Eliciting Occupants' Preferences for Direct Load Control in Residential Buildings: A Discrete Choice Experiment

Constanze Liepold, Institute for Future Energy Consumer Needs and Behavior (FCN), School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University, +49 241 80 49832, Constanze.liepold@eonerc.rwth-aachen.de
Reinhard Madlener, Institute for Future Energy Consumer Needs and Behavior (FCN), School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University; Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology (NTNU), 7491 Trondheim, Norway, +49 241 80 49820, RMadlener@eonerc.rwth-aachen.de

Overview

This study investigates Direct Load Control (DLC) acceptance and tariff preferences in Germany, Austria, and Switzerland, analyzing data from more than 10,000 respondents to examine regional differences and the role of financial compensation and socio-economic factors. Previous research has investigated DLC preferences in specific contexts, such as socio-demographic characteristics in Mayotte, Comoro Islands (Schöne et al., 2022), residential motivators in Finland (Sridhar et al., 2023), and acceptance in the U.S. during summer conditions (Xu et al., 2018). Studies like Yilmaz et al. (2022) have explored preferences for specific devices, such as heat pumps and Battery Electric Vehicles (BEVs), in Switzerland. However, these studies often focus on individual regions or devices only and lack a cross-national analysis that considers the role of socio-economic differences in shaping preferences. These gaps are adressed in the present study by providing a comprehensive cross-national analysis, and emphasizing the need to consider socio-economic and regional differences when designing effective and publicly accepted DLC programs.

Methods

This study employed a Discrete Choice Experiment (DCE) for assessing DLC acceptance and preferences. Participants were asked to choose between various tariff options based on attributes such as financial compensation, types of devices controlled (e.g., battery storage, BEVs, heat pumps), frequency, and the duration of control measures. The sample included approximately 5,000 respondents from Germany and 2,500 each from Austria and Switzerland. Additionally, socio-economic status (SES) indicators were derived using education, income, and occupation variables combined through principal component analysis (PCA). Energy-related financial literacy was also measured to understand participants' awareness and decision-making capabilities regarding energy consumption and tariffs.

Results

The results reveal that the control of BEVs is consistently the least preferred option across all three countries, while battery storage emerges as the most favored device for direct control. Preferences for other devices, such as heat pumps and air conditioning, show notable variations between Germany, Austria, and Switzerland, underscoring the importance of regional tailoring in DLC program designs. Financial compensation and the type of device controlled were identified as the most critical factors influencing DLC acceptance. Furthermore, socio-economic factors, such as the SES indicators, where found to play a significant role in shaping preferences.

Conclusions

The findings underscore the importance of designing DLC programs that address regional and socio-economic differences. Tailored programs that offer appropriate financial incentives and target preferred devices are more likely to achieve higher acceptance rates. Future research should focus on refining tariff designs and exploring the socio-economic drivers of DLC acceptance in greater depth.

References

Liepold, Constanze; Madlener, Reinhard (2025). What Will You Accept? - An Analysis of Occupants' Preferences For Direct Load Control in Residential Buildings, FCN Working Paper xx/2025 (in prep.)

Schöne, Nikolas; Greilmeier, Kathrin; Heinz, Boris (2022): Survey-Based Assessment of the Preferences in Residential Demand Response on the Island of Mayotte. In: Energies 15 (4), S. 1338. DOI: 10.3390/en15041338.

Sridhar, Araavind; Honkapuro, Samuli; Ruiz, Fredy; Stoklasa, Jan; Annala, Salla; Wolff, Annika; Rautiainen, Antti (2023): Residential consumer preferences to demand response: Analysis of different motivators to enroll in direct load control demand response. In: Energy Policy 173, S. 113420. DOI: 10.1016/j.enpol.2023.113420.

Xu, Xiaojing; Chen, Chien-fei; Zhu, Xiaojuan; Hu, Qinran (2018): Promoting acceptance of direct load control programs in the United States: Financial incentive versus control option. In: Energy 147, S. 1278–1287. DOI: 10.1016/j.energy.2018.01.028.

Yilmaz, Selin; Chanez, Cédric; Cuony, Peter; Patel, Martin Kumar (2022): Analysing utility-based direct load control programmes for heat pumps and electric vehicles considering customer segmentation. In: Energy Policy 164, S. 112900. DOI: 10.1016/j.enpol.2022.112900.