Elicitation of Preferences Regarding Electric Mobility Charging Behavior

Stefanie Wolff, Hendrik Schmitz, and Reinhard Madlener
Institute for Future Energy Consumer Needs and Behavior (FCN), School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University, Mathieustrasse 10, 52074 Aachen, Germany, +49 241 80 49820, swolff@eonerc.rwth-aachen.de, hschmitz@eonerc.rwth-aachen.de, RMadlener@eonerc.rwth-aachen.de

Overview

Electric mobility charging behavior is the focal point between the sustainable energy and sustainable mobility transitions. The energy transition is characterized by a reduction of fossil fuel usage as well as of related CO_2 emissions in the energy sector, while the mobility transition aims at achieving these goals in the transport sector, and especially the individual transport subsector, and includes changes in the mobility behavior towards more sustainable solutions. The electric vehicle (EV) charging possibilities should adapt to both the energy transition and mobility transition. From a user perspective, standard charging of the EV battery takes considerably longer than filling the gasoline tank. Thus, EV charging options will have to be adjusted to better fit human expectations, needs, and behavior.

Consequently, it is crucial to understand the charging preferences of current and potential future EV drivers in a more mature EV market. In the literature, there are studies that investigate single attributes of the charging process; Hackbarth and Madlener (2013, 2016), Hidrue et al. (2011), and Tanaka et al. (2014), for instance, investigate the willingness to pay (WTP) for the EV adoption whereas Ito et al. (2013) examine the willingness to pay for the EV-charging infrastructure. Franke et al. (2012) find factors influencing range anxiety. However, none of the mentioned studies has looked at the charging preferences as a whole including related services.

Therefore, the aim of our study is to assess EV drivers' valuation of different attributes of the charging process such as charging speed, location, and price. Valuation means the WTP for specific attributes, measured in monetary terms, e.g. a 10% decrease in charging duration is worth x Euros to consumers. By extracting consumers' marginal WTP, we elicit by how much attributes have to be improved so that the WTP increases over-proportionately. We then derive managerial implications both for specific attributes and for complete mobility solutions. For example, if EV drivers assign a high value to the charging duration, this could be an area to place additional focus on when offering new charging solutions and services.

Methods

Due to the low number of current EV users in Germany, analyzing consumers' preferences and their WTP for them based on real usage data is challenging. In addition, the results would not be transferable to the development of sound business cases since the sample size would be too low. Therefore, we gather data through a Discrete Choice Experiment (DCE) conducted in Germany. We analyze the data using econometric methods in order to gain actionable insights into current and future charging behavior of EV drivers.

Results

As a result of the experiment, we predict tendencies of consumer behavior and show which attributes are highly valued by potential EV drivers and which ones are not. These consumers can be divided ex-post into specific adopter categories (e.g. first movers, early adopters, laggards) and driver segments (e.g. homeowner, streetlamp parker, commuter, car-sharer), respectively.

References

Franke, Thomas; Neumann, Isabel; Bühler, Franziska; Cocron, Peter; Krems, Josef F. (2012): Experiencing Range in an Electric Vehicle. Understanding Psychological Barriers. In Applied Psychology 61 (3), pp. 368–391. DOI: 10.1111/j.1464-0597.2011.00474.x.

Hackbarth, André; Madlener, Reinhard (2013): Consumer preferences for alternative fuel vehicles. A discrete choice analysis. In Transportation Research Part D: Transport and Environment 25, pp. 5–17. DOI: 10.1016/j.trd.2013.07.002.

Hackbarth, André; Madlener, Reinhard (2016): Willingness-to-pay for alternative fuel vehicle characteristics. A stated choice study for Germany. In Transportation Research Part A: Policy and Practice 85, pp. 89–111. DOI: 10.1016/j.tra.2015.12.005.

Hidrue, Michael K.; Parsons, George R.; Kempton, Willett; Gardner, Meryl P. (2011): Willingness to pay for electric vehicles and their attributes. In Resource and Energy Economics 33 (3), pp. 686–705. DOI: 10.1016/j.reseneeco.2011.02.002.

Ito, Nobuyuki; Takeuchi, Kenji; Managi, Shunsuke (2013): Willingness-to-pay for infrastructure investments for alternative fuel vehicles. In Transportation Research Part D: Transport and Environment 18, pp. 1–8. DOI: 10.1016/j.trd.2012.08.004.

Tanaka, Makoto; Ida, Takanori; Murakami, Kayo; Friedman, Lee (2014): Consumers? Willingness to pay for alternative fuel vehicles: A comparative discrete choice analysis between the US and Japan. In Transportation Research Part A: Policy and Practice 70, pp. 194–209. DOI: 10.1016/j.tra.2014.10.019.