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Energy Crisis, Climate Crisis, and the Future of Warm Homes

Considerations of House Owners to Install Green Heating Systems.

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Abstract

This study aims to answer the question, **“To what extent do attitudes, subjective norms, perceived behavioral control, and concerns explain the intention to install a green heating system of house owners in Germany in 2022?”**. Attitudes, subjective norms, perceived behavioral control are the three independent variables to explain behavior intention in the Theory of Planned Behavior. Several researchers consider “environmental concern” a meaningful variable that could add more sophisticated insights to Ajzen’s theory. This research contributes to the theoretical discussion and fact-based policymaking to promote green heating systems. Moreover, the study considered autarky and financial concern variables. Initially, the paper introduces the Theory of Planned Behavior, reflects further theoretical considerations about concerns and develops nine hypotheses. A particular focus lies on different approaches to explain the role of feelings in the decision-making process. Within the framework of a cross-sectional study design, participants answered standardized questions. These questions address the main concepts and additional variables of the Theory of Planned Behavior regarding green heating systems. The multiple regression analysis shows no significant result. The discussion reflects on potential problems (N=35) and concludes how other researchers can use the findings for future research.

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Introduction

“Renewable energies free us from dependencies. Renewable energies are therefore energies of freedom. We rely on freedom energies.” (Lindner, 2022, own translation). With this quote, Christian Lindner, Germany’s Minister of Finance, explained the position of the German Government three days after the Russian invasion of Ukraine. The Russian war on Ukraine, western sanctions, and the absence of gas delivery through the Nord Stream 1 pipeline led to rising fossil fuel prices and showed Germany's dependence on Russian gas. To compensate for the lack of Russian energy, the German Government decided to import LNG (liquid natural gas), which is more expensive in production than (Russian) natural gas (Halser & Paraschiv, 2022, p. 8). The German Government had planned to be less dependent on several countries from the Arabian Peninsula due to the miserable human rights situation.

Nevertheless, since the beginning of the war, Germany has been planning to buy LNG from these countries (Welfens, 2022, p. 52). The whole situation has again shown the world, especially the German Government, that energy is a geopolitical instrument. As the quote illustrates: promoting renewable energies is not a purely environmental project for (energy) resource-poor countries like Germany. Also, the climate protection targets (e.g., Paris Agreement) commit Germany to a reduction of greenhouse gases.

Energy consumption has become a challenge in Germany. Due to the German climate goals and reducing Russian energy imports, a change in energy consumption seems mandatory. In Germany, heating accounts for a share of more than 50% of the total energy consumption. With an amount of 90%, private households use almost all their energy for heating. An essential contribution to energy saving is the insulation of buildings. While this measure can reduce energy consumption, it will not be possible to eliminate energy consumption for heating in private households. For climate protection and energy independence, house owners must apply new patterns to produce heating for their houses. Eco-friendly heating systems can reduce CO₂ emissions and contribute to climate protection (Halser & Paraschiv, 2022, p. 8). During the last decade, the percentage of green heating systems in existing buildings has increased in Germany. Green heating systems is a contested term, and the chapter green heating systems clarifies the concept. In particular, this paper considers heating pumps, solar thermal systems, and green district heating systems. In the case of heat pumps, the share of all heating systems doubled from 1,1 % in 2011 to 2,8 % in 2021 (BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., 2022). Still, the percentage of green heating systems remains low, and 75% of the heating systems newly installed in 2021 were fossil fueled. Only 25% were biomass or heating pumps heating systems (Bundesverband der Deutschen Heizungsindustrie, 2022). For these reasons, the German Government identified the installation of green heating systems as leverage to increase energy independence and reduce CO₂ emissions.

The commitment of private households in Germany is crucial to successfully installing more green heating systems. The Theory of Planned Behavior (TPB) can give more insights into the decision-making processes. In several studies (Kamalanon et al., 2022; Liobikienė et al., 2021; Wei et al., 2021), researchers showed how the TPB from Ajzen can explain behavior intention and behavior. Three independent variables are central: attitude towards the behavior, subjective norms (peer pressure), and perceived behavioral control. Perceived behavioral control discusses to what extent a person assumes to be able to conduct a particular behavior (Ajzen, 2020, p. 315).

Many researchers consider “environmental concern” to be a meaningful additional variable to extend the TPB and generate a more comprehensive explanation for behavior. In accordance with the TPB, Groot and Steg (2007, p. 1830) and Wei et al. (2021, p. 8) constructed models that include environmental concerns as an independent variable for attitudes. Liobikienė et al. (2021, p. 591) identified the

interaction of attitude and environmental concerns as a relevant extension of the TPB. A third approach found evidence that environmental concerns are an independent variable for behavioral intention (Kamalanon et al., 2022, p. 18).

According to Ajzen, researchers can introduce additional variables to the TPB. Nevertheless, he argued that the TPB should be extended only after careful consideration, for which he defined several criteria (Ajzen 2020, p. 317; 321). While the first approach is consistent with ground theory, the second and the third represent a violation of some of Ajzen's rules. The theory chapter defines these variables in detail and discusses theoretical problems in their specification. A review of the existing literature demonstrates that there is no consensus on the role and importance of environmental concerns for behavioral intention. In addition, the current literature cannot explain to what extent environmental concerns influence attitude compared to economic considerations. This work will focus on the impact of concerns in decision-making processes. While the existing literature in the field of TPB focuses on a specific type of concern (environmental concerns), different concern variables, which explicitly include concerns regarding economic developments in the future, were not considered. Various discoveries within TPB (see the discussion about environmental concern) and findings based on other theories, for example, regarding the importance of feelings (Damasio, 2004) and fear (Brower-Rabinowitsch, 2022), suggest that worries can influence decision-making. Therefore, this work discusses the environmental concerns variable and the extension of environmental concerns into different concern variables.

In addition to the relevance of this work for the theoretical development of TPB, there is also a practical relevance: how can the TPB explain the intention to buy green heating systems? While several papers have already dealt with the application of the TPB to green behavior (Wei et al., 2021), there is no knowledge about the application of the TPB regarding green heating systems. At the same time, Mahapatra and Gustavsson (2008, p. 589) studied the decision-making process for green heating systems in 2008. However, this paper used the Diffusion of Innovations as the theoretical framework, not the TPB. Furthermore, within the last 15 years, new knowledge about climate change, technical innovations in the heating market, and political developments have potentially changed the thinking of potential green heating buyers.

To answer the given theoretical and practical puzzle, this thesis investigates the question:

"To what extent do attitudes, subjective norms, perceived behavioral control, and concerns explain the intention to install a green heating system of house owners in Germany in 2022?"

Therefore, the research should clarify whether the TPB gives sufficient insights to explain the decision for a new heating system. Moreover, the study examines the potential of concern variables as additional variables for the TPB. The explanatory research question builds on a post-positivist paradigm. The paper assumes that a measurable reality exists, but people's perspectives matter to understand that reality. Answering this question can help create policies promoting the installation of eco-friendly heating systems. The following study aims to close the theoretical gaps and explain the decision-making process for new heating systems to contribute to fact-based policymaking in that field. In addition, this paper helps to develop an extensive framework to analyze environmental questions with the TPB.

The Theory chapter summarizes and processes previous studies and develops a distinct definition of green heating systems. Furthermore, this chapter explains the TPB in detail and addresses gaps for further investigation. These gaps examine this paper in 9 hypotheses. The following Methods chapter elaborates on the chosen research design and analysis methods. This chapter describes the translation of all theories and concepts into a quantitative survey, the survey conduction, and the data analysis process. The research tool is SPSS, and this chapter explains the data analysis and the testing of relationships with different regressions. The Analysis chapter presents and examines the results, and the discussion

chapter examines potential problems and solutions in this research. Moreover, it creates a perspective for further study and answers the research question to a possible extent. In the conclusion, the researcher summarizes all findings and answers the research question.

Theory

In the following chapter, scientific findings from other research projects are presented and classified for the research process of this paper. Furthermore, green heating systems are scientifically classified and defined. The theoretical framework of this scientific investigation is based on the Theory of Planned Behavior by Ajzen (1985). The following chapter introduces this theory and discusses its scientific development. Based on these findings, the paper formulates a total of 9 hypotheses.

Literature review

As mentioned in the introduction, a concern might be essential to explain the intention to buy green heating systems. The literature presents two strings of practical applications of the TPB for analyzing decisions of environmentally friendly behavior. Some researchers strictly applied the rules and expectations of the ground TPB with attitude, subjective norm, and perceived behavioral control as the leading independent variables (Groot & Steg, 2007, p. 1830; Wei et al., 2021, p. 8). Others chose a broader approach by adding environmental concerns as a fourth independent variable to the TPB (Kamalanon et al., 2022, p. 18). Both approaches have in common that they narrow down their concern variable to the environment and do not consider a broader variable of concern. In addition, the body of literature about the social-political reasoning for adopting green heating systems is very limited.

So, which insights does existing literature provide? In 2008 Mahapatra and Gustavsson (p. 589) argued that “annual heating cost, investment cost, and functional reliability were the most important factors when choosing a new heating system.” In addition, they showed that environmental consideration partly influences the decision to install a new heating system. Due to the age of this research and the changes in technologies, at least the considered innovative heating systems are partly outdated (see chapter heating systems and green heating systems). Their study's theoretical framework was Roger's (2003) Diffusion of Innovations. While Mahapatra and Gustavsson focused on that framework of a processual character of considering and deciding on new heating systems, other studies focused on Ajzen's TPB (Korcaj et al., 2015; Liobikienė et al., 2021). Ajzen argued in his ground theory that attitude towards the behavior, subjective norms (peer pressure), and perceived behavioral control (perceived capacity to conduct behavior) are sufficient independent variables to predict decisions in different contexts (Ajzen, 1991, p. 188). Various studies show that the TPB is suitable to be applied to predict more sustainable behavior of citizens. Wei et al. (2021, p. 7) show the scientific value of environmental concerns as an explanatory variable for attitudes to analyze green power certificate purchase behavior. Moreover, they point out that perceived behavioral control is the most crucial variable in explaining purchase intention.

Also, Groot and Steg (2007, p. 1830) applied the TPB in their investigation of mobility hubs in a meaningful way. In their study, they evaluate the variable of environmental concerns and show that especially egoistical motives are the main drivers for being concerned about the environment. Liobikienė et al. (2021) reveal that environmental concerns are not only an explanatory variable for positive attitudes towards renewable energy but also the interaction of attitudes and environmental concerns partially explains the intention to use renewable energy. Based on Kamalanon et al.'s (2022, p. 18) research, the TPB is extendable with several additional variables. In contrast to the ground theory, their finding supports the introduction of environmental concerns as a fourth independent variable that influences sustainable purchase decisions.

Furthermore, they identified the environmental knowledge and innovativeness of the consumers as moderating variables. “Innovativeness is one consumer trait that represents the degree to which an individual adopts an innovation relatively earlier than his or her peers” (Kamalanon et al., 2022, p. 8). This concept is, in turn, a reference to the work of Rogers about the adoption of innovations (Rogers & Shoemaker, 1971).

Green heating systems

The green heating system is a concept whose content changes dynamically with technical development. Li et al. (2004, p. 227) define green heating systems “as heating systems whose primary energy consumption, as well as emission rates, are significantly lower than those of currently implemented advanced heating systems.”

