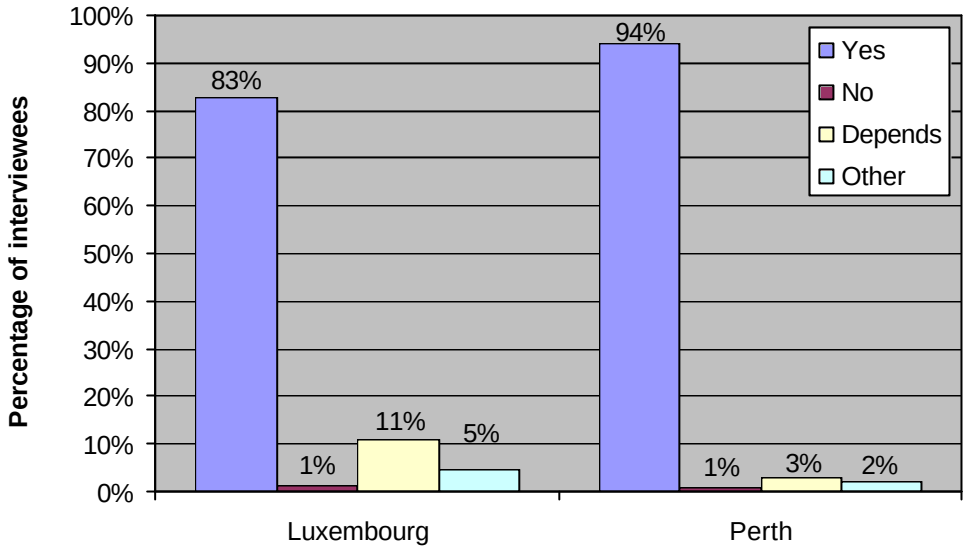

Fig. 2: 'Do you think that it is a good idea that Luxembourg/Perth is trialing hydrogen fuel cell buses?'

35% of the respondents in London support the broad-scale introduction of hydrogen vehicles in their respective cities with 62% in Luxembourg and 42% in Perth. Only four persons out of 1,016 respondents opposed the introduction of hydrogen vehicles. Yet, a majority of all respondents does neither support nor oppose the introduction of hydrogen vehicles but stated to 'need more information'.

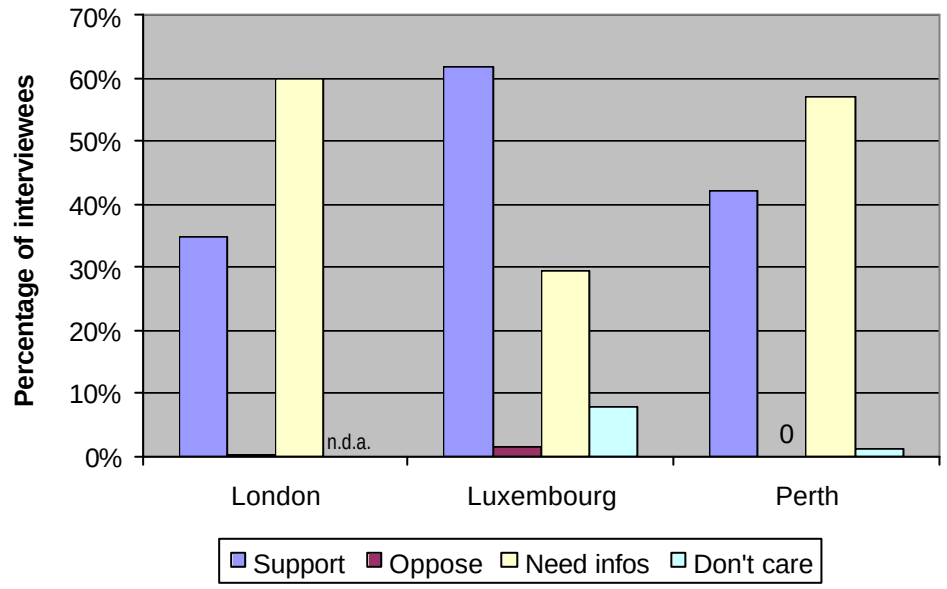

Fig. 3: 'How would you feel about hydrogen powered vehicles being introduced in London/Luxembourg/Perth?'

