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Acceptance of Hydrogen Technologies and the Role of Trust

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Abstract

It is well known in socio-economic studies, that the success of an innovation process depends not only on the technological innovation itself or the state of the economic and institutional environment, but also on the public acceptance of the innovation. Public acceptance can be an obstacle for the development and introduction of a new and innovative idea as the example of genetic engineering in agriculture shows. In respect to hydrogen technology this means, that the compilation and communication of scientific risk assessments are not sufficient to generate or enhance public acceptance. Moreover, psychological, social and cultural aspects of risk perception have to be considered when introducing new technologies. This paper focuses on trust as a central parameter of risk perception and the public acceptance of new technologies.

1 Acceptance

Public acceptance can be best defined as “the chance to get the explicit or implicit consensus of a group or person for specific concepts, measures, proposals or decisions” [1]. In the context of innovative technologies this includes a variety of behaviours that range from using the new technology, buying a product based on the innovative technology or simply not opposing a political decision regarding this technology. Public acceptance of hydrogen technology will be fundamental for its successful implementation. The way the public perceives hydrogen will have implications for its success or failure. One parameter influencing acceptance is the perception of risk. Other factors are general values and norms, cultural attitudes towards risk and practices for managing it, the amount of knowledge concerning a new technology, experiences with the new technology and innovations in general, prior conversations about the new technology and current incidents surrounding it.

Studies of the public acceptance of hydrogen vehicles indicate a relatively high level of acceptance. Despite low levels of knowledge regarding hydrogen technologies and fuel cells, people tend to have positive attitudes towards hydrogen, and generally accept it as a fuel. Concerns about safety risks are considered to be less important [2].

- In an analysis of Dinse [3] 150 randomly selected people in the streets of Berlin were interviewed with regard to technical, political and social implications of hydrogen vehicles. The results indicate a very high level of acceptance.

- In 2001 members of the Bayerische Eliteakademie in Munich interviewed high level executives from science, industry as well as the public sector and launched an internet survey [4]. The interviews and survey aimed at analyzing the parameters that influence the market success of hydrogen powered vehicles. Both, the interviewed executives and the survey participants showed a positive attitude towards hydrogen technologies in transport. Safety concerns were noticeable, but limited.
- Altmann and Graesel [5] analyzed the acceptance of 145 hydrogen bus passengers in Munich. The acceptance of hydrogen amongst the interviewed passengers was high. The perception of risk was low.
- In 2005 a HHICE bus was tested under cold weather conditions in Winnipeg. Interviewers used the ride to ask passengers about their perception of hydrogen technologies. The results of this study [6] indicate that the public views hydrogen as being an acceptable fuel.
- In 2003 the first hydrogen buses were introduced into the public traffic of Reykjavik (Iceland). In 2004 passengers and bus drivers were asked about their experiences. Passengers and other commuters stated that they had a positive attitude towards the new technology. The bus drivers were also had a very positive attitude towards the technology [7, 8].
- Similar positive results were found in studies conducted by Dinse [9] and VAG [10] which also indicate overall support and little opposition to hydrogen technologies and fuels.
- In the United States, a study by Hart [11] indicated that the majority of respondents supported the government decision to financially support the transition to hydrogen.
- A study by O'Garra et al. [12] revealed that the majority of people with prior knowledge supported the introduction of hydrogen vehicles. Safety concerns were low.

All of the above studies indicate a positive public attitude towards hydrogen technologies. But due to the low level of public experience with these technologies the validity of the studies for the estimation of societal acceptance seems to be rather limited. Ricci et al. [2] argue that while support for hydrogen in general may be high, support for specific applications, infrastructure or prospective large scale infrastructure build-ups could be much lower. Furthermore, it is still not yet known if the stated acceptance levels refer to hydrogen itself, or to specific hydrogen applications. It is therefore important to know which associations underlie the evaluation of hydrogen and hydrogen technologies. A systematic analysis of acceptance that includes the complete supply chain is therefore necessary to gauge the public attitude and its implications for the broad scale introduction of this technology.

