

# **Filling the Information Gap of House Owners and Technologies: A Design Case Study of a recommender for home energy system**

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## **ABSTRACT**

The transition to clean energy and energy-efficient technologies is crucial for reducing carbon emissions and mitigating climate change. However, households lack the sufficient knowledge and guidance on these technologies, including the potential benefits that can be obtained through their adoption. This study aims to fill the information gap and support decision-making on the adoption of clean energy and energy technologies for house owners. Design Case Studies will be used as the research framework. . . .

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# Notations and Abbreviations

**CO<sub>2</sub>** Carbon dioxide. 1

**EU** European Union. 2, 3, 58

**GHG** Greenhouse gas. 1

**HP** Heat pump. 27, 28

**IV** Information Visualisation. 26

**NL** Natural language. 26

**PV** Photovoltaic. 10, 12, 14, 16, 18, 27, 28, 51

**RS** Recommender systems. 21, 23

**SEMS** Smart energy management system. 18, 27, 28

# Chapter 1

## Introduction

### 1.1 Background

Human-induced climate change is causing dangerous and widespread disruption in nature, thereby affecting billions of lives globally [24]. To tackle climate change and its negative impacts, two main strategies are addressed: climate change mitigation and adaptation.

- **Climate change mitigation** refers to the actions taken to reduce or prevent greenhouse gas (GHG) emissions and ultimately stabilise the concentration of these gases in the atmosphere to limit global warming and its adverse effects [33]. This goal entails a range of related projects, spanning farming, land use, peatland management, renewable energies, and energy efficiency. Integrated projects that implement climate change mitigation strategies and action plans at regional or national levels are also pertinent [11]. Notably, to curb carbon dioxide (CO<sub>2</sub>)

emissions in the energy system, two main approaches are pursued: (1) *reducing energy consumption on the demand side through efficiency improvement and behavioral changes* and (2) *transitioning to renewable energy sources on the supply side*.

- **Climate change adaptation** encompasses measures to manage the adverse impacts of climate change, such as natural disasters, changes in precipitation patterns, and rising sea levels, among others [33], which includes projects relating to urban adaptation and land-use planning, infrastructure resilience, sustainable water management in drought-prone areas, flood and coastal management, as well as the resilience of the agricultural, forestry, and tourism sectors [11].

The work in this thesis belongs to the category of climate change mitigation.

### 1.1.1 Mitigating climate change through energy transition

The Paris Agreement, a historic international agreement, sets long-term goals to substantially reduce global emissions and limit the global temperature increase to 2 degrees Celsius in this century [39]. To achieve this ambitious goal, the world is facing an unprecedented imperative to a rapid transition in the energy sector. The European Union (EU)'s "Energy 2020. A strategy for competitive, sustainable and secure energy" and "Energy Roadmap 2050" are key strategy papers guiding energy developments in the EU [28], aiming to lead in global climate action and achieve net-zero emissions by 2050 through a socially-fair and cost-efficient transition [10].

### **1.1.2 Households in energy transition**

Households are a crucial component of the energy transition, as they are responsible for a significant proportion of final energy consumption in the EU, as highlighted by Eurostat's 2023 report. In fact, in 2020, the residential sector accounted for 27.4% of total final energy consumption or 18.7% of gross inland energy consumption in the EU [12]. Therefore, reducing energy consumption in households through energy-efficient building construction and renovations, as well as digitalisation and smart demand-side management, can have a significant impact on achieving the EU's energy and climate targets [22]. This underscores the importance of developing and implementing effective policies and strategies to promote energy efficiency and renewable energy use in households to facilitate the energy transition.

### **1.1.3 Technologies for home energy system**

Technologies for home energy systems have rapidly advanced in recent years, with a growing focus on energy efficiency and renewable energy sources. Smart home technologies, such as energy management systems, allow households to optimise their energy consumption and reduce waste. Moreover, rooftop solar panels and home battery storage systems enable households to generate and store their own renewable energy, reducing dependence on the grid and lowering electricity bills. In addition, the integration of electric vehicles with home energy systems can further reduce household carbon emissions and provide a source of backup power. These technologies have the potential to significantly transform the way households consume and generate energy, contributing to a more sustainable and resilient energy system.

## 1.2 Opportunity

Despite the growing availability and accessibility of home energy technologies, there remains a significant information gap regarding their effective utilisation. A survey conducted by Palmer et al. [31] identified a lack of knowledge and guidance among homeowners, preventing them from maximising the benefits of these investments in terms of reducing future energy expenses. Therefore, there is an opportunity in exploring effective ways to inform and educate house owners on those technologies.

