



## Actual preferences for EV households in Denmark and Sweden

Jensen, Anders Fjendbo; Haustein, Sonja; Cherchi, Elisabetta; Thorhauge, Mikkel

*Publication date:*  
2017

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

*Citation (APA):*

Jensen, A. F., Haustein, S., Cherchi, E., & Thorhauge, M. (2017). Actual preferences for EV households in Denmark and Sweden. Abstract from The VI European Association for Research in Transportation (hEART) Symposium, Haifa, Israel.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## Actual preferences for EV households in Denmark and Sweden

Anders Fjendbo Jensen\*, Sonja Haustein\*\*, Elisabetta Cherchi\*\*\*, Mikkel Thorhauge\*

\*Division of Transport Modeling, DTU Management Engineering, Technical University of Denmark

\*\* Division of Technology and Innovation Management, DTU Management Engineering, Technical University of Denmark

\*\*\*Transport Operations Research Group, School of Civil Engineering and Geoscience, Newcastle University

Battery electric vehicles (EVs) have received vast attention in the recent decade, especially due to their potential environmental benefits. The car industry has invested huge amounts in the battery electric vehicle technology, leading to a much larger selection of car models with better comfort, driving range and options for recharging the batteries. Several studies have indicated that a great share of car households would now be able to maintain their current mobility patterns with only a minor level of adaption (Christensen 2011; Pearre et al. 2011; Greaves et al. 2014). Still, the driving range of a fully recharged EV is of great importance to the potential users (Jensen et al. 2013; Dimitropoulos et al. 2013; Mabit & Fosgerau 2011; Franke & Krems 2013), but as the battery capacity of the EVs continue to increase, the mobility constraints related to former EV models will most probably be reduced. Thus, the EV alternative has changed from being a product for a very small group of enthusiasts to being an actual car alternative for a common household and knowledge about which type of households would be interested in EVs is extremely valuable for both industry and policy makers. However, as the EV market is still quite immature in most countries, lack of data on EV users is a common problem for researchers. Data on EV purchase and use have thus often been collected by means of data from intentional statements (see e.g. Bühler et al. 2014), stated preferences (see e.g. Bunch et al. 1993; Hidrue et al. 2011; Jensen et al. 2014) and EV vehicle trials (Golob & Gould 1998; Franke & Krems 2013; Jensen et al. 2014). While such studies have provided important insight into various areas of the EV market, the fact that the results are not based on actual behaviour means that they are subject to a high degree of uncertainty. Being the global EV market forerunner, Norway has a better foundation for studying the EV market based on actual EV owners. On these grounds, Klöckner et al. (2013), studied differences in car use between EV and conventional vehicle (CV) users. Also in Norway, Mersky et al. (2016) and Bjerkan et al. (2016) both studied the effect of policy incentives on EV purchase.

Compared to these existing studies, we contribute to the literature with a more advanced model to study the EV market and we focus on the market in Denmark and Sweden. In particular, we use revealed preference information to investigate how household characteristics, attitudes, norms, perceived barriers and perceived functional attributes of the EVs affect the probability of being an EV household. The data utilized in this study was collected in connection with the EU project GREAT, which aims to reduce fossil emissions by improving supply for alternative-fuelled vehicles in northern Europe. Besides detailed individual and household characteristics from a sample of both EV and CV household users, the data contains detailed information on individual determinants of EV adaption based on the Theory of Planned Behaviour (Ajzen 1991).

Data were collected through an online survey in Sweden and Denmark. The Swedish study was distributed through different channels including the intranet of regions Skåne and Västra Götaland,

different newsletters and EV related facebook groups. In Denmark, EV users were contacted via the infrastructure provider E.ON, while the CV users were contacted through the online panel of the market research institute EPINION. In total 1364 observations are available for Denmark and 1288 for Sweden. Descriptive statistics of the sample show that EV respondents were to a much higher extent male, had a higher household income and higher education level and were more often self-employed, lived less often alone and more often had children compared to CV users. Comparing Tesla users to other EV users, we found that Tesla users perceived less functional barriers in terms of EV usage, had more positive affective attitudes related to driving an EV and felt to a higher degree supported by relevant others to use/buy an EV (subjective norm). Interestingly, they did not report more positive symbolic attitudes in relation to their EV ownership.

We modelled the probability of being an EV household with an advanced discrete choice model, taking both household characteristic and the latent determinants of EV adoption into account. A preliminary hybrid choice model with a latent variable for perceived barriers and most relevant household characteristics is presented below for the Danish sample.