2 Trust

The level of trust in actors or institutions, who are engaged in the development and implementation of innovations, heavily influences public acceptance as well as risk perception [13]. The source of information is highly relevant to citizens for their evaluation of

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the information. This is especially true for topics that are too big or complex for individuals to understand. In these cases, people rely on the judgment of trustworthy sources [14]. Trust leads to a more emotional than rational decision process, and often results in blind trust.

Several studies reveal that the confidence people have in institutions influences their level of risk perception: The higher the confidence in an institution the lower the risk perception and vice versa [15, 16]. The „risk-survey Baden-Wurttemberg 2001“ [17] for example ascertained, that the acceptance or non-acceptance of genetic engineering was determined by the confidence in the problem solution capacities of the institutions involved. Lacking confidence especially in the competence of the government to cope with a problem resulted in feelings of powerlessness that lead to a considerable change of their affective assessment and their risk-benefit evaluation.

So far, there have only been a few studies that analyze the level of public trust in the actors and institutions that are involved in the implementation and regulation of hydrogen applications in the automotive sector.

- In an opinion poll on “Public Engagement with Hydrogen Infrastructures in Transport” 1003 participants were asked to what extent they agree or disagree with the statement “Modern science can be relied on solving our environmental problems.” 40 % agreed with this statement, 33 % disagreed and 25 % were neutral [18].
- A total of 12 focus groups were held in April and May of 2007 [18, 19]. Some participants of the focus groups didn't trust the government or the industry to initiate the changes necessary for a hydrogen society. They questioned the government's will to act because of vested interests and the amount of effort that was necessary. The participants didn't believe in the willingness of the government or the petrochemical industry to change the current situation as they considered them as being too reliant on the income generated from the production and taxation of fossil fuels.

In the context of the German H₂ mobility project – that brings nine leading companies from the automotive, petroleum and gas industry as well as an energy provider together, in order to push the nationwide build-up of hydrogen fuelling stations – it is essential to reflect these results in the German context and analyze different kinds of trust: The trust in specific institutions and the trust in the technological system as a whole.

3 The HyTrust Project

The German HyTrust project was launched in autumn 2009 (www.hytrust.de) and is the socio-scientific research project that accompanies the German Federal Government's "National Innovation Programme for Hydrogen and Fuel Cell Technologies". The aim of the project is to investigate

- the current state of public acceptance in hydrogen technology
- the level of public familiarity with hydrogen technologies and the public's trust in the actors who are engaged in the technological implementation
- ideas and methods for the effective and successful deployment of hydrogen technology in the mobility sector

In a first step statements and position papers of German institutions with regard to hydrogen and fuel cells have been analyzed in order to identify the general disposition towards hydrogen and fuel cell technologies in Germany. In recent years, more than 80 institutions have publicly commented on hydrogen technologies. Most position papers came from the political and industrial spheres. Most papers indicate a very positive view of hydrogen and related technologies. The main reasons that were given for support were:

- hydrogen facilitates sustainable mobility as fuel for cars
- the use of hydrogen greatly reduces pollution
- hydrogen increases the use of renewable energies in the future energy supply
- hydrogen technologies contribute to climate protection because they produce no greenhouse gases
- hydrogen based technologies strengthen the economic competitiveness of Germany
- hydrogen technologies guarantee the energy supply of the future
- hydrogen technologies are able to reduce the dependency on foreign oil and gas

In a second step interviews were conducted and focus groups were held with citizens from Berlin and Hamburg. The aim was to understand how people perceive hydrogen technologies and what future concepts citizens have for this technology. The working hypothesis being, that mental images and associations with hydrogen and hydrogen cars are a good indicator on how the technology will be framed by the public. Associations with "hydrogen" were mostly neutral and revolved around topics like chemistry, fuel cell cars and buses. One main positive association was that hydrogen enables mobility without the use of fossil fuels. There were only very few associations with the hydrogen bomb or the zeppelin disaster. Associations with "hydrogen cars" were almost completely positive. In the view of the citizens, hydrogen cars were a desirable technology for the future, because the cars are environmentally friendly, quiet and clean. The few negative associations were not linked to risks but to specific features of the car. From the citizen's perspective hydrogen cars appeared slower, less powerful and more expensive than conventional cars.

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