University of Basel

Faculty of
Business and Economics

February 2022

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WWZ Working Paper 2022/03

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Tailored interventions in a major life decision: A home relocation discrete choice experiment*

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Abstract

Major life decisions such as the choice of housing and its characteristics have significant implications for a household and its energy consumption because they alter structural aspects of energy demand. Energy policy interventions targeting these decisions can therefore have a long-lasting impact. To assess non-monetary policy instruments as incentives for energy-conserving housing choices we implement a discrete choice experiment with a representative sample of Swiss households. The purpose of this paper is the investigation of behavioural differences across households in reaction to social norms and energy-related information. To this end, we distinguish different types of households with a segmentation approach useful for policy makers. Our study provides insights for the question whether the tailoring of non-monetary measures can contribute to a more effective policy design compared to a one-size-fits-all approach. Estimating panel mixed logit models, we find treatment effects to significantly differ across household segments as well as with the baseline energy consumption. The evident treatment heterogeneity suggests a targeted approach for non-monetary interventions.

Keywords: Housing choice, household heterogeneity, non-monetary incentives, social norms, energy literacy

* The experiment was designed in collaboration with Paul Burger, Iljana Schubert, Annika Sohre (University of Basel) and Bernadette Sütterlin, Uroš Tomic (Zurich University of Applied Sciences). We are grateful for helpful discussions with and comments from Frank Krysiak, Hannes Weigt, Beat Hintermann, Anne Baumgartner, Beaumont Schoeman, Mine Melzig, as well as from participants of the SCCER Lunch Seminar, EMEE Workshop 2020, EAERE Annual Conference 2020 and SSES Annual Congress 2021. We gratefully received funding for this project from the Swiss Federal Office of Energy as part of the research program Energy-Economy-Society (EES). This research is part of the Swiss Competence Center for Energy Research - Competence Center for Research in Energy, Society and Transition (SCCER CREST). All errors are our own.

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1 Introduction

Tackling climate change requires the implementation of appropriate energy policies to reach zero net emission objectives until 2050 as set for example by the European Union (EU) and Switzerland (European Commission, 2019; Swiss Federal Office of Energy, 2020a). Across all sectors of final energy consumption, efforts have to be made to contribute to energy savings. One target group of such policies are households. The residential sector accounts for a considerable share of final energy consumption (EU: 26.3%; Switzerland: 27.2% in 2019), and additional household energy consumption accrues in the transport sector (European Commission, 2021; Swiss Federal Office of Energy, 2020b). Crucial determinants of household energy demand are thus dwelling characteristics. On the one hand, they affect energy consumed for the purpose of room climate. In Switzerland, households use energy in the residential sector mainly for space and water heating purposes (Kemmler and Spillmann, 2020). Policy measures in this sector therefore focus on energy efficiency for energy savings. On the other hand, dwelling characteristics, notably the dwelling location, also affect mobility-related energy demand. [1] Hence, policy interventions addressing investments in dwellings have the potential to be particularly efficient in the promotion of energy conservation. If targeted at the right stage to influence investment decisions, successful interventions can have a long-lasting impact on the energy consumption of a household through lock-in effects.

In this context, households are not only approached with traditional monetary measures but also with non-monetary measures such as information campaigns and social norms to achieve energy savings. We thus ask whether the use of such soft measures as energy policy tools could be improved by tailoring them to the responsive households compared to a one-size-fits-all approach. Evidence of the effectiveness of non-monetary measures as incentives for energy conservation is mixed (Abrahamse et al., 2005; Nemati and Penn, 2020; Ramos et al., 2015; Allcott, 2011; Farrow et al., 2017). Although a design of policy instruments based on a standard uniform approach might be relatively easy to implement, it fails to capture behavioural differences across different types of households. The sensitivity to social norms for example can vary across households (Kimbrough and Vostroknutov, 2016). In this line of reasoning, we challenge the assumption of a universal susceptibility to soft measures (i.e. social norms, information). We hypothesise that energy conservation behaviour can be influenced more effectively with soft incentives when household heterogeneity is considered.

We address this issue by considering a tailored approach to non-monetary measures in the situation of a home relocation. The dwelling choice is one of the most significant

[1] The dwelling location relative to other important places of daily life determines the commuting distance, which has increased over the last two decades in Switzerland (Swiss Federal Statistical Office, 2021). There are some differences across commuters (i.e. urban vs. rural commuters) though.

household investments with a long-lasting impact on energy conservation. It unites several infrequent decisions about energy-related characteristics at once. Hence when deciding on a new home, dwelling characteristics set a path for future household energy consumption through lock-in effects. We focus on three characteristics that are highly relevant for a household's energy consumption as well as for the quality of life. The first is the size of the living space since it positively influences energy consumption for heating (and cooling) (Viggers et al., 2017). A large living space requires more energy to reach the desired room temperature compared to a small living space. Another relevant dwelling aspect and a central objective of policy efforts is energy efficiency, which is reflected in the structure of a building (i.e. insulation, quality of windows). An energy efficient building is an important factor in sustaining a good room climate without an inefficient loss of energy through the evasion of heat or the intrusion of ambient temperature. Lastly, we consider the choice of the home location relative to places that are frequently travelled to by household members such as the place of work, school, or other daily responsibilities. The shorter the implied commuting distance is the less energy is required for commuting independent of the favoured mode of transport.

Using the setting of a home relocation, we investigate the relevance of differences in household types for the effectiveness of two soft measures. Since home relocation decisions cannot be observed frequently, we conduct a discrete choice experiment with a representative sample of Swiss households to elicit stated choice preferences regarding the size of the living space of a home, its energy efficiency standard, and the implied commuting distance. To incentivize households to choose energy efficient and low energy consuming housing options, two treatments are tested. Experiment participants assigned to a treatment group receive either a social norms or an energy-related information treatment. The benefit of our experiment design is the testing of treatments in choice situations where decision makers face a trade-off between various energy-related attributes. This comes closer to real life decisions instead of a focus on the treatment effects on the choice of for example the energy efficiency alone. Additionally, we exploit comprehensive survey data of our sample to investigate treatment effects in detail. In this manner, household lifestyles as well as baseline energy consumption implied by characteristics of currently inhabited dwellings can be accounted for as sources of treatment effect heterogeneity. We consider different lifestyles approximated by observable household characteristics and segment participants into ex-ante determined distinct types of households. For the analysis of the experiment, we employ a panel mixed logit model.

Our findings show that there are significant differences in treatment effects across treatments and household types. Both tested treatments influence the choice of the housing size but not in all household segments. Across all households, there is only a significant average treatment effect for social norms. The lack of a significant effect

of the information treatment across all households deceives about the significant effect in some of the segments. Mid-age rural households react to both treatments, whereas young urban and senior households only react to the information and the social norms treatment respectively. Households of two other segments showed no reaction to the tested measures in their housing size choices. The direction and the size of the effects depend on the current housing size conditions of the households, which are closely related to the baseline energy consumption. This observation coincides with insights from Andor et al. (2020) who find treatment effects to be context dependent. Our results support heterogeneous treatment effects across different levels of baseline energy consumption. In addition, we contribute evidence for effect heterogeneity across households with different lifestyles. Regarding the choice of the energy efficiency and the dwelling location, we find very limited evidence for an impact of the tested treatments. Overall, these results suggest that tailoring non-monetary incentives can lead to efficiency improvements of policy design.

We contribute to a better understanding of household heterogeneity and its relevance for policy interventions for energy conservation. Despite its importance, there is only a limited amount of studies analysing the variation of non-monetary treatment effects across households (e.g. Schultz et al., 2007; Byrne et al., 2018; Andor et al., 2020). This study offers insights into a major life decision of households, that is the relocation of the home, with a distinction of household lifestyles. The combination of this setting with non-monetary incentives adds novel evidence for the effectiveness of such measures to the literature. By distinguishing household type-specific treatment effects, we provide valuable insights for a more efficient design of policy instruments for the promotion of energy-conscious decisions. Finally, we provide a household segmentation approach to support tailored non-monetary interventions. The use of observable household characteristics as a reflection of lifestyles is a practical approach for policy makers.

The remainder of this paper is organised as follows. Section 2 gives an overview of the relevant literature. Sections 3 and 4 describe the methodology used in this study as well as the data. Results are presented in Section 5 and discussed in Section 6. The paper concludes with Section 7.

2 Literature Review

The modelling of residential location goes back to von Thünen (1826) who suggested the importance of transport costs on activity locations. Several studies have identified different characteristics affecting the residential location preferences, from the characteristics of the residential unit to the accessibility of the residence. Among the residential characteristics, the studies include (i) size, (ii) energy efficiency, and (iii) price.

The dwelling size and type, the number of rooms and bedrooms are important determinants in choosing a residence (Habib and Miller, 2009; Eliasson, 2010 and Guo et al., 2020). For instance, Habib and Miller (2009) uses a retrospective approach combined with a dwelling supply data in Canada and finds that households have a preference for gains in the number of bedrooms. In the same vein, Eliasson (2010) combines the national travel survey and housing survey in Sweden to show that households have a preference for more floor space than less, and for many rooms given the floor space. Instead of a retrospective approach, Guo et al. (2020) designs an integrated pivoted stated choice experiment in China to show that households prefer to have more living space when relocating.

While most studies on residential location choice consider the dwelling size and type, very few studies consider energy efficiency. Studies on the choice behaviour regarding energy efficiency measures have used two different data based on revealed and stated preference methods. The first approach relates to actual choice decisions (see Ayala et al., 2016) while the second method includes interviews and choice experiments (see Banfi et al., 2008 and Kwak et al., 2010). In the Spanish housing market, Ayala et al. (2016) applies the hedonic price technique and finds a price premium for energy-efficient dwellings between 5.4% and 9.8%. Given the small share of energy-efficient buildings, many studies have used a stated preference method. Banfi et al. (2008) investigates the household's valuation of energy efficiency measures in Switzerland using a choice experiment. The study uses a fixed-effects logit model and finds that consumers have a significant preference for energy-saving attributes, mainly energy savings, environmental benefits, and comfort benefits.

The other residential characteristic that has been widely discussed in the literature is housing sale prices or rental costs. While some studies find significant negative impact of prices on the decision to choose a residence (see Banfi et al., 2008; Habib and Miller, 2009 and Schirmer et al., 2014), there is no consensus on the existence of this price effect (see Carlsson et al., 2007; Pedersen et al., 2011; Lanz and Provins, 2013; Zanten et al., 2016; Aravena et al., 2014 and Burton et al., 2017). Carlsson et al. (2007) argues that in a choice experiment, households may differently consider the price attribute. Pedersen et al. (2011) finds that excluding the price attribute does not affect preferences for non-monetary attributes. Furthermore, Lanz and Provins (2013) finds that a small but significant percentage of households do not react or consider the price attribute in choosing their residential location. Strong preferences for a better housing option can explain this price insensitivity.

Apart from the specific housing characteristics discussed above, the residential choice also depends on the accessibility of the residence, which usually refers to the commuting distance or time to work activities. A number of studies show that commuting distance has a negative influence on the residential location choice (Guo and Bhat, 2007;

Waddell et al., 2007; Habib and Miller, 2009; Zolfaghari et al., 2012; Clark et al. (2016); Beige and Axhausen, 2017; and Shiran et al., 2017). Using a retrospective survey that covers the Zurich region in Switzerland, Beige and Axhausen (2017) finds that the commute is shorter after a residential relocation while it is longer when it is associated with a work move. In the same vein, Shiran et al. (2017) also finds that home relocation reduces the commuting distance by using a household survey in Australia. Similarly, Clark et al. (2016) uses two waves of panel data in the UK to show that commute mode changes are mainly driven by changes in job or home relocation. Furthermore, some studies consider other accessibility measures, including access to open space (Chen et al., 2008), services and shops (Eliasson, 2010; and Lee et al., 2010).

Given the importance of the housing characteristics mentioned above, studies have investigated intervention measures that can influence household decisions in terms of energy conservation. The literature distinguishes between the use of monetary and non-monetary measures to influence environmental behaviour. The usual economic compensation and incentives include coupons, cash, subsidies, etc. Although, those monetary incentives may have positive influence (see Mizobuchi and Takeuchi, 2013; Lanzini and Thøgersen, 2014; Bradley et al., 2016 and Maki et al., 2016), this influence may disappear over time (Abrahamse et al., 2005 and Asensio and Delmas, 2016).

Alternatively to monetary measures, a number of studies focus on non-monetary measures or soft incentive measures such as information (see Dharshing and Hille, 2017; Lee et al., 2018 and Lang et al., 2021) and social norms (see Schultz et al., 2007 Allcott, 2011; Farrow et al., 2017 and Blasch et al., 2019).

Regarding the influence of information, Dharshing and Hille (2017) has conducted a choice-based conjoint experiment about home energy efficiency in the Swiss context. The study considers two experimental groups that differ only from displaying information concerning energy cost savings. Their results show that there is no influence of numeracy and energy literacy on the importance of energy cost savings in the decision of consumers to invest in an energy-efficient home. In the same Swiss context, Lang et al. (2021) also finds that the provision of information, which makes energy costs salient, does not affect the choice of a highly energy-efficient heating system among homeowners in Switzerland. Furthermore, Lee et al. (2018) shows in South Korea, a different context, that when energy performance information is provided, the energy efficiency level of the house has a significant effect on the residential choice of a consumer. These mixed results suggest that more targeted behavioural interventions should replace generic information strategies.

Next to information, social norms have also been explored as a soft incentive to affect energy-saving behaviour. Farrow et al. (2017) gives an overview of studies analysing the effect of social norms on pro-environmental behaviour. Social norms can be classified into descriptive or injunctive norms (Cialdini et al., 1991). Descriptive norms

describe behaviour that is commonly exhibited by others. They serve as a cognitive shortcut (Cialdini and James, 2009). By observing how other people behave, one can derive optimal behaviour. Others will have gone through a similar thought process before when deciding, for example, what to choose in a certain type of choice situation. Such guidance is especially valuable if it is costly to acquire information to make the decision. Injunctive norms, on the other hand, relate to the element of social sanctions and describe behaviour that one ought to exhibit (Cialdini et al., 1991). Such norms affect people through expected social approval or threatened disapproval of a behaviour.

As reported by previously mentioned studies, soft measures are tested and used for interventions in household energy demand. Various studies provide evidence for an influence of soft measures on, for example, the reduction of electricity consumption or on the investment in energy-efficient appliances (e.g. Allcott, 2011; Schultz et al., 2007; Blasch et al., 2019). Our contribution to the literature is a study that looks at residential energy demand in a broader sense. The setting of the home relocation enables us to explore various aspects of energy consumption at once.

