

# **REGIONAL FLEXIBILITY MARKETS AND FLEXIBLE USE OF RESIDENTIAL HEAT PUMPS: EMPIRICAL FINDINGS FROM A CHOICE EXPERIMENT AMONG GERMAN HOUSEHOLDS**

Jonas Bender, Institute of Economics, University of Kassel, +49 561 804 3825, jonas.bender@uni-kassel.de

Larissa Fait, Institute of Economics, University of Kassel, +49 561 804 1959, larissa.fait@uni-kassel.de

Heike Wetzel, Institute of Economics, University of Kassel, +49 561 804 7750, heike.wetzel@uni-kassel.de

## **Overview**

The growing share of renewables is increasingly leading to an imbalance of energy supply and demand in the regional and local electricity distribution grids. Accordingly, the need for flexibility in grid balancing is also growing. While a balancing energy market with ancillary services providing flexibility in the transmission grid is already established, regional flexibility markets involving residential households are still in a research stage. Currently, grid operators have a limited possibility to request flexibility on a regional or local stage. One solution could be regional flexibility markets (RFMs) for trading flexibility. Initial studies on RFMs show that economic design parameters are important (Mengelkamp et al., 2019), but also intrinsic participation factors such as community identity, affinity to technology and the importance of green products play a role (Mengelkamp et al., 2018).

Richter and Pollitt (2018) investigated residential preferences for electricity service contracts. They suggest a fixed and transaction based payment to compensate remote monitoring and control of appliances by the service provider. Evidence for usage implications and controllability is given in Kubli et al. (2018). They investigated the co-creation of flexibility by households and found a lower willingness to provide flexibility by heat pump users compared to users of PV+storage and battery electric vehicles. In contrast, Ruokamo et al. (2019) found a lower sensitivity to restrictions in electric heating than for restrictions in electricity usage of household appliances e.g. dishwashers, washing machines and tumble dryers. Based on their findings, it seems reasonable to integrate in particular heat pumps into RFMs. Therefore, in this paper we investigate household preferences for integrating heat pumps in RFMs and whether these preferences are affected by the provision of different information to the households such as information on the reduction of grid expansion needs and environmental protection. Thereby, we focus on a number of contract modalities for providing flexibility such as monthly compensation, frequency of calls and other service attributes.

## **Methods**

We are carrying out an empirical study. In January 2020 we started to contact customers of a big distribution grid operator in Hesse, Germany, who already own a renewable power plant. In total, 40.000 customers will be contacted. We expect the data collection to be finished at the end of February 2020. The survey is conducted online, using the surveytool QuestionPro. In addition to questions on socio demographic characteristics, environmental attitudes and economic preferences, the survey includes a stated choice experiment in order to determine preferences for providing net-benefiting flexibility with heat pumps.

The choice experiment consists of five attributes: i) monthly compensation, ii) maximum number of flexibility calls per month, iii) guaranteed minimum room temperature in case of a call, iv) frequency of information provision about the occurred calls and v) personal influence on the interruption of calls. Each choice set captures three unlabeled alternatives (or rather contracts) and an optout option, i.e. "I choose non of these options". In total, each respondent has to answer six choice sets. The choices of the respondents in each choice set will show what tradeoffs they have made between each attribute and thus reveal their preferences for the different attributes. In addition, we use different information treatments in order to determine the effects of additional information on the choice preferences. Buryk et al. (2015) show that additional information on the environment has an impact on the choice preferences for dynamic tariffs. Therefore we implemented two information treatments about the reduction of grid expansion needs and the importance of environmental protection.

For our analysis, we will use mixed logit models (MLM) which are more flexible than e.g. multinomial or conditional logit models. By this, we will get evidence for the preferences and prices of requested flexibility from residential heating systems. Altogether, our investigations allow us to determine the preferences for the provision of flexibility via heat pumps in RFMs and to examine whether certain information flows have an additional influence on these preferences.

## Results

We expect insights into the preferences of residential customers who could potentially participate with their heat pumps in RFMs and offer flexibility by increasing or decreasing their demand of electric heating. Based on previous studies, we expect that a decrease in the guaranteed minimum room temperature and an increase in the maximum number of flexibility calls per month have a negative effect on flexibility offers, whereas a higher personal influence on the interruption of a call, a higher frequency of information provision about the occurred calls and a higher monthly compensation are positively related to flexibility offers. Further, according to the findings from Buryk et al. (2015), the information treatments on the reduction of grid expansion needs and the importance of environmental protection via renewable energy production should positively affect the provision of residential flexibility in RFMs.

## Conclusions

With an increasing market penetration of heat pumps in residential buildings the electricity demand raises. However, this also enhances the potential to use flexibility of residential costumers in the heating sector. In our study we contribute to overcome the problem of matching demand and supply in regional and local distribution grids. To encourage residential customers to participate in RFMs, it is crucial to analyse their preferences for heating in conjunction with flexibility requests. Therefore, our results will help to answer the questions of willingness to participate in RFMs and the required contract design in order to motivate customers to provide flexibility.

## References

- Buryk, S., Mead, D., Mourato, S., Torriti, J. (2015): Investigating preferences for dynamic electricity tariffs: The effect of environmental and system benefit disclosure. In: *Energy Policy* 80, S. 190–195. DOI: 10.1016/j.enpol.2015.01.030.
- Kubli, M., Loock, M., Wüstenhagen, R. (2018): The flexible prosumer: Measuring the willingness to co-create distributed flexibility. In: *Energy Policy* 114, S. 540–548. DOI: 10.1016/j.enpol.2017.12.044.
- Mengelkamp, E., Schönland, T., Huber, J., Weinhardt, C. (2019): The value of local electricity - A choice experiment among German residential customers. In: *Energy Policy* 130, S. 294–303. DOI: 10.1016/j.enpol.2019.04.008.
- Mengelkamp, E., Staudt, P., Gartner, J., Weinhardt, C., Huber, J. (2018): 2018 15th International Conference on the European Energy Market (EEM). 27-29 June 2018. Piscataway, NJ: IEEE. Online verfügbar unter <http://ieeexplore.ieee.org/servlet/opac?punumber=8456920>.
- Richter, L., Pollitt, M. (2018): Which smart electricity service contracts will consumers accept? The demand for compensation in a platform market. In: *Energy Economics* 72, S. 436–450. DOI: 10.1016/j.eneco.2018.04.004.
- Ruokamo, E., Kopsakangas-Savolainen, M., Meriläinen, T., Svento, R. (2019): Towards flexible energy demand – Preferences for dynamic contracts, services and emissions reductions. In: *Energy Economics* 84, S. 104522. DOI: 10.1016/j.eneco.2019.104522.