## 1.3 Research questions and aims

The following research question was raised initially to guide the study:

- **What practice can effectively bridge the information gap for house owners in the adoption of renewable energy and energy-efficient technologies?**

As the research progresses, the second question was raised:

- **How to develop effective explanations that build trust for a recommender in supporting households making sustainable decisions?**

The aim of this study is to address the information gap and support house owners in their decision-making process regarding the adoption of clean energy and energy-efficient technologies.

This thesis seeks to contribute to the HCI community by introducing an energy technology recommender as a new IT artifact, and providing insights into trust, explainability, and opportunities related to the energy technology recommender. Overall, the findings of this thesis hopefully can inform the development of future HCI interventions to address environmental challenges.

# **Chapter 2**

## **Methodology**

The study uses Design Case Studies [41] as the research framework.

### **2.1 Context Study**

In the pre-study phase, an empirical analysis is conducted to examine the practices and tools used in the home energy sector. The main objective is to identify effective methods that can support households in making informed decisions about renewable energy and energy-efficient technologies. However, due to the limited availability of successful initiatives in this field, alternative options, including energy audits and research models, are being explored as potential solutions.

## **2.2 Design study**

comes up with an innovative design for an ICT artifact related to the findings of the first phase

## **2.3 Appropriation Study**

investigates into the appropriation of the technical artifact over a longer period of time.

# **Chapter 3**

## **Pre-study**

### **3.1 Home Energy Assessments**

Currently, homeowners have limited avenues to access information about home energy systems. Presently, individuals seeking such information typically have two options. One is visiting the official websites of specific technology providers or physically visiting nearby stores that specialise in the sale of one or various energy technologies. However, this necessitates a prerequisite understanding of the particular energy technology. Moreover, the information obtained through this approach may be restricted to the specific technology being explored, thus failing to offer a holistic perspective on the overall energy system, as energy technologies often function collaboratively. An alternative approach is through professional home energy assessments, commonly known as home energy audits. These assessments are conducted by experts who visit the house and perform a comprehensive inspection. Following the assessment, these professionals provide recommendations re-

garding house renovations, and in some cases, advice on suitable energy technologies to optimise energy efficiency.

## 3.2 Research-based models

Several research-based models furnish evidence to aid homeowners in making informed decisions regarding home energy systems.

### 3.2.1 PVGIS online tool

PVGIS [9] is a web-based application by the European Commission's Joint Research Centre, that enables users to access comprehensive data regarding solar radiation and the energy production of **PV** systems. This service encompasses a wide range of geographical regions, including Europe, Africa, substantial portions of Asia, and America. Which can be of a great help to house owners when deciding an investment in a **PV** system.

As shown in the Figure 3.1, the interactive tool allows users to navigate through the map and obtain information regarding performance of grid-connected **PV** based on the selected location. The visualisation of monthly energy output provides a clear and descriptive representation of the energy generated by a **PV** system throughout a year. Additionally, the outcome offers highly precise and specialised data, including detailed parameters such as yearly in-plane irradiation and year-to-year variability as well. While this information is highly valuable for researchers, it may pose comprehension challenges for homeowners lacking expertise in the field, thereby hindering their learning process. Furthermore, the data provided is only **PV** related,

lacking the connection to the specific circumstances of individual households.