Some studies in the literature on non-monetary measures have discovered effect heterogeneity across households (e.g. Schultz et al., 2007; Brunner and Haefeli, 2008; Allcott, 2011; Costa and Kahn, 2013; Tiefenbeck et al., 2018; Byrne et al., 2018; Andor et al., 2020). These studies find heterogeneous treatment effects of social norms or information by distinguishing households by energy consumption behaviour. A study by Andor et al. (2020) looks into the effects of home energy reports on household electricity consumption in Germany, similar to a study by Allcott (2011) conducted in the United States. Andor et al. (2020) find treatment effects to be context-dependent. Compared to the United States, effects in Germany are much lower because of lower energy consumption base levels. Furthermore, they note that interventions would not be cost-effective if effect heterogeneity is ignored. A study by Costa and Kahn (2013), which distinguishes households by political affiliation, finds heterogeneous effects of social norms. Brunner and Haefeli (2008) also finds the same heterogeneous effects with a segmentation approach that is based on attitudes and opinions regarding mobility style. The authors conclude that the tailoring of such measures should be considered. However, a practical segmentation approach in support of policy design has not yet been well established. For this research gap, we provide new insights.

3 Methodology

Major life decisions such as the home relocation do not occur frequently and are thus difficult to investigate with observational data. A more suitable method for the purpose of this study is a stated preference approach. To assess the impact of non-monetary measures on the dwelling choice we use a discrete choice experiment. The experiment approximates the real life decision of choosing new housing motivated by a relocation.

Participants face choice decisions where housing options differ with regard to three characteristics that are relevant for household energy consumption. See Section 3.1 for a description of the experiment design. At the same time, the experiment allows the testing of soft incentives. The considered treatments are social norms and energy-related information (see Section 3.2). Participants receive treatment-specific messages in the introduction of the experiment if they are randomly assigned to a treatment group.

The experiment is implemented in an online survey with a representative sample of the population of the German and French speaking regions of Switzerland. In this manner, there is information about households available that is otherwise difficult to obtain but essential for our endeavour. With the experiment, not only can the choice of housing under the influence of non-monetary measures be observed but also can data about household characteristics be collected. This is crucial to segment households in order to distinguish reactions to the treatments across different types of households. To learn more about whether non-monetary measures are more efficient if used in a targeted or in a uniform manner the segmentation of households is conducted ex-ante for the analysis of treatment effects but does not affect the experiment itself.

3.1 Experimental Design

The experimental design of the choice experiment is set up as follows. The scenario is an imaginary home relocation. Experiment participants are asked to imagine that they move to a new home for a long period of time (i.e. at least five years). Choice sets consist of two choice alternatives that describe homes with varying characteristics. An opt-out option is not offered. Choice alternatives are unlabelled and differ in levels of the attributes energy efficiency, home size and commuting distance.[2] Each experiment participant faces six choice sets in a randomised order. These choice sets were generated using the Software Ngene to elicit an efficient design based on the D-error measure (ChoiceMetrics, 2018). The attributes which define the housing options are energy efficiency, housing size, and (commuting) distance. They were chosen among the dwelling characteristics that can be selected during a relocation and based on their impact on the energy consumption of a household. Energy efficiency of a dwelling, as defined in the experiment, relates to the electricity and heating demand. It broadly describes characteristics of the home that constitute energy efficiency such as the quality of insulation and the energy efficiency standard of large built-in appliances. An energy efficient home has, ceteris paribus, a lower energy consumption than one with a low energy efficiency. Another important determinant of household energy consumption for heating is the housing size. The larger the living space the more energy is required

[2]Unlabelled options are solely defined by the levels of the attributes. The options, which are called either ”Option A” or ”Option B”, do not give away any information by name only.

for heating.[3]

The attributes pertaining to the in-home energy consumption are complemented by the distance attribute. It describes the distance to places that are frequented on normal weekdays such as work, school or caretaker responsibilities. The location of a home and thereby the distance to frequented places directly affects mobility-related energy consumption. A short distance requires less energy consumption than a long distance, given the mode of transport. Together, these three attributes cover significant determinants of household energy consumption. Since they cannot be changed in the short term the choice of these characteristics creates lock-in effects.[4]

Figure 1: Example of a choice decision

Which of the two housing options do you prefer?

Please note: You can receive additional information by moving the mouse cursor to the characteristics of the housing options.

	Option A	**Option B**
Size of the living space	80 m^2	120 m^2
Energy efficiency	high	low
Distance to frequently visited places	long	long
Price in CHF (rent / buy)	1'456 / 491'700	1'853 / 656'280

The attributes *energy efficiency* and *distance* take on one of two levels. *Energy efficiency* can be either low or high, where a high energy efficiency is described by a good quality of the dwelling insulation and highly energy efficient technologies (heating system, large built-in electric appliances). *Distance* can be long or short. We specify a long distance as one that implies a 70 minutes commute on average (one-way) with the preferred mode of transport of an experiment participant. A short distance in our setting implies a 30 minutes commute on average. The levels of the attribute *size of the*

[3] In the Swiss context, heating is the dominant factor of in-home energy consumption. Air conditioning systems are not common in residential buildings.

[4] Given current energy policy measures (see Section 1) and ongoing efforts to improve the energy efficiency of dwelling, we assume the stock of energy efficient dwelling to be adaptable. Promoting the choice of energy efficient housing options increases demand and incentives for further energy-efficient improvements of buildings. With a fixed stock, the reallocation of households to energy efficient and low energy efficient dwelling might not affect aggregate energy efficiency.

living space are set based on a pivot design. The efficient design of choice sets is created with the relative levels *smaller*, *same sized* and *larger*. Experiment participants are shown housing options that are either smaller, equally sized or larger than their current homes. These relative levels are translated into absolute levels in square meters based on the currently inhabited living space size of participants. To this end, participants are assigned to size groups. Thus, only housing options relevant to the participant are presented. Figure 1 depicts an example of a choice decision that an experiment participant currently living in a home with around 100 square meters of living space would face. In this example, one of the offered alternatives is smaller than the current home (Option A) and the other alternative is larger (Option B). Table 1 lists all possible levels of the attribute *size of the living space* in relative and absolute terms. It also gives an overview of the levels of the other two attributes. The experiment participants receive an objective description of these attributes in the introduction of the experiment to clarify how the attributes are to be interpreted. Detailed information about the meaning of the attributes is also available during the experiment via mouse-over text (see Appendix A.2).

Table 1: Description of the attributes of choice alternatives

Attribute	*Attribute levels*
Size of the living space:	
relative	*smaller, same sized, larger*
absolute (in m^2)	*20, 40, 60, 80, 100, 120, 145, 180, 260, 350*
Energy efficiency	*low, high*
Distance	*short, long*

In order to provide a more realistic choice scenario, we also present price information for each choice alternative. [5] Dwelling prices are specified for renting as well as for buying to circumvent the distinction between tenants and home owners. Importantly, prices are considered to be a "pseudo" attribute. They directly reflect the main attributes energy efficiency, home size and distance. Hence, there is no variation of prices other than through the variation of the main attributes. The stated prices are based on real market values and thus reflect market equilibrium prices, which experiment participants would face in a real life situation. The necessary price information was obtained from a Swiss spatial development consultancy for an accurate depiction of the housing market in Switzerland. The specified prices result from a hedonic pricing model and are calculated based on average prices by home size, a premium for a high energy efficiency standard and regional differences.[6] The distance attribute is

[5] For a more detailed discussion on the importance of a price attribute, see Carlsson et al. (2007), Pedersen et al. (2011), Lanz and Provins (2013), Aravena et al. (2014), Zanten et al. (2016) and Burton et al. (2017).

[6] The prices reflect investment costs. For tenants, the prices (rents) do not include any additional costs (i.e. heating costs).

priced based on the price differentials between housing close to large regional labour markets and housing that is further away. Housing close to these markets comes with a price premium. This ensures a trade-off between a shorter commuting distance and the price. For housing with a high energy efficiency standard a price premium has to be paid over housing with a state regulated energy efficiency standard. It reflects the market valuation of the high energy efficiency standard. The most substantial determinant of prices is the size of the living space however. Housing prices increase with the size of the home. Based on the data underlying the hedonic model, prices describe flats up until a certain size threshold. After this threshold, prices depict houses. This structure is not disclosed to experiment participants. They are simply asked to consider the housing options presented and to assume that all other housing characteristics not explicitly specified match personal preferences.

3.2 Experiment Treatments

When participants enter the experiment, they are randomly assigned to either the control or one of two treatment groups. Treated respondents receive additional text information in the introduction of the experiment. The first treatment group receives a message containing social norms related elements. In the treatment message, descriptive and injunctive norms are expressed in relation to energy-related characteristics of homes in Switzerland. The message describes the housing characteristics of the homes of the majority of Swiss people *(descriptive norms)*. For a complex decision such as the housing choice, descriptive norms can be useful as a supportive decision tool. Furthermore, it communicates the approval of pro-environmental and energy-conserving behaviour *(injunctive norms)*. By conveying what is commonly done in society as well as what is ought to be done, the treatment raises awareness for these social components, and we expect experiment participants to include them in their choice decision.

All three housing attributes are referred to in the treatment message (see Appendix A.1 Figure A.1). The energy-conserving characteristics are a small but sufficient living space, a high energy-efficiency classification and a location that implies a short commuting distance. The treatment is expected to affect choice behaviour and utility attributed to these housing characteristics through several channels. As previously described, descriptive norms can reduce cognitive effort and the costs of information acquisition to make a decision. In this manner, benefits of the energy-conserving housing characteristics are highlighted, which might not have been considered otherwise. Descriptive norms suggest that choosing a low-energy consuming home over another housing option can increase utility. If many other people have previously made such energy-conserving choices, they must be connected to high utility. Otherwise, the majority of people would have made different choices. Injunctive norms on the other hand inform about social sanctions that can be avoided and social approval that can be gained with the choice of the dwelling. This signifies further improvements in the val-

uation of an energy-conserving home. Thus, the social norms treatment could lead to higher expected utility of norm-conforming dwelling and consequently also to a higher choice probability.

The second treatment group is provided with information about potential economic savings implied by the choice of housing with energy-saving characteristics. This speaks to the energy usage costs (i.e. heating and electricity costs) beyond the investment prices provided with the housing options. The information calls the experiment participants' attention to cost savings through the choice of housing with a high-energy efficiency standard because of a reduction in energy usage costs. Similarly, the smaller the living space of a home the more energy and therefore costs can be saved on heating. Regarding the distance attribute, participants are informed about time and cost savings by choosing a short rather than long commuting distance. The full treatment text can be viewed in Appendix A.1 Figure A.2. The content of the treatment addresses and promotes energy literacy. Participants gain knowledge about the costs of energy consumption through the provided information in case there was a lack thereof before. Otherwise, the treatment serves as an activator. Based on how people value the provided energy cost aspects the informational message in the experiment can cause increases in utility derived from energy-conserving housing options and changes in choice behaviour.

We expect these treatments to positively influence the choice probability of dwelling with energy-conserving characteristics in the experiment. Yet, the treatments might not affect all participants equally based on insights from the literature on non-monetary incentives. The conjecture is that participants react heterogeneously to the treatments. One source of heterogeneity could stem from a varying energy consumption baseline. In the experiment setting, this can be tested particularly with regard to the housing size because of the pivot design of this attribute. Experiment participants are offered housing options that depend on the current housing size. Consequently, reactions to the treatments can be differentiated based on whether a household lives in a small or a large home. We assume the likelihood of the soft incentives swaying housing choices to vary with current living conditions. With the expectation of social norms influencing choices in the direction of normative behaviour (e.g. sufficient but not abundant living space per person), the effectiveness of the treatment depends on the discrepancy between current and normative behaviour. In case of the second treatment, the implications of the provided information for potential energy consumption reductions and cost savings are expected to vary between a household with for example currently 25 square meters and one with 100 square meters of per person living space.

Another cause of heterogeneity could be a diverse susceptibility to social norms and information across different types of households. Not everyone might be equally likely to react to social norms or be receptive for energy-related information. To test

this hypothesis the segmentation of households becomes relevant.

3.3 Household Segmentation

A substantial contribution of this study is the investigation into the relevance of household heterogeneity for the reaction to non-monetary incentives. To compare treatment effects across households we segment experiment participants. The aim is to identify households with broadly comparable lifestyles within each segment. We achieve this by distinguishing five different types of households according to the age group they belong to and their place of living (see Table 2). To sort households by age we consider the age of the experiment participant.[7] The place of living distinguishes households living in urban areas from households in rural areas such as the agglomeration or the countryside. Household Segment 1 and Segment 2 describe young households aged

Table 2: Household segmentation by age and place of living

	Urban	**Rural**
20-39	Segment 1	Segment 2
40-64	Segment 3	Segment 4
65+	Segment 5	

20 to 39. Households with an age between 40 and 64 are sorted into Segment 3 if they live in urban areas and into Segment 4 otherwise. Finally, senior households with an age of 65 or more form Segment 5. These segments are correlated with other socio-demographic covariates and can therefore also be characterised by them. Summary statistics for the household segments are presented in Section 4. The segmentation is conducted ex-post. All household segments experience the same experiment and receive no segment-specific treatment or information.

The two selected household characteristics approximate different lifestyles. In urban regions, households have access to a broad range of amenities and activities in close proximity to their homes. Civic participation however tends to be lower in urban than in rural areas (Buchecker and Frick, 2020). Rural households on the other hand might enjoy better access to natural recreation areas and experience a different kind of community life than urban households. Likewise with the distinction of age groups, households lead different types of daily life defined by elements such as work, family, friends and leisure activities depending on the age. If these differences influence the way social norms spread in and affect communities as well as the way information is received and distributed, there should be a closer focus on the susceptibility of households to these soft incentives as energy policy instruments. Not all households will react equally to social norms or energy-related information. Because of behavioural differences across various types of households this study argues that a tailoring ap-

[7] Experiment participants are persons that are at least partly in charge in the household.

proach to policy design is potentially more effective compared to a traditional uniform intervention approach. If household segments with a similar behavioural pattern can be identified, policy instruments can be targeted at and designed specifically for each household segment. The identification of households that are susceptible to either one of these measures could therefore be used to improve the design of policies.

In addition to the approximation of lifestyles, our segmentation approach thus also satisfies requirements for a straightforward identification of households that is feasible for policy makers.[8] This implies that the segmentation does not necessarily identify household groups with the most distinct reactions to social norms and information. However, there needs to be sufficient heterogeneity across the segments in order for the tailoring of measures to be more effective than a one-size-fits-all approach.

3.4 Econometric Strategy

For the analysis of the experiment, we adopt a structural approach. To model discrete choices, we build on the random utility maximisation framework, where a utility maximising participant n derives utility U_{njt} from a choice alternative j in choice situation t. We employ a mixed logit model with a panel structure following Train (2009) and Hensher et al. (2015).[9] This specification accounts for correlations over choices, which could arise from the repeated choices of participants. Moreover, it allows for heterogeneous and correlated preferences by relaxing the *Independence of Irrelevant Alternatives* assumption imposed by the conditional logit model.