Mahapatra and Gustavsson (2008, p. 578) discuss wood pallet boilers as an innovative heating system in their study about innovative heating systems. At the beginning of 2020, many scientists do not consider wood pallet boilers as innovative. Burning wood releases only the amount of CO₂ that the trees previously absorbed but makes a stepwise use (e.g., furniture production-paper) of wood fibers impossible. European forests could store twice as much CO₂ per year (245.4 to 456 million t CO₂) if no one cut energy wood in Europe (Welle et al., 2020, p. 3). In their study about the future of European forests, Welle et al. (2020, p. 53) argue for a circular economy of wood products and against wood as an energy source (partially excluded: branches). The German government classifies biomass heating systems as sustainable. It subsidizes single biomass heating systems with up to 15% and renewable energy hybrid heating systems with biomass with up to 25% (Richtlinie Für Die Bundesförderung Für Effiziente Gebäude – Einzelmaßnahmen (BEG EM), 2022).

Three other technologies are more the focus of discussions about green heating systems: geothermal systems, solar thermal systems, and air-based heating pumps (Möller et al., 2019, p. 559). All these systems use renewable energy to heat. The German Ministry for Economy and Climate Protection especially favors heating pumps (air-based, geothermal, and water-based) with the highest rate of subsidies for a whole new heating system (40%). The subsidies consist of 25% for the heat pump and another 10% for replacing a fossil heating system (gas heating older than 20 years). Suppose the heat pumps utilize water, soil, or wastewater as a heat source, the state grants an additional bonus of 5%. Germany subsidizes renewable energy hybrid heating systems without biomass up to 30% and solar thermal systems with 35% (Richtlinie Für Die Bundesförderung Für Effiziente Gebäude – Einzelmaßnahmen (BEG EM), 2022). The categorization of district heating systems depends on the type of energy used. District heating use often waste heat from industrial processes (e.g., garbage incineration), and only 17,8% of the heat in 2020 came from renewable energy. The incineration of garbage makes the recycling process impossible. Instead, reducing waste could be preferred to burning generated waste. Nevertheless, the German government identifies district heating as a core element for green heating (Bundesministerium für Wirtschaft und Klimaschutz, 2021). Therefore, the German government supports the connection to a district heating network by up to 35%. These subsidies require an exchange of a fossil fuel-based heating system (Bekanntmachung Änderungen von Richtlinien Vom 21. Juli 2022, 2022, p. 1). Also, Chen et al. (2020, p. 9) show the potential to build district heating systems based on green energy sources in their study.

In 2021, the German government amended the German Climate Protection Act of 2019 and set stricter sector-specific targets for CO₂ equivalent emissions. The law required the buildings sector to emit a maximum of 113 million metric tons of CO₂ equivalent in 2021. This building sector missed the target by 2 million metric tons of CO₂ equivalent. By 2030, the law mandates a reduction to 67 million metric tons of CO₂ annual emissions, which would nearly halve emissions (Bundes-Klimaschutzgesetz (KSG),

2021). There is great potential to reduce emissions and achieve this goal in the building sector through sustainable heat production. Currently, almost three-quarters of heating energy used for German residential houses is based on the two primary fossil energy sources, gas (49,5 %) and oil 24,8 %. In addition, 16,7 % of the heating energy (14,1 % district heating and 2,6 % electrical energy) was produced only partly green (BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., 2022). Thus, only 44,2% of German electricity comes from renewable energy production (DE Statis Statistisches Bundesamt, 2022). Moreover, 2,6% of the heating energy for private houses came from heating pumps. The remaining 6,2% of electrical energy came from other fossil and renewable sources (BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., 2022).

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) presents a framework that explains the intention to perform a particular behavior and the performance of that behavior. Ajzen introduced this theory as an advancement of the reasoned action theory (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). This theory consists of two variables: attitude and subjective norm. Attitudes describe the perspective of a person towards a specific behavior, and subjective norms refer to the opinion of the social environment towards behavior and its influence on an individual's behavioral intention. The TPB acknowledges perceived behavioral control as the striking third independent variable. This variable discusses to which extent a person thinks they can influence a particular behavior (Ajzen 1991, p. 181). Figure 1 visualizes the reasoning of the TPB and shows how the three independent variables (attitude, subjective norm, and perceived behavioral control) can explain behavioral intention. Behavioral intention is the intention to conduct a specific behavior. Behavioral intention and perceived behavioral control determine behavior. Attitude, subjective norm, perceived behavioral control, and intention share in their construction the principle of compatibility: All these variables should be based and name target, action, context, and time element (tact). Generally, this feature is characteristic of the ground theory (Ajzen, 2020, p. 314). Another element is the “salient beliefs,” which underlie attitude (behavioral beliefs), subjective norms (normative beliefs), and perceived behavioral control (control beliefs). The strength of salient beliefs multiplied by the evaluation result of these salient beliefs constructs the three independent variables in the ground theory (Ajzen, 1991, p. 192). The ground theory explicitly measures no general values. Accordingly, the theory makes no claims about constructing the salient beliefs (Ajzen, 1991, p. 189). Nevertheless, Ajzen acknowledges general values and socio-economic variables as background factors that can contribute to the explanation (Ajzen, 2020, p. 318).

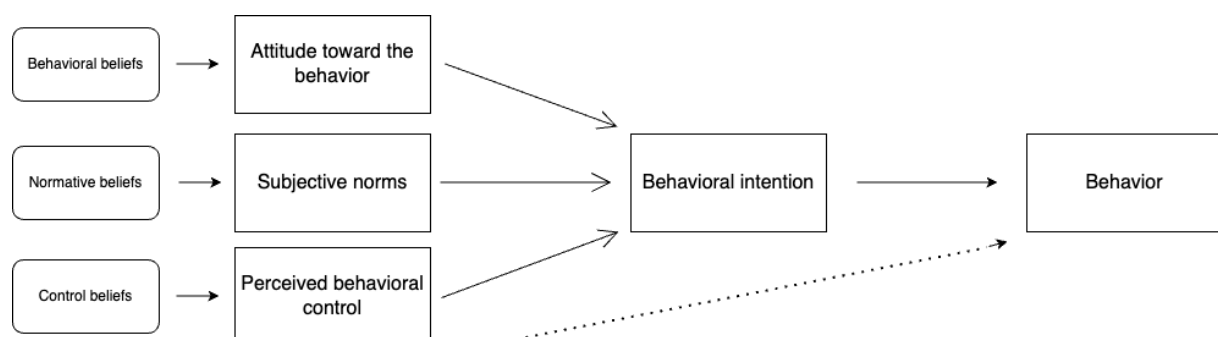


Figure 1: Reasoning of the Theory of Planned Behavior (Ajzen, 1991, p.182)

According to Ajzen (1991, p. 191), “*attitudes* [are] develop[ed] reasonably from the beliefs people hold about the object of the attitude.” Therefore, attitudes are positive or negative assessed attributes that people associate with behavior. The theory expects that people have a set of preexisting, already evaluated beliefs and, therefore, can express their attitudes towards a behavior without a lengthy evaluation process. In accordance with Fishbein's (1963¹, 1967) research, the attitude formats automatically. Only a few beliefs (five to nine) determine the seemingly intuitive attitude towards behavior. If a person has more time, an active reflection process can change some attitudes (Fishbein & Ajzen, 2009, p. 97). In addition, personal beliefs about behavior and its consequences can also reflect past experiences. Individuals prefer behavior from which they assume that the results suit their values and beliefs (Ajzen 1991 p. 191). Also, affect and emotions can serve as background factors for constructing attitudes. Ajzen differentiates between affective attitudes and instrumental attitudes. “The instrumental beliefs were found to predict an instrumental attitude measure (e.g., useful–useless) better than an experiential measure (e.g., interesting–boring), and the reverse was true for the affective beliefs.” (Ajzen, 2011, p. 1117). Therefore, the measurement combination of both types of attitudes alters the prediction quality of the attitude variable (2011, p. 1117).

This study understands attitude as the opinion of house owners about installing green heating systems in their houses (tact). Therefore, attitude can be positive or negative. The intention is the willingness to install a green heating system in their home within the next 12 months and can therefore be high or low. Wei et al. have disclosed that attitude towards green power certificates positively correlates with the intention to buy these certificates (Wei et al. 2021). Also, Kamalanon et al. (2022, p. 13) showed that attitudes to renewable green significantly affect green product purchase intention. Therefore, hypothesis 1 expects that the attitude toward green heating systems positively correlates with buying a green heating system (H1).²³

Model 1:

Hypothesis 1 (H1). People with a more positive attitude towards green heating systems have a higher intention to install a green heating system.

Subjective norms are peer pressure that influences an individual's behavior (Ajzen 1991 p. 195). In the context of this study, subjective norms are seen as peer influence to install a green heating system in their house. Peers could identify fossil-based heating systems as a threat to stopping the climate crisis and influence the respondent indirectly (talking about the necessity of new heating systems) or directly demand a greener behavior. Also, actions can be subjective norms when, e.g., peers buy green heating systems. Subjective norms are positive if the environment favors green heating systems and acts accordingly to their preference. If the social environment is against green heating systems, subjective norms measure the hostility towards green heating systems. To clarify the relationship between subjective norms and green heating systems, the researcher formulates H2.

Model 1:

Hypothesis 2 (H2). People with more positive subjective norms towards green heating systems have a higher intention to install a green heating system.

¹ Problematic research design/question: Attitudes towards People of color (here “negro”) as research objects.

² The hypotheses were developed based on Kamalanon et al. (2022) research.

³ Figure 2 visualize all hypotheses.

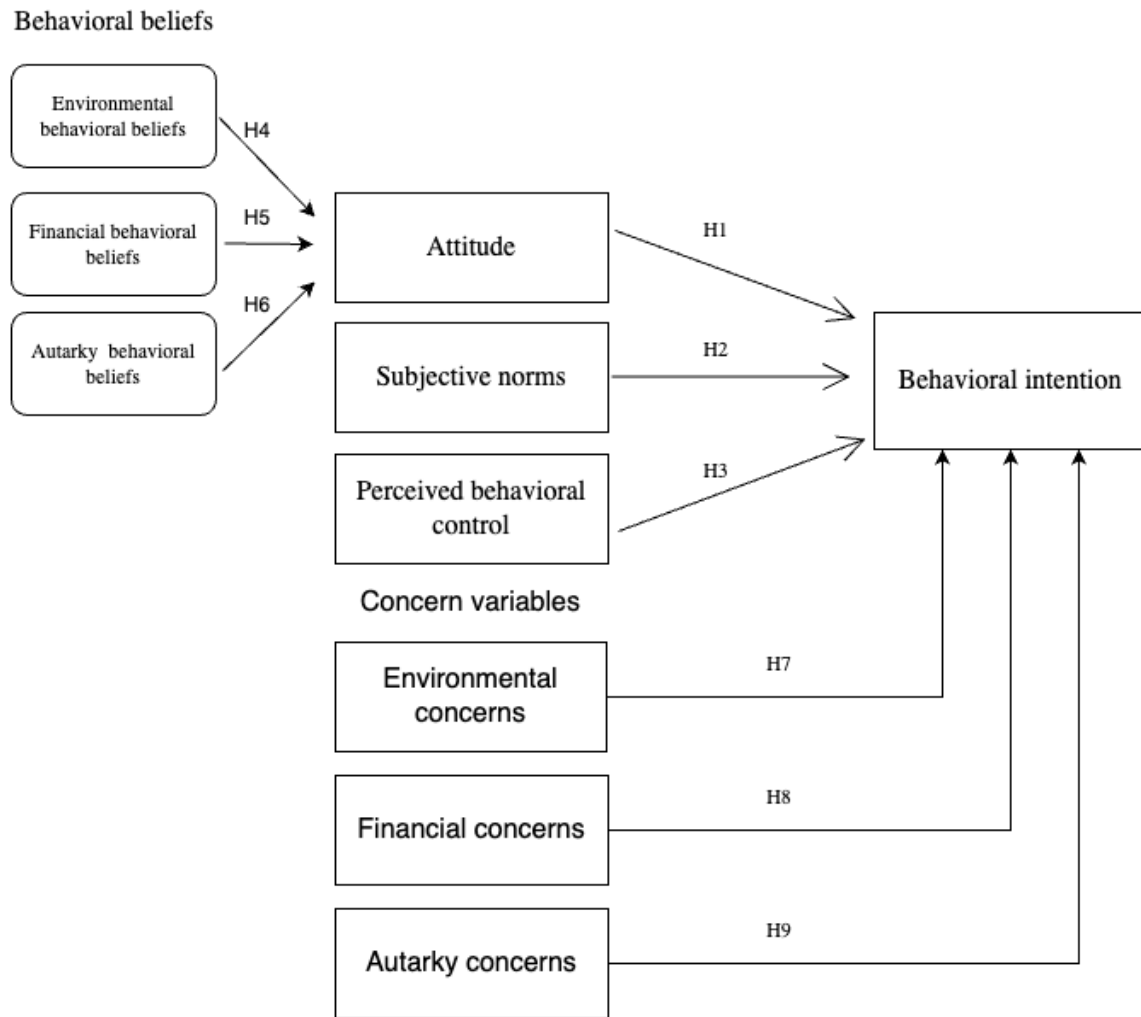


Figure 2: Extended model Theory of Planned Behavior of this research (own illustration)