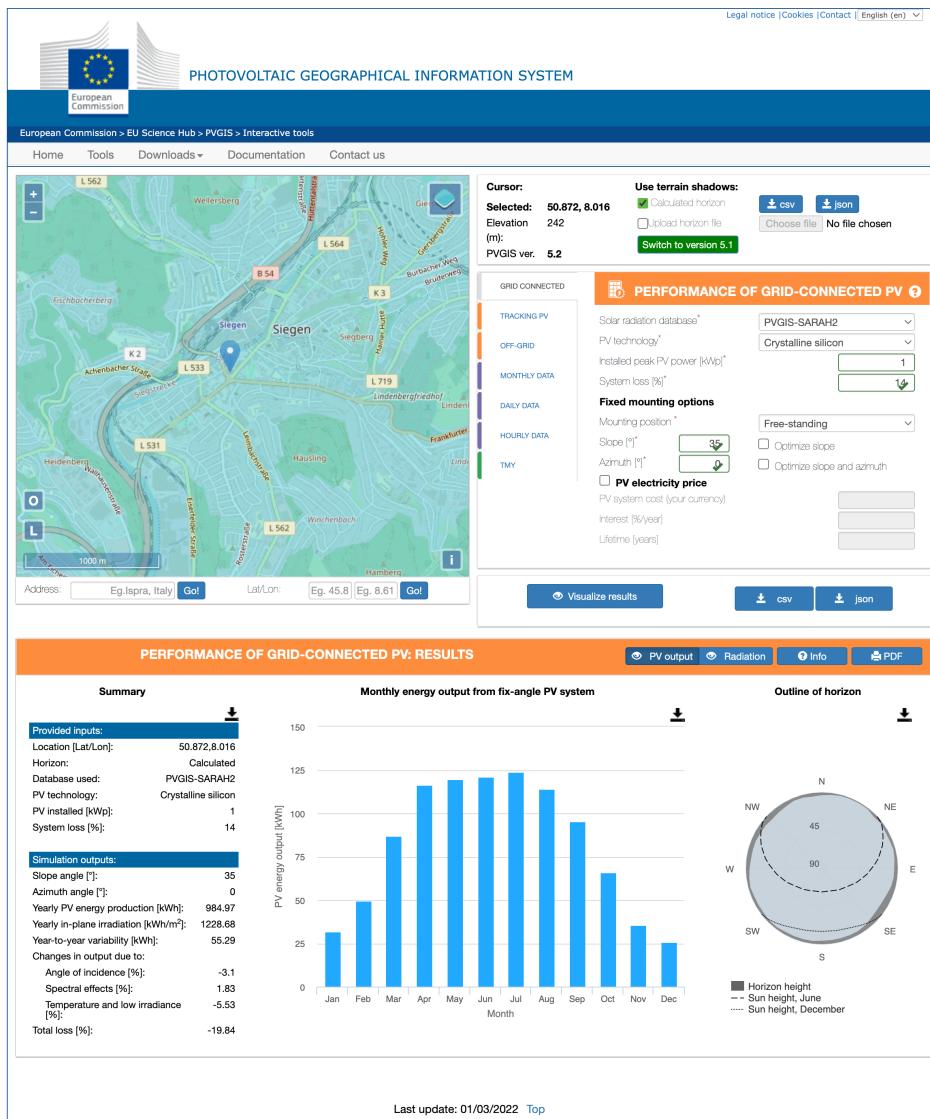


Figure 3.1: Screen of PVGIS online tool

### 3.2.2 FLEX models

The FLEX models [42], developed under the newTRENDS project<sup>1</sup> by the Fraunhofer Institute for Systems and Innovation Research, aim to improve the building modeling suite and to analyse the societal trends of prosumaging and energy communities, are capable of calculating the energy demand of buildings at an hourly resolution, while considering the impact of household behaviour, PV generation, and energy storage (thermal and battery) on energy consumption. These models were developed to offer evidence-based information to decision-makers in industry, government, and civil society.

The models take various factors into account, including weather condition, household behaviours and energy technologies, as illustrated in Figure 3.2. Consequently, it offers a comprehensive evaluation of the energy consumption of a representative building. Moreover, the tool can be used to predict energy bills, enabling comparisons of energy expenses associated with different technology adoptions.

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<sup>1</sup><https://newtrends2020.eu/>

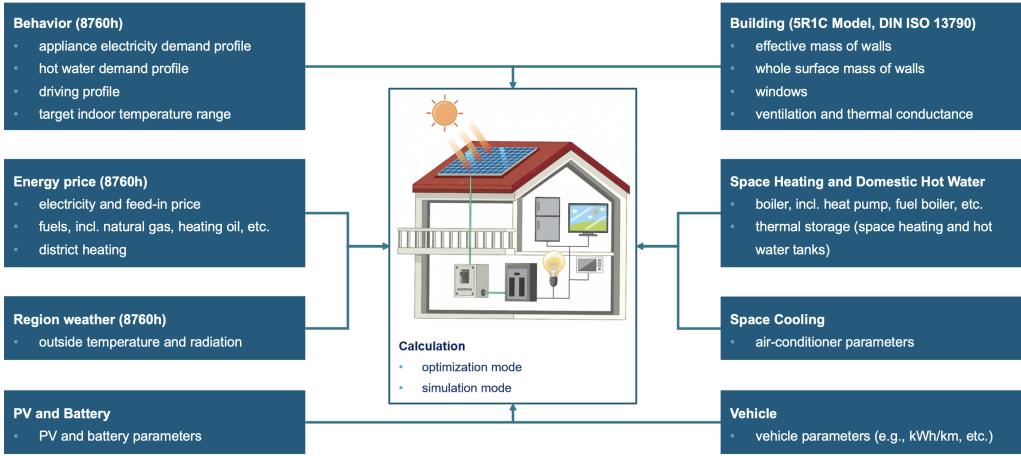


Figure 3.2: Model structure for individual households

### 3.3 Recommender system

#### 3.3.1 Decision-making process

#### 3.3.2 Motivators for investment decisions

The attitudes and perspectives of users regarding energy efficiency, particularly in relation to home energy systems, were investigated through a comprehensive survey conducted by Palmer et al. [31] in the United States. The survey revealed various motivating factors that influence homeowners in their decision to investments in improving energy efficiency. Notably, saving money on utility bills (72%) emerged as the primary motivator, closely followed by the low costs associated with improvements (66%). These findings suggest that homeowners prioritise the financial aspects of energy efficiency when making investment decisions. Surprisingly, preferences related to environmental sustainability (“Green”) and the potential increase in property values do not appear to significantly influence their decisions.