Latent utility can be decomposed into an observable (V_{njt}) and an unobservable (ϵ_{njt}) component, which is assumed to follow an independent and identical extreme value one (Gumbel) distribution, with $n = 1, ..., N$; $j = 1, 2$ and $t = 1, ..., 6$.

$$U_{njt} = V_{njt} + \epsilon_{njt} \tag{1}$$

In the experiment, we observe the choice-specific attributes of the housing alternatives. Furthermore, there is individual-specific information about the participants available. Most relevant for our analysis are indicators for assigned treatment groups and the household characteristics used for the identification of household segments.

To investigate treatment effect heterogeneity two model specifications are used. The first one allows to look into differences of effects across households. The second one builds on the first model and additionally accommodates heterogeneous treatment effects with regard to the baseline energy consumption. Thus, the observable component

[8] For the partition of each dimension we follow the classification of age groups and the urban rural typology as defined by the Swiss Federal Statistical Office.

[9] This type of model is also known as mixed or random parameters multinomial logit model.

of the first utility model (Model I) is specified as follows:

$$V_{njt} = \boldsymbol{\beta}_n' \boldsymbol{X}_{njt} + (\boldsymbol{\gamma} \boldsymbol{X}_{njt})' \boldsymbol{T}_n + Price_{njt} \boldsymbol{\alpha}' \boldsymbol{Y}_n \tag{2}$$

The utility that an individual generates from a housing alternative depends on preferences for housing characteristics. The main attributes $\boldsymbol{X}$ are the size of the living space, the energy efficiency and the implied commuting distance. The size of the living space of a housing alternative is measured relative to the currently inhabited home. Since it can be either smaller, equally sized or larger than the current home it enters the model with two variables indicating a smaller and a larger housing option respectively compared to the current living space size. The other two attributes are measured by an indicator variable for a high compared to a low energy efficiency and by an indicator for a short compared to a long commuting distance to regularly frequented places such as work or school. The model parameters $\boldsymbol{\beta}$ reflect individuals' preferences for these housing characteristics. They are modelled as random parameters in order to account for preference heterogeneity across households.

The variable *Price* measures the market price of the housing alternative. Experiment participants see rents as well as buying prices for each housing option. Because of the very high correlation between renting and buying prices by construction the estimated models each include only one of the two pricing specifications. To control for differences in income the price variable is interacted with household income. Since the price is also included on its own, the first entry of $\boldsymbol{Y}$ is 1 followed by income indicators.[10] The parameters $\boldsymbol{\alpha}$ of the price variable as well as of the interactions with income are modelled fixed. Limited sample sizes of the individual household segments and computational restrictions do not allow us to estimate random pricing parameters.

In addition to the attributes, we assume the experiment treatments $\boldsymbol{T}$ to influence preferences. The utility which respondents generate from housing attributes is updated by the valuation induced by the provided treatment. Given that a respondent successfully receives the treatment, information about potential future cost-savings through the choice of energy conserving housing characteristics translates into a change in valuation.[11] Individuals could for example derive higher utility from a housing alternative with energy-conserving characteristics because of potential cost-savings and the reduction of negative externalities due to the contribution to energy conservation. Similarly, in the case of the second treatment, the reception of messages communicating social norms can adjust preferences when implications of compliance to or disregard of these norms are taken into account.

[10] Data on household income is available in income classes and thus enters the model as indicator variables in interaction with the price variable.

[11] We understand the active reading and processing of the treatment text in the introduction of the experiment as a successful reception of the treatment. Participants whose experiment time was too short were excluded from the analysis (see Section 4).

We exploit the random assignment of treatments to identify treatment effects γ. The treatment variables are specified as indicators for the social norms and the information treatment group respectively to identify which treatment a respondent receives. The control group is set as the base category. These indicator variables enter the utility model in interaction with attributes $\boldsymbol{X}$ due to the fact that choice probabilities depend on the relative utility ordering in mixed logit models, whereby invariant variables drop out. Individual-specific information such as the treatment group indicators does not vary within a choice set for a participant and the inclusion on its own is thus not feasible. Moreover, separate terms for treatment indicators would be meaningless given that housing options are not labelled in the experiment. There is no reason why a treatment would change preferences for a generic housing alternative "Option A" compared to an alternative "Option B" when the attributes are disregarded.[12] Thus, including treatments as interaction terms allows for the identification of treatment effects on choice probabilities through preferences for attributes. The gamma parameters for the interaction terms between housing characteristics and treatments describe the value of the provided information and the implications of the communicated social norms in connection to the respective housing attribute as explained in Section 3.2.

To test our hypothesis of heterogeneous treatment effects, we allow treatment parameters to vary across household segments but not within. The gamma parameters, which identify treatment effects, are hence assumed to be fixed. In order to compare these effects across different types of households the model is estimated individually for each household segment. The analysis of effect variation across segments serves the discovery of potential benefits of policy tailoring methods.

To explore the baseline energy usage as a second possible source of treatment heterogeneity the absolute size of the living space per household member, which is available in the current dwelling, is considered in a second model specification (Model II).[13] Since this baseline does not vary across choices for a participant it enters the model in interaction with attribute variables. By interacting the current per person living space ($SpacePP$) with the relative size variables for smaller and larger housing options nonlinear preferences for the housing size can be investigated. More importantly, we allow for three-way interactions with the treatment indicators to distinguish treatment effects by the baseline housing size with the parameters $\boldsymbol{\lambda}$ (see model specification (3)).[14] The

[12] No value can directly be derived from unlabelled choice alternatives such as "Option A" or "Option B". In contrast, with labelled choice alternatives such as "Car" and "Bike" people associate value with the alternatives before even considering attribute levels.

[13] We only consider the current dwelling size here because it is used as a condition for the dwelling size of the choice options. With the other two attributes, there is no such path dependency in the experiment between choices and the corresponding current dwelling characteristics. Nonetheless, the baseline energy consumption approximated by the energy efficiency of the current dwelling and the current commuting distance are discussed in Appendix A.4.

[14] Since $SpacePP$ is only interacted with size variables the parameter matrices $\boldsymbol{\theta}$ and $\boldsymbol{\lambda}$ contain zero entries so that only parameters for the interaction between the size indicator variables and $SpacePP$ are

interaction terms are modelled with fixed parameters. The underlying assumption for this model specification is that preferences for an increase or decrease of the housing size depend on the currently available per person living space. Moreover, we expect the effectiveness of the treatments to also vary with this baseline. For example, incentivising a reduction of the housing size is assumed to be more difficult if the current per person living space is already scarce than when it is abundant. In Model II, the observable component of utility is thus specified as follows:

$$V_{njt} = \boldsymbol{\beta}_n' \boldsymbol{X}_{njt} + SpacePP_n \boldsymbol{\theta}' \boldsymbol{X}_{njt} + (\boldsymbol{\gamma} \boldsymbol{X}_{njt})' \boldsymbol{T}_n + SpacePP_n (\boldsymbol{\lambda} \boldsymbol{X}_{njt})' \boldsymbol{T}_n + Price_{njt} \boldsymbol{\alpha}' \boldsymbol{Y}_n \quad (3)$$

Based on these models, choice probabilities for housing options can be derived by contrasting the utilities of the options (see e.g. Train (2009)). The logit probability for a housing option i is then defined as

$$L_{nit} = \frac{e^{V_{nit}(\beta)}}{\sum_{j=1}^{2} e^{V_{njt}(\beta)}} \quad (4)$$

and conditional choice probabilities for the six sequential choices of experiment participants are obtained by taking the product of these logit probabilities over all choice sets. Choice probabilities are conditional on the distribution of preferences because preference heterogeneity itself is unobserved.[15] Assuming a normal distribution of preferences, the unconditional choice probability P_{ni} of a choice alternative i can then be defined as the integral of the product of conditional choice probabilities over the preference distribution $f(\beta)$ (see eq.5).

$$P_{ni} = \int \prod_{t=1}^{T} \left[\frac{e^{V_{nit}(\beta)}}{\sum_{j=1}^{2} e^{V_{njt}(\beta)}} \right] f(\beta) d\beta \quad (5)$$

The specified models are estimated using maximum simulated likelihood estimation with 750 Halton draws. The variables in the two model specifications with the exception of the variables *Price* and *SpacePP* are effects coded.

4 Data

The choice experiment was conducted in May of 2019 as part of the Swiss Household Energy Demand Survey (SHEDS). The SHEDS is an annually conducted survey and representative regarding age, gender, home ownership and place of living for the French and German speaking parts of Switzerland (Weber et al., 2017). The survey has a rolling panel structure and covers the three household energy demand areas electricity, heating and mobility. Furthermore, it includes individual- and household-specific

defined.

[15] In the case of Model II, unobservable is preference heterogeneity after controlling for the current per person living space.

information, as well as further information such as psychological and sociological aspects.

Survey respondents were randomly chosen to participate in the choice experiment if they had already participated in the survey at least once before. In total, 970 respondents were assigned to the home relocation experiment and either to the control or one of our two treatment groups. In the data cleaning process, a few respondents, which did not complete the experiment, were dropped. For the remaining respondents, data from the experiment as well as data from the base catalogue of the SHEDS are available. This includes socio-demographic variables and characteristics of current homes. Additional respondents were dropped based on the time they took to go through the experiment. If the experiment time was below two minutes, respondents independent of their group assignment were eliminated from the experiment. Since this study aims to uncover treatment effects, the outcome depends on experiment participants successfully having received the treatment, i.e. having read the treatment text provided in the introduction of the experiment. Consequently, respondents of the treatment groups with a very short experiment time were also considered to be excluded from the sample. The cut-off value was chosen at the five percent percentile which corresponds to an overall response time of around four minutes. Considering the minimum time required to read the introductory text and to answer the experiment, this seems a reasonable value. The final sample consists of 799 experiment participants.

The composition of the sample was conditioned on equally sized experiment groups. The balance of these groups is ensured by the representativeness of the survey sample and the random assignment of treatments. Table 3 shows summary statistics of the experiment sample compared to the full survey sample. The experiment groups are balanced in regards to important socio-demographic characteristics such as age, education and household size.[16] The average income class is slightly higher in the information treatment group. The distribution of the current accommodation size and the costs of housing as a share of household income are again balanced across the experiment groups.

Since there is also data about the household size available in the SHEDS, it is possible to account for the per person accommodation size of a household in the analysis (Model II). This is particularly relevant for the identification of treatment effects when we expect to observe non-linearity in preferences and treatment effects. In the experiment sample, members of an average household would each have 56 square meters of living space available in housing options that have the same size as their current homes, but there is substantial variation in the data (standard deviation of 30 square meters).

All five household types are also sufficiently represented in each group. Shares of

[16] Education is measured on the individual level of the experiment participant.

Table 3: Summary statistics

	Control		**Social Norms**		**Information**		**SHEDS**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	49.96	16.16	48.22	15.10	49.64	15.14	46.00	15.56
Female	0.43	0.50	0.55	0.50	0.51	0.50	0.51	0.50
Years of education	13.82	2.05	13.81	2.13	14.03	1.89	13.92	2.05
Household size	2.36	1.23	2.29	1.25	2.46	1.29	2.34	1.31
Household with children	0.25	0.43	0.21	0.41	0.25	0.43	0.22	0.42
Home owner	0.37	0.48	0.40	0.49	0.44	0.50	0.37	0.48
Accommodation size in m^2	120.15	89.51	116.88	62.39	123.35	63.22	118.97	71.30
Current space p.p.	54.75	28.20	58.99	34.00	54.00	28.88	58.24	35.79
Household gross income								
up to 3'000 CHF	0.06	0.24	0.09	0.29	0.06	0.24	0.06	0.24
3'000-4'459 CHF	0.10	0.30	0.11	0.32	0.05	0.22	0.09	0.28
4'500-5'999 CHF	0.19	0.39	0.16	0.37	0.13	0.34	0.15	0.36
6'000-8'999 CHF	0.27	0.44	0.27	0.44	0.30	0.46	0.28	0.45
9'000-12'000 CHF	0.22	0.41	0.20	0.40	0.23	0.42	0.23	0.42
12'000 + CHF	0.16	0.37	0.16	0.37	0.23	0.42	0.18	0.38
Net housing costs in % of net income								
<20%	0.43	0.50	0.46	0.50	0.46	0.50	0.44	0.50
20-30%	0.42	0.50	0.38	0.49	0.40	0.49	0.41	0.49
31-40%	0.11	0.31	0.10	0.30	0.11	0.31	0.11	0.31
>40%	0.04	0.19	0.06	0.23	0.04	0.18	0.04	0.20
Place of living								
Urban	0.46	0.50	0.46	0.50	0.47	0.50	0.49	0.50
Rural	0.54	0.50	0.54	0.50	0.53	0.50	0.51	0.50
Household segments								
Young urban	0.18	0.38	0.16	0.37	0.17	0.37	0.22	0.41
Young rural	0.15	0.36	0.17	0.38	0.16	0.36	0.18	0.38
Mid-age urban	0.16	0.37	0.23	0.42	0.20	0.40	0.19	0.40
Mid-age rural	0.29	0.45	0.27	0.44	0.28	0.45	0.25	0.43
Senior	0.22	0.41	0.17	0.37	0.20	0.40	0.15	0.36
Number of observations	273		270		256		4859	

Note: The table describes the three experiment subsamples and the full SHEDS sample in 2019. For each subsample, the mean and standard deviation of the data are reported. There are no minors in the SHEDS data. Education level is translated into years. Current space p.p. describes the per person living space at home in square meters. All variables are dummy variables with the exception of age, years of education, household size, accommodation size and current space p.p..

the household types within the experiment groups range between 15 and 29 percent (see Table 3). The household segments approximate different lifestyles and stages of life. As can be observed in Appendix A.3 Table A.1, these segments can be described by other socio-demographic characteristics. In the full experiment sample, experiment participants living in young urban households (Segment 1) have on average a higher education than participants in young rural households (Segment 2). At the household level, segment two describes households with more members and with a higher average income than households in segment one. Compared to households in urban areas, household size and income decrease from young to middle-aged households in rural areas on average. Independent of the place of living, there is a larger share of home owners in the middle-aged household segments than in the young segments. Similarly,

there are more home owners in rural areas as in urban areas as would be expected. In cities, it is more difficult to buy housing for a private household, as demand commonly exceeds supply, than in rural areas. Moreover, young, urban households have the highest costs of housing as a share of income followed by senior households. The hike of housing costs for Segment 5 is due to the decrease of household income after retirement. On average, households across all segments spend between twenty and thirty percent of their monthly income on housing. However, the average living space ranges between 90 and 136 square meters with urban households living in smaller spaces than rural households.