	Value	Robust t-test	p-value
<i>Choice Model</i>			
Alternative Specific Constant, EV	5.2	7.86	0
Number of adults in household	-0.167	-1.75	0.08
Number of children in household	-0.12	-1.24	0.21
Potential access to homecharging dummy	1.44	7.92	0
Household income, DKK	0.402	7.62	0
Degree of perceived barriers	-1.6	-11.83	0
Female dummy	-2	-9.15	0
<i>Latent Variable Model, Structural model</i>			
Intersect	4.8	45.92	0
Standard deviation of error term	0.0227	0.9	0.37
Number of adults in household	-0.0652	-1.95	0.05
Number of children in household	-0.0649	-1.96	0.05
Potential access to homecharging dummy	-0.466	-7.1	0
Household income, DKK	-0.0896	-5.27	0
<i>Latent Variable Model, Measurement equation</i>			
Indicator 1, standard deviation	-0.445	-11.48	0
Indicator 2, intercept	0.568	6	0
Indicator 2, attitude parameter	0.885	37.64	0
Indicator 2, standard deviation	-0.462	-11.78	0
Indicator 3, intercept	2.42	19.86	0
Indicator 3, attitude parameter	0.541	18.74	0
Indicator 3, standard deviation	-0.214	-10.06	0
Indicator 4, intercept	0.449	4.37	0
Indicator 4, attitude parameter	0.907	34.23	0
Indicator 4, standard deviation	-0.324	-9.42	0

Indicator 5, intercept	1.66	13.41	0
Indicator 5, attitude parameter	0.715	23.95	0
Indicator 5, standard deviation	-0.183	-7.51	0

The most relevant variables in the choice model are highly significant and with the expected sign. EV households are more likely to have a higher income and have access to a private parking place where home charging can be installed. Furthermore, these results indicate that EV owners are more likely men, which contradicts with previous studies based on stated preferences (Jensen et al. 2013; Glerum et al. 2013). Finally, the results indicate that EV ownership is related to a lower degree of perceived barriers related to EV use. Looking further into the structural model, it is seen that especially potential access to homecharging and income relates to a lower perceived barrier related to EV use, which is in line with our expectations.

This study will further advance by testing all relevant household characteristics and latent variables including subjective and personal norm, symbolic and affective attitudes and lifestyle characteristics. Besides testing different specifications of hybrid choice models, a latent class model based on the latent constructs will be tested. In order to test differences across Denmark and Sweden, the model will be estimated jointly on the two datasets taking possible scaling differences into account.

## References

- Ajzen, I., 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), pp.179–211.
- Bjerkan, K.Y., Nørbech, T.E. & Nordtømme, M.E., 2016. Incentives for promoting Battery Electric Vehicle (BEV) adoption in Norway. *Transportation Research Part D: Transport and Environment*, 43, pp.169–180.
- Bunch et al., 1993. Demand for clean-fuel vehicles in California: a discrete-choice stated preference pilot project. *Transportation Research, Part A: Policy and Practice*, 27(3), pp.237–253.
- Bühler, F. et al., 2014. Is EV experience related to EV acceptance? Results from a German field study. *Transportation Research Part F: Traffic Psychology and Behaviour*, 25, pp.34–49.
- Christensen, L., 2011. *EDISON Report WP 1.3 Electric Vehicles and the Customers*, Available at: [http://www.edison-net.dk/Dissemination/Reports/Report\\_011.aspx](http://www.edison-net.dk/Dissemination/Reports/Report_011.aspx).
- Dimitropoulos, A., Rietveld, P. & van Ommeren, J.N., 2013. Consumer valuation of changes in driving range: A meta-analysis. *Transportation Research Part A: Policy and Practice*, 55, pp.27–45.
- Franke, T. & Krems, J.F., 2013. What drives range preferences in electric vehicle users? *Transport Policy*, 30(1), pp.56–62.
- Glerum, A. et al., 2013. Forecasting the Demand for Electric Vehicles: Accounting for Attitudes and Perceptions. *Transportation Science*, 48(4), pp.483–499.
- Golob, T.F. & Gould, J., 1998. Projecting use of electric vehicles from household vehicle trials. *Transportation Research Part B: Methodological*, 32(7), pp.441–454. Available at: <http://www.sciencedirect.com/science/article/pii/S0191261598000010>.

- Greaves, S., Backman, H. & Ellison, A.B., 2014. An empirical assessment of the feasibility of battery electric vehicles for day-to-day driving. *Transportation Research Part A: Policy and Practice*, 66(0), pp.226–237.
- Hidrué, M.K. et al., 2011. Willingness to pay for electric vehicles and their attributes. *Resource and Energy Economics*, 33(3), pp.686–705.
- Jensen, A.F., Cherchi, E. & Mabit, S.L., 2013. On the stability of preferences and attitudes before and after experiencing an electric vehicle. *Transportation Research Part D: Transport and Environment*, 25, pp.24–32.
- Jensen, A.F., Cherchi, E. & Ortúzar, J. de D., 2014. A long panel survey to elicit variation in preferences and attitudes in the choice of electric vehicles. *Transportation*, 41(5), pp.973–993.
- Klößner, C.A., Nayum, A. & Mehmetoglu, M., 2013. Positive and negative spillover effects from electric car purchase to car use. *Transportation Research Part D: Transport and Environment*, 21, pp.32–38.
- Mabit, S.L. & Fosgerau, M., 2011. Demand for alternative-fuel vehicles when registration taxes are high. *Transportation Research Part D*, 16(3), pp.225–231.
- Mersky, A.C. et al., 2016. Effectiveness of incentives on electric vehicle adoption in Norway. *Transportation Research Part D: Transport and Environment*, 46, pp.56–68.
- Pearre, N.S. et al., 2011. Electric vehicles: How much range is required for a day's driving? *Transportation Research Part C: Emerging Technologies*, 19(6), pp.1171–1184.