### **3.4 Conclusion**

As mentioned, existing studies identify financial aspects as the primary factors guiding homeowners' decisions when contemplating upgrades to their home energy systems. In light of this, the FLEX models emerge as an ideal tool for assisting homeowners in determining which technologies to invest in. These models encompass numerous factors, enabling relatively accurate predictions of energy consumption and associated energy bills. Therefore, the FLEX models can be utilised to provide valuable insights to homeowners seeking to make informed decisions about their system investments.

# Chapter 4

## Design

In order to bridge the information gap regarding home energy systems, this study aims to provide households with knowledge of available technologies in the market. Based on the findings from pre-study and to address the potential issue of information overload, the study proposes a home energy system recommender to present households with a tailored selection of technologies that better fit their unique home situations. For instance, by learning the location of the house, in order to estimate the amount of sunlight it is likely to receive over the course of a year, to evaluate whether installing a PV system would be a viable and economic way for the household. The learning theory suggests that individuals learn new knowledge by connecting it with existing knowledge and experiences, as this helps to create a framework for understanding and retention of the new information. Therefore, by focusing on personalised recommendations, the study hypothesises that households may be more receptive to learning about home energy technologies. Meanwhile, nudging house owners towards making informed decisions.

## 4.1 Design concept: The home energy system recommender

The home energy system recommender is a software application that integrates the FLEX models, offering personalised recommendations to households based on their individual circumstances. Through the recommended technology configurations and simulated energy costs, users will not only be guided on these technologies but also be educated on the potential benefits of transitioning to more sustainable energy systems.

## 4.2 Input to the recommender

### 4.2.1 Household profiles

The concept of household profile has been developed to gain insights into the energy demand and supply dynamics of households. To ensure the accuracy of this profile, thereby accurately anticipate household's energy costs, various factors that may impact the household's energy consumption must be considered, 4 categories as shown in Figure 4.1, they are *the external environment, building materials, energy consumption behaviors, and the current home energy system*. By creating such a profile, a comprehensive understanding of the household's situation can be attained, enabling the offering of more tailored and effective recommendations.

The categories were inspired by the FLEX models [42]. The models take a set of variables into account when simulating, they can be divided into

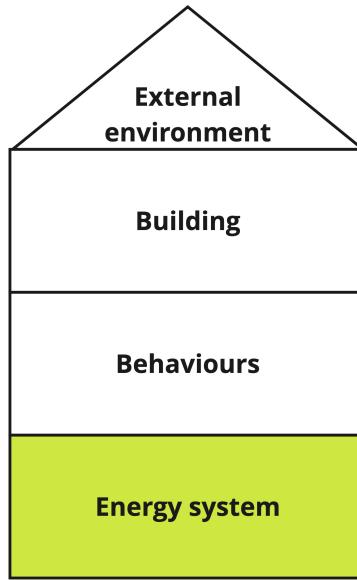


Figure 4.1: Household profile

following 15 categories: *behaviour profile, battery, behaviour, boiler, building, energy price, heating element, hot water tank, PV, region, space cooling technology, space heating tank, vehicle, energy price, region weather*. The specific data required by the FLEX models within each category can be found in Appendix A.

#### 4.2.2 Households data collection

While collecting more detailed data leads to increased accuracy in simulations in FLEX models, it is crucial to maintain user-friendly by not overwhelming users with excessive information requests. To strike a balance, a set of 13 questions (as outlined in Table 4.1) was developed to gather relevant information for household profile analysis. Using the provided user answers, additional specific information can be inferred. For example, by inputting

the construction period of the house, corresponding details such as building materials and sizes can be assumed.

Category	Question	Note
External environment	Where is the house located?	Understanding the location of the house can provide valuable insight into its environmental factors, such as the amount of sunlight it receives.
Building	<p>When was the house built?</p> <p>Has the house ever been renovated before?</p> <p>What has been renovated in the house?</p>	<p>Knowing the year a house was built can provide insight into its construction materials, such as the composition of the walls.</p> <p>Renovations can include upgrading insulation, replacing windows with energy-efficient ones, installing high-efficiency HVAC systems, sealing air leaks, etc.</p>
Behaviour	How many people are living in the house?	

