WHAT ARE CONSUMERS WILLING TO PAY FOR RESIDENTIAL HEATING SYSTEMS IN GERMANY?

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Overview

In the fight against climate change, the decarbonization of global energy systems is essential. At the level of private households, besides power supply and mobility, residential heating is a major driver of greenhouse gas emissions in many regions of the world. For the EU 27, around 64% of energy consumption in private households was used for space heating, representing almost 17% of final energy consumption within the EU in 2020 [1]. Together with the establishment of an energy-efficient building stock, decarbonization efforts in the heating sector must advance the use of alternative technologies for heat generation, thus phasing out the use of fossil fuels, which currently are predominant. For the case of Germany, half the housing stock was heated with natural gas and another quarter with heating oil in 2020 [2]. Even in new homes, natural gas is still frequently used [3].

Since the majority of heat for private households is generated decentrally using fuel oil and natural gas boilers, a change in heat supply crucially depends on individual preferences and decisions of each household. Based on this challenge, our work investigates the preferences of German private households in their decision to purchase alternative heating systems. We ask the questions: To what extent do consumer preferences for certain monetary and non-monetary attributes of heating systems influence the decision-making process? How do these preferences differ with respect to the socioeconomic background of individual households? To answer these questions an online survey including a discrete choice experiment (DCE) was conducted. The resulting data allowed us to estimate the willingness-to-pay (WTP) using a statistical mixed-logit model of different socioeconomic groups in Germany for individual attributes of heating systems.

Methods

For the elicitation of the preferences, we use the quantitative method of the DCE within an online survey. In our case, the experiment was a sequence of eight binary decision scenarios. In each scenario, participants were asked to imagine that a new heating system needed to be installed in their home and therefore they had to make a choice between two alternatives. In each case, two generic heating systems were offered for selection, differing merely in their respective attributes. The basis of the selection of attributes analyzed in the framework of the DCE is threefold: (1) on existing literature which mainly considers monetary attributes like investment and operation cost, as well as sustainability measures [5, 6], (2) on a qualitative analysis focused on preference screening as part of the MANIFOLD project (publication pending) and (3) on the results of a pilot survey, which was performed in 2020, prior to this study also within the MANIFOLD project. Thus, we selected the following attributes for our DCE: (1) investment cost, (2) operating cost, (3) CO_2 emission avoidance, (4) additional time effort during operation, (5) availability of professional installers for planning and implementation and (6) positive signals from the government.

The experiment was implemented as part of an online survey. In addition to the DCE, the survey contained a preceding socioeconomic questionnaire, as well as additional preference questions which were asked in the form of eleven Likert-scale questions.

The data from the DCE was statistically analyzed using a mixed-logit model. The resulting preference parameters for the individual attributes were then converted into willingness-to-pay (WTP) in a second step. The conversion was performed by using the preference parameter for investment cost as a monetary scaling factor. The translation into WTP pursues two objectives. On the one hand, it allows easier interpretation and comparability of the individual attributes, on the other hand, the WTP represents a monetary value, which in turn can serve as an input variable in energy system modelling [7].

Results

Participants show a positive WTP for the avoidance of CO_2 emissions and accept higher investment cost if thereby operating cost and additional effort during operation can be reduced. Additionally, a positive WTP can be observed for heating systems associated with positive political signaling. A possible explanation here is that participants are already expecting further regulatory measures by the government that would disadvantage certain heating systems in the future. The final examined attribute was the degree information regarding planning and installation of the heating system could be retrieved from professional installers or was subject to own research. Participants showed a

significantly positive WTP for the case in which all information regarding the heating system was provided by a professional installer compared to the case in which the information had to be obtained solely through their own research.

In addition to the results for the full sample, we analyzed different socioeconomic groups to gain a better understanding on the heterogeneous nature of the preferences for attributes of the heating systems. In *figure 1*, WTP results for homeowners and renters are displayed separately. Interestingly, renters show a higher WTP for all attributes, indicating a higher sensibility towards high investment cost. A possible explanation for this observation is that the decision of buying a heating system is rather abstract for renters compared to homeowners, thereby inflating their expressed readiness to bear high investment cost. In the full-length manuscript, we will present descriptives of the survey as well as further analysis for different socioeconomic groups.

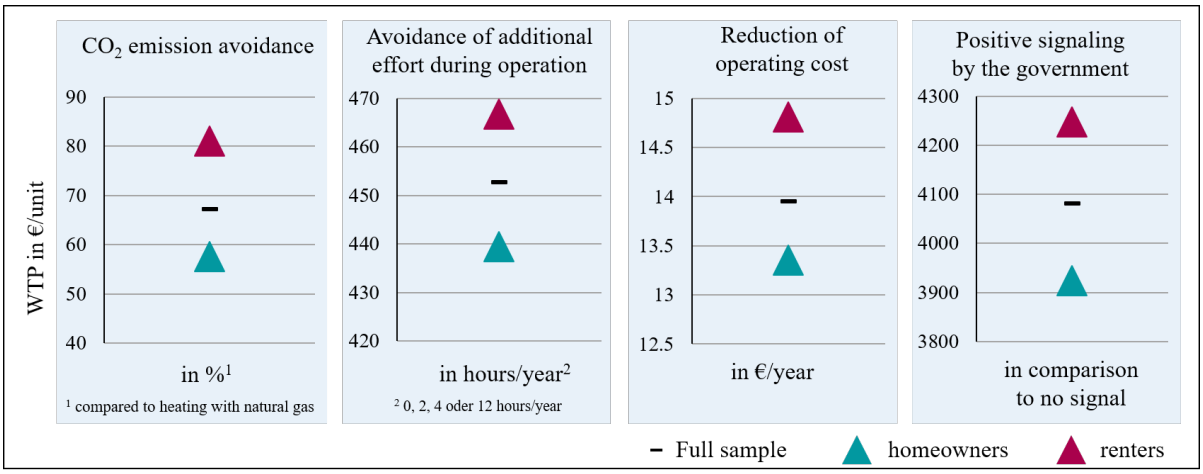

Figure 1. WTP values of renters and homeowners for different attributes of residential heating systems.

Conclusions

In many areas, advances in reduction of greenhouse gas emissions rely crucially on individual decision making. For that reason, understanding consumer preferences and especially differences of these preferences between various socioeconomic groups are of great importance for both, the construction of adequate policy measures for more sustainability, as well as the integration of behavioural aspects in energy system modelling.

Our paper represents an example of WTP-calculation for consumer preferences towards different attributes of generic heating systems in Germany. Similar approaches could be adapted to study preferences for heating systems in other countries. The method could also be transferred to other areas of the energy system, where individual choices are playing an increasingly important role. As input variables for larger energy system models, the results of this work will be used to make projections about the development of the German heating sector in the coming decades.

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