A further independent variable of the TPB is *perceived behavioral control*. Ajzen developed this variable because he realized that not only attitude and peer pressure (subjective beliefs) shapes behavioral intention but also the assumed capabilities and power to conduct the behavior. The concept of control beliefs underlies this assumption. These beliefs reflect past experiences or shared narratives about experiences from peers. Perceived power describes the assumed capabilities to solve obstacles arising from the control beliefs. (Ajzen 1991, p. 196). Research has shown that the perceived behavioral control variable measures the capacity to conduct a behavior (e.g., resources) and the autonomy to decide about the conduction of that behavior. A combined perceived behavioral control variable has a high internal consistency (Fishbein & Ajzen, 2009, p. 166). “When people have perfect volitional control over the behavior of interest, and when they strongly believe that they are capable of performing the behavior if they so desire, behavioral control is irrelevant, and the TPB reduces to the theory of reasoned action.” (Ajzen, 2020, p. 316). In the context of the study, perceived behavioral control covers the perceived capacities to invest in a green heating system. In addition, the variable also measures whether the participants assume their house is suitable for a green heating system. To sum up, perceived behavioral control discusses to what extent an individual thinks they can install a green heating system in their house within the next 12 months (tact). Positive perceived behavioral control means that an individual thinks he or she can install a green heating system within the next 12 months. Thus, H1 hypothesizes the effect of perceived behavioral control on behavioral intention.

Model 1:

Hypothesis 3 (H3). People with more positive perceived behavioral control towards green heating systems have a higher intention to install a green heating system.

Overall, the TPB claims to predict behavior by using perceived behavioral control and intention of conducting a particular behavior as independent variables (Ajzen 1991 p. 183). According to the theory, the researcher assumes that the intention of buying a green heating system increases the likelihood of purchasing a green heating system. Nevertheless, investigating behavioral intention and actual behavior is only possible in the longitudinal design (Babbie, 2016, p. 106). Therefore, this paper will not further discuss the correlation between behavioral intention, perceived behavioral control, and behavior.

Ajzen has shown in different studies that attitude, subjective norms, and perceived behavioral control can predict behavioral intention and behavior. Moreover, he tested several additional independent variables. The added variables could not significantly contribute to the degree of explanation (Ajzen 1991, p. 200). The TPB considers demographic variables like age, gender, or education as determining factors for attitude and behavior. Therefore, this work evaluates these factors as control variables for the sample structure (Ajzen 2011, p. 1123).

Nevertheless, Ajzen pointed out: “The Theory of Planned Behavior is, in principle, open to the inclusion of additional predictors” (Ajzen 1991, p.199). He limits the introduction of new variables to several criteria. The new variables must contribute to the explanation of the TPB and should present a causal relationship. Also, the variable should be valid and relevant for a broader range of social science research. Moreover, the variable should be conceptually independent of the established predictors and measurable “in terms of the target, action, context, and time elements” (Ajzen, 2020, p. 317).

Concern variables

As shown in the literature review, several researchers included environmental concerns in the TPB to investigate the patterns of adopting green technology. Generally, the variable describes a person's awareness of ecological challenges (Kamalanon et al., 2022, p. 6). Groot and Steg (2007, p. 1826) further developed the concept of egoistical environment concerns (self-interest of surviving in an unspoiled environment).

The discussion of whether and how researchers can add environmental concerns to the TPB underlies more extensive debates from human psychology research: To what extent are decisions conscious or resulting from unconscious feelings? From a consequentialist perspective, feelings are just byproducts of a decision-making process. Feelings have no causal influence on the decision (Loewenstein et al., 2001, p. 268). The approach of “feeling as a process determinant” rejects this assumption. Feelings draw attention to a topic and prioritize decisions that a person must urgently take. If humans had to work through tasks one after the other and could not be flexible in their priorities regarding upcoming challenges, immense consequences could arise. This mechanism is critical in the case of decision-making under time pressure. One example is the coordination of arrivals at a big airport. In an emergency, air traffic control has a short time to decide which plane can land first. Therefore, air traffic controller personnel must switch from standardized work to emergency reaction without extended cognitive evaluation (Betsch et al., 2011, p. 126). According to Simon (1967, p. 34), feelings lead to an interrupt mechanism in this situation. A third approach is based in large part on the work of Bell (1982), Loomes, and Sugden (1982) and focuses mainly on (negative) feelings: The disappointment and the regret theory. *“Regret theory rests on two fundamental assumptions: first, that many people experience the sensations we call regret and rejoicing; and second, that in making decisions under uncertainty, they try to anticipate and take account of those sensations.”*(Loomes & Sugden, 1982, p. 820). These

feelings reflect experiences from past experiences. A further development was the disappointment theory. This theory includes people's experiences when their chosen decision led to a worse outcome than expected (Betsch et al., 2011, p. 127). "Disappointment and regret are different kinds of pain that one may experience when one reflects on 'what might have been.'" (Loomes & Sugden, 1986, p. 281). In contrast, the regret theory can explain violations of the transitivity axiom (e.g., $A > B$ and $B > C$, then $A > C$). The disappointment theory explains the violation of the sure thing principle (Loomes & Sugden, 1986, p. 281; Shafer, 1990, p. 276). This principle states that someone will act regardless of the outcome of an event in the future. The following example explains this principle: When a person buys a property in any case, regardless of which party will win the next presidential election, the sure thing principle is fulfilled (Savage, 1972, p. 21). According to Loomes and Sugden (1986, p. 281), the inclusion of emotions in the analytical framework of the decision-making process does not violate their basic assumption that decisions are taken based on rational choice considerations. Instead, the two researchers see feelings as one factor among others. A broad body of literature with many findings supports both theoretical approaches (Betsch et al., 2011, p. 128; see Loomes et al., 1989; Zeelenberg et al., 2000).

A fourth approach regarding decision-making and feelings comes from Damasio (2004). The somatic marker hypothesis sees feelings as an individual independent variable for decision-making. In other words, feelings are not byproducts of logical reasoning or influencing logical reasoning but have their individual influence on decisions. Different neuroscientific cases and investigations form the bases of this theory. The case of Phineas P. Gage illustrates this theory. Due to a work accident in 1848, Gage's orbital frontal region in his brain was injured. After his accident, he could still examine complex logical tasks (Damasio, 2004, pp. 8; 23). Nevertheless, "the decisions he made did not take into account his best interest" (Damasio, 2004, p. 11). Other cases show similar trades (see Elliot): People could still answer intelligent tests successfully but could not make meaningful decisions (Damasio, 2004, p. 50).

According to Damasio (2004, p. 226), the mind roots in neural circuits, and the evolutive development of the brain embeds these circuits. The needs of the organism have shaped the formation of the neuronal circuit based on the need of the organism. Hence, this theory rejects the idea of a dualism of mind as the controller and body as its tool. The very successful popular science book *Factfulness* refers to the same concept:

"The human brain is a product of millions of years of evolution, and we are hard-wired with instincts that helped our ancestors to survive in small groups of hunters and gatherers. Our brains often jump to swift conclusions without much thinking, which used to help us to avoid immediate dangers." (Rosling et al., 2018, p. 7)

Also, Hsee and Rottenstreich (2004, p. 25) showed the importance of feelings in the decision-making process. In an experiment, two groups received information about the need to protect pandas. While one affect-poor presentation demonstrates facts, the affect-rich presentation uses emotions. Research participants following the affected-rich presentation were willing to donate significantly more for panda protection. This experiment shows that priming (subtle manipulation) of feelings influenced the decision-making process.

Environmental concerns narrow the concept of worry down to one type of concern. Researchers could apply distinct concern variables to a broader range of studies without connection to ecological questions. Moreover, Hsee and Rottenstreich (2004) found evidence supporting the idea that environmental control beliefs and financial and autarky control beliefs can serve as attitudes' background factors. Also, Kastner and Matthies (2016, p. 6) disclosed the importance of financial considerations for decision-making. Furthermore, Shiller (1997, p. 57) exposed that many people in Germany and the US are terrified of

inflation and its consequences. The recently published study "Ängste der Deutschen" (Fears of the Germans) underpinned these findings, in which 67% of respondents said they were worried about rising living costs. In the second place, participants mentioned costs of living (58%), and in the third place, a poor economic situation (57%). Fear of natural disasters and extreme weather followed in sixth place with 49% (Brower-Rabinowitsch, 2022). Based on the literature and existing findings about the inclusion of feelings, concern variables could contribute more to the extension of the TPB. The author of this paper is very much aware that the concern variables are an initial conceptualization. The researcher intends to lay the foundation for a deeper exploration of concerns and the TPB with this paper. Thus, the researcher acknowledges that other research projects could consider further aspects of concerns, and the applied variable construction for concern is not exhaustive. (Brower-Rabinowitsch, 2022). This paper studies environmental, financial, and autarky concerns for the given reasons.

Some researchers (Groot & Steg, 2007, p. 1830; Wei et al., 2021, p. 8) found evidence to identify environmental concerns as an independent variable for attitude. Therefore, they found no direct correlation between environmental concerns and intention. The construction of a concern variable under consideration of the principle of compatibility is in accordance with the ground theory of TPB. The researcher names this construct *environmental behavioral beliefs* to differentiate the theory-conform construction (model 2) from the non-conformal model 3 (see H7-H9). Values and emotions can be background factors for attitudes and contribute to the explanation (Ajzen, 2020, p. 314; Fishbein & Ajzen, 2009, p. 224). Given these findings, H4-H6 hypothesize that environmental, financial, and autarky behavioral beliefs construct an independent variable to determine the attitude toward green heating systems (model 2). Strong environmental, financial, and autarky behavioral beliefs mean that people associate green heating systems with a solution for the respective challenge (environmental, financial, or autarkical problems).

Model 2:

Hypothesis 4 (H4). People with stronger environmental behavioral beliefs have a more positive attitude toward green heating systems.

Hypothesis 5 (H5). People with stronger financial behavioral beliefs have a more positive attitude towards green heating systems.