The experiment sample is representative of the Swiss population with regard to gender, home ownership and income.[17] The average Swiss person is younger (42.5 years of age) than the average participant, since the experiment sample does not include minors. The Swiss averages for years of education (13 years), the average household size (2.2) and the average living space per person (46m^2) are slightly lower than the experiment sample means. Average gross housing costs as a share of net income in Switzerland are around 20 percent and thus comparable to the experiment sample.[18] For the household segmentation we distinguish households living in urban and rural areas. Here, "rural" defines households living either in agglomerations or rural areas. The majority of participants in our experiment are assigned to the rural category, whereas the majority of Swiss households (63 percent) lived in urban areas in 2019.[19]

5 Results

Using data of the full sample as well as of the five household segment subsamples separately, we estimate the in Section 3.4 specified choice models individually for each subsample. This allows us to distinguish treatment effects across different types of households. Our results suggest significant effect heterogeneity of soft incentives. Once we allow for non-linear effects dependent on current housing conditions, we find household segments to react to either just one type of incentive or to show no response at all. Only one household segment reacts to both types of treatments. The full sample results, where no distinction of household types is made, overlook this treatment heterogeneity.

The estimation results of the model specification Model I (eq. (2)) are reported in Table 4. Subsequently, the results of Model II (eq. (3)), which takes the baseline per person living space into account, are presented in Table 5. We first describe general choice behaviour based on the housing attribute coefficients for a better understanding

[17] Data for Switzerland is taken from the Swiss Federal Statistical Office (FSO).

[18] For the experiment sample we have information about net housing costs as a share of net income.

[19] There are several different typologies used for the classification of living areas available. The discrepancy observed here could be due to differences in the typologies used for the SHEDS sample and data published by the FSO.

of the underlying preferences before we report treatment effects.

5.1 Model I

Estimation results of the first model specification show statistically significant and substantial standard deviations of the random parameters for the size, energy efficiency and distance attributes in the full sample as well as in segment subsamples. This is strong evidence for heterogeneous preferences across participants and legitimate the use of the mixed logit model. A conditional logit model with fixed preference parameters could not have captured this unobserved preference variation.[20] On average, we find a clear indication of people choosing housing in favour of a high energy efficiency standard and a short commuting distance as well as no change in the housing size.[21] The positive preference for energy efficient housing at the mean is relatively consistent across the different household segments. Between 56 and 72 percent of the experiment participants are estimated to have such positive preferences. The negative preferences for housing located far away from important places such as work generally reflect the implied lifestyles of the different household types. We observe urban households to dislike long commuting distances more strongly than rural ones. Short distances are especially important to young urban and to senior households. Regarding preferences for the housing size, the average participant chooses the current housing size over a larger option at current market prices. Furthermore, no change of the housing size over a decrease is favoured on average, although the relevant parameter is not statistically significant. Ultimately, current housing size conditions of households as observed in SHEDS are in line with stated preferences in the experiment. Since choices in the experiment also reflect stated preferences for the residential location, it gives support for participants exhibiting honest choice behaviour instead of random choices.[22] Only for the positive preferences for energy efficient housing in the experiment we cannot find sufficient support in the stated current housing conditions. One reason could be energy efficiency-related technological changes and infrequent home relocations that lead to a discrepancy between current preferences and current housing characteristics.

The pricing coefficients indicate, as expected, that price preferences are negative. Furthermore, households with a high income have less budgetary restrictions when choosing housing than households with a low income. This is indicated by the smaller negative price preferences of high income households. In the reported model estimations, the *Pricing* variable is measured in rents expressed in 1'000 Swiss Francs. For the results using buying prices as the unit of measurement for prices we refer to Section

[20] For results of the conditional logit model see Appendix A.4 Table A.3.

[21] To report average preferences for all participants we calculate predicted probabilities for the treated subgroups under no treatment (counterfactual). No change is necessary for the predicted probabilities for the control group.

[22] A comparison of elicited and stated attribute preferences is provided in Appendix A.3.

Table 4: Model I

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller size						
Mean	−0.19	−0.65+	0.10	−0.17	0.16	−0.77+
	(0.15)	(0.39)	(0.37)	(0.46)	(0.31)	(0.43)
Standard deviation	1.28***	0.89***	1.32***	1.50***	1.59***	1.20***
	(0.11)	(0.21)	(0.31)	(0.35)	(0.27)	(0.23)
× Social norms	0.18	−0.16	0.40	0.05	0.63*	0.02
	(0.11)	(0.22)	(0.30)	(0.30)	(0.26)	(0.25)
× Information	0.02	0.16	0.21	−0.18	−0.35	0.37
	(0.12)	(0.23)	(0.30)	(0.33)	(0.26)	(0.26)
Larger size						
Mean	−0.37*	0.07	−0.75+	−0.46	−0.76*	0.31
	(0.15)	(0.37)	(0.39)	(0.45)	(0.33)	(0.41)
Standard deviation	0.94***	0.46+	1.30***	0.76*	1.40***	0.49
	(0.11)	(0.24)	(0.32)	(0.30)	(0.25)	(0.31)
× Social norms	−0.09	0.09	−0.15	−0.05	−0.28	−0.07
	(0.10)	(0.20)	(0.29)	(0.26)	(0.24)	(0.22)
× Information	−0.11	−0.31	−0.25	0.04	−0.09	−0.16
	(0.11)	(0.20)	(0.30)	(0.29)	(0.25)	(0.23)
Energy efficiency						
Mean	0.51***	0.60***	0.42*	0.33	0.41**	0.70***
	(0.08)	(0.16)	(0.20)	(0.22)	(0.16)	(0.21)
Standard deviation	1.43***	1.04***	1.38***	2.04***	1.33***	1.51***
	(0.11)	(0.18)	(0.28)	(0.39)	(0.22)	(0.24)
× Social norms	−0.15	−0.04	−0.55+	0.18	−0.12	−0.13
	(0.11)	(0.20)	(0.29)	(0.29)	(0.22)	(0.25)
× Information	0.07	0.10	−0.07	−0.26	−0.02	0.38
	(0.11)	(0.21)	(0.28)	(0.31)	(0.21)	(0.26)
Distance						
Mean	−1.01***	−1.26***	−0.59**	−1.53***	−0.83***	−1.10***
	(0.10)	(0.24)	(0.21)	(0.35)	(0.19)	(0.23)
Standard deviation	1.11***	0.91***	1.12***	1.42***	1.26***	0.73***
	(0.09)	(0.17)	(0.22)	(0.27)	(0.20)	(0.19)
× Social norms	0.12	0.12	−0.10	0.03	0.27	0.12
	(0.09)	(0.18)	(0.21)	(0.24)	(0.20)	(0.17)
× Information	−0.12	−0.18	−0.14	−0.22	−0.17	0.06
	(0.09)	(0.19)	(0.22)	(0.25)	(0.19)	(0.18)
Pricing						
Rent in 1'000 CHF	−1.94***	−2.18+	−1.30	−2.63+	−1.39+	−4.29***
	(0.42)	(1.23)	(1.02)	(1.47)	(0.82)	(1.29)
Income interactions	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2357.93	−401.32	−393.10	−411.98	−666.54	−425.93

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. All variables except the price variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

5.4.[23]

Treatment effects are derived from the interaction between housing attributes and treatment indicators. The estimation results presented in Table 4 do not reveal treatments to be particularly successful in influencing housing choices. The only incidence of a significant treatment effect is found amongst mid-aged rural households. In this segment, social norms have a positive effect on the choice of a decrease of the living space. This type of incentive induces an increase of the choice probability by 0.11 on average for the treated. There is also limited evidence for an effect of social norms on the energy efficiency of housing in the young rural household segment. Against our hypothesis, households in this segment which received the social norms treatment were less likely to choose energy-efficient choice options than their peers in the control group. This boomerang effect could be due to the current housing conditions in this segment and is discussed in Section 6.

Thus for the average participant, social norms and information are not found to be very effective incentives for more energy-conscious housing choices in the full sample as well as across household segments. With effects at the average there is only very limited effect heterogeneity across different types of households. Although the influence on average choices is negligible, the results do not allow to conclude that most household segments are not susceptible to the tested measures.

5.2 Model II

The second model specification takes the current size of the living space per household member, which relates to the baseline energy consumption, into account.[24] We hypothesise that preferences for the housing size are non-linear and that the effectiveness of the treatments depends on the baseline energy consumption as implied by the current living situation.[25] Model II differentiates preferences and treatment effects by the current per person living space size. A likelihood ratio test for the two model specifications supports Model II as the preferred specification (p-value <0.001). The estimation results are displayed in Table 5 and confirm our hypothesis of treatment heterogeneity.

Average preferences for the analysed housing characteristics as well as preference heterogeneity are mostly consistent with the Model I results described in Section 5.1. Yet, with the further distinction of the living space preferences we gain a better under-

[23] Although experiment participants had access to both types of price measurements it is likely that they focused more on renting than on buying prices. First, the majority of participants are tenants and are therefore more familiar with rental market prices. Second, the comparison between monthly rents and monthly household income to evaluate benefits and costs of housing options is less challenging than the comparison of buying prices and income, independently of the owner or tenant status of participants. In Switzerland, a well-known rule of thumb is that rental costs should not exceed one third of gross income.

[24] For the inclusion of other current housing conditions (energy efficiency, home location) that relate to the baseline energy consumption see Appendix A.4

[25] The baseline energy consumption approximated by the energy efficiency of the current dwelling and the current commuting distance are discussed in Appendix A.4.

Table 5: Model II

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller size						
Mean	−0.65**	−1.21*	−0.37	−1.30+	−0.33	−1.03*
	(0.20)	(0.57)	(0.50)	(0.68)	(0.38)	(0.52)
Standard deviation	1.24***	0.91***	1.31***	1.38***	1.54***	1.11***
	(0.11)	(0.22)	(0.31)	(0.32)	(0.27)	(0.22)
× Current space p.p.	0.01***	0.01	0.01+	0.03**	0.01*	0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Social norms	−0.22	−0.12	0.66	−0.94	−0.12	−0.19
	(0.23)	(0.59)	(0.58)	(0.73)	(0.46)	(0.52)
× Social norms × Current space p.p.	0.01+	−0.00	−0.01	0.02	0.01+	0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	0.11	−0.44	−0.38	0.19	0.11	0.49
	(0.24)	(0.67)	(0.62)	(0.82)	(0.46)	(0.51)
× Information × Current space p.p.	−0.00	0.01	0.01	−0.01	−0.01	−0.00
	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Larger size						
Mean	−0.00	1.32*	−0.56	0.12	−0.45	0.63
	(0.18)	(0.55)	(0.50)	(0.57)	(0.37)	(0.45)
Standard deviation	0.89***	0.29	1.32***	0.61*	1.32***	0.31
	(0.11)	(0.31)	(0.33)	(0.31)	(0.25)	(0.39)
× Current space p.p.	−0.01***	−0.03**	−0.01	−0.02*	−0.01+	−0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
× Social norms	0.62**	−0.34	0.15	0.53	1.12*	0.78+
	(0.22)	(0.54)	(0.59)	(0.61)	(0.46)	(0.45)
× Social norms × Current space p.p.	−0.01***	0.01	−0.01	−0.01	−0.02***	−0.02*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	−0.31	1.65*	−0.59	0.47	−1.05*	−0.05
	(0.22)	(0.71)	(0.66)	(0.69)	(0.46)	(0.45)
× Information × Current space p.p.	0.00	−0.05**	0.01	−0.01	0.02*	−0.00
	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Energy efficiency						
Mean	0.51***	0.63***	0.40+	0.36	0.42**	0.60**
	(0.08)	(0.17)	(0.20)	(0.23)	(0.16)	(0.19)
Standard deviation	1.42***	1.01***	1.41***	2.02***	1.34***	1.44***
	(0.11)	(0.18)	(0.29)	(0.39)	(0.22)	(0.23)
× Social norms	−0.13	−0.04	−0.55+	0.15	−0.07	−0.20
	(0.11)	(0.20)	(0.29)	(0.31)	(0.21)	(0.25)
× Information	0.06	0.12	−0.10	−0.21	−0.06	0.38
	(0.11)	(0.22)	(0.28)	(0.31)	(0.21)	(0.25)
Distance						
Mean	−0.93***	−1.28***	−0.55*	−1.40***	−0.75***	−0.91***
	(0.09)	(0.24)	(0.21)	(0.33)	(0.18)	(0.22)
Standard deviation	1.11***	0.93***	1.12***	1.49***	1.26***	0.69***
	(0.09)	(0.17)	(0.23)	(0.29)	(0.20)	(0.18)
× Social norms	0.10	0.12	−0.10	0.08	0.24	0.11
	(0.09)	(0.18)	(0.22)	(0.25)	(0.20)	(0.17)
× Information	−0.12	−0.20	−0.14	−0.28	−0.14	0.08
	(0.09)	(0.20)	(0.22)	(0.26)	(0.19)	(0.17)
Pricing						
Rent in 1'000 CHF	−1.29**	−2.27+	−0.98	−1.55	−0.64	−2.95*
	(0.44)	(1.21)	(1.11)	(1.32)	(0.85)	(1.27)
Income interactions	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2335.61	−391.85	−390.54	−404.44	−655.21	−418.35

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

standing of choice behaviour. Following, we first report average preferences devoid of treatment effects. Although experiment participants prefer no change in the size of the living space in the full sample on average, they are more likely to choose a downsized living space the more spacious the current home is for each household member. Participants with over 65 square meters of living space available to each person in the household are more willing to downsize compared to households with less square meters per person. Households in the young, urban segment on the other hand prefer housing with a similar size as their current home independently of the per person living space. Preferences for larger living space complement these findings. No change in the housing size is preferred on average over an increase. Without treatment however, the choice probabilities for same sized and larger living spaces converge with the current per person space. The only households that are indifferent between an increase and no change of the housing size on average are young, rural households.

In contrast to the Model I results, we find that the tested soft incentives have a positive influence on the choice of energy-conserving housing when effect heterogeneity with regard to the baseline energy consumption is allowed. Although no significant impact of the treatments was identified at the average with Model I, Model II reveals that the treatments are particularly effective as disincentives for the choice of an increase of the housing size with households that have an above average baseline energy consumption.

In the full sample, social norms have a significant impact on the choice of larger housing. The direction of the effect depends on the current per person housing size. Participants with currently little space available react to social norms by choosing an increase of the housing size more often than untreated participants. On the contrary, if household members have plenty of living space available participants are less likely to choose an increase of the housing size under treatment than in the control group. In comparison to the initial model specification where no such effect of social norms was found, the identification of a significant impact of social norms is driven by households with currently very small or large per person living space. Similar to the findings of Andor et al. (2020), treatment effects are stronger when current behaviour is less energy conservation friendly. The effects of social norms were strongest on participants with over 65 square meters per household member. The average treatment effect on the choice probability of larger housing over housing with a size equal to the current one is -0.184 for these social norms treated participants (see Table 6). For households with an average per person living space between 35 and 65 square meters on the other hand the effect is zero.

