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Assessing Consumer Preferences for Hydrogen Driven Road-Sweepers

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1 The Demonstration Project “hy.muve”

The Swiss Federal Laboratories for Materials Testing and Research (Empa) and the Paul Scherrer Institute (PSI), two Swiss research institutions in the field of future powertrain technologies developed in collaboration with industrial partners a prototype fuel cell street-sweeper which is close to a pre-production series. The vehicle now undergoes operational testing on the streets of various cities in Switzerland.

In view of their driving profile (fleet operation from a fixed refuelling point, possibility to operate such vehicles in pedestrian areas and even indoor, etc.) road-sweepers appear particularly well suited for a soon niche market introduction of fuel cells and a possible early commercialization.

Besides technical investigation, the project called “hy.muve” (“hydrogen-driven municipal vehicle”) also serves as a research platform for socio-economic studies focusing on non-technical challenges for the implementation of fuel cell and hydrogen technology and its public acceptance. Promising market introduction strategies will be developed.

Figure 1: CityCat H_2 – The prototype fuel cell street-sweeper.

2 Niche Market Research

Only a few studies already exist analyzing the acceptance of hydrogen and hydrogen technologies in the general public (which include both potential users and non-users). Yetano Roche et al. (2009) recommend developing further the use of non-market valuation approaches for investigating demand for hydrogen fuel cell vehicles on a large scale, as strong and robust quantitative evidence is still relatively scarce. They also suggest a whole-system perspective, looking at hydrogen technologies in the context of other competing technologies. With our study we aim at making an important contribution to this field of research.

A sound knowledge about the current state of preferences and determinants of demand of consumers is required, as this is of great importance for introducing a new, innovative technology into the market, or niche market respectively. In contrast to a technological niche, a niche market is defined not around a particular technology, but around a set of performance attributes. Levinthal (1998, p. 220) characterizes niches as *"populations of (potential) consumers [that] are distinguished by the functionality they desire and their willingness to pay for these various attributes."*

This begs the following questions: Which attributes are relevant for the purchase decision of street-sweeper users? Which trade-offs are they willing to make? Does a niche market for hydrogen driven street-sweepers exist? What preferences do the target groups beyond this possible eco-niche have? Innovators (the technology enthusiasts and environmentally active consumers) may not be representative for early adopters and the other target groups beyond the eco-niche, as they are more price-sensitive or less environmentally active (see figure 2).

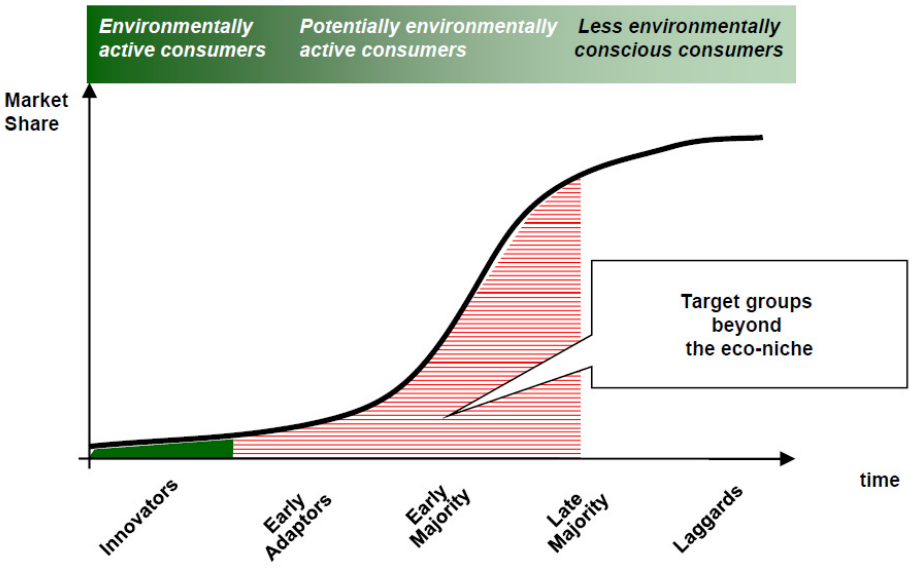

Figure 2: From eco-niche to mainstream market.
Source: Derived from Wüstenhagen (2000) & Moore (1999)

There are challenges in doing research for innovative, environmental products: When it comes to environmental issues people have a tendency to provide socially desirable answers. This means that the more direct they are asked, the more biased they will answer

and this may lead to an overestimation of people's willingness to buy sustainable products. So what can be done? One possible solution is to use more sophisticated quantitative methods that avoid socially desirable answers like the choice experiment approach.

3 Choice Experiments in Eco-Innovation Research

Choice experiments have been widely used in market research for product innovation, and can be beneficial for eco-innovation research, too. Hence, we conducted an online survey with choice experiments implying 1'600 choice decisions by 160 respondents in Switzerland, to determine users preferred street-sweeper.

Our study extends previous research on consumer preferences in two ways.

