

AcceptH2: Public Acceptance and Economic Preferences Related to Hydrogen Transport Technologies in Five Countries

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Abstract

The international project AcceptH2 aims to understand and measure public perception of hydrogen buses in different locations as well as to assess economic preferences towards the potential and actual use of hydrogen buses by conducting economic valuation studies. This knowledge will be used to develop and disseminate recommendations for maximizing 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 (United Kingdom), Luxembourg, Berlin (Germany), Perth (Australia) and Oakland (California, USA).

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

- The support for hydrogen and fuel cells is generally high.
- There is practically no opposition to the introduction of hydrogen fuel and hydrogen vehicles. Many people are undecided and need more information.
- Males and people with a higher formal education have a higher knowledge on hydrogen technologies than females and people with lower formal education.
- Hydrogen is connected to positive (environment, ...), negative (bomb, explosive, ...) as well as neutral associations (physical properties, ...).

- 50% of all respondents would be willing to pay at least an additional 0.20 Euro (Berlin, Luxembourg), 0.30 £ (London) or 0.20 Australian \$ (Perth) per single bus fare for hydrogen buses.

The project is funded by the European Commission and the Government of Western Australia. Project details can be found at www.acepth2.com.

Keywords: Hydrogen, fuel cell, acceptance, public perception, economic valuation, bus demonstration project, willingness to pay, hydrogen bus survey

1. Introduction

AcceptH2 [1] is the logical next step in a series of acceptance studies in the field hydrogen technologies.

The introduction of hydrogen fuelled vehicles is taking place in selected demonstration cities world-wide, with a view to achieving full commercialization. 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 cooperation objectives of the European Commission.

AcceptH2 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.

In this paper, we describe the international project AccpetH2 and present preliminary results of ex-ante surveys which have already been concluded in Berlin, 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.

1.2 Project AcceptH2

1.2.1 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. Factors that explain the degrees of success and influence of each of the five demonstration projects will be analyzed, 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. Recommendations for maximizing the positive influence and uptake of demonstration and commercial projects will be developed and widely disseminated.

1.2.2 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.

1.2.3 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) [2]
- BVG hydrogen bus trial (Berlin/Germany)
- STEP – Sustainable Transport Energy Perth (Perth/Australia) [2], [3].

1.3 Existing studies

1.3.1 Studies on hydrogen acceptance

Only very few studies exist analyzing the acceptance of hydrogen technologies in the general public and in more specific target groups [4], [5], [6], [7], [8], [9].

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. At present, related work is being carried out in Iceland in the framework of the ECTOS project [10], and in the USA.

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 an 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.

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".

1.3.2 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 (for literature references see [11]). 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.

It appears, from the 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 conventional vehicles in terms of price and performance, then environmental concern may indeed act as a predictor of consumer choice. In other words, even though alternative fuels are perceived as being 'clean' environmental concerns are of low importance for vehicle choice, and the willingness to pay for environmental benefits is low.

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 [11].

1.4 Preliminary results of AcceptH2 surveys

In the course of AcceptH2, ex-ante interviews have been finalised in Berlin, London, Luxembourg and Perth so far.

In the London ex-ante survey 414 people were interviewed, 345 in Berlin and 300 each in Luxembourg and Perth. The interviews were conducted by telephone. In Berlin and Luxembourg, only bus users were interviewed. In London and Perth, 74% and 49% of the interviewees, respectively, stated to be bus users.

1.4.1 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 Berlin, however, people are significantly more aware of the industrial hydrogen car developments with 72% of interviewees giving a positive answer and only 26% negative answers (2% were not sure).

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 about hydrogen powered buses. 25% of the respondents would – at least once – wait for a longer time in order to catch the hydrogen bus rather than the conventional one.

1.4.2 Attitude towards hydrogen

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

The free associations to hydrogen are dominated by neutral associations (between 37% and 74% of all respondents) and a significant fraction of 'don't know' statements in the case of Luxembourg (see Figure 1).

In Luxembourg, positive associations outweigh negative ones, while in Berlin positive and negative associations are quite balanced. In London and Perth in contrast, more than double as many interviewees give negative associations than positive. Of those people having stated negative associations in Berlin and Luxembourg, 17% and 25%, respectively, also mentioned positive associations.

It is often assumed by hydrogen experts that the 'Hindenburg' would be an issue for the general public recalling the severe dirigible incident at Lakehurst/USA in 1937. Yet, survey

data disprove this assumption. The word 'Hindenburg' (or related terms such as 'dirigible') was only sporadically mentioned in Perth (2%). In Berlin and Luxembourg, it didn't show up at all.