The estimation results also provide some evidence that social norms affect the choice of smaller housing. The effect on the choice probability is positive and strengthens with the current per person living space size. Overall, social norms have a positive influence

Table 6: Average treatment effects on the treated

	Full sample	Households segments: Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller x Social norms:						
$<35m^2$	0.040				0.106	
	(0.052)				(0.108)	
35-64m^2	0.048				0.115	
	(0.040)				(0.082)	
$65m^2\leq$	0.068				0.132	
	(0.069)				(0.127)	
Larger x Social norms:						
$<35m^2$	0.095				0.124	0.279+
	(0.059)				(0.112)	(0.153)
35-64m^2	−0.000				0.020	0.055
	(0.043)				(0.083)	(0.114)
$65m^2\leq$	−0.179**				−0.201+	−0.326**
	(0.064)				(0.118)	(0.124)
Larger x Information:						
$<35m^2$		0.152			−0.137	
		(0.142)			(0.097)	
35-64m^2		−0.229*			−0.105	
		(0.104)			(0.074)	
$65m^2\leq$		−0.640**			−0.030	
		(0.232)			(0.133)	
Energy efficiency x Social norms			−0.274**			
			(0.103)			

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. ATTs on the choice of the living space size are summarised by subgroups w.r.t. the current per person living space size. Effects are only included if the coefficients in the model estimation are statistically significant at the 10 percent level.

on housing size choices contributing to energy conservation when current conservation efforts are limited. For the information treatment there is no evidence for an effect in the full sample. Nevertheless, the extent of the effectiveness of the two treatments is overlooked when it is assumed that all households react the same to soft incentives. There are considerable differences in treatment effects across household segments.

5.3 Treatment Heterogeneity

There are two sorts of deviations from the full sample results when we allow households to differ in their behaviour based on their characteristics. Compared to the full sample average, households either do not actually react to social norms or they react stronger (or weaker). The estimation results in Table 5 reveal heterogeneous reactions

of the various household segments to the tested soft incentives. Three of the distinguished five types of households show no reaction to social norms when choosing the size of the living space. They are young households in urban and rural areas as well as mid-age, urban households. In contrast to these households, the mid-age, rural and the senior household segments are influenced by social norms in their housing size choices and appear to be the driving force behind the full sample treatment effects. They adapt their choice behaviour under treatment even stronger than the average full sample results would suggest.

To illustrate the differences in treatment effects we report the average treatment effects on the treated participants (ATT) in the full sample and per household segment in Table 6. It depicts effects on the choice probabilities of housing with the specified housing characteristics in comparison to housing with the reference level characteristic (i.e. smaller versus no change). Since the effectiveness of the treatments on the choice of the living space size depends on the distinction of the current living space size, ATTs are reported for subgroups of current per person housing sizes to highlight the effect range. The size groups represent relatively small housing with less than 35 square meters per person, average sized housing (35-64 square meters per person) and relatively large housing with at least 65 square meters of living space per person.[26] The first table row for example shows the average treatment effect of social norms on the choice probability of smaller housing when the alternative is no change of the living space size for the social norms treated participants living in homes with at most 35 square meters per person.

The disparity of the influence of social norms between all households and households in the senior segment becomes particularly apparent when comparing ATTs for the choice of larger housing. Although senior households are susceptible to social norms, they show a stronger reaction to this soft incentive than the average household in the full sample. With an ATT of -0.33, they are less likely to choose larger over equal sized housing under the normative treatment than peers in the control group if their current home is large with over 65 square meters of per person living space. Importantly, this effect counterbalances tendencies of senior households in large homes to prefer an increase of the living space size when not treated.

In the mid-age rural segment, both treatments are successful in provoking changes in the choice behaviour. Social norms cause a lower choice probability of an increase of the housing size. The households in this segment are less likely to choose larger housing when already living in a large home and when treated with social norms compared to untreated households. For example, if household members currently have over 65 square meters of living space available, the choice probability decreases by 0.20 on av-

[26] The cutoff values for the size groups were chosen based on the 25th and the 75th percentile of the full sample distribution of the current per person living space.

erage. Although social norms have a positive effect on energy-conserving choices for these households they have the contrary effect on households in small homes. Households with little per person living space are more likely to choose an increase of the housing size than their peers in the control group. This negative effect suggests that people weigh their behaviour off against a threshold they assume based on the social norm message. As a result, they make their choices accordingly in order to conform more closely to the social norm. Similar to the negative feedback effect (boomerang effect) of descriptive norms observed for example by Schultz et al. (2007), less energy-conserving behaviour can be justified based on the normative benchmark. Hence, the social norms treatment can have an undesired negative effect on households with small per person living space. To target such households with scarce per person living space the information treatment is the better incentive within the mid-age rural household segment. Providing information about potential energy cost savings is an effective instrument to disincentivize the choice of an increased housing size. Unlike the effect of social norms, the information effect is inverted when differentiated by the current per person living space. Whereas with social norms households with limited per person space are more likely to desire an increase of the housing size the opposite is the case under the information treatment. Information has an ATT of -0.14 compared to an effect of 0.12 of social norms. Moreover, information acts as a disincentive for the choice of larger housing for all households in this segment. The effect size differs and decreases with the current per person housing size, but it is distinctly positive in favour of energy-conserving choices.

Another household segment that is susceptible to information is the young urban segment. The treatment leads to a sharp drop of 0.64 in the choice probability of an increase of the housing size for households with much per person living space in the current home. There is also a noticeable effect on households with average available living space (ATT=-0.23). Without the provision of information about energy consumption and its costs, young, urban households have stronger preferences for an increase of the housing size the larger their current homes are. Thus, the soft incentive is an effective tool to achieve housing choices in favour of energy conservation.

Two segments are not significantly influenced by soft incentives in the choice of the living space size. Young rural households form one of these segments. As already identified with Model I, there is instead an effect of social norms on the choice of less energy efficient housing observable. An estimated model, which takes the energy efficiency of the current home as an approximation for the baseline energy consumption into account, does not provide further insights into this effect (for further discussion see Section 6). The remaining household segment with mid-age, urban households shows no significant reaction to soft incentives in the housing choice setting.

Overall, these results suggest a heterogeneous susceptibility to social norms and

information across different types of households in the housing choice setting. There is no evidence for a universal reaction to these measures. Most of the segments are responsive but only react to one of the incentives. One exception is the mid-age urban segment for which the soft measures cannot promote energy-conserving dwelling choices. Another exception is the mid-age rural segment in that it is responsive to both incentives. In addition to the effect variation across different types of households, the size of the effects varies with the baseline energy consumption of households. The higher the baseline consumption, which is implied by the current per person living space, the more effective are the soft measures at the promotion of more energy-conserving housing choices. This pattern is consistent across household segments and can be observed for all but one case. In the mid-age rural segment, the negative effect of information on the choice of an increase of the dwelling size is strongest for current low energy consumers.

5.4 Robustness

There are some reservations regarding the presented model specifications that we address with the following checks. The first one is a small adaption in the modelling of the random parameters that measure preferences for the housing size. The relative ordering of the size of the living space implies that there is a potential correlation between preferences for a decrease of the housing size and an increase of the housing size. We thus allow the random parameters for the *smallsize* and *largesize* variables to be correlated. Indeed, there is a significantly negative correlation between the two estimated parameters. Positive preferences for a decrease of the housing size coincide with negative preferences for larger living space. The estimation results are presented in Appendix A.4. The treatment effects are consistent with the previous model estimations. Furthermore, the results fortify the previously found treatment heterogeneity due to a better precision of the estimated effects. Thus, the average treatment effects reported in Table 6 are conservative values. For example, the positive effect of social norms on the choice probability of a smaller living space increases from 0.132 (see Table 6) to 0.204 on average for mid-age rural households with at least 65 square meters of current living space and it is statistically significant at the 0.1 level.

Another reservation about the measurement of attribute preferences is the simultaneous provision of buying and rental prices of choice options in the experiment design. In order to control for potential biases in the pricing parameters we also test a model specification with an interaction between current owner or tenant status of the participants and the pricing variable. Our main results are unaffected by this inclusion. The results of the models estimated with buying prices (see Appendix A.4 Tables A.4 and A.5) are in line with the previously presented results with rental prices. The treatment effects and the effect heterogeneity are consistent in both pricing variations of the model. Nonetheless, we cannot eliminate all concerns. It is possible that this design

had an influence on the choices of participants. Note also that the interpretation of the attribute preference parameters in our study diverges from other discrete choice experiments (e.g. Banfi et al. (2008)) because the price variation is endogenously determined by the attributes. We cannot distinguish clearly, whether the preference parameters reflect universal attribute preferences or whether they are driven by price preferences.[27] Consequently, preferences for housing attributes as deduced from the results should be interpreted with caution. In spite of this, concerns about treatment effects and the observed heterogeneity can be alleviated. A bias would apply to participants in all experiment groups. Since treatments are randomly assigned, the identification of their effects is not impaired.

Concerning the observed treatment heterogeneity we also consider alternative specifications of household types and the baseline energy consumption as sources of effect variation.[28] The household segmentation undertaken in this study aims at the approximation of lifestyles with distinct reactions to soft incentives. An additional criterion is the practicability of the approach for policy makers. We achieve this by distinguishing the place of living and the age group of households. Nevertheless, there are also other approaches that could be considered. An alternative segmentation is for example the distinction between households with and without children. These two household segments can be characterised by distinct lifestyles and could be targeted separately as well. With this segmentation approach, we find social norms to be an effective soft incentive in favour of the choice of a living space decrease and against the choice of a living space increase for childless households. For households with children in contrast, energy-related information can reduce the choice probability of a housing size increase independently of the baseline energy consumption. Other possible segmentation approaches are based on household characteristics such as income, home ownership or commuting behaviour (commuters vs. non-commuters). All tested approaches revealed treatment effect heterogeneity across household segments. Whether a segmentation approach satisfies the practicability criterion depends on the responsible policy institution.[29]

6 Discussion

The results of the choice experiment support our hypothesis of heterogeneous treatment effects across the different household segments. Whether social norms and information are an effective incentive for more energy-conscious choice decisions depends on the type of household. Only households in rural areas and senior households ap-

[27] For a further discussion of this issue, we refer to Appendix Section.

[28] Alternative model specifications that account for effect heterogeneity due to the baseline energy consumption as measured by the energy efficiency and location of the current home are discussed in Appendix A.4.

[29] For some household characteristics there will either be no information available or it may not be feasible to utilise the information for policy purposes.

pear to be sensitive to normative messages, whereas urban households are not. A potential reason is the significance of social norms in these communities. Personal social circles coincide with the community to a greater extent in rural than in urban regions, where life is more anonymous. Anonymity has been found to reduce adherence to social norms (Krysowski and Tremewan, 2021).[30] In the experiment, the normative treatment is formulated with regard to social norms in Swiss society. If the experience of anonymity in society differs between rural and urban areas, the effectiveness of such a treatment could also differ between households in these regions. Thus for households in urban areas, references to social norms in more immediate social circles, which are perceived as less anonymous, might be a more promising use of social norms as a policy measure.

Then again, with young households in urban areas we find the information treatment to be an effective measure to promote the choice of energy-conscious living spaces instead. The treatment-induced promotion of energy-conserving housing choices could coincide with trends in lifestyle of such households, which facilitates behavioural changes (Lindén et al., 2006). The aspiration to a sustainable way of living is common among young, urban households in Switzerland.[31] Hence, this could explain a sensitivity to information about energy consumption and energy cost savings related to dwelling characteristics, particularly the size of the living space. Another household segment, which reacts to the provision of information, is the mid-age, rural one. A high share of households in this segment are homeowners (see Appendix A.3), which in a study by Lang et al. (2021) with a related choice setting have been found to be positively influenced by information that increases the salience of energy costs.

In addition to the treatment heterogeneity due to different household types, we also find treatment effects to systematically vary with the baseline energy consumption. Given the household segment-specific susceptibility to a treatment, effects are found to be strongest when the baseline energy consumption is high. These results thus agree with previous findings (e.g. Allcott (2011), Andor et al. (2020)). We identify the largest effects for households currently living in homes with large per person living space. The information treatment was found to have a particularly strong impact on young urban households in currently large homes. Although only 11 percent of households live in housing with at least 65 square meters per person in this segment such a treatment could be very effective at preventing living space upgrades.

Even though social norms and energy-related information are revealed to be effec-

[30]The relevant aspect of anonymity is not necessarily the unobservability of actions. The physical absence of observers of one's behaviour is not a prerequisite for the effectiveness of social norms (Cialdini et al., 1991). Identifiability of social counterparts is the more relevant aspect (Bohnet and Frey, 1999).

[31]In Switzerland, national voting results reflect tendencies towards sustainability. An urban-rural divide is frequently observed in national votes with the majority of people in cities voting on the left political spectrum. Voting results in cities and particularly among young people tend to favour sustainable voting proposals (Rohm and Wurster, 2016).

tive incentives for the choice of, ceteris paribus, less energy-consuming living space sizes there is not much indication for their influence on the choice of the energy efficiency or the location of the home. The only exception is the significant, albeit negative, effect of social norms on the choice of the energy efficiency of a home in the young rural household segment. A possible explanation for this puzzling negative impact (p-value <0.1) is that the young rural household segment stands out with the highest share of households currently living in energy efficient homes in the experiment sample.[32] With the social norms treatment drawing attention to the energy efficiency of Swiss homes the observed negative effect could be similar to the boomerang effect that we observe with households living in small homes. If the treatment cannot convincingly convey that the average Swiss household lives in a highly energy efficient home or participants in this segment believe the energy efficiency of their current home to be above average, participants may adapt their behaviour to conform to the norm and choose the less energy efficient choice option. [33] As Schultz et al. (2007) note, the effect of social norms depends on the share of targeted households, which behave above average. Since a large share of households in the young rural segment already live in energy-efficient homes, it might thus be necessary to use alternative policy instruments when a more effective or personalised injunctive norm component cannot be included in the treatment.[34]

With the energy efficiency and the location attributes the energy-conserving attribute levels are correlated with higher prices, whereas the opposite is the case with the size of the living space. Thus, there is a conflict between higher costs and the incentives accentuated by the treatments for the choice of a high energy efficiency and a short commuting distance. Since we do not observe significant treatment effects with these attributes, the promoted benefits of the less energy-conserving housing options might not sufficiently increase marginal utilities to change choices. A further inhibiting factor could be the strong preferences for the energy efficiency and especially the commuting distance. The stronger the housing preferences are the less likely it is to see a treatment change a choice. Finally, it is possible that the formulation of the treatments themselves was too weak with regard to these attributes and limited the effectiveness. Thus, our findings agree with previous evidence (Dharshing and Hille, 2017; Lang et al., 2021) that generic information, even when targeted at individual household segments, does not sufficiently incentivize the choice of dwelling with a high energy efficiency or the choice of a short commuting distance.

[32] Information about the energy efficiency of the dwelling of participants is available in SHEDS.