First, most past research has been conducted about individual consumer (or household) preferences for alternative fuelled vehicles. This research focuses on fleet buyers' preferences, as fleet managers are a very promising target group for early testing and implementing of new drive train technologies (compare Nesbitt & Sperling (1998)). A grounded understanding of fleet purchase behaviour will lead to more effective marketing and policy strategies. Second, in addition to the typical vehicle-choice predictors (e.g. price) we also considered noise emissions.

In the choice experiment, the respondent is presented to a number of choice situations and asked to choose the most preferred. Specifically, respondents were provided with descriptions of three street-sweeper types: (1) conventional diesel vehicles (defined as the status quo), (2) vehicles which run on compressed natural gas/biogas, and (3) hydrogen driven ones. The use of different alternatives allows for the analysis of hydrogen in the context of other competing technologies.

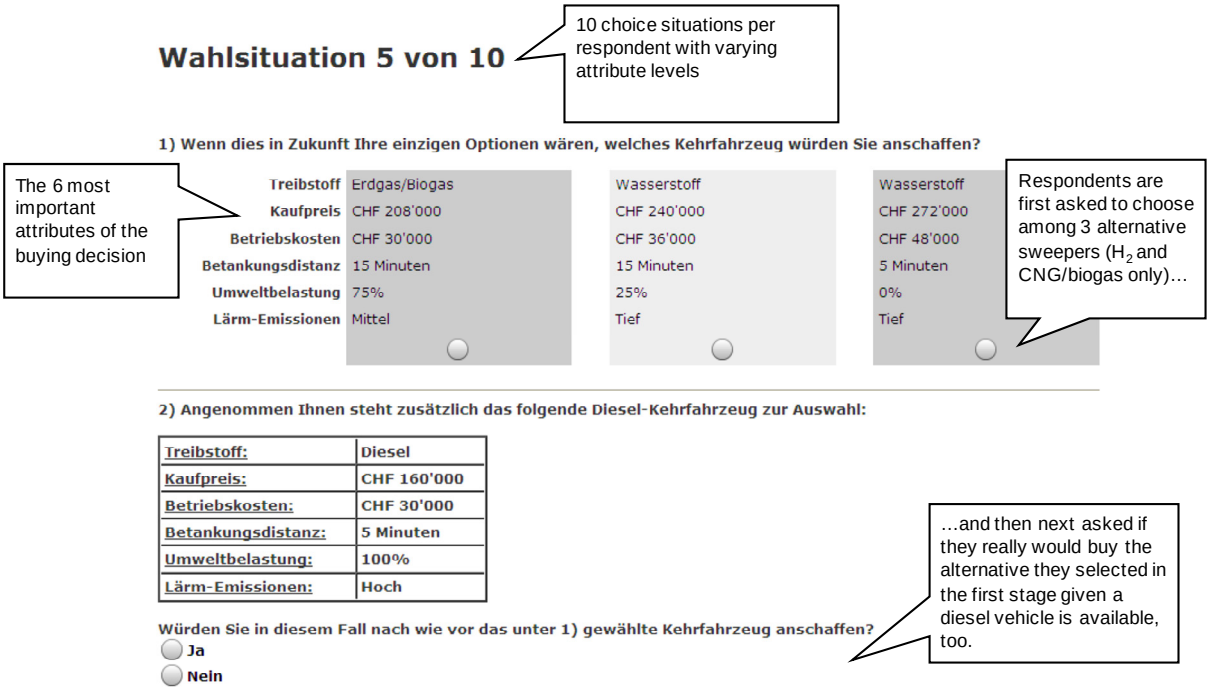

Figure 3: Sample Choice Situation.

Through expert interviews and a literature review, we identified the most relevant attributes for road-sweepers. The attributes include (1) fuel type, (2) purchase price, (3) running costs, (4) refuelling distance (i.e., the time it takes to drive the road-sweeper to the next refuelling station), (5) polluting emissions, and (6) noise emissions. In addition to these six attributes, respondents were told to assume that the street-sweepers are identical in all other aspects (e.g. cruising range and reliability).

4 First Results

By using Hierarchical Bayes estimation we determined customer preferences and the importance of product attributes in vehicle choice. This procedure makes it possible to simulate different market scenarios based on stated preferences and to answer strategic questions such as communication or pricing strategies. A first selection of scenarios will be presented at the conference. We also conducted “sensitivity analysis” for the attributes. For example, the relative price sensitivity (e.g. a 10% raise in price) can be used to generate relative demand curves.

One of the most frequently cited rationales for targeting fleets for the introduction of a new drive train technology is that they often refuel their vehicles at one location (on-site or central refuelling). Therefore it would be interesting to see whether the street-sweeper fleet’s refuelling practices could potentially mitigate the “chicken-or-egg” quandary of marketing fuel cell vehicles in the absence of a public refuelling station network. Furthermore we will present whether our results are consistent with the findings from previous studies which state a low level of public awareness and knowledge of hydrogen and its associated technologies.

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