Hypothesis 6 (H6). People with stronger autarky behavioral beliefs have a more positive attitude towards green heating systems.

Others identified environmental behavioral beliefs in the form of environmental concerns as a fourth independent variable that directly influences behavioral intentions (Kamalanon et al. 2022, p. 18). According to the ground theory, introducing a new independent variable for intention must fulfill special requirements. Firstly, scholars must define target, action, context, and time elements. A construction of concern variables as background variables is consistent with the principle of compatibility. An argument against concerns as an independent variable is that behavioral beliefs and concerns measure the same and have no conceptual independence. Therefore, scholars should conceptualize concern variables as independent variables. Hence concern variables discuss worries independently from the main research object (in the study: green heating systems). Furthermore, the introduced variable should be able to explain various cases. Environmental concerns are, in that regard, very limited to environmental questions. Opening the concept of environmental concerns to different concern variables can solve the narrow theoretical concept of environmental concerns (Ajzen, 2011, p. 119). Nevertheless, including a concern variable as an independent variable for behavioral intention violates the ground theory's theoretical requirements.

As shown at the beginning of this chapter, feelings (e.g., in the form of concerns) can be part of the decision-making processes. Contrary to the common assumption that the TPB has a cold, rational choice logic, Ajzen acknowledges the role of feelings in the decision-making processes. On the one hand, emotions can function as background factors (model 2). Moreover, Ajzen recognizes that the regret theory might contribute to the TPB. According to the scholar, there are no clear findings for including regret theory into the TPB. Therefore, he rejects (for now) the influence of the regret theory on the TPB (Ajzen, 2011, p. 1116, 2020, p. 321). However, the work of Damasio and other researchers shows reasonable arguments for considering emotions as an independent variable of behavioral intention. Also, Kamalanon et al. (2022, p. 18) were able to showcase that environmental concerns can be a meaningful predictor for behavioral intention within the TPB (model 3).

Thus, H7-H9 examine the relationship between the concern variables as predictors for green heating system installation intention.

Model 3:

Hypothesis 7 (H7). People with more vital environmental concerns have a higher intention to install a green heating system.

Hypothesis 8 (H8). People with more vital financial concerns have a higher intention to install a green heating system.

Hypothesis 9 (H9). People with more vital autarky concerns have a higher intention to install a green heating system.

Methods

The TPB investigates the cognitive processes which influence behavior. The deductive study applies the TPB to the decision-making process for a green heating system. The research of this paper created a survey to answer the explanatory research questions and a cross-sectional study design is the study scheme. This design provides a snapshot of the thoughts of many different people at one point in time (Babbie, 2016, p. 106). The research based the sampling on the principle of “Reliance on Available Subjects”. As no financial resources are available, the data collection relies on the participation of contacts of the author. To collect the data, the colleagues Emily Harris and Moritz Dilling and the author of this study shared the questionnaire by e-mail and messenger within their social webs. Therefore, the sampling is not probabilistic (Babbie, 2016, p. 186). The standard error could be very high depending on the standard deviation of the answers. Therefore, Babbie recommends a sample of at least 400. If there had been participation higher than $n=400$, the researcher would have applied a quota sampling. A quota sampling might reduce some biases (e.g., the overrepresentation of men in the database). Still, the sample would remain non-probabilistic, and therefore results are very limited and generalizable (Babbie, 2016, pp. 188, 200).

The Questionnaire

The researcher conducted the questionnaire accordingly to the TPB with some modifications (see Appendix a). It is a standard of questionnaires for TPB to measure the different items on a Likert Scale. This type of scaling enables closed-ended questions with uniform answers. Therefore, the responses are comparable and easily processable with statistical tools (Ajzen & Fishbein, 2008, p. 2224; Babbie, 2016, p. 249; Liobikienė et al., 2021, p. 589).

According to the theory, firstly, a pilot study reveals control, normative and behavioral beliefs in the study population (formative indicators). Based on these insights, items for attitudes, subjective norms, and perceived behavioral control can be developed. “Each of these [...] constructs is assessed by means of reflective indicators (or so-called direct measures)” (Ajzen, 2020, p. 319). After accessing and improving these items in a second pilot, the survey for the main study can be finalized and distributed (Ajzen, 2020, p. 318). Due to a lack of capacity (financial and time resources), the researcher conducted no comprehensive pilot study. Moreover, the scientist added concern and formative items (behavioral

beliefs). All items in this study are constructed based on an extensive literature review. Furthermore, the researcher applied the following criteria for the item construction: Conciseness, clearness, unambiguousness, and concreteness. For this reason, the items avoid expressions and double-barreled questions (Babbie, 2016, p. 250; Spector, 1992, p. 23). Many items are adapted items from other studies about the TPB and sustainable energy consumption or purchase intention, which should alter the reliability and validity of all items (Ajzen, 2011, p. 1117; Fishbein & Ajzen, 2009, p. 250; Hoffmeyer-Zlotnik & Warner, 2013, p. 29, 2018, p. 26; Korcaj et al., 2015, p. 410; Shiller, 1997, p. 26; Wei et al., 2021, p. 4). In addition, the research examined all items for their face validity. Furthermore, the study checked the statistical reliability of all variables with Cronbach's alpha (Babbie, 2016, p. 148).

Another deviation from the ground TPB theory is the specific scaling of the responses. According to Ajzen, usually, a seven-point Likert unipolar or bipolar scale is chosen to measure the items. Nevertheless, the theory gives the option to apply another type of scaling. Nemoto and Belgar (2014, p. 4) recommend a six-point Likert scale (from strongly agree to strongly disagree). Six-point Likert scale is processable for adults and provides the possibility of precise measurement. The essential quality of this scaling is that no "neutral" option exists. One of their arguments is that "Likert-scale categories should be conceptualized in the same way as physical measurements." (Nemoto & Beglar, 2014, p. 4). Moreover, a neutral option should be unnecessary, as only answerable questions should be part of the analysis. If not know the answer, the participant can skip the question in the survey. Furthermore, the six-point scaling can help to avoid a moderate response bias (tendency to give moderate answers) because no neutral option is given (Bogner & Landrock, 2016, p. 4).

Other researchers (Sturgis et al., 2014, p. 34) identify the inclusion of a neutral option as a meaningful option to represent the whole range of opinions about every item and not force a particular answer. Another reason for the neutral choice "is [to] avoid social embarrassment among respondents who feel that they should have an opinion on important issues" (Sturgis et al., 2014, p. 34). Thiessen and Blasius (2001, p. 366) emphasize that the neutral position can hide "I don't know" as well as a substantive opinion. Therefore, they have no recommendation on how to proceed with the neutral option. After considering the different theoretical arguments, the researcher decided to apply the six-point scale approach as its advantages prevail.

The labeling is linked with the measurement of the variables. In the ground theory, two variables measure every salient belief: The belief strength measures to what extent a person believes that there is a correlation between a specific behavior and a result (e.g., doing sports (behavior) lowers blood pressure(result)). The outcome evaluation examines the assessment of the research subject toward the result (lower blood pressure). The TPB uses the agree-disagree label for the first item, and the second item is wired with good-bad. (Ajzen & Fishbein, 2008, p. 2225). In practice, almost no researcher in the discussed papers applied this approach (Kamalanon et al., 2022, p. 22; Korcaj et al., 2015, p. 410; Liobikienė et al., 2021, p. 590; Wei et al., 2021, p. 4). The researchers did not differentiate between outcome evaluation and belief strength. Moreover, every study used agree-disagree labeling (Kamalanon et al., 2022, p. 11,22; Korcaj et al., 2015, p. 410; Liobikienė et al., 2021, p. 589; Wei et al., 2021, p. 4). An advantage of fewer items could be a higher closure rate of the survey. Following the examples of a practical application of the TPB also, this study does not differentiate between belief strength and outcome evaluation. It applies foremost the agree-disagree label (exception: likelihood to install a green heating system).

Spector (1992, p. 23) recommends formulating some items negatively to avoid biases (e.g., confirmation bias). Seemingly contradictive advice Babbie (2016, p. 252) to prevent negative items because these items tend to be misinterpreted by research participants. For this study, the researcher tried to formulate the items in a natural way. The survey includes only negative items when their formulation is standard in regular communication. Furthermore, some items' formulation violates the compatibility principle (Ajzen, 2020, p. 314). In particular, some items have no timeframe. The researcher of this paper based this decision on the recommendation of Babbie (2016, p. 252) to develop short items because respondents are often unwilling to read for long times. Moreover, in field research almost every item is positively formulated (Liobikienė et al., 2021, p. 590; Wei et al., 2021, p. 4).

The questionnaire requested some socio-economic items to get an overview of the participants in the sample and identify potential biases (Babbie, 2016, p. 258). The author acknowledges the necessity of a third gender category. Therefore, the study codes gender as female, male, and non-binary (Lindqvist et al. 2021, p. 336). The research measures education in a comparable manner with other European school systems in the Hoffmeyer-Zlotnik/Warner Matrix of Education. Scientists can sort vocational and general education degrees in the matrix and give them a more exact value for occupational prestige (Hoffmeyer-Zlotnik & Warner, 2018, p. 26). The proposed questions Q911 and Q921 from Hoffmeyer-Zlotnik and Warner (2013, p. 29) measure education. The survey divides the income into three different categories: under 2500 €, 2500-5000€ and over 5000€ per month. Each class includes around one-third of all households in Germany based on the income distribution of 40.683 thousand households in Germany in 2019 (Bundeszentrale für politische Bildung, 2020). The paper intends to only provide an overview of the sample structure by displaying the income distribution. For this purpose, the chosen categorization is sufficiently precise.

Data Collection and Response

The self-administrated questionnaire was constructed and conducted on Qualtrics in cooperation with Emily Harris and Moritz Dilling. Since this is a student project, no financial recourses were available to collect data with a data collection agency. The three involved researchers reached out to 85 local and 21 regional units of the house-owning association “Haus und Grund.” Nevertheless, none of these organizations replied to the request to share the survey. Therefore, Emily Harris, Moritz Dilling, and Luc Appold changed their data collection approach to the principle of “Reliance on Available Subjects,” and distributed the questionnaire in their social environment in Germany. Data collection occurred between December 16, 2022, and January 8, 2023.

The survey consisted of three blocks: Clarification of the living situation, TPB items for three different green technologies blocks (green heating systems, solar panels, and smart meter), and items for socio-economic variables. The research participants answer two of three green technology blocks based on specific filter questions and a random distributor. The first filter question for the green heating systems block was: “Can you install heating at home without asking third parties for consent?”. This question could also be an item for perceived behavioral control, and excluding a case based on denying the question violates the TPB.

Nevertheless, the questionnaire used the filter question to determine whether there is, in general, the possibility of installing a green heating system. This contingency question should guarantee that purchasing a green heating system is a relevant consideration for the respondent (Babbie, 2016, p. 255). Due to that question, participants can be excluded from that block and can answer questions from the two other blocks. Moreover, the inclusion of people with no perceived behavioral control about the installation of a green heating system distorts the results because then perceived behavioral control is the exhaustive variable to determine behavioral intention. The decision for a heating system is a long-term, single decision: On average, heating systems in Germany are over 17 years old (BDEW Bundesverband der Energie- und Wasserwirtschaft e. V., 2019). The study assumes that people who have already purchased a green heating system will not install another one soon. To avoid asking questions unrelated to the research and increase the participation rate for the other blocks, the survey excluded participants who already bought a green heating system from the sample. Based on the theoretical considerations, the questionnaire defines the green heating systems as air-, water-, geothermal - heating pump, solar thermal system, and renewable energy-based district heating systems.