Looking more closely at the outcomes of the Luxembourg ex-ante survey, 73%[1] of those supporting the introduction of hydrogen powered vehicles have already heard that car companies are developing hydrogen propelled cars. Predominantly women stated to require additional information before either supporting or opposing the introduction of hydrogen vehicles. In Luxembourg, respondents equally supported the introduction of hydrogen vehicles in general as well as the large-scale introduction of fuel cell buses alone. One third of the Luxembourg respondents stated that their support for the introduction of fuel cell buses would 'depend' on certain conditions.

[1] revised figure

Throughout all three cities, the majority of interviewees support the introduction and storage of hydrogen at their local petrol station. A higher percentage of people in Perth are sceptical about hydrogen being stored at their local petrol station than either London or Luxembourg. This attitude is indicated by the percentage of respondents requiring more information (40% of Perth respondents and around one fourth of London and Luxembourg respondents would require further information).

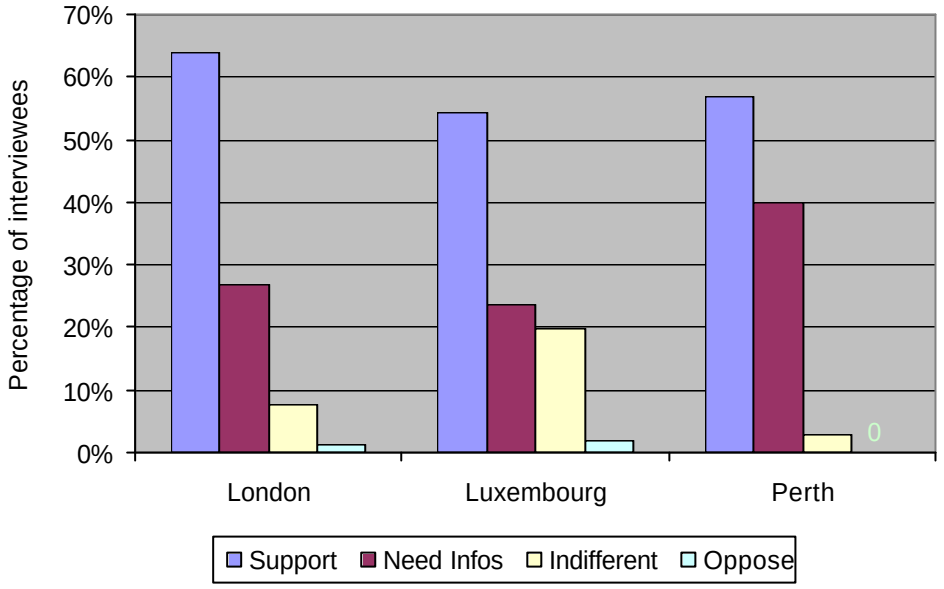

Fig. 4: 'How would you feel about hydrogen stored and included as a fuel option at your local petrol station?'

In Luxembourg, 85%[2] of those supporting the storage of hydrogen at their petrol station knew that car companies are developing hydrogen powered vehicles. The number of Luxembourg respondent opposing the installation of hydrogen storage at their petrol station is too low (6 respectively 2%) for making a further statistical analysis. Once again, predominantly women stated to require additional information.

4.4 Willingness to pay

When interviewees were asked whether they would support the introduction if that meant a small increase in bus fares, much more people responded 'yes' than 'no' (Fig. 5). Two thirds of the London respondents would support the introduction even if it meant an increase in bus fares. Some 40% would do so in Luxembourg. In both cities around every tenth respondent stated that they would object the support if it meant an increase in bus fares. Yet, the majority of Luxembourg interviewees said that their decision would 'depend' or that they 'don't know'. In both cities the number of respondents who said 'depends' or 'don't know' is together by far larger than the number of respondents who stated 'no'.