	<p>How often does each adult work from home?</p> <p>Is there any air conditioner in the house?</p> <p>What type of heating energy is used in the house?</p>	
Home energy system	<p>Is there a photovoltaic (PV) system in the House?</p> <p>What is the size of the PV system?</p> <p>Is there a battery system in the house?</p> <p>What is the capacity of the battery?</p> <p>Is there a smart energy management system (SEMS) in the house?</p>	<p>A <b>PV</b> system is a system that uses solar panels to convert sunlight into electricity for use in a building.</p> <p>The average size of a <b>PV</b> system is 5 kilowatt-peak.</p> <p>A home battery system is a device that stores energy produced by solar panels or other sources to be used later when needed.</p> <p>The average capacity of a home battery system is around 7 kilowatt-hours.</p> <p>A <b>SEMS</b> is a technology to optimise energy usage, monitor consumption, and enhance energy efficiency.</p>

Table 4.1: Survey questions

To further enhance user experience, a decision tree approach was implemented, enabling users to navigate through the questionnaire without the obligation to answer all questions. As a result, the number of questions to be answered ranges from a maximum of 13 to a minimum of 10, as depicted in Figure 4.2.

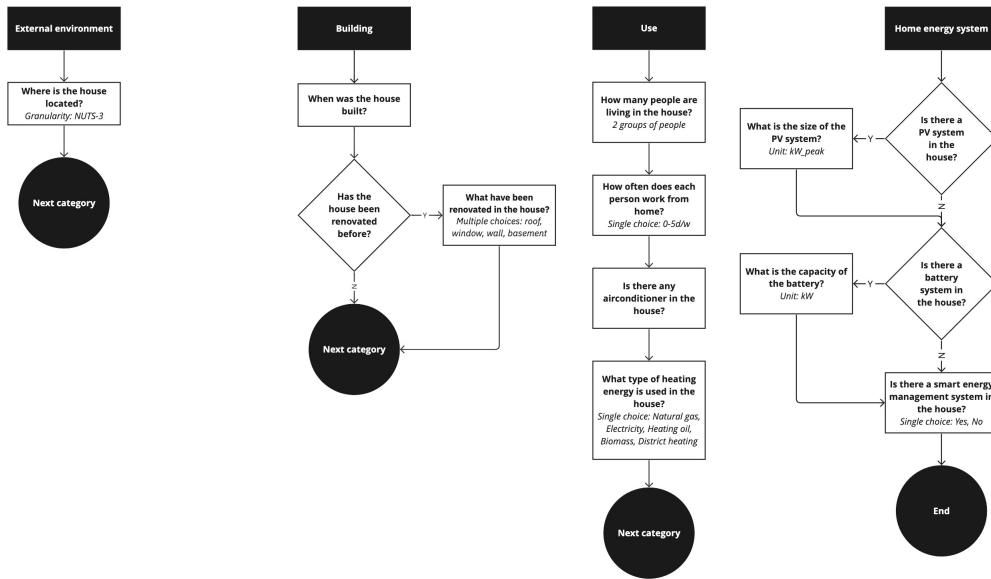


Figure 4.2: Question decision trees

## 4.3 Output from the recommender

### 4.3.1 Recommendations

A sustainable home energy system should prioritise *energy-efficiency, reducing dependence on non-renewable fossil fuels, and lowering overall energy costs*. All recommendations aligned with these fundamental principles, aim to promote sustainable energy practices while also reducing household energy costs. The energy technologies recommended to users are for generating renewable energy, managing energy usage, and improving energy efficiency. For example, the recommended technologies include the **PV** system, the battery system, the **SEMS** system, **HP**, and house renovation, as they contribute to energy efficiency improvements. An overview of the recommended technologies and their functionalities can be found in Table 4.2.

#### Recommendation rules

The recommendation generation process follows a rule-based approach. By employing the FLEX models, our system identifies configurations that can lead to lower energy bills compared to the user's current situation. However, to avoid overwhelming users with an excessive number of recommendations resulting from the various arrangement combinations of technologies, particularly when accounting for different sizes, we aim to provide recommendations that offer tangible financial benefits to users. To achieve this, we considered three distinct perspectives. Firstly, we present the most techno-economic solution, which compares the annualised investment costs and the annual energy cost to determine the configuration that yields the highest

financial advantage for households. Secondly, we offer the solution with the highest energy bill savings, disregarding investment costs, since investment costs may vary across different areas, and there is a possibility that users can find cheaper options for implementing the recommended technologies. This allows users to gain insights into the most energy-efficient configurations available for their homes. Lastly, we provide the solution with the lowest investment cost, enabling users to identify a cheaper step towards enhancing their home energy system. In addition, we empower users to customise the energy system according to their specific needs and preferences in the detail page. Presenting recommendations from three perspectives while allowing customisation is believed to be an appropriate balance. The efficacy of this approach will be evaluated during the testing phase.