Method of Data Analysis

After data collection, the researcher analyzed the dataset with the statistical software SPSS (Syntax: see Appendix b). Firstly, all cases of participants who own a fossil fuel-based heating system or a residential heating system based on fossil energy and with a complete dataset were selected. All negatively coded items (Q105_4, Q105_5) were reversed in the second step. To identify possible outliers and obtain an overview of the data, the study analyzed all items with descriptive statistics (boxplot). After deciding about noticeable data points the researcher cleared the data set (Babbie, 2016, p. 451; Osborne, 2013, p.

93). The researcher created all relevant variables (attitude, subjective norms, perceived behavioral control, environmental, financial, and autarky behavioral beliefs, environment, financial, and autarky concerns) by calculating the mean of the corresponding items (Babbie, 2016, p. 421). The paper used Cronbach's alpha to check reliability of the variables. Before the linear regression, the research tests the regression assumption of linearity, independence of errors, homogeneity of errors (homoscedasticity), and normality of errors (van den Berg, 2021, p. 217). Finally, a multiple regression analysis in SPSS examined the nine hypotheses. (Babbie, 2016, p. 458).

Socioeconomic sample structure

The display of the socio-economic variables gives an overview of the sample structure and does not add to the explanation of the regression models. The following statistics provide only a reference point for potential sample problems and further research. The descriptive statistic for income shows that no participant has a net household income of over 5000€. Instead, 61,29% belong to the middle-income group (2500€-5000€). Since one-third of German households have a net income of over 5000€, this distribution indicates an underrepresentation of this income group (Bundeszentrale für politische Bildung, 2020). Also, the Gender variable shows an apparent underrepresentation of women in the sample (38,2%).

Furthermore, the Hoffmeyer-Zlotnik/Warner Matrix reveals that no person without a school education is part of the sample. In addition, 54,84 % of the participants have a general university entrance qualification, and 38,7% have an academic title compared to the average in German society (33,5% respectively 18,5%) these groups are overrepresented in the sample (Statistisches Bundesamt, 2020). On average, three persons live in the household of the participants. A noticeable point is the outlier of 9 persons in a household, which seems possible and was therefore not excluded.

Variables Construction

The reliability test (Cronbach's alpha) exposes for the initially planned construction of the variables several problems. Environmental behavioral beliefs, financial behavioral beliefs, autarky behavioral beliefs, subjective norms, and environmental concerns have a Cronbach's Alpha between 0,8- and 0,9 and are, therefore, very reliable. Autarky concerns has a reasonable level of reliability (.766). Cronbach's alpha "[...] should not be too high (over .90 or so) [, but attitude exceeds this requirement (.959)]. Higher values may reflect unnecessary duplication of content across items and point more to redundancy than to homogeneity" (Streiner, 2003, p. 102). Therefore, it looks pretty likely that some items of attitude are redundant. In addition, some constructed variables like perceived behavioral control (.505) and general intention (-.207) are unreliable (Cronbach's Alpha <.6). This analysis also exposes one problem in the questionnaire construction: Only one item exists for autarky concerns. Therefore, the researcher could not test the reliability of the variable (Flandorfer, 2023).

SPSS recommends deleting Q103_1, 105_4_recode, Q104_6, 107_4, and 107_5 to improve Cronbach's Alpha and the researcher removed the discussed items. Moreover, the reliability analysis shows that no behavioral intention item (heating, pump, solar thermal system, and renewable energy-based district heating systems) can be deleted to increase the reliability of a general intention variable. Usually, a housing unit has only one heating system. Therefore, it is not crucial for the research to generate a scale that understands behavioral intention as one comprehensive variable. Instead, the study understands behavioral intention as an index variable. The general intention variable includes only the highest value for intention to install a heating pump /solar thermal heating system/district heating system.

Table 1: Matrix of analyzed variables- description, source, Cronbach's alpha, number of items, and excluded items. N=35.

Items for variables	Description	Sources	Cronbach's α	Number of items	Included items
Attitude	Attitude toward green heating systems	Ajzen, 2011, p. 1117 Wei et al. (2021, p. 4)	.959	5	Q102_1, Q102_2, Q102_3, Q102_4, Q102_5
Environmental behavioral beliefs	Belief how green heating system help with environmental challenges	Korcaj et al. (2015, p. 411)	.887	4	Q103_11, Q103_12, Q103_13, Q103_14
Financial behavioral beliefs	Belief how green heating system help with financial challenges	Korcaj et al. (2015, p. 411)	.865	5	Q103_6, Q103_7, Q103_8, Q103_9, Q103_10
Autarky behavioral beliefs	Belief how green heating system help with energy autarky challenges	Korcaj et al. (2015, p. 411)	.880	4	Q103_2, Q103_3, Q103_4, Q103_5
Subjective norms	Attitudes toward green heating systems of persons from the respondent environment	Korcaj et al. (2015, p. 410)	.873	5	Q104_1, Q104_2, Q104_3, Q104_4, Q104_5
Perceived behavioral control	Perceived capacity of the respondent to install a green heating system	Korcaj et al. (2015, p. 410), Wei et al. (2021, p. 4)	.505	5	Q105_1, Q105_2, Q105_3, Q105_5recode
General intention	The best value for intention to install one of the three heating systems (heating pump, solar thermal and district heating)	Fishbein and Ajzen (2009, p. 250)	-	3	Q106_1, Q106_2, Q106_3
Environmental concerns	Respondent worries about the environment	Kamlanon et al. (2022, p. 22) Wei et al. (2021, p. 4)	.806	3	Q107_6, Q107_7, Q107_8, Q107_9
Financial concerns	Respondent worries about private and national financial developments	Korcaj et al. (2015, p. 411) Shiller (1997, p. 26)	.766	2	Q107_1, Q107_3

Autarky concerns	Respondent worries about energy supply	Korcaj et al. (2015, p. 411)	-	1	Q107_2
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Table 2 gives an overview of all variables, their mean, standard – deviation, minimum and maximum. Data from only 35 cases are available for the study. An analysis of the data shows that the average of participants has a positive attitude towards green heating systems (mean=4,78). The perspective of the environment on green heating systems (subjective norm) and the perceived behavioral control about the capability to install green heating systems is in the average of the sample lower (3,1 respective 3,9). On average, the participants associate green heating systems with different positive features to solve distinct (e.g., environmental) problems (behavioral belief).

Furthermore, the participants have a high level of environmental and financial concern. Generally, the average intention to install the three different heating systems is low for every system. Especially the average intention to connect to a district heating system is the lowest (1,6). Remarkably, the mean of the independent variables for model 1 (attitude, subjective norms, and perceived behavioral control) are higher than the mean intention to install a heating pump or a solar thermal or district heating system. In addition, the mean for attitude and perceived behavioral intention is higher than for general intention (3,57). Since “3” means “rather unlikely”, and “4” is “rather likely to install a green heating system within the next 12 months”, the mean for general intention shows no clear tendency of the participants to install or not install a green heating system. Besides autarky concern, the remaining concern variables (environmental concerns and financial concerns) score higher in the sample average than the general intention variable (model 3). The variables for model 2 show that the participants, on average, agree with the positive contribution of green heating systems to problems and have on average positive attitudes towards green heating systems.

Only some variables on a Likert scale display outliers (e.g., environmental behavioral beliefs: 1 case, perceived behavioral control: 1 case). Since people may have very contradicting standpoints on, e.g., their perceived behavioral control and the number of participants is low, the study did not exclude a case.

Checking inference assumptions

The linearity test for H5(financial behavioral beliefs – attitude) was significant. The linearity analyses for all other hypotheses indicate that neither a linear nor a non-linear (deviation of linearity) regression is significant for a significance level of 0,05. Moreover, the research found no sign of collinearity between the analyzed independent variables. The sample design (Reliance on Available Subjects) does not differentiate between different subgroups of participants. Likewise, all participants received the same link to the questionnaire. Therefore, no differentiation between the contact person of the three researchers is possible. In sum, the researcher expects independence of errors. The modified Breusch-Pagan-Test is for no hypothesis significant (Herwartz, 2006, p. 3570). Therefore, the data set fulfills the regression assumption of homoscedasticity of all errors. The normality test (Kolmogorov-Smirnov) shows that all hypothesized models' errors significantly differ from a normal distribution (Lopes, 2011, p. 718). To sum up, besides homoscedasticity, the collected data in the dataset violates all regression assumptions. The Central Limit Theorem states that a normal distribution can be assumed for a sample size of $N < 30$ (LaMorte, 2016). The Since the sample size is over 30, the violation of the inference assumption is acceptable.

Table 2: Matrix of analyzed variables - Means, Standard-Deviation, Minimum, Maximum. N=35.

Variables	M	SD	Min.	Max.
Attitude towards green heating	4,79	1,33	1	6
Environmental behavioral beliefs	5,31	0,76	2,75	6
Financial behavioral beliefs	4,15	1,09	1,4	6
Autarky behavioral beliefs	4,56	1,11	2,25	6
Subjective norm	3,11	1,17	1	5,4
Perceived behavioral control	3,94	0,93	2,25	6
Environmental concerns	5,12	0,61	4	6
Financial concerns	4,93	1,04	2	6
Autarky concerns	3,09	1,17	1	6
Intention heating pump	2,11	1,41	1	6
Intention solar thermal	2,86	1,73	1	6
Intention district heating	1,6	1,31	1	6
General intention	3,57	1,77	1	6

Results

As pointed out in the Method chapter, regression analysis and inference statistics quality depend on the quality and quantity of the sample(design) (Babbie 2016, p. 469). The author notes that only 35 cases per variable are available in this research.

Correlation Matrix and Regression Analysis

Table 3 shows the results of the correlation analysis of variables. Overall, only a few significant correlation coefficients (Person's R) are significant. Table 4 presents the regression analysis results of model 1 and model 3. The regression analysis of model 1 shows no significant support for any of the three ground theory hypotheses (H1-H3). The hypothesized positive relationship between a positive attitude towards green heating systems and the intention to install a green heating system finds no support in the empirical data. Also, the hypothesis analysis for the influence of subjective norms on the intention to install green heating systems is insufficiently supported. Moreover, the hypothesis that positive perceived behavior control to install a green heating system increases the intention to install such a system lacks support. Since the standard coefficients for attitude (.15), subjective norms (.178), and perceived behavioral control (.158) are very low, only 9 % of the intention to install a green heating system explains the ground model 1 of Ajzen's theory. Following these results, the study found insufficient support for hypotheses 1 to 3 (H1-H3).

Table 3: Correlation matrix of analyzed variables (Pearson's R). N=35

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Attitude	-									
2. Environmental behavioral beliefs	.32	-								
3. Financial behavioral beliefs	.35*	.72**	-							
4. Autarky behavioral beliefs	.26	.31	.57**	-						
5. Subjective norm	.32	.64**	.58**	.49**	-					
6. Perceived behavioral control	.08	.18	-.08	-.19	-.19	-				
7. Environmental concern	.15	.47**	.20	.15	.43**	.12	-			
8. Financial concerns	.34*	.09	.29	.30	.20	-.55**	.15	-		
9. Autarky concerns	.18	.31	.20	.26	.35*	-.12	.13	.30		
10. General intentions	.22	.13	.13	.32	.20	.14	.06	-.11	.29	-

Note. *p < .05, ** < .01 *** < .001, two-tailed test

Table 4: Linear Regression Analysis of Behavioral Intention. (N=35)

Variable	H1-H3	H7-H9
	β	β
Attitude	.150	.236
Subjective norm	.178	.073
Perceived behavioral control	.158	.017
Environmental concerns		-.003
Financial concerns		-.280
Autarky concerns		.305
R ²	.09	.185

Note. *p < .05, ** < .01 *** < .001, one-tailed-test.