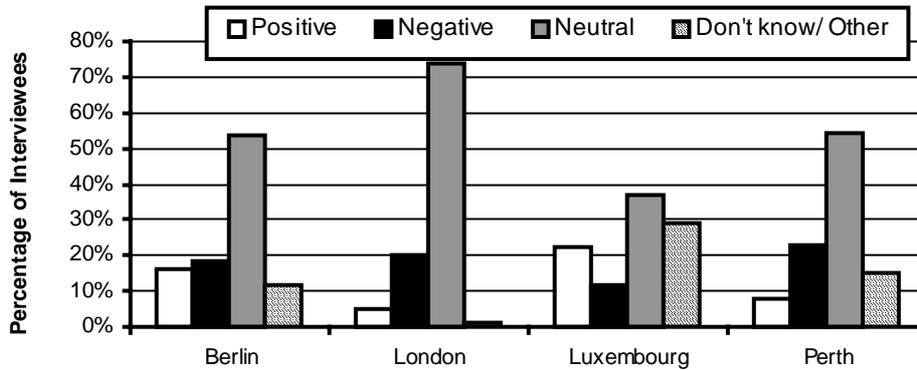


Figure1. Free associations to hydrogen (B1)

1.4.3 Support for the introduction of hydrogen vehicles

A vast majority of above 80% think it is a good idea to trial hydrogen buses. Less than 2% object to trialing hydrogen buses in the four cities. A small, but noticeable fraction in Berlin and Luxembourg replied with 'it depends'.

In London, Luxembourg and Perth hydrogen fuel cell buses are being/ will be demonstrated in commercial operation, while in Berlin a hydrogen bus with internal combustion engine propulsion will be demonstrated. Interviewees in the former three cities have been asked for 'hydrogen fuel cell' buses, while in Berlin the questions were on 'hydrogen' buses.

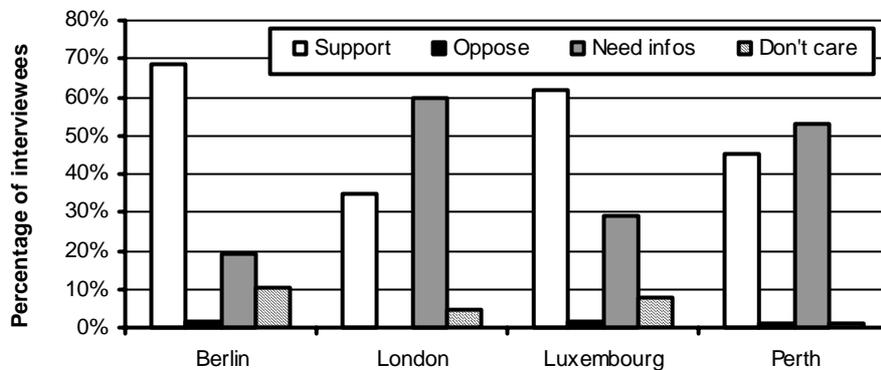


Figure 2 'How would you feel about hydrogen powered vehicles being introduced in Berlin/London/Luxembourg/Perth?' (B3)

Asked for their views on a broad scale introduction of hydrogen powered vehicles in general in the respective city some noticeable differences showed up (see Figure 2). In Berlin and Luxembourg, support is above 60%. 20% to 30% of the interviewees require further information before being able to make a decision. In London and Perth, support is between 35% and 45%, while here the desire for additional information prevails at 50% to 60%. However, opposition to a broad introduction of hydrogen vehicles is practically zero. Between 1% and 10% of respondents don't care about this. A similar picture is achieved when specifically asking about the support for the introduction of hydrogen (fuel cell) buses.

Looking more closely at the outcomes of the Luxembourg ex-ante survey, 71% 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.

Throughout all four cities, the majority of interviewees support the introduction and storage of hydrogen at their local petrol station (see Figure 3). A relatively high percentage of people in Perth (41%) feel they require additional information before making a decision. In Berlin, London and Luxembourg the percentages are lower at 13%, 27%, 24%, respectively. Opposition is practically never expressed.

In Luxembourg, 69% 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 interviewees or 2%) for making a further statistical analysis. Once again, predominantly women stated to require additional information.

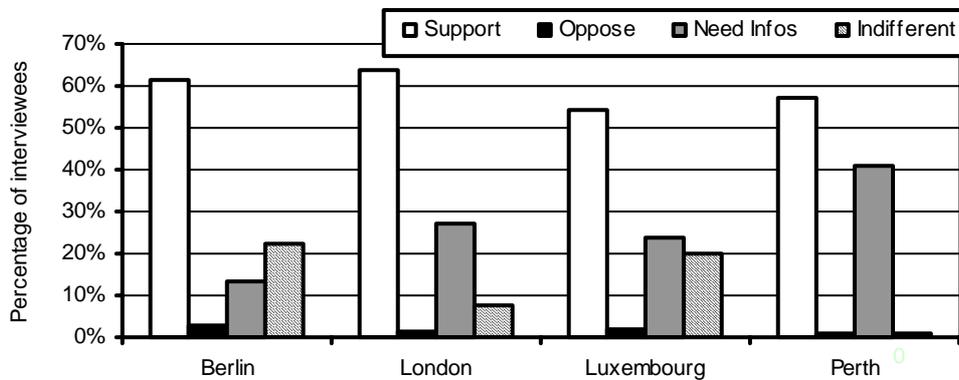


Figure 3. 'How would you feel about hydrogen stored and included as a fuel option at your local petrol station?' (B8)

1.4.4 Willingness to pay

When interviewees were asked whether they would support the introduction of hydrogen buses if that meant a small increase in bus fares, many more people responded 'yes' than 'no' in London, Luxembourg and Perth (see Figure 4).