### 4.3.2 Explainability

Explainability plays a crucial role in establishing trust among users in Recommendation Systems ([RS](#)), and this principle holds true for our system as well. When the system generates recommendations for users, it is important for users to understand why a particular configuration is being recommended to them. Explanations aim to bridge this gap by shedding light on the factors that contribute to the recommendation and how they align with the user's preferences (the financial aspect specifically).

#### Explanation

According to Nunes and Jannach [[30](#)], previous studies have identified ten purposes of explanations, including *transparency, effectiveness, trust, prersua-*

*siveness, satisfaction, education, scrutability, efficiency, debugging.* In our case, the explanations provided by the system are intended to serve three purposes: *effectiveness, trust, and education.*

**Effectiveness** The system aims to support users in making informed decisions by providing the corresponding yearly energy bill. As they can immediately gauge the financial implications and potential cost savings associated with each recommendation.

**Trust** By offering more detailed simulated energy consumption patterns, users gain a deeper understanding of how the energy bills are calculated in the recommended configurations, thereby building trust and confidence in the accuracy and reliability of the system's outcomes.

**Education** The system utilises explanations as educational tools to offer users valuable insights into the recommended technologies and their impact on energy bills, furthermore, the system can also provide information about the broader context of climate change, helping users understand the larger picture and the importance of sustainable energy practices.

## Exploration

Beside retrospective explanations, prospective user interfaces can play a significant role in guiding users incrementally toward their goals and enhancing user control and transparency in the recommendation process. According to a study by Siepmann and Chatti [35], such interfaces have the potential to facilitate the development of a more accurate mental model of the decision-making system. Therefore, in our design, by providing interactive and visual

interfaces, users are empowered to actively explore and adjust various configurations of the recommended technologies. This level of control allows users to observe and analyse the corresponding simulated results in real-time. As users manipulate the configurations, they gain a better understanding of how changes impact the outcomes. By making the system’s workings visible and allowing users to actively participate, users can develop a clearer mental model of how the system functions and how different choices influence the results. This transparency and user empowerment contribute to increased trust and understanding of the decision-making system.

### Levels of explanations

In addition, a study conducted by Kim et al. [26] examined the explainability needs of 20 diverse end-users and revealed that the level of explainability required varied based on participants’ backgrounds in AI and their interests in the domain. While there was a general curiosity about AI among participants, only those with a high level of AI expertise or a significant interest in the domain expressed a need for detailed explanations regarding the RS system. Therefore, it is essential to provide different levels of explanations to accommodate the varying characteristics of users and meet their specific needs.

**The first level of explanation** For users who are primarily focused on improving their home energy systems without a deep interest in understanding the underlying system, this level of explanation presents the recommended configurations, specifying the technology products that should be installed or upgraded in their homes. Additionally, it provides information on the corresponding yearly energy bills associated

with each configuration. The objective is to ensure that users comprehend the potential benefits of implementing the recommendations. By clearly presenting the recommended configurations and their associated energy bills, users can readily evaluate the potential improvements that can be achieved in terms of energy efficiency and cost savings.

**The second level of explanation** For users who have doubts about the recommendations and possess a curiosity about how the system operates, besides the first level information, this level of explanation offers insights through generated energy consumption patterns and encourages user exploration to understand the underlying workings of the system. They can observe how different configurations or technology choices impact energy consumption and ultimately influence the calculation of yearly energy bills. By facilitating user interaction and transparency, the system aims to build trust and alleviate doubts, enhancing user confidence in the system's recommendations.

**The third level of explanation** This level of explanation focuses on providing cognitive knowledge to users. It goes beyond the technical aspects of the system and delves into the broader context of environmental protection and sustainability. Users are encouraged to consider the long-term consequences of their energy-related decisions and their role in contributing to a more sustainable future. It aims to raise awareness among users, foster a sense of responsibility, and offer additional information and resources for embracing sustainable practices beyond the immediate recommendations of the system.

## **Additional information**

In addition to the aforementioned, there are several other techniques that are considered to further support users in their decision-making process. These techniques aim to provide additional information to enhance user understanding, facilitate comparisons, and enable informed choices.

**Comparison with current situation** To ensure users can verify the accuracy of our system, we provide a valuable reference point by offering simulated versions of their current energy bill and consumption. This feature allows users to compare the system's simulations with their actual energy usage, enabling them to assess the reliability and accuracy of the recommendations. By presenting users with their simulated current energy bill and consumption, they can directly observe how closely the system's simulations align with their real-life data. This serves as a tangible measure of the system's effectiveness and enhances user confidence in its recommendations. The verification process not only fosters user trust and confidence but also allows us to collect valuable user feedback for continuous improvement. By actively seeking user perspectives and incorporating their feedback, we can refine the algorithms and models, ensuring that the recommendation system evolves and remains responsive to users.