Table 4 provides no significant support extent the TPB with the three additional variables, environmental, financial, and autarky concerns (H7-H9). Neither the hypothesis that environmental

concerns (H7) nor the hypothesis that financial concerns (H8) positively influence the intention to install green heating systems is significant. Instead, table 4 depicts an insignificantly supported negative correlation between financial concerns and behavioral intention ($R=-.28$). This finding contradicts the theoretical expectation of a positive influence of financial concerns on the intention to install green heating systems from H8. Also, the positive influence of vital autarky concerns on the intention to install green heating systems is not significantly supported. Model 3 can explain 18,5% of the overall variation in behavioral intention. Since the standardized coefficient beta is insignificant, this relation might not be found in a larger sample. Due to the statistical insignificance, the additional variables do not add more insights to the TPB and explain behavioral intention than the standard model. The hypotheses that concerns may help explain the intention to install a green heating system (H7-H9) are not empirically supported by the data in this study.

Table 5: Linear regression analysis for attitude as dependent variable (H4-H6). N=35

Variable	β
Environmental behavioral beliefs	.164
Financial behavioral beliefs	.169
Autarky behavioral beliefs	.116
R^2	.143

Note. * $p < .05$, ** $< .01$ *** $< .001$, one-tailed-test.

The correlation matrix (table 3) shows a significant correlation coefficient for financial behavioral beliefs and attitude towards green heating systems (H5). Nevertheless, the applied linear regression analysis indicates no significant support for a positive relationship between strong financial behavioral beliefs and the attitude toward green heating systems (table 5). Furthermore, table 5 identifies no significant effect of environmental (H4) and autarky behavioral beliefs (H6) on attitude toward green heating systems. The entire linear model explains 14,3 % of the variance for the dependent variable. The hypothesis that behavioral beliefs can explain the attitude towards green heating systems (model 2) is insufficiently supported in this study.

The remaining significant correlation coefficients from table 3 are significant in contradiction to the theoretical expectations.

Discussion and Conclusion

Discussion

The following discussion reflects the theoretical approach of this thesis and the results. Moreover, it tries to find a first explanation for the insignificant support for all nine hypotheses. After some general remarks about the survey and the variable construction, this chapter discusses the implication of these remarks for all nine hypotheses.

A significant problem for the statistical test might be the low number of cases. Babbie recommends at least 400 cases for a statical analysis, but in this study, only data from 35 cases were available for each

variable (Babbie, 2016, p. 200). Since this is a student project, no financial resources were available to collect data with a data collection agency. The three involved researchers reached out to 85 local and 21 regional units of the house-owning association “Haus und Grund.” Nevertheless, none of these organizations replied to the request to share the survey. One problem might be that the researchers conducted the research in the pre-Christmas time, and therefore, “Haus und Grund” had no capacities. Moreover, it might be possible that there are internal regulations that allow only cooperation within official research projects. Since students conduct this research, it might lack seriousness from the perspective of “Haus und Grund” representatives.

To generate data, the three researchers distributed the survey in their social environment (reliance on available subjects). Thus, the number of potential participants was limited. Non-probabilistic samples have a significant disadvantage as these samples include a bias. Due to the connection between participants and the author, some comparable traits (e.g., similar social classes) can be overrepresented (Babbie, 2016, p. 186). The sample structure supports the bias assumption. Similar to the researchers' traits, persons with a higher education degree and households with an income between 2500 € – 5000 € (61,29%) were overrepresented. The research designed the income variable to include about one-third of the German population in each income group (Bundeszentrale für politische Bildung, 2020). There were no participants from the over 5000 € household income category. Moreover, there is also an overrepresentation of men in the sample. In addition, data collection followed a cross-sectional design. Developing an intention to install a green heating system and implementing the decision (behavior) is a process. The snapshot character is also a weakness of that method as it limits the perspective on processes (Babbie, 2016, pp. 106). Due to the cross-sectional design, the non-probabilistic sample, and the level of participation (N=35), the potential to generalize the study results is very limited. For the following study, the researcher would make some adjustments (e.g., not distributing the survey during Christmas time). The two main potential issues, lack of trust in the research by students and lack of financial resources for a bachelor thesis, cannot be solved in the case of a bachelor project.

Apart from the lack of participation, the research questionnaire contains some problems. Initially, participants were excluded from this sample when they indicated that they could not install a green heating system without the consent of a third party. The researcher took this decision for two pragmatic reasons. At first, the whole questionnaire consists of three different green technologies blocks. The research ruled out participants without behavioral control to increase their participation in the other green technologies blocks. The idea was that their data might be more meaningful for the two other blocks. Secondly, the researcher already expected a low level of participation, which was dependent on the goodwill of the social contacts. Since the questionnaire has many items, the researcher decided not to “bother” the participants with (seemingly) unnecessary questions. The idea behind this strategy was to prevent participants abort the survey. This decision might create a significant bias which could have harmed the consistency of the perceived behavioral control variable. In a following research project, the researcher would avoid this survey construction. This revised design would require more participants. These considerations might also explain why Cronbach's alpha for perceived behavioral control (.554) was below the minimum requirements (>.6) to consider the variable as applicable in the correlation and regression analysis. Since Korcaj et al. (2015) and Wei et al. (2021) successfully applied the used items for perceived behavioral control in their studies, they should be reliable. Moreover, these items and the constructed variables are valid based on facial validity. The small number of available cases could also explain the low level of Cronbach's alpha. The exclusion of item 105_4 increased Cronbach's alpha from .48 to .55. It is possible that the participants read over the negative formulation of this item and gave answers contradicting their opinion.

Another potential selection bias is excluding people who already own a green heating system. For similar reasons to the first sample selection choice (decision without the consent of a third party), the researcher tried to increase the degree of participation for other green technological blocks. Moreover, no participant should end the survey without answering all questions due to a lack of interest. The researcher based this choice on the assumption that the decision for a heating system is a long-term decision and that people who own a green heating system have no intention to install another one. The paper grounds this assumption merely on theoretical considerations. Therefore, excluding the group (green heating system owners) might have recused the potential for further insights.

Especially for new items, TPB suggests having two pilot studies to access and improve the chosen items (Ajzen, 2020, p. 318). Since no financial and time resources were available, conducting a pilot test was impossible. The existing literature gives some proof of the validity of the items. Nevertheless, the researcher did not identify a paper with an identical research design. Consequently, the study had to adapt existing items and develop new items.

For this reason, the used items are only valid to a limited extent and would therefore have to be scrutinized for a new study further. This might also explain the problematic operationalization of autarky concerns and financial concerns. Only one item in the questionnaire asked for autarky concern. The evaluation of the items with Cronbach's alpha showed that the financial concerns variable in this study consists only of two items. The low number of items presents a problem rooted in the initial stage of the questionnaire construction. Due to the lack of studies about this variable and the goal of a time-efficient survey, the study introduced fewer items. Initially, the researcher planned to create a comprehensive variable for concern. The researcher rejected this idea during the research process. Because of the lack of time, the data collection already started, and no adjustment was possible. Since the concept of different concerns was newly introduced to the TPB by the author, the applied concern items are the first operationalization for various concerns. Therefore, the study can positively contribute to further investigation as a first pilot about concerns.

This study shows that the intention to install a heating system differs between different heating systems. Especially the intention to connect to a district heating system within the next 12 months is very low. One reason might be that district heating systems rely on a central power plant that provides the heat. Therefore, people thinking about installing a green heating system depend more on energy suppliers for their decision. The created index general intention variable could negatively influence the analysis. The assumption that the behavioral intention to install a green heating system is the highest value for the behavioral intention to install one of the three heating systems is reasonable but unproven. Moreover, this conceptualization of behavioral intention reduces the information of the variable compared with the separate behavioral intention variables. An advantage of this conceptualization is the clearness of the behavioral intention variables: Since people might have a problem understanding the concept of green heating systems, the question after each heating system is precise and, therefore, better to answer. An additional investigation focusing on the different green heating systems could give fruitful insights into these considerations. For example, a new study might identify a lower level of perceived behavioral control for district heating systems.

Another conspicuity is the overall low intention to install the different green heating systems. An explanation is a lack of knowledge about green heating systems. While people might have a generally positive attitude towards green heating systems and think they could install such a system (perceived behavioral control) and their environment would appreciate it (subjective norm)), they still could lack knowledge about the consequences of the installation. This approach has three different dimensions. Initially, it could be related to the discussion about long-term effects. While the decision to buy green

products can be reversed at every moment (Kamalanon et al., 2022), the investment into a green heating system has long-term consequences and house owners cannot reverse the decision. Even if a person has demonstrated a high level of attitude, subjective norms, and perceived behavioral control, this does not necessarily equate to behavioral intention. He or she might want to evaluate their behavioral intention before stating in a survey, e.g., “it is very likely that I will install a green heating system within the next 12 months”. This perspective might include the technical complexity of a green heating system, through which the survey respondent might be overwhelmed. Another dimension is the complexity of subsidies for green heating systems. Different regulations and percentage rates exist for distinctive green heating systems and their configuration. Moreover, the latest amendment of rules for green heating systems is from the 12 of December 2022, which was introduced due to the Russian war on Ukraine and contained many changes in regulations. Since the ministry has not already updated every document, the researcher of this paper had to confirm the information about the subsidies by inquiring theses form of the responsible ministry. This anecdote illustrates the complexity of requesting grants for green heating systems. A third potential explanation might be that green heating system is a vague term. Although the introduction text in the survey defined green heating systems, the participants might not be able to connect this term with the three mentioned technologies. The research of Kamalanon et al. (2022, p. 15) examined the effect of knowledge. Their extended model demonstrates that environmental knowledge has a mediating impact between environmental concerns and the company’s perceived green image, which significantly determines perceived behavioral control. Nevertheless, the standardized coefficient was low (.069). Moreover, they could not find a significant mediating effect between environmental concerns and behavioral intention. Another investigation with more cases could examine the explanation for the low level of behavioral intention. Since the German government wants to motivate citizens to install green heating systems, findings of a low behavioral intention could have social relevance. If the low level of intention were related to the complexity of green heating systems and the substitution regulations, a political recommendation would be to simplify the law and increase the behavioral intention.

As shown in the theory chapter, the TPB is based on a considerable body of literature (Liobikienė et al., 2021; Wei et al., 2021) and was applied in several studies concerning energy consumption. Hence, the ground model of the TPB (H1-H3) should show significant results for the research in this paper. The low number of available cases and the non-reliable variable perceived behavioral control could explain the insufficient support of the ground model 1(H1-H3). Moreover, constructing the behavioral intention within 12 months might be problematic. In addition, the long-term decision for a green heating system might be too complex to answer in a survey without further knowledge.

Although behavioral beliefs do not significantly correlate with attitude (H4-H6), the literature supports the three hypotheses (Korcaj et al., 2015). The behavioral beliefs consist of the beliefs to what extent the installation of a green heating system could contribute to solving a specific problem (e.g., climate change). It seems reasonable that people thinking positively about one potential problem-solving capacity of green heating systems are more likely to think about other aspects. Therefore, attitude comprises comprehensive, e.g., positive stands (behavioral beliefs) towards green heating systems. As shown in the theory section, this explanation would match the TPB.