[33] We also estimated a model specification, which includes a distinction of treatment effects by the energy efficiency of the current home as an approximation for the baseline energy consumption. The results suggest no significant difference of the treatment effect by this baseline. Hence, an explication for the observed effect is more in line with a shared belief about the energy efficiency of the average Swiss household within the young rural household segment.

[34] Injunctive norms have been established as an effective component to counterbalance boomerang effects of descriptive norms when normative messaging is employed (Schultz et al., 2007).

Instead, the results highlight that the tested soft incentives are particularly effective at influencing housing size choices. For household energy consumption this effect is highly relevant since the size of the living space is directly linked to the amount of energy required for heating. Data from the SHEDS reveal a substantial correlation between the per person living space and the heating costs per person.[35] Results from an ordinary least squares estimation of a regression model show that per person heating costs increase by 3.4 percent for a 10 percent increase of the per person living space (in square meters) when controlling for average room temperature and housing characteristics. Especially relevant against this background are the treatment effects in the senior and the mid-age rural household segments, which inhabit the most living space per person on average. With the right policy instrument a large share of households could be motivated to adapt their energy consumption behaviour.

Thus, when targeting energy consumption reductions, the insights gained in this study suggest a policy design, which considers differentiated reactions of households to soft incentives. The potential of social norms and energy-related information can be exhausted through the tailoring of these instruments to the responsive households. To avoid undesirable negative effects especially of social norms a further distinction of households by the baseline level of energy consumption is recommended. If not feasible for policy makers, the usage of injunctive norms is useful to counterbalance negative effects of descriptive norms (Schultz et al., 2007). Although the social norms treatment in this experiment contains elements of descriptive and injunctive norms, the latter appears to have been insufficiently strong to prevent the negative effect. For example, households living in homes with limited per person living space, which is a less energy-consuming baseline compared to a scenario with ceteris paribus excessive per person living space, are found to prefer an increase of the housing size when treated with social norms. A more effective application of injunctive norms could have been a more immediate direction of the normative component to the housing attributes.

A limitation of this study is the indistinction of homeowners and tenants in the experiment design since it requires the simultaneous provision of rental and buying prices for the housing options. Consequentially, this is a possible disturbance for the estimation of the housing preferences. Because the pricing information measures market prices the ratio of the two prices is not constant over all choice options. Depending on which price an experiment participant focuses on when making a choice decision the marginal utility of the choice attributes may differ. Thus, the estimates for the attribute preferences could be biased. Since we allow for heterogeneous preferences, the random parameters would capture this bias. It would be manifested in a more highly dispersed distribution leaving treatment effects robust. In return, there was no need for a distinction between homeowners and tenants in the random selection of

[35] There is no data about energy consumption for heating purposes available within the SHEDS. We use heating cost data as an approximation instead and control for the type of heating system.

the experiment participants and the analysis of the data. This was advantageous because the household characteristics used for the segmentation imply a correlation with home ownership. To gather sufficient participants for each subgroup, a larger pool of participants to draw from would have been necessary. This was not possible in the implementation stage. For future research a distinction by home ownership could be beneficial.

In addition, there are some reservations about the online stated choice experiment setting. The choices that participants make are without consequences. It is also relatively easy to behave according to what is socially approved of. Nonetheless, the insights gained in this study and the evidence available in the literature document the effectiveness of social norms and information. Thus, for the application to real life choices the question is not whether households react to soft incentives but rather how strongly. It requires a careful design of the policy instruments.

Despite these caveats, the results show that the impact of the treatments identified for the full sample are not representative of all household segments. We cannot find evidence for a homogeneous response to social norms and energy-related information across different types of households. To achieve a higher effectiveness of social norms and energy-related information our results suggest to target these incentives at the household segments, which respond to them.

7 Conclusion

The purpose of this study was to investigate, whether household segment-specific, targeted policy measures are more effective in influencing energy conserving behaviour than a standard uniform policy intervention. By conducting a discrete choice experiment we have tested the influence of social norms and information on the choice of housing. To explore heterogeneous reactions to these soft measures we have distinguished households by the lifestyle approximating variables age and place of living. We have found evidence for heterogeneous treatment effects of non-monetary incentives across different types of households. The tested incentives significantly influence housing choices and thereby can contribute to a less straining use of energy resources especially through the reduction of heating-related energy demand. Most notably, the soft measures reduce the probability of an increase of the living space. However, the effectiveness of the individual measures depends on the type of household as well as the current housing conditions. Although the full sample results suggest social norms to be the effective incentive, this is only confirmed for three of the five examined household segments. Two segments showed a significant reaction to the information treatment and one segment was not responsive to either treatment. Furthermore, treatment effects are strongest when current housing conditions imply a high energy consumption. The lower the baseline level of consumption (i.e. living space) is the smaller is the

impact of the treatment.

These findings highlight the relevance of tailored interventions for energy conservation behaviour. Based on comprehensive knowledge about the experiment sample, the results reveal potential energy savings through the choice of the housing size. The size of the living space is positively correlated with energy demand for heating. Accordingly, incentives could be especially effective when the current dwelling has large per person living space coupled with high temperature settings for rooms (high baseline energy consumption). These housing conditions can be observed for example in the senior household segment by exploiting data from the base catalogue of the SHEDS. Particularly strong treatment effects were found for young urban households. With the provision of energy-related information, these households, which might not have settled down yet, could be prevented from moving to larger housing. This is crucial when they choose long-term housing. It follows that energy consumption reductions could be realised with an improved intervention strategy.

Hence, household heterogeneity is highly relevant for the design of policy interventions that contribute to the energy conservation in the residential sector. In contrast to monetary policy instruments, there are no political barriers to distinguish and target selected types of households with interventions involving social norms and energy-related information. These soft incentives could be used more efficiently if tailored to the responsive household types compared to a one-size-fits-all intervention, because not all households show a reaction. The household segmentation approach developed in this study revealed a segment-specific susceptibility to soft measures. This was achieved with an approach that was designed to be useful in practice and thus identifies not the most distinct but sufficiently distinct reactions to treatments across household types. The household segmentation with the observable characteristics age and place of living demonstrated that some types of households react to only one of the incentives and some should be approached with different measures altogether.

The testing of alternative segmentation approaches has also confirmed heterogeneous treatment effects. Furthermore, it has indicated potential for the effectiveness of soft measures on the choice of the energy efficiency of homes. This leaves room for additional research to identify successful interventions to target these housing aspects. Furthermore, it would be insightful to test the segmentation approach in another region for evidence of heterogeneous household responses to soft measures outside of the Swiss context. Lastly, the gained insights are highly relevant for the efficient design of policies. Nevertheless, they should be treated with some caution, as we have used a stated preference approach. Supporting evidence could be explored with a revealed preference approach. Accounting for differences by the home ownership status of households in housing choice situations could also further improve the experiment design.

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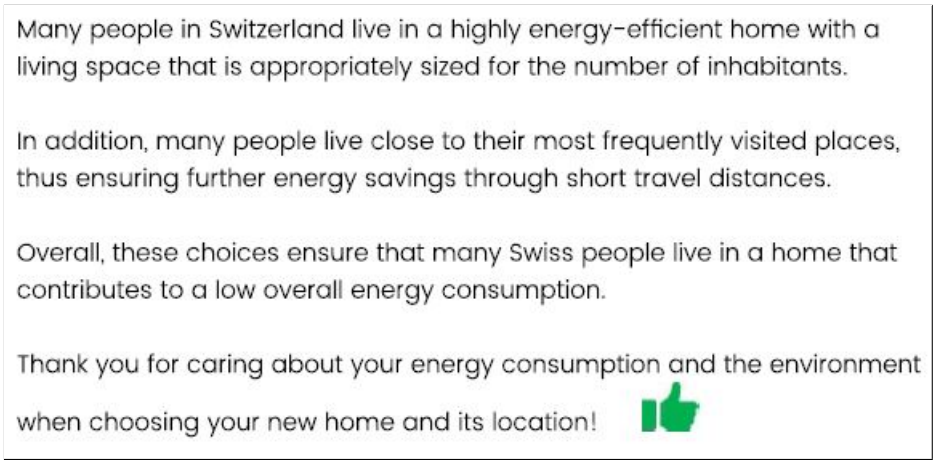
Appendix

A.1 Treatment Texts

Figure A.1: Treatment text as displayed to the social norms group

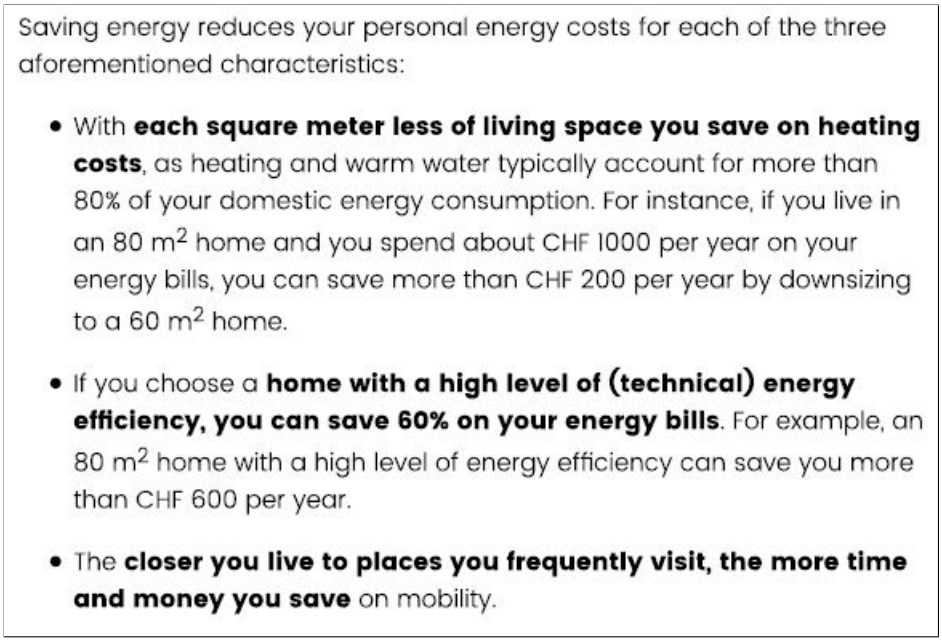

Many people in Switzerland live in a highly energy-efficient home with a living space that is appropriately sized for the number of inhabitants.

In addition, many people live close to their most frequently visited places, thus ensuring further energy savings through short travel distances.

Overall, these choices ensure that many Swiss people live in a home that contributes to a low overall energy consumption.

Thank you for caring about your energy consumption and the environment when choosing your new home and its location!

Figure A.2: Treatment text as displayed to the information group


Saving energy reduces your personal energy costs for each of the three aforementioned characteristics:

- With **each square meter less of living space you save on heating costs**, as heating and warm water typically account for more than 80% of your domestic energy consumption. For instance, if you live in an 80 m^2 home and you spend about CHF 1000 per year on your energy bills, you can save more than CHF 200 per year by downsizing to a 60 m^2 home.
- If you choose a **home with a high level of (technical) energy efficiency, you can save 60% on your energy bills**. For example, an 80 m^2 home with a high level of energy efficiency can save you more than CHF 600 per year.
- The **closer you live to places you frequently visit, the more time and money you save** on mobility.

A.2 Mouse-over Text

The following description of the choice attributes was available as mouse-over text to the experiment participants:

- Size of the living space: "The living space is expressed in square meters (m^2)"
- Energy efficiency: "The energy efficiency of a home is defined by the quality of the insulation (i.e. roof, walls, windows), the heating system, other housing

technology and large, built-in electric appliances."

- Distance to frequently visited places: "The distance to places you frequent on normal weekdays relates to the travel time required to get to places such as work, school/university or others you frequent the most. It can be looked at as "commuting" distance. A short distance translates to a travel time (one-way) of around 30 minutes on average, while a long distance corresponds to a travel time (one-way) of around 70 minutes on average."
- Price in CHF (rent / buy): "The price informs you about the monthly basic rental costs (net rent, excluding heating and other additional costs) if you want to rent the home and about the buying price if you want to own it. (Assume that you can choose whether you rent or buy your new home.)"

A.3 Descriptive Statistics

Table A.1: Summary statistics of the experiment sample by household segment

	Young urban		**Young rural**		**Mid-age urban**		**Mid-age rural**		**Senior**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Female	0.47	0.50	0.57	0.50	0.57	0.50	0.48	0.50	0.41	0.49
Years of education	14.49	1.81	14.18	2.16	13.99	2.06	13.78	2.05	13.15	1.83
Household size	2.33	1.23	2.69	1.27	2.53	1.29	2.50	1.42	1.79	0.72
Household with children	0.27	0.45	0.39	0.49	0.26	0.44	0.26	0.44	0.03	0.16
Home owner	0.10	0.30	0.35	0.48	0.37	0.48	0.56	0.50	0.53	0.50
Accommodation size in m^2	90.26	40.24	132.23	75.53	112.11	53.81	136.22	83.29	121.15	84.89
Current space p.p.	44.21	17.67	53.46	27.86	48.60	20.80	60.79	36.95	68.63	33.63
Household gross income										
up to 3'000 CHF	0.08	0.27	0.07	0.26	0.05	0.22	0.07	0.26	0.08	0.28
3'000-4'459 CHF	0.09	0.28	0.04	0.19	0.08	0.28	0.09	0.28	0.14	0.35
4'500-5'999 CHF	0.15	0.36	0.11	0.31	0.13	0.34	0.14	0.35	0.27	0.45
6'000-8'999 CHF	0.22	0.42	0.33	0.47	0.25	0.43	0.27	0.45	0.32	0.47
9'000-12'000 CHF	0.22	0.42	0.28	0.45	0.23	0.42	0.24	0.43	0.13	0.33
12'000 + CHF	0.24	0.43	0.18	0.38	0.25	0.43	0.19	0.40	0.06	0.23
Net housing costs in % of net income										
<20%	0.38	0.49	0.51	0.50	0.47	0.50	0.47	0.50	0.41	0.49
20-30%	0.44	0.50	0.38	0.49	0.41	0.49	0.40	0.49	0.38	0.49
31-40%	0.12	0.32	0.07	0.26	0.08	0.28	0.10	0.29	0.17	0.37
>40%	0.06	0.24	0.04	0.19	0.04	0.19	0.04	0.19	0.04	0.21
Number of observations	136		129		156		221		157	

Note: The table describes the household segment subsamples. Education level is translated into years. Current space p.p. describes the per person living space at home. All variables are dummies with the exception of years of education, household size, accommodation size and current space p.p..