[2] revised figure

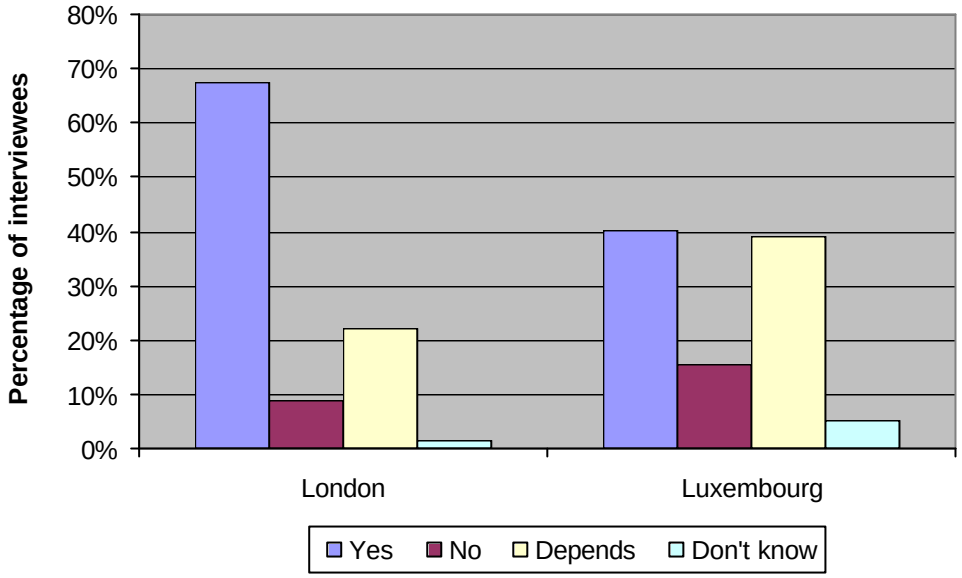

Fig. 5: 'Would you support the introduction of hydrogen fuel cell buses in London/Luxembourg bus routes if that meant a small increase in bus fares?'

In empirical social research it can be observed that respondents not necessarily state their true opinion. Respondents generally tend to answer questions in a socially favoured way. An indication about how serious respondents are about a certain topic is their willingness to pay. Interviewees thus were asked how much more they would actually be willing to pay per fare to have hydrogen fuel cell buses introduced in their city. Preliminary Luxembourg data affirm a very large significance that interviewees did not change their mind.

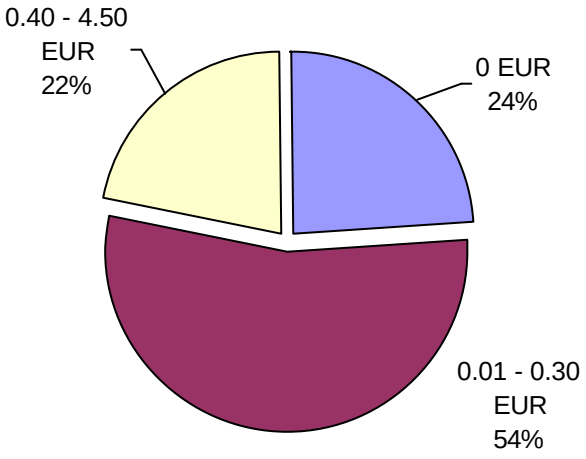

Fig. 6: Willingness to pay an extra charge per bus fare (in percentage of all respondents) in Luxembourg

24% of all respondents (n=287) in Luxembourg stated that they would not be willing to pay an extra fare in order to have hydrogen fuel cell buses introduced in Luxembourg.

Of the 76% of respondents who are willing to pay an extra charge (n=218), some 50% would be willing to pay between 0.01 EUR and 0.20 EUR per bus fare. Fig. 7 plots the distribution of the respondents' willingness to pay an extra fare in detail.