**Technology explanation** a brief explanation (Table 4.2) of each recommended technology is provided to help users understand their functionalities and how they contribute to energy efficiency. The technology introductions are presented in a clear and straightforward manner, avoiding technical jargon and using language that is easily understand-

able for users with varying levels of knowledge about energy systems. This ensures that users can quickly grasp the main concepts and functionalities of each technology without feeling overwhelmed by complex technical details. It empowers users to make more informed decisions by providing them with the necessary knowledge to assess the relevance and suitability of each technology for their specific energy needs and goals.

<b>Technology</b>	<b>Explanation</b>
PV system	A PV system can convert sunlight directly into electricity.
Battery system	A battery system can store excess energy generated by solar panels or other renewable sources of energy during the day.
SEMS	A Smart Energy Management System (SEMS) can optimise energy usage by adjusting heating and cooling systems, lighting, and other energy-consuming devices to minimise energy waste; and turning off or reducing energy usage during periods of low occupancy or when energy prices are high.
HP	A heat pump is a device that transfers heat from one place to another, providing both heating and cooling for spaces.
Hot water tank	A hot water tank is a device used to store domestic hot water for use in homes. The hot water in the tank can be used in sinks, showers, or appliances.
Space heating tank	A space heating tank is a device used to store hot water to provide heat to interior spaces in homes.
Building renovation	Building renovation can have a significant impact on improving home energy efficiency performance by reducing the amount of energy needed to heat, cool, and operate a home.

Table 4.2: Brief introduciton of each technology

**Investment costs** The consideration of supplementary information pertinent to users' investment decisions holds significance. Hence, we endeavor to furnish users with additional information regarding technology costs. However, it is imperative to acknowledge that various brands exhibit divergent pricing structures, and the performance or size variations of individual technologies directly influence their corresponding costs. In light of this, we present users with a range of costs associated with each technology, aiming to facilitate their decision-making process by fostering informed choices. The specific cost ranges are presented in the Table 4.3.

Technology	Initial investment (€)	Life (year)	Annualised cost (€)	Ref
PV system	1200/kWp	15	115.61/kWp	[5]
Battery system	428.57/kW h	15	41.29/kW h	[5]
SEMS	1000	15	96.34	[5]
HP	/	/	900	[6]
Building renovation	/	/	2000	[21] [20]

Table 4.3: Investment costs of different technologies

## Presentation

Both Natural language (**NL**) and Information visualisation (**IV**) techniques are used to serve different purposes and enhance the overall clarity and effectiveness of conveying information to users. **NL** explanations, in the form of textual descriptions, are utilised to provide detailed information about

technology functionalities and costs. Charts are employed to present energy consumption data in a visual format. Visualising energy consumption data of each sector using charts helps to simplify complex information, enabling users to grasp patterns and comparisons more easily. Users can observe the relative contributions of different sectors, identify areas of high or low energy consumption, and explore alternative scenarios or configurations.

## 4.4 Medium

At present, the service is designed as a one-time interaction where users receive recommendations and may not revisit the system in the near future. Meanwhile, the explanations provided can be presented in a highly detailed manner, as users have the opportunity to carefully read and understand the information. The interactive nature of the system allows users to compare complex data and explore different configurations. A larger screen offers a more comfortable viewing experience, therefore, the current focus is on desktop or larger screens. However, considering the prevalent use of smartphones in today's society, it is important to acknowledge the need for a mobile-friendly version of the service.

## 4.5 Interfaces

In this chapter, several key interfaces are explained, providing an overview of the important pages and features of the system. While not all pages are covered, the focus is on highlighting the interfaces that play a significant role in the user experience and decision-making process.

## **Homepage**

The homepage (Figure 4.3) of the website serves the purpose of informing participants about the functionality and process of the service. Several factors related to usability are considered in the design and content of the home page:

**Purpose introduction** The homepage should clearly communicate the purpose of the service, highlighting its main objective and benefits for participants, in order to help users understand the core function and value proposition of the website.

**Explanation of steps** A 2-step explanation is provided to guide users through the process of using the service even before they begin, this is to ensure that users are mentally prepared for the service and have a clear roadmap to follow.

**A time indicator** The estimated time required to complete the questionnaire is provided to users as a feature to mentally prepare them for the task at hand. By indicating the expected time commitment, users can have a better understanding of the anticipated duration of their engagement with the system.