Also, the paper found no support for extending the TPB with concern variables (H7-H9, model 3). In the theory chapter, the researcher could show that Ajzen considered feelings as relevant but only as a background factor for the primary three variables of the TPB. Moreover, the chapter demonstrates that Damasio's understanding of feelings as an immediate factor in decision-making has solid scientific support. Nevertheless, the discussion about feelings and decision-making is so complex that it was impossible to present every aspect in a bachelor thesis. Therefore, this work could only introduce the

different feeling theories and show their potential for the TPB. A synthesis of the TPB and the somatic marker hypothesis should again be given attention in a revised research design with more cases before the scientific community can finally reject this hypothesis.

Conclusion

Overall, the debate about energy consumption and autarky from (Russian) fossil energy became central in Germany in 2022. One key solution strategy was and is the turn towards green heating systems. This work contributed to this discussion with scientific cognitions. It analyzed the intention to install a green heating system to answer the question **“To what extent do attitudes, subjective norms, perceived behavioral control, and concerns explain the intention to install a green heating system of house owners in Germany in 2022?”**. The Theory of Planned Behavior constituted a critical theoretical framework for this discussion. Based on the collected data, the TPB cannot explain the intention of people in Germany to install a green heating system. Moreover, the data does not provide evidence for concerns as a driver for decision-making. Nevertheless, this study presented the TPB as a potentially useful framework to analyze the intention to install green heating systems. Furthermore, the research addressed a frequently debated extension of TPB with environmental concerns as a new variable. This paper contextualized this debate within a broader discussion about the influence of feelings in decision-making processes. Based on the existing literature, the paper draws nine hypotheses to examine theoretical puzzles. Neither the ground theory model 1 nor the extended model 3 with three different concern beliefs displayed significant relations. Also, the model to explain attitude was not significant. Hence, based on the data, the researcher found insufficient support for all hypotheses and the underlying assumption of the research question. The reader of this paper should note that due to some methodological problems of the survey and the number of cases, an adequate statistical examination of the hypothesis was not possible. Nevertheless, this research is the first approach to investigate how scientists can include feelings in the TPB. Contradicting Ajzen’s theory’s theoretical framework, this paper was able to show the scientific potential of feelings as an independent variable for behavioral intention. This work conceptualized feelings as three different concerns. For a meaningful use of feelings as an independent variable, a reconceptualization of concerns is necessary. The new variable should be more comprehensive than the current division into the environment, autarky, and financial concerns. Also, the data uncovers additional puzzles for further research. All findings, the identified potential problems in the conception of the items, and the overall research design form an excellent basis for comprehensively investigating the influence of emotions in the decision-making process. Further study would also be politically relevant to increase the installation of green heating systems with targeted measures. Since this study has not produced significant results, the researcher cannot give practical policy advice. Instead, this paper recommends that governments and educational institutions provide comparable studies with a sufficient budget to obtain reliable and well-founded results.

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Appendix

A) The questionnaire

Zielgruppe: Umfeld. Creating green citizens: Warum investieren Haus- und Grundbesitzer in Energie-Te

Beginn des Blocks: Einführung & Einverständniserklärung

EINFÜHRUNG Herzlich Willkommen! Wir sind Luc Appold, Moritz Dilling und Emily Harris, und wir sind Bachelor-Studenten der Fakultät für Behavioural, Management and Social Sciences an der Universität Twente. Wir freuen uns sehr, dass Sie sich für unsere gemeinsame Umfrage zur Akzeptanz von grüner Haus- und Energietechnik – speziell Heizsystemen, Photovoltaik, und intelligenten Stromzählern – interessieren.

Die Teilnahme an dieser Studie ist freiwillig. Sie können die Umfrage jederzeit beenden oder Fragen überspringen, die Ihnen unangenehm sind. Die im Rahmen dieser Befragung erhobenen Daten werden in anonymisierter Form aufgezeichnet und nicht an Dritte weitergegeben. Es werden keine persönlichen Informationen abgefragt, die Sie als Teilnehmer dieser Studie identifizieren könnten. Das Ausfüllen des Fragebogens dauert 5 bis 20 Minuten. Nur eine Person pro Haushalt kann an dieser Umfrage teilnehmen. Diese Person sollte volljährig und am stärksten im Bereich der Haus- und Energietechnik involviert sein. Unser Forschungsprojekt wurde von der Ethikkommission unserer Fakultät genehmigt. Der zuständige Projekt-Koordinator ist Dr. Jörgen Svensson. Kontaktangaben für weitere Informationen zum Forschungsprojekt Luc A. Appold (Heizungsanlagen) – Moritz Dilling (Photovoltaik) – Emily L. Harris (intelligente Stromzähler) – Bei Rückfragen zu Ihren Rechten als Forschungsteilnehmer können Sie sich auch an die zuständige Ethikkommission der Universität Twente wenden .

Herzlichen Dank, dass Sie sich die Zeit für die Beantwortung des Fragebogens nehmen!

Seitenumbruch

EINVERSTÄNDNIS Einverständniserklärung Indem Sie sich bereit erklären an der Studie teilzunehmen, bestätigen Sie, dass Sie den Einleitungstext des Fragebogens vollständig gelesen haben

und mit der Teilnahme an dieser Studie einverstanden sind.

☐ Ja, ich bin einverstanden und möchte an der Studie teilnehmen. (1)

☐ Nein, ich möchte nicht teilnehmen. (2)

Überspringen bis: Ende des Blocks Wenn Einverständnis = Ja, ich bin einverstanden und möchte an der Studie teilnehmen.

Überspringen bis: Ende der Umfrage Wenn Einverständnis = Nein, ich möchte nicht teilnehmen.

Ende des Blocks: Einführung & Einverständniserklärung

Beginn des Blocks: Filter-Fragen

F1 **In** **welchem** **Bundesland** **wohnen** **Sie?**

▼ Baden-Württemberg (1)

Bayern (2)

Berlin (3)

Brandenburg (4)

Bremen (5)

Hamburg (6)

Hessen (7)

Mecklenburg-Vorpommern (8)

Niedersachsen (9)

Nordrhein Westfalen (10)

Rheinland-Pfalz (11)

Saarland (12)

Sachsen (13)

Sachsen-Anhalt (14)

Schleswig-Holstein (15)

Thüringen (16)

keine Angabe (17)

F2 Wohnen Sie derzeit im Eigentum oder zur Miete?

- ☐ Eigentum (4)
- ☐ Miete (5)
- ☐ keine Angabe (6)
-

F3 Wo wohnen Sie?

- ☐ in einem Einfamilienhaus / in einer Einfamilienhaushälfte (1)
- ☐ in einer Wohnung eines Mehrparteienhauses (2)
- ☐ in einem Zimmer einer Wohngemeinschaft (3)
- ☐ anderswo, nämlich: (4) _____
- ☐ keine Angabe (5)
-

F4 Können Sie zuhause eine Heizung installieren, ohne Dritte um Zustimmung zu bitten?

Dritte können Vermieter oder Eigentümergemeinschaften sein, die zum Beispiel gemeinsam die Installation einer Heizungsanlage beschließen müssen.

- ☐ Ja (1)
- ☐ Nein (2)
- ☐ keine Angabe (3)
-

F5 Können Sie zuhause eine Photovoltaikanlage installieren (z.B. auf dem Haus oder im Garten), ohne Dritte um Zustimmung zu bitten?

Dritte können Vermieter oder Eigentümergemeinschaften sein, die zum Beispiel gemeinsam die Installation einer Photovoltaikanlage beschließen müssen.

- ☐ Ja (1)
- ☐ Nein (2)
- ☐ keine Angabe (3)

Ende des Blocks: Filter-Fragen

Beginn des Blocks: Grüne Heizsysteme

INTRO Grüne Heizsysteme Grüne Heizsysteme zeichnen sich durch die Nutzung von erneuerbaren Energien aus natürlichen Energiequellen aus. Zu den grünen Heizsystemen zählen Luft-Wärmepumpen, Erdreich-Wärmepumpen (Geothermie), See-Wärmepumpen, thermische Solaranlagen, sowie Fernwärme basierend auf erneuerbaren Energien. Fossile Heizsysteme verbrennen Gas, Öl oder Kohle zur Wärmeengewinnung. Dieser Prozess setzt klimawirksames CO₂ frei. Auch holzbasierte Heizsysteme zählen heutzutage nicht zu den grünen Heizsystemen, da sie CO₂ und weitere Schadstoffe freisetzen.

Seitenumbruch

Q101 Welches Heizsystem verwenden Sie?

Wenn Sie einen Auftrag zur Installation eines neuen Heizsystems erteilt haben, nennen Sie bitte auch das neue Heizsystem. Mehrfachnennungen sind möglich.

☐ Grüne Heizsysteme (Luft-Wärmepumpe, Erdreich-Wärmepumpe (Geothermie), See-Wärmepumpen, Thermische Solaranlage) (1)

☐ Fernwärme (5)

☐ Verbrennungs Heizsysteme (Elektrokessel, Öl-Heizkessel, Gas-Heizkessel, Pellet-Heizkessel, Holzheizkessel) (6)

☐ ein anderes, nämlich (11)

☐ keine Angabe (12)

Überspringen bis: Ende des Blocks Wenn Installiertes Heizsystem = Grüne Heizsysteme (Luft-Wärmepumpe, Erdreich-Wärmepumpe (Geothermie), See-Wärmepumpen, Thermische Solaranlage)

Überspringen bis: Q102 Wenn Installiertes Heizsystem = Verbrennungs Heizsysteme (Elektrokessel, Öl-Heizkessel, Gas-Heizkessel, Pellet-Heizkessel, Holzheizkessel)

Überspringen bis: Q102 Wenn Installiertes Heizsystem = ein anderes, nämlich

Überspringen bis: Q102 Wenn Installiertes Heizsystem = keine Angabe

Überspringen bis: Q101b Wenn Installiertes Heizsystem = Fernwärme

Seitenumbruch

Q101b Wird Ihre Fernwärme aus erneuerbaren Energien produziert?

Fernwärme wird aus erneuerbaren Energien produziert, wenn auf die Verbrennung von fossilen Energieträgern wie Öl, Kohle oder Gas verzichtet wird. Stattdessen werden industrielle Abwärme oder verschiedene Wärmequellen in der Umwelt (z.B. durch Wärmepumpen) für die Fernwärme verwendet.