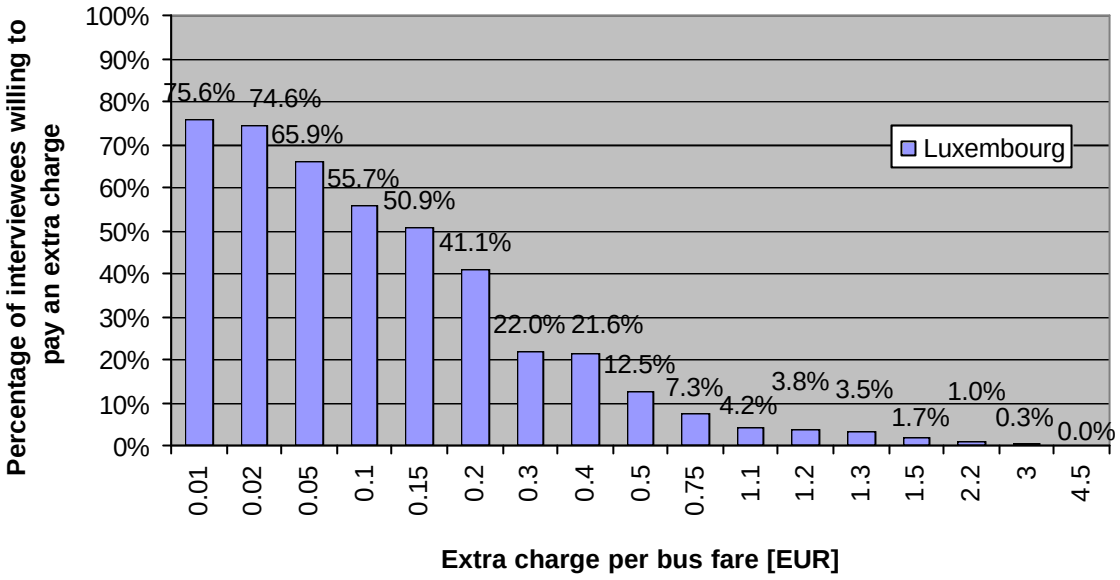

Fig. 7: Percentage of respondents willing to pay an extra charge of more than x EUR per bus fare in Luxembourg (100% = all respondents). Read: '55.7% of all respondents would be willing to pay an extra charge of more than 0.10 Euro per bus fare')

In Luxembourg, respondents strongly disagree to pay extra charges for hydrogen buses via taxes. There may be several reasons for this. Firstly, people tend to have the notion that those who cause the costs – namely the bus users – shall pay for them ('costs-by-cause' principle). Secondly, there may also be psychological reasons for this. The amount of money spent per ride (such as a couple of euro cent) may be perceived far more negligible than the annual additional amount of tax payment (such as ten euro or more). Or, tax increases may be rejected in general independent of the possible reason. Furthermore, a US study on the willingness to pay for renewable energy (Wiser, 2003) comes to the conclusion that people tend to have more faith in the direct provider of public goods than governmental provision.

5 Conclusions

By now, the vast majority of studies on the acceptance of hydrogen and fuel cell technologies were geographically focused on Germany. AcceptH2 is the first socio-empirical study comparatively assessing the perception of various cultures of the western hemisphere. The project will be completed in 2005. The presented results of ex-ante surveys of London, Luxembourg and Perth are based on preliminary data. Further results will be developed progressively.

The preliminary results presented are in general accordance with former acceptance studies in the field.

People strongly support hydrogen and fuel cells. There are practically no objections to hydrogen and fuel cells – neither in general nor when these technologies are applied in vehicles. Yet, a significant group of people 'need more information' (introduction of hydrogen powered vehicles and storage of hydrogen at the local refueling station) or stated that their support would 'depend' on certain conditions (support for hydrogen fuel cell buses in case an extra charge would be required).

Those supporting hydrogen and fuel cell technology are willing to pay an extra charge if this is initially required. It may be questioned how valid this approval is if the extra charge is actually called in. Yet, public transport bus operators could take this result into account when setting up financial plans for the introduction of hydrogen buses. Special payment schemes would e.g. be feasible in conjunction with electronic ticketing.

In several German states, hydrogen and/or fuel cell technology is part of the curriculum. Demonstration project operators should consider whether to provide a program for teachers, such as guided tours, presentations or experiments at school.

Hydrogen is connected to positive (environment, …), negative (bomb, explosive, …) as well as neutral associations (physical properties, …). In conjunction, negative and neutral associations as well as 'don't know' statements outnumber positive associations by far which leaves room for the general perception of hydrogen to potentially change from generally positive (support for introduction) to generally negative (opposition to introduction). Other studies in the field indicate that demonstration projects have a positive influence on the appraisal of hydrogen technologies (within AcceptH2, observations of this kind may at the earliest be derived after the ex-post surveys will have been conducted in the course of 2004 and 2005). This suggests that demonstration projects should be as publicly accessible as possible to let people experience hydrogen technology.