Comparison of elicited and stated attribute preferences

At the end of the choice experiment, participants were asked to state their valuation (negative, neutral or positive) and the importance (5 point scale between not important and very important) they attribute to the housing characteristics when choosing a new home. Descriptive statistics of this data is presented in Table A.2. On average, a housing size increase, a high energy efficiency and a short commuting distance are valued positively. Solely the senior segment values a size increase negatively on average. The lowest average relative importance of the attributes for the housing choice is

stated for the size increase across all segments and particularly by participants in the mid-age rural and senior segements. Only the young urban segment states a housing size increase as somewhat important for the housing choice. For all segments, the most important attribute is the short commuting distance followed by the price for young and mid-age rural households and by the energy efficiency for mid-age urban and senior households. These stated preferences mostly agree with the elicited preferences in the experiment.

Table A.2: Summary statistics of the stated attribute valuation and importance

	Full Sample		**Young urban**		**Young rural**		**Mid-age urban**		**Mid-age rural**		**Senior**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Attribute valuation												
Size increase	2.24	0.68	2.46	0.62	2.36	0.65	2.32	0.72	2.20	0.67	1.93	0.64
Highest energy efficiency	2.60	0.54	2.60	0.52	2.63	0.53	2.63	0.55	2.59	0.53	2.54	0.55
Shortest distance	2.74	0.49	2.85	0.38	2.81	0.45	2.78	0.47	2.69	0.51	2.59	0.55
Attribute importance												
Size increase	3.01	1.06	3.30	1.04	3.20	1.06	3.15	1.08	2.92	1.07	2.60	0.90
Higest energy efficiency	3.66	0.87	3.58	0.87	3.61	0.83	3.74	0.84	3.62	0.89	3.73	0.88
Shortest distance	3.97	0.88	4.21	0.83	4.10	0.88	4.03	0.81	3.87	0.88	3.75	0.91
Lowest price	3.72	0.88	3.76	0.85	3.88	0.82	3.65	0.89	3.83	0.84	3.45	0.94
Number of observations	799		136		129		156		221		157	

Note: The first column describes the full sample. The rest of the table describes the household segment subsamples. Attribute valuation equals 1 for a negative, 2 for a neutral and 3 for a positive valuation. Attribute importance for the housing choice ranges between 1 (not at all important) and 5 (very important).

A.4 Additional Tables and Regression Results

Table A.3: Conditional logit estimation with the full sample

	Model I	Model II
Smaller size	0.00	−0.21*
	(0.09)	(0.11)
Smaller size × Current space p.p.		0.01***
		(0.00)
Smaller size × Social norms	0.07	−0.09
	(0.06)	(0.11)
Smaller size × Social norms × Current space p.p.		0.00
		(0.00)
Smaller size × Information	0.04	0.04
	(0.06)	(0.12)
Smaller size × Information × Current space p.p.		0.00
		(0.00)
Larger size	−0.22*	−0.04
	(0.09)	(0.10)
Larger size × Current space p.p.		−0.01***
		(0.00)
Larger size × Social norms	−0.04	0.24*
	(0.06)	(0.11)
Larger size × Social norms × Current space p.p.		−0.01**
		(0.00)
Larger size × Information	−0.07	−0.14
	(0.06)	(0.12)
Larger size × Information × Current space p.p.		0.00
		(0.00)
Energy efficiency	0.19***	0.19***
	(0.03)	(0.03)
Energy efficiency × Social norms	−0.05	−0.04
	(0.05)	(0.05)
Energy efficiency × Information	−0.01	−0.01
	(0.05)	(0.05)
Distance	−0.39***	−0.36***
	(0.04)	(0.04)
Distance × Social norms	0.04	0.04
	(0.04)	(0.04)
Distance × Information	−0.03	−0.03
	(0.04)	(0.04)
Rent in 1'000 CHF	−0.68**	−0.40
	(0.26)	(0.27)
Income interactions	Yes	Yes
Number of observations	9588	9588
Number of participants	799	799
Log likelihood	−2785.19	−2754.55

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors clustered at the participant level in parentheses. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Table A.4: Estimation results for Model I with buying prices

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age Rural	Senior
Smaller size						
Mean	−0.31+	−0.57	0.07	−0.64	0.11	−0.44
	(0.16)	(0.37)	(0.38)	(0.48)	(0.32)	(0.44)
Standard deviation	1.30***	0.90***	1.34***	1.49***	1.60***	1.26***
	(0.12)	(0.21)	(0.31)	(0.37)	(0.27)	(0.25)
× Social norms	0.17	−0.21	0.42	0.03	0.60*	−0.02
	(0.11)	(0.23)	(0.30)	(0.31)	(0.26)	(0.27)
× Information	0.04	0.21	0.25	−0.14	−0.31	0.42
	(0.12)	(0.23)	(0.30)	(0.33)	(0.25)	(0.28)
Larger size						
Mean	−0.27+	−0.01	−0.75+	−0.01	−0.74*	−0.08
	(0.15)	(0.34)	(0.39)	(0.47)	(0.33)	(0.40)
Standard deviation	0.96***	0.48*	1.36***	0.74*	1.38***	0.63*
	(0.11)	(0.23)	(0.33)	(0.29)	(0.25)	(0.26)
× Social norms	−0.09	0.14	−0.16	−0.02	−0.25	−0.07
	(0.10)	(0.20)	(0.30)	(0.26)	(0.24)	(0.23)
× Information	−0.13	−0.36+	−0.28	0.03	−0.11	−0.20
	(0.11)	(0.21)	(0.31)	(0.28)	(0.24)	(0.25)
Energy efficiency						
Mean	0.56***	0.62***	0.46*	0.39+	0.42**	0.73***
	(0.09)	(0.17)	(0.21)	(0.22)	(0.16)	(0.21)
Standard deviation	1.43***	1.05***	1.40***	2.00***	1.33***	1.58***
	(0.11)	(0.18)	(0.29)	(0.40)	(0.22)	(0.28)
× Social norms	−0.14	−0.02	−0.57+	0.23	−0.12	−0.08
	(0.11)	(0.20)	(0.29)	(0.30)	(0.22)	(0.26)
× Information	0.06	0.09	−0.11	−0.34	−0.01	0.30
	(0.11)	(0.21)	(0.28)	(0.31)	(0.22)	(0.28)
Distance						
Mean	−1.34***	−1.40***	−0.73*	−2.10***	−1.10***	−1.42***
	(0.14)	(0.31)	(0.33)	(0.47)	(0.29)	(0.39)
Standard deviation	1.12***	0.90***	1.15***	1.36***	1.26***	0.76***
	(0.09)	(0.17)	(0.23)	(0.25)	(0.20)	(0.18)
× Social norms	0.10	0.09	−0.10	−0.03	0.25	0.09
	(0.09)	(0.18)	(0.22)	(0.24)	(0.20)	(0.18)
× Information	−0.11	−0.13	−0.09	−0.17	−0.15	0.07
	(0.09)	(0.19)	(0.22)	(0.24)	(0.19)	(0.18)
Pricing						
Price in 100'000 CHF	−0.59***	−0.51+	−0.39	−0.99**	−0.43*	−0.76*
	(0.11)	(0.27)	(0.27)	(0.35)	(0.21)	(0.31)
Income interactions	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2353.40	−400.12	−392.05	−408.04	−666.43	−428.14

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. All variables except the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Table A.5: Estimation results for Model II with buying prices

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller size						
Mean	−0.88***	−1.15*	−0.44	−1.98**	−0.52	−0.95+
	(0.22)	(0.56)	(0.52)	(0.75)	(0.41)	(0.52)
Standard deviation	1.26***	0.91***	1.34***	1.41***	1.55***	1.12***
	(0.11)	(0.22)	(0.33)	(0.35)	(0.27)	(0.22)
× Current space P.P.	0.01***	0.01	0.01+	0.03*	0.01*	0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Social norms	−0.28	−0.19	0.74	−0.97	−0.19	−0.24
	(0.23)	(0.60)	(0.59)	(0.74)	(0.46)	(0.52)
× Social norms × Current space p.p.	0.01*	−0.00	−0.01	0.02	0.01+	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	0.16	−0.37	−0.41	0.12	0.21	0.51
	(0.24)	(0.68)	(0.61)	(0.83)	(0.47)	(0.52)
× Information × Current space p.p.	−0.00	0.01	0.01	−0.01	−0.01	−0.00
	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Larger size						
Mean	0.21	1.30*	−0.52	0.78	−0.26	0.59
	(0.20)	(0.54)	(0.51)	(0.62)	(0.39)	(0.45)
Standard deviation	0.92***	0.30	1.37***	0.66*	1.32***	0.36
	(0.11)	(0.31)	(0.34)	(0.31)	(0.25)	(0.35)
× Current space p.p.	−0.01***	−0.03**	−0.01	−0.02+	−0.01+	−0.02**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
× Social norms	0.67**	−0.27	0.11	0.56	1.17*	0.81+
	(0.22)	(0.55)	(0.60)	(0.62)	(0.47)	(0.46)
× Social norms × Current space p.p.	−0.01***	0.01	−0.01	−0.01	−0.02***	−0.02*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	−0.34	1.59*	−0.59	0.57	−1.13*	−0.06
	(0.22)	(0.71)	(0.66)	(0.70)	(0.47)	(0.46)
× Information × Current space p.p.	0.00	−0.05**	0.01	−0.01	0.02*	−0.00
	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Energy efficiency						
Mean	0.55***	0.65***	0.45*	0.45+	0.44**	0.63**
	(0.08)	(0.17)	(0.21)	(0.24)	(0.16)	(0.20)
Standard deviation	1.42***	1.02***	1.42***	2.05***	1.36***	1.45***
	(0.11)	(0.18)	(0.29)	(0.41)	(0.22)	(0.23)
× Social norms	−0.12	−0.01	−0.56+	0.21	−0.06	−0.17
	(0.11)	(0.20)	(0.29)	(0.32)	(0.21)	(0.25)
× Information	0.05	0.11	−0.14	−0.26	−0.06	0.35
	(0.11)	(0.22)	(0.29)	(0.32)	(0.21)	(0.25)
Distance						
Mean	−1.25***	−1.43***	−0.68*	−2.05***	−1.02***	−1.12***
	(0.14)	(0.31)	(0.34)	(0.49)	(0.28)	(0.32)
Standard deviation	1.11***	0.93***	1.16***	1.44***	1.24***	0.70***
	(0.09)	(0.17)	(0.24)	(0.28)	(0.20)	(0.17)
× Social norms	0.09	0.09	−0.10	0.00	0.24	0.07
	(0.09)	(0.19)	(0.22)	(0.25)	(0.20)	(0.17)
× Information	−0.10	−0.16	−0.10	−0.22	−0.13	0.10
	(0.09)	(0.20)	(0.22)	(0.26)	(0.19)	(0.17)
Pricing						
Price in 100'000 CHF	−0.50***	−0.54*	−0.36	−0.90*	−0.35	−0.52*
	(0.11)	(0.27)	(0.28)	(0.36)	(0.22)	(0.26)
Income interactions	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2328.87	−390.66	−389.60	−400.26	−654.82	−417.86

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Table A.6: Estimation results for Model II with an alternative household segmentation

	No children	Children
Smaller size		
Mean	−0.65*	−0.62+
	(0.28)	(0.35)
Standard deviation	1.54***	0.61**
	(0.16)	(0.20)
× Current space p.p.	0.01***	0.01
	(0.00)	(0.01)
× Social norms	−0.34	−0.88+
	(0.32)	(0.51)
× Social norms × Current space p.p.	0.01+	0.03*
	(0.00)	(0.01)
× Information	−0.11	0.99*
	(0.33)	(0.48)
× Information × Current space p.p.	0.00	−0.02+
	(0.01)	(0.01)
Larger size		
Mean	−0.16	−0.01
	(0.24)	(0.34)
Standard deviation	0.98***	0.62**
	(0.13)	(0.20)
× Current space p.p.	−0.01***	−0.00
	(0.00)	(0.01)
× Social norms	0.65*	1.12*
	(0.29)	(0.52)
× Social norms × Current space p.p.	−0.01**	−0.03+
	(0.00)	(0.01)
× Information	−0.04	−1.00*
	(0.29)	(0.49)
× Information × Current space p.p.	−0.00	0.02
	(0.00)	(0.01)
Energy efficiency		
Mean	0.48***	0.55***
	(0.10)	(0.14)
Standard deviation	1.55***	1.15***
	(0.14)	(0.16)
× Social norms	−0.00	−0.38*
	(0.13)	(0.19)
× Information	0.08	−0.07
	(0.14)	(0.18)
Distance		
Mean	−0.98***	−0.82***
	(0.12)	(0.18)
Standard deviation	1.13***	1.04***
	(0.11)	(0.15)
× Social norms	0.08	0.11
	(0.10)	(0.17)
× Information	−0.06	−0.24
	(0.11)	(0.17)
Pricing		
Rent in 1'000 CHF	−1.01	−3.35**
	(0.63)	(1.06)
Income interactions	Yes	Yes
Number of observations	7308	2280
Number of participants	609	190
Log likelihood	−1730.78	−570.77

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. The models include subsamples of participants with no underage children and participants with underage children. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Baseline energy consumption

Analogously to the inclusion of the current housing size, we test a model specification which accounts for the current energy efficiency of the participant's home, which affects the baseline energy consumption of a household. Bear in mind however that this relation could be less pronounced than in the case of the dwelling size. With the energy efficiency, the attribute level is not conditioned on the current level and thus there is no path dependency for choices within the experiment. Nonetheless, we expect some more insights potentially for the negative boomerang effect of social norms previously found for the young rural household segment.

Detailed data describing current housing characteristics of experiment participants is included in the SHEDS and enables us to distinguish households with high energy efficient homes. Our measure of a high energy efficient home is a dwelling with the Swiss energy efficiency standard "Minergie". 14 percent of the full sample (14% of the control group and information treatment group, 15% of the social norms treatment group) state to live in a Minergie home, whereas the rest of the sample either does not or does not know. Results of a model estimation that builds on Model II 3 and additionally includes interaction terms with the current energy efficiency are presented in Appendix A.4 Table A.7 and support our previous findings. The full sample results indicate both treatments to influence choice behaviour. Social norms are found to inhibit the choice of energy efficient housing whereas information promotes it. ATTs are strongest when participants currently live in a Minergie dwelling. Then again, the full sample results are not representative of all household segments. Senior households are more likely to choose energy-efficient housing with the information treatment than without and the effect is stronger if the current dwelling has the Minergie standard. The social norms treatment only affects young households in the choice of the energy efficiency. Moreover, there appears to be a negative boomerang effect with the social norms treatment among young urban households in Minergie homes. With the social norms treatment, they are less likely to choose energy efficient housing. For young urban households in less energy efficient housing social norms has a slight positive ATT. For the young rural household segment the previously found results (see Section 5) persist and the current energy efficiency does not affect them. Lastly, no significant impact of the two treatments on the choice of the energy efficiency can be identified for the mid-age household segments.

To also test the current commuting distance as a proxy for the baseline energy consumption, we use a SHEDS subsample of workers for which the current commuting distance can be approximated by the distance between the zip code of the home and the place of work. With this information a model with an inclusion of the current commuting distance analogously to the previously described model estimations with the current energy efficiency can be specified. However, estimations for this specification

were not feasible for three out of five segments and results are thus not reported here.