- ☐ Ja (1)
- ☐ Nein (2)
- ☐ keine Angabe (3)
- ☐ weiß nicht (4)

Überspringen bis: Ende des Blocks Wenn Fernwärmequelle = Ja

Seitenumbruch

Q102 Für mich ist der Kauf von umweltfreundlichen Heizsystemen:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	
1. sehr unerfreulich	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	sehr erfreulich
2. sehr unbefriedigend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	sehr befriedigend
3. sehr nachteilhaft	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	sehr vorteilhaft
4. sehr wertlos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	sehr wertvoll
5. sehr schlecht	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	sehr gut

Seitenumbruch

Q103 Geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Stimme überhaupt nicht zu (1) Stimme nicht zu (2) Stimme eher nicht zu (3) Stimme eher zu (4) Stimme zu (5) Stimme voll zu (6)

1. Ein grünes Heizsystem hilft mir, mich von steigenden Energiepreisen unabhängiger zu machen. (1)
2. Eine grüne Heizung garantiert mir eine höhere Energieversorgungssicherheit. (2)
3. Ein grünes Heizsystem macht mich unabhängig von meinem Energieversorger. (3)
4. Ein grünes Heizsystem gibt mir mehr Kontrolle über meine Energieversorgung. (4)
5. Mit einem grünen Heizsystem kann ich meinen Bedarf an Heizenergie selbstständig decken. (5)
6. Ein grünes Heizsystem dient der privaten Altersvorsorge. (6)
7. Eine grüne Heizung ist eine sichere Geldanlage. (7)
8. Ein grünes Heizsystem ist langfristig rentabel. (8)
9. Eine grüne Heizung senkt meine monatlichen Heizkosten erheblich. (9)
10. Ein grünes Heizsystem ist dank der staatlichen Förderung finanziell attraktiv. (10)
11. Mit einem grünen Heizsystem trage ich zum Schutz von Umwelt und Klima bei. (11)
12. Mit dem Betrieb eines grünen Heizsystems helfe ich, den Ausstoß von Treibhausgasen zu reduzieren. (12)
13. Mit einem grünen Heizsystem erzeuge ich Wärme auf ökologisch günstige Art und Weise. (13)
14. Mit einem grünen Heizsystem schone ich natürliche Ressourcen. (14)

Q104 Geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Stimme überhaupt nicht zu (1) Stimme nicht zu (2) Stimme eher nicht zu (3) Stimme eher zu (4) Stimme zu (5) Stimme voll zu (6)

1. Menschen, die mir wichtig sind, werden einen guten Eindruck von mir haben, wenn ich ein grünes Heizsystem installiere. (1)
 2. Menschen, die mir wichtig sind, erwarten von mir, dass ich ein grünes Heizsystem installiere. (2)
 3. Ich fühle mich gesellschaftlich verpflichtet, ein grünes Heizsystem zu installieren. (3)
 4. Für Menschen in meiner Situation ist es üblich, ein grünes Heizsystem zu installieren. (4)
 5. Viele Menschen in meinem persönlichen Umfeld besitzen ein grünes Heizsystem. (5)
 6. Meine Nachbarn haben ein grünes Heizsystem installiert. (6)
-

Q105 Geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Stimme überhaupt nicht zu (1) Stimme nicht zu (2) Stimme eher nicht zu (3) Stimme eher zu (4) Stimme zu (5) Stimme voll zu (6)

1. Ich könnte innerhalb eines Jahres ein grünes Heizsystem installieren, wenn ich es wollte. (1)
 2. Ich bin zuversichtlich, dass die Finanzierung eines grünen Heizsystems für mich möglich ist. (2)
 3. Ich habe innerhalb der nächsten 12 Monate die zeitliche Ressourcen um ein grünes Heizsystem zu kaufen und zu installieren. (3)
 4. Mein Haus ist für die Installation eines grünen Heizsystems ungeeignet (z.B. aufgrund Schatten durch Bäume für Solaranlagen, unzureichende Gartenfläche für Erdwärme). (4)
 5. Die Entscheidung, innerhalb des nächsten Jahres ein grünes Heizsystem installieren zu lassen, liegt nicht in meiner Hand. (5)
-

Q106 Geben Sie an, mit welcher Wahrscheinlichkeit Sie die folgenden Heizsysteme in den nächsten 12 Monaten installieren werden:

Fernwärme wird aus erneuerbarer Energie produziert, wenn auf die Verbrennung von fossilen Energieträgern wie Öl, Kohle oder Gas verzichtet wird. Stattdessen wird industrielle Abwärme oder verschiedene Wärmequellen in der Umwelt (z.B. durch Wärmepumpen) für die Fernwärme verwendet.

Sehr unwahrscheinlich (1) Unwahrscheinlich (2) Eher unwahrscheinlich (3) Eher wahrscheinlich (4)
Wahrscheinlich (5) Sehr wahrscheinlich (6)

1. Wärmepumpe (Luft, Erdwärme, Wasser) (1)
2. Solarthermie (2)
3. Fernwärme mit erneuerbarer Energie (3)

Seitenumbruch

Q107 Geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Die Angaben beziehen sich auf die nächsten 12 Monate.

Stimme überhaupt nicht zu (1) Stimme nicht zu (2) Stimme eher nicht zu (3) Stimme eher zu (4) Stimme zu (5) Stimme voll zu (6)

1. *Ich habe Sorgen, dass die Energiepreise steigen. (1)*
2. *Ich bin besorgt nicht genügend Energie zum Heizen zu haben. (2)*
3. *Ich habe Sorgen, dass mein Geld weniger wert wird. (3)*
4. *Ich mache mir Sorgen, dass ich langfristig nicht genügend Geld für meinen Lebensunterhalt haben werde. (4)*
5. *Mein Handeln hat Auswirkungen auf die Umwelt. (5)*
6. *Ich würde mich als umweltbewussten Menschen bezeichnen. (6)*
7. *Umwelt- und Klimaschutz ist für mich sehr wichtig. (7)*
8. *Ich bin besorgt über den sich verschlechternden Zustand der Umwelt. (8)*
9. *Natürliche Ressourcen zu schonen ist für mich sehr wichtig. (9)*

Ende des Blocks: Grüne Heizsysteme

Beginn des Blocks: Photovoltaik

Ende des Blocks: Intelligente Stromzähler

Beginn des Blocks: Kontrollvariablen



Q901 Wie alt sind Sie in Jahren?

Q902 Welchem Geschlecht würden Sie sich am ehesten zuordnen?

☐ männlich (1)

☐ weiblich (2)

☐ nicht-binär (3)

☐ keine Angabe (4)

Seitenumbruch

Q911 Welches ist der höchste allgemeinbildende Schulabschluss, den Sie erreicht haben? *Bitte denken Sie daran, dass die Mittlere Reife und das Abitur, das zum Studium berechtigt, auch durch eine erfolgreich abgeschlossene Berufsausbildung erreicht werden können.*

- ☐ kein Schulabschluss (1)
- ☐ Hauptschulabschluss (2)
- ☐ Mittlere Reife (3)
- ☐ Fach- / Fachhochschulzugangsberechtigung (4)
- ☐ Abitur oder Universitätszugangsberechtigung (5)
- ☐ Ich bin noch Schüler/in (6)
- ☐ keine Angabe (7)
- ☐ weiß nicht (8)

Überspringen bis: Q931 Wenn Schulabschluss = Ich bin noch Schüler/in

Seitenumbruch

Q921

Welche beruflichen Bildungsabschlüsse haben Sie erworben? *Zu den beruflichen Bildungsabschlüssen zählen auch Hochschulabschlüsse. Bitte wählen Sie aus dieser Liste alle beruflichen Bildungsabschlüsse aus, die Sie erworben haben. Mehrfachnennungen sind möglich.*

- ☐ kein beruflicher Ausbildungsabschluss (1)
- ☐ Ausbildung im dualen System (2)
- ☐ Beruflich-schulische Ausbildung (Berufsfachschule, Handelsschule, Vorbereitungsdienst für den mittleren Dienst in der öffentlichen Verwaltung) (3)
- ☐ Fachschule, Meisterschule, Technikerschule, Berufs- oder Fachakademie (4)
- ☐ (Fach-) Hochschule: Diplom, Bachelor (5)
- ☐ (Fach-) Hochschule: Master (6)
- ☐ Universität: Bachelor (7)
- ☐ Universität: Master, Magister, Staatsexamen (8)
- ☐ Universität: Promotion (9)
- ☐ Noch in der Ausbildung (Auszubildende/r, Schüler/in einer berufsorientierten Aufbau- oder Fachschule, Praktikant/in, Student/in) (10)
- ☐ keine Angabe (11)
- ☐ weiß nicht (12)

Seitenumbruch

Diese Frage anzeigen:

If Stromzähler vorhanden = Nein

Or Stromzähler vorhanden = weiß nicht

Und wenn

Stromzählerpflicht = Nein

Or Stromzählerpflicht = weiß nicht

Q931 Sind Sie erwerbstätig? *Erwerbstätigkeit bezieht sich auf Arbeit gegen Entgelt (Lohn, Gehalt, Honorar), Gewinn (bei Selbstständigen), oder Familieneinkommen (bei mitarbeitenden Familienangehörigen).*

- ☐ vollzeitbeschäftigt (1)
- ☐ teilzeitbeschäftigt (2)
- ☐ gelegentlich oder unregelmäßig erwerbstätig (3)
- ☐ nicht erwerbstätig (4)
- ☐ nicht mehr erwerbstätig (5)
- ☐ keine Angabe (6)
- ☐ weiß nicht (7)

Seitenumbruch

Diese Frage anzeigen:

If Stromzähler vorhanden = Nein

Or Stromzähler vorhanden = weiß nicht

Und wenn

Stromzählerpflicht = Nein

Or Stromzählerpflicht = weiß nicht

Q942

Welche berufliche Stellung haben Sie in Ihrer Haupterwerbstätigkeit? *Wenn Sie derzeit nicht oder nicht mehr berufstätig sind, nennen Sie bitte die berufliche Stellung, die Sie zuletzt innehatten.*

- ☐ Angestellte/r (1)
 - ☐ Arbeiter/in (2)
 - ☐ Beamter/Beamtin (auch Anwälter/in) (3)
 - ☐ Landwirt/in im Haupterwerb (4)
 - ☐ Selbstständig erwerbstätig mit Mitarbeitern und Mitarbeiterinnen (5)
 - ☐ Selbstständig erwerbstätig ohne Mitarbeiter und Mitarbeiterinnen (6)
 - ☐ Mithelfende/r Familienangehörige/r (unbezahlt) (7)
 - ☐ Auszubildende/r (auch Praktikant/in, Volontär/in) (8)
 - ☐ Freiwillig Wehrdienst- oder Bundesfreiwilligendienstleistende/r (9)
 - ☐ Freiwilliges soziales / ökologisches / kulturelles Jahr (10)
 - ☐ noch nie erwerbstätig gewesen (11)
 - ☐ keine Angabe (12)
-

Diese Frage anzeigen:

If Stromzähler vorhanden = Nein

Or Stromzähler vorhanden = weiß nicht

Und wenn

Stromzählerpflicht = Nein

Or Stromzählerpflicht = weiß nicht

Q943 Nehmen Sie eine Führungsaufgabe wahr, d. h. sind Sie Mitarbeitern und Mitarbeiterinnen gegenüber weisungsbefugt, die keine Auszubildenden sind?

☐ Ja, als Führungskraft (mit Entscheidungsbefugnis über Personal, Budget und Strategie) (1)

☐ Ja, als Aufsichtskraft (Anleiten und Beaufsichtigen von Personal, Verteilen und Kontrollieren von Arbeit) (2)

☐ Nein (3)

☐ keine Angabe (4)

Seitenumbruch

Q951

Wie hoch ist in etwa das monatliche Netto-Einkommen Ihres Haushalts insgesamt? Bitte zählen Sie die monatlichen Einkommen aller Haushaltsmitglieder (einschließlich Elterngeld, Kindergeld usw.) nach Abzug von Steuern und Sozialabgaben zusammen.

- ☐ unter 2500 Euro (1)
- ☐ von 2500 bis 5000 Euro (3)
- ☐ über 5000 Euro (4)

Überspringen bis: Q952a Wenn Haushaltseinkommen = unter 2500 Euro

Überspringen bis: Q952b Wenn Haushaltseinkommen = von 2500 bis 5000 Euro

Diese Frage anzeigen:

If Stromzähler vorhanden = Nein

Or Stromzähler vorhanden = weiß nicht

Und wenn

Stromzählerpflicht = Nein

Or Stromzählerpflicht = weiß nicht

Und wenn

Haushaltseinkommen = unter 2500 Euro



Q953 Wie viele Personen leben ständig in Ihrem Haushalt, Sie selbst mit eingerechnet?

Ende des Blocks: Kontrollvariablen