We assume that people who gained positive experiences in one field of hydrogen application will more likely adopt hydrogen technologies in other fields of applications, such as the portable or stationary sector. The communication about hydrogen demonstration projects thus should reference – or at least should be kept open – to other fields of applications. Yet, a validation of this thesis is due to further studies in the field as it is not in the scope of AcceptH2.

6 Acknowledgement

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Bibliography

AcceptH2 project website: www.accepth2.com

Altmann, M. and Graesel, C. (1998) The Acceptance of Hydrogen Technologies – Die Akzeptanz von Wasserstofftechnologien, www.HyWeb.de/accepth2 (Englisch version), www.HyWeb.de/akzepth2 (German version)

Bateman, I., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D.W., Sugden, R., and Swanson, J. (2002) Economic Valuation with Stated Preference Techniques: A Manual, Edward Elgar, Cheltenham

Bennett, J. and Blamey, R (2001) The Choice Modelling Approach to Environmental Valuation, Cheltenham, UK: Edward Elgar

Dinse, G. (2000) Akzeptanz von wasserstoffbetriebenen Fahrzeugen – Eine Studie über die Verwendung eines neuen und ungewohnten Kraftstoffs (Acceptance of hydrogen vehicles – A study on the use of a new and unusual fuel), Institut für Mobilitätsforschung Charlottenstr.43, 10117 Berlin, Germany

Dinse, G. (1999) Wasserstoffahrzeuge und ihr Funktionsraum – Eine Analyse der technischen, politisch-rechtlichen und sozialen Dimensionen (Hydrogen vehicles and their ambiance – An analysis of the technical, political and social dimensions), Institut für Mobilitätsforschung Charlottenstr.43, 10117 Berlin, Germany

Fishbein, M. and Ajzen, I. (1975) Belief, Attitude, Intention and Behaviour, Reading, Mass: Addison-Wesley Publishing

Gould, J. and Golob, T.F. (1998) 'Clean Air Forever? A Longitudinal Analysis of Opinions about Air Pollution and Electric Vehicles', Transportation Research Part D, 3(3), 157-169

Hensher, D.A. (2001) Travel Behaviour Research: the Leading Edge, Pergamon

Kurani, K.S., Turrentine, T. and Sperling, D. (1996) 'Testing electric vehicle demand in `hybrid households' using a reflexive survey', Transportation Research Part D, 1, 131-150

Kurani, K.S., Sperling, D., Lipman, T., Stanger, D., Turrentine,T. and Stein, A. (1995) 'Household markets for neighbourhood electric vehicles in California' (executive summary), Research Report UCD-ITS-RR-95-6, Inst of Transportation Studies, University of California, Davis Prepared for Calstart NEV Market Study

Lossen, U., Armbruster, M., Horn, S., Kraus, P. and Schich, K. (2003) Einflussfaktoren auf den Markterfolg von wasserstoffbetrie-benen Fahrzeugen (Factors influencing the market success of vehicles powered by hydrogen), expert verlag, ISBN3-8169-2174-4, selected results available at www.goh2.de

Louviere, J.J., Hensher, D.A. and Swait, J.D. (2000) Stated Choice Methods, UK: Cambridge University Press

Mitchell, R.C. and Carson, R.T. (1989) Using Surveys to Value Public Goods: the Contingent Valuation Method, Washington: Resources for the Future

Mourato, S., Saynor, B. and Hart, D. (2003) Greening London's black cabs: A study of driver preferences for fuel cell taxis, Energy Policy (in press; on line since March 2003).

Polak, J. and Jones, P. (1996) 'Using stated-preference methods to examine traveller preferences and responses', In Stopher, and Lee-Gosselin, (eds) Understanding Travel Behaviour in an Era of Change, Oxford: Pergamon

Turrentine, T. and Kurani, K. (1995) 'The household market for electric vehicles', Research Report UCD-ITS-RR-95-5, Inst of Transportation Studies, University of California, Davis

Urban, G.L., Weinberg, B.D. and Hauser, J.R. (1996) 'Premarket forecasting of really-new products', Journal of Marketing 60, 47-60

Wiser, R. (2003) 'Using Contingent Valuation to Explore Willingness to Pay for Renewable Energy: A Comparison of Collective and Voluntary Payment Vehicles', Report LBNL-53239, Environmental Energy Technology Division, Lawrence Berkeley National Laboratory, Berkeley, California/USA

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