Correlated Housing Size Parameters

The model specification with correlated living space size parameters was possible to estimate for all household segments except the mid-age urban one. Because of non-convergence there are no new insights for this segment and this type of household thus remains non-responsive to soft incentives. The estimation results for the full sample and the other household segments are reported in Appendix A.4 Table A.8 and discussed in Section 5.4.

Model II without price variable

Since price information was not considered in the D-efficient experiment design, we provide estimations of Model II without the price variable and its interaction with income in Table A.9. With the exclusion of pricing information, the consequences of the price endogeneity for the model results are more extensive than when pricing information is included in the estimation models. Particularly the housing size parameters then reflect preferences for the housing size as well as price. Relative housing size is correlated with absolute housing size, which is an important determinant of prices, and therefore it is correlated with the error term of the model when price information is ignored. This leads to a downward bias in the parameters for attributes that correlate with higher prices (i.e. larger size, energy efficiency) and to an upward bias for the less expensive attributes (i.e. smaller size, long distance). In contrast, treatment effects remain closely comparable although statistical significance suffers in some instances. This is also reflected in the ATTs reported in Table A.10 in comparison to the ATTs in Table 6.

Consequently, Model I and II are our preferred model specifications. Without the inclusion of price, the relative size parameters reflect preferences of participants in all absolute size groups, while with the price inclusion the absolute size is implicitly controlled for via the price due to the high correlation between the two.

Table A.7: Model II with current energy efficiency

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller size						
Mean	−0.65**	−1.22*	−0.40	−1.28+	−0.34	−1.02+
	(0.20)	(0.57)	(0.50)	(0.68)	(0.39)	(0.52)
Standard deviation	1.23***	0.90***	1.31***	1.36***	1.53***	1.09***
	(0.11)	(0.22)	(0.32)	(0.32)	(0.28)	(0.22)
× Current space p.p.	0.01***	0.01	0.01+	0.03**	0.01*	0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Social norms	−0.23	−0.19	0.67	−0.94	−0.13	−0.19
	(0.23)	(0.60)	(0.58)	(0.73)	(0.46)	(0.51)
× Social norms × Current space p.p.	0.01+	−0.00	−0.01	0.02	0.01+	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	0.13	−0.41	−0.43	0.19	0.12	0.51
	(0.24)	(0.67)	(0.61)	(0.81)	(0.47)	(0.51)
× Information × Current space p.p.	−0.00	0.01	0.01	−0.01	−0.01	−0.00
	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Larger size						
Mean	−0.00	1.32*	−0.55	0.10	−0.43	0.62
	(0.18)	(0.55)	(0.50)	(0.57)	(0.37)	(0.45)
Standard deviation	0.89***	0.31	1.33***	0.60+	1.31***	0.32
	(0.11)	(0.29)	(0.33)	(0.32)	(0.25)	(0.38)
× Current space p.p.	−0.01***	−0.03**	−0.01	−0.02+	−0.01+	−0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
× Social norms	0.63**	−0.29	0.17	0.52	1.15*	0.78+
	(0.22)	(0.55)	(0.59)	(0.61)	(0.47)	(0.45)
× Social norms × Current space p.p.	−0.01***	0.01	−0.01	−0.01	−0.02***	−0.02*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	−0.32	1.61*	−0.58	0.46	−1.06*	−0.07
	(0.22)	(0.70)	(0.66)	(0.69)	(0.46)	(0.45)
× Information × Current space p.p.	0.00	−0.04**	0.01	−0.01	0.02*	−0.00
	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Energy efficiency						
Mean	0.53***	0.60**	0.39	0.29	0.30	0.83**
	(0.11)	(0.20)	(0.27)	(0.34)	(0.20)	(0.26)
Standard deviation	1.40***	0.98***	1.38***	2.03***	1.33***	1.41***
	(0.11)	(0.18)	(0.29)	(0.41)	(0.22)	(0.22)
× Minergie	0.02	−0.04	0.00	−0.08	−0.17	0.33
	(0.10)	(0.17)	(0.24)	(0.33)	(0.19)	(0.22)
× Social norms	−0.32*	−0.33	−0.62+	−0.20	−0.11	−0.30
	(0.15)	(0.26)	(0.36)	(0.44)	(0.30)	(0.34)
× Social norms × Minergie	−0.26+	−0.44+	−0.14	−0.42	−0.05	−0.13
	(0.13)	(0.24)	(0.32)	(0.43)	(0.28)	(0.33)
× Information	0.30+	0.26	0.30	0.14	0.16	0.61+
	(0.15)	(0.28)	(0.38)	(0.50)	(0.28)	(0.36)
× Information × Minergie	0.31*	0.19	0.53	0.41	0.30	0.28
	(0.14)	(0.25)	(0.35)	(0.48)	(0.26)	(0.33)
Distance						
Mean	−0.93***	−1.28***	−0.54*	−1.39***	−0.76***	−0.90***
	(0.09)	(0.24)	(0.22)	(0.33)	(0.18)	(0.22)
Standard deviation	1.10***	0.92***	1.11***	1.48***	1.24***	0.67***
	(0.09)	(0.17)	(0.23)	(0.29)	(0.20)	(0.17)
× Social norms	0.10	0.12	−0.10	0.07	0.24	0.11
	(0.09)	(0.18)	(0.22)	(0.25)	(0.19)	(0.17)
× Information	−0.12	−0.20	−0.15	−0.27	−0.13	0.07
	(0.09)	(0.20)	(0.23)	(0.26)	(0.19)	(0.17)
Price						
Rent in 1'000 CHF	−1.29**	−2.29+	−0.93	−1.47	−0.73	−2.93*
	(0.44)	(1.21)	(1.11)	(1.32)	(0.85)	(1.27)
Income interactions	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2332.85	−390.07	−389.43	−403.95	−653.95	−416.94

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Table A.8: Model II with correlated random parameters

		Household segments			
	Full sample	Young urban	Young rural	Mid-age rural	Senior
Smaller size					
Mean	−0.64*	−1.56+	−0.10	−0.35	−1.10
	(0.29)	(0.84)	(0.68)	(0.58)	(0.70)
Standard deviation	2.17***	1.81***	2.15***	2.49***	1.91***
	(0.19)	(0.32)	(0.50)	(0.42)	(0.39)
× Current space P.P.	0.01***	0.02	0.01	0.01	0.01+
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
× Social norms	−0.36	−0.64	0.78	−0.26	−0.46
	(0.33)	(0.89)	(0.77)	(0.64)	(0.74)
× Social norms × Current space p.p.	0.01+	0.00	−0.01	0.02+	0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
× Information	0.06	−0.30	−0.37	0.15	0.67
	(0.33)	(0.95)	(0.90)	(0.68)	(0.70)
× Information × Current space p.p.	−0.00	0.01	0.01	−0.01	−0.00
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Larger size					
Mean	−0.00	1.73*	−0.81	−0.41	0.73
	(0.26)	(0.79)	(0.70)	(0.55)	(0.61)
Standard deviation	1.83***	1.32***	2.30***	2.29***	1.30***
	(0.17)	(0.26)	(0.52)	(0.40)	(0.35)
× Current space p.p.	−0.01**	−0.04**	−0.01	−0.01	−0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
× Social norms	0.73*	0.15	−0.00	1.22+	1.07
	(0.31)	(0.81)	(0.79)	(0.64)	(0.66)
× Social norms × Current space p.p.	−0.01**	0.00	−0.00	−0.03**	−0.02+
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
× Information	−0.26	1.56+	−0.46	−1.07	−0.19
	(0.31)	(0.95)	(0.91)	(0.67)	(0.61)
× Information × Current space p.p.	0.00	−0.05*	0.00	0.02+	−0.00
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Energy efficiency					
Mean	0.50***	0.69***	0.42*	0.44*	0.65**
	(0.09)	(0.19)	(0.21)	(0.17)	(0.22)
Standard deviation	1.21***	0.90***	1.13***	1.15***	1.32***
	(0.12)	(0.23)	(0.33)	(0.26)	(0.26)
× Social norms	−0.09	0.17	−0.54+	−0.21	−0.10
	(0.11)	(0.24)	(0.28)	(0.23)	(0.26)
× Information	0.05	0.08	−0.02	0.04	0.41
	(0.11)	(0.25)	(0.29)	(0.24)	(0.26)
Distance					
Mean	−1.07***	−1.47***	−0.53*	−0.91***	−1.08***
	(0.12)	(0.28)	(0.25)	(0.24)	(0.30)
Standard deviation	1.10***	0.99***	1.24***	1.31***	0.74***
	(0.10)	(0.20)	(0.29)	(0.24)	(0.22)
× Social norms	0.11	0.04	−0.03	0.32	0.13
	(0.09)	(0.21)	(0.24)	(0.21)	(0.18)
× Information	−0.12	−0.15	−0.19	−0.19	0.04
	(0.09)	(0.22)	(0.25)	(0.22)	(0.18)
Price					
Rent in 1'000 CHF	−2.14**	−3.15+	−1.47	−2.07	−3.65*
	(0.66)	(1.76)	(1.58)	(1.33)	(1.75)
Income interactions	Yes	Yes	Yes	Yes	Yes
Corr(Smaller size, larger size)	−0.95***	−1.00***	−0.91***	−0.96***	−0.95***
	(0.02)	(0.00)	(0.05)	(0.03)	(0.06)
Number of observations	9588	1632	1548	2652	1884
Number of participants	799	136	129	221	157
Log likelihood	−2192.45	−368.60	−368.47	−598.46	−403.11

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p and the pricing variable are effects coded and take on the values -1,0 and 1. Each model estimation includes 5 interactions between the pricing variable and household income indicator variables.

Table A.9: Model II without price variable

		Household segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller size						
Mean	−0.29+	−0.55	−0.15	−1.09*	−0.12	−0.06
	(0.16)	(0.41)	(0.41)	(0.54)	(0.32)	(0.36)
Standard deviation	1.23***	0.86***	1.38***	1.29***	1.54***	1.12***
	(0.11)	(0.21)	(0.32)	(0.30)	(0.28)	(0.22)
× Current space p.p.	0.01***	0.01	0.01	0.03**	0.01**	0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
× Social norms	−0.22	−0.08	0.57	−1.07	−0.09	−0.10
	(0.22)	(0.55)	(0.58)	(0.69)	(0.45)	(0.51)
× Social norms × Current space p.p.	0.01*	−0.00	−0.00	0.02+	0.01	0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	0.08	−0.22	−0.29	0.11	0.07	0.40
	(0.24)	(0.62)	(0.59)	(0.76)	(0.46)	(0.51)
× Information × Current space p.p.	−0.00	0.01	0.01	−0.01	−0.01	−0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Larger size						
Mean	−0.32*	0.68+	−0.79+	−0.00	−0.66*	−0.21
	(0.15)	(0.39)	(0.44)	(0.43)	(0.32)	(0.32)
Standard deviation	0.88***	0.27	1.37***	0.56+	1.33***	0.39
	(0.11)	(0.32)	(0.33)	(0.32)	(0.26)	(0.30)
× Current space p.p.	−0.01***	−0.03**	−0.01	−0.02*	−0.01*	−0.01**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
× Social norms	0.62**	−0.32	0.28	0.65	1.09*	0.66
	(0.21)	(0.51)	(0.58)	(0.58)	(0.46)	(0.45)
× Social norms × Current space p.p.	−0.01***	0.01	−0.01	−0.01	−0.02**	−0.01*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
× Information	−0.27	1.34*	−0.74	0.57	−1.00*	0.05
	(0.22)	(0.64)	(0.66)	(0.65)	(0.45)	(0.45)
× Information × Current space p.p.	0.00	−0.04*	0.01	−0.01	0.01*	−0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Energy efficiency						
Mean	0.48***	0.55***	0.42*	0.39+	0.40*	0.52**
	(0.08)	(0.15)	(0.21)	(0.22)	(0.16)	(0.18)
Standard deviation	1.39***	0.92***	1.43***	1.87***	1.38***	1.40***
	(0.11)	(0.17)	(0.30)	(0.34)	(0.23)	(0.23)
× Social norms	−0.13	−0.02	−0.52+	0.12	−0.07	−0.19
	(0.11)	(0.19)	(0.29)	(0.30)	(0.21)	(0.24)
× Information	0.06	0.12	−0.13	−0.18	−0.06	0.37
	(0.11)	(0.20)	(0.28)	(0.30)	(0.21)	(0.24)
Distance						
Mean	−0.78***	−1.00***	−0.52**	−1.21***	−0.63***	−0.54***
	(0.07)	(0.16)	(0.18)	(0.25)	(0.15)	(0.13)
Standard deviation	1.10***	0.86***	1.14***	1.41***	1.26***	0.74***
	(0.09)	(0.15)	(0.23)	(0.26)	(0.20)	(0.17)
× Social norms	0.10	0.11	−0.10	0.09	0.22	0.15
	(0.09)	(0.17)	(0.22)	(0.24)	(0.20)	(0.17)
× Information	−0.12	−0.21	−0.14	−0.33	−0.13	0.03
	(0.09)	(0.19)	(0.22)	(0.25)	(0.19)	(0.17)
Number of observations	9588	1632	1548	1872	2652	1884
Number of participants	799	136	129	156	221	157
Log likelihood	−2346.02	−397.35	−392.84	−408.89	−657.64	−426.30

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Mean and standard deviation describe random parameters. X indicates interaction terms. Current space p.p. describes the per person living space of the current home. All variables except current space p.p are effects coded and take on the values -1,0 and 1.

Table A.10: Average treatment effects on the treated (Model II without prices)

		Households segments				
	Full sample	Young urban	Young rural	Mid-age urban	Mid-age rural	Senior
Smaller x Social norms:						
$<35m^2$	0.043				0.107	
	(0.058)				(0.110)	
35-64m^2	0.054				0.113	
	(0.044)				(0.083)	
$65m^2\leq$	0.076				0.120	
	(0.070)				(0.119)	
Larger x Social norms:						
$<35m^2$	0.092				0.121	0.234
	(0.057)				(0.111)	(0.146)
35-64m^2	−0.001				0.023	0.038
	(0.041)				(0.080)	(0.095)
$65m^2\leq$	−0.163**				−0.165	−0.236*
	(0.058)				(0.107)	(0.094)
Larger x Information:						
$<35m^2$		0.169			−0.132	
		(0.145)			(0.093)	
35-64m^2		−0.177+			−0.107	
		(0.093)			(0.070)	
$65m^2\leq$		−0.453+			−0.050	
		(0.241)			(0.122)	
Energy efficiency x Social norms			−0.261*			
			(0.103)			

Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. ATTs on the choice of the living space size are summarised by subgroups w.r.t. the current per person living space size. Effects are only included if the coefficients in the model estimation are statistically significant at the 10 percent level.