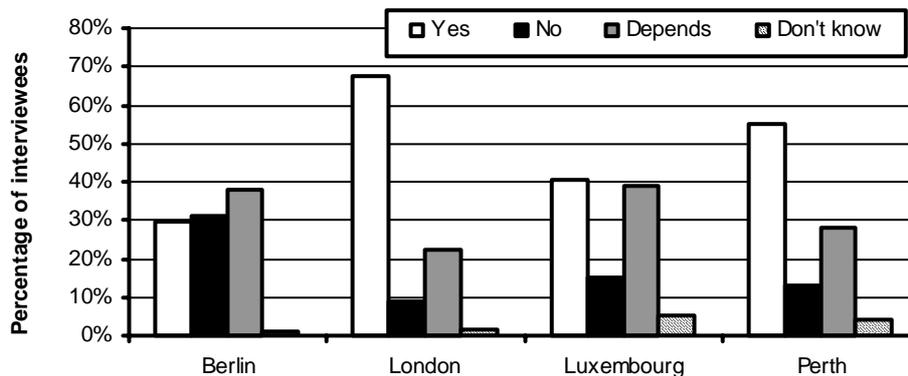


Figure 4. 'If the hydrogen buses could only be introduced if there was a small increase in the bus fare, would you, in principle, support their introduction?' (C1)

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 and some 55% in Perth. In the

three cities around every tenth respondent stated that they would object to an increase in bus fares. In Berlin in contrast, 'yes' and 'no' answers were equally frequent (about 30% each). Between 20% and 40% of the interviewees in the four cities said that their decision would 'depend' or that they 'don't know'.

In order to quantify their willingness to pay, interviewees were asked how much more they would actually be willing to pay per single bus fare to have hydrogen (fuel cell) buses introduced in their city. Figure 5 presents the willingness of bus users to pay an extra charge per single bus fare in the four cities. 50% of all respondents would be willing to pay at least an additional 0.20 Euro (Berlin, Luxembourg), 0.30 £ (London) or 0.20 Australian \$ (Perth) per single bus fare for hydrogen buses. Using the currency exchange rates of September 2003, these values correspond to 0.43 Euro for London and 0.12 Euro for Perth, respectively.

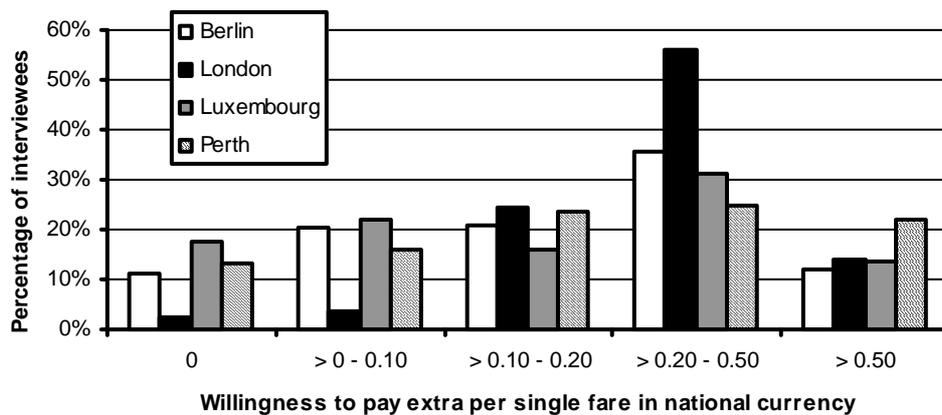


Figure 5: Willingness to pay an extra charge per bus fare (in percentage of all bus users giving valid responses) (C2)

Relating the willingness to pay to the current price of a single bus fare is another interesting way of comparing the results. It is questionable whether the majority of the interviewees made this relationship when responding to the question, but at least some definitely did. In Berlin the median willingness to pay an extra 0.2 Euro corresponds to a 9% increase of the price of a single bus fare. In Perth the increase would be 10%, in Luxembourg 17%, and in London 43%. In London, respondents show the highest willingness to pay in nominal terms (0.3 in national currency), in terms of currency value (0.43 Euro) and in relative terms (43% price increase).

In the three European cities, respondents strongly disagree to pay extra charges for hydrogen buses via taxes. In Perth in contrast, the majority of respondents are willing to pay extra tax.

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 Berlin, London, Luxembourg and Perth are based on preliminary data. Further results will be developed progressively. The 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.

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 which leaves room for the public 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 be derived during the second project phase from the comparison of the ex-ante and the ex-post surveys. This suggests that demonstration projects should have the highest possible public visibility in order to let people experience hydrogen technology and consolidate their generally positive perception.

2. Acknowledgements

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