**Data privacy information** Users are informed about the data handling practices and security measures implemented by the website. Additionally, users also have the opportunity to delve deeper into the specifics of data handling practices by accessing more detailed information. The privacy policy can be found in Appendix B.

**Involvement of organisations** The homepage introduces the relevant organisations involved in the development and operation of the service to establish credibility in the reliability and expertise of the system.

**Contact details** Email addresseses is provided to allow participants to reach out for support, clarification, or any other inquiries they may have.

**Language options** The service offers language options in both English and German to cater to a broader audience in Europe.

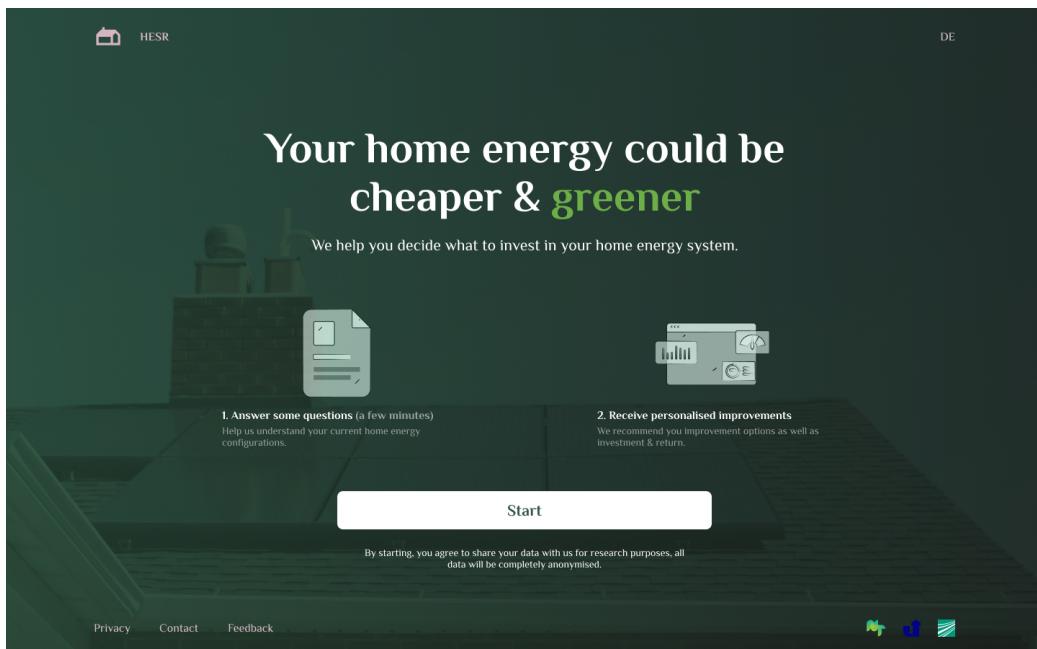


Figure 4.3: Homepage

## Questionnaire

The questionnaire page (Figure 4.4) is specifically designed to collect information pertaining to the household's current energy demand and supply-related factors. Its purpose is to gather comprehensive data in order to construct a

detailed household profile. Several usability factors are taken into account to enhance user experience on this page:

**One question at a time** To present one question at a time, ensuring that users understand precisely what information is being requested from them. Users can focus their attention on each individual question without feeling overwhelmed by a large set of inquiries, which allows for better comprehension and reduces the risk of confusion or misunderstanding.

**Question categorisation** Each question is assigned a relevant category to provide context to users.

**Transparent process** The page outlines the overall process, indicating the number of categories involved.

**Detailed explanations** For unfamiliar or complex concepts, the page offers more detailed explanations to provide users with a better understanding.

**”I Don’t Know” option** Users are provided with an option to select ”I don’t know” if they are unsure about a particular question.

**Return and edit** The page allows users to easily navigate back to the previous page and make changes if they need to modify their answers.

## Recommendation

The recommendation page (Figure 4.5 and 4.6) serves as a crucial component of the system, aiming to inform users about the available home energy system

DE

Tell us about your Home Energy System

**Is there a photovoltaics (PV) system in the house?**

[What is a PV system?](#)

Yes

No

Privacy   Contact   Feedback

Figure 4.4: Questionnaire

options that can potentially lower future energy costs and improve energy efficiency. The page provides clear and simple explanations (annual energy costs) behind each recommendation. To ensure usability and meet user needs, the recommendation page incorporates the following features:

**List of recommendations** The page presents all the recommended options, or in some cases, informs users if no specific recommendation is available.

**Estimated current energy bill** Users are provided with an estimated current energy bill, allowing them to compare their existing energy costs with the potential savings offered by the recommended options. This provides a tangible reference point for users to assess the financial impact of the recommendations.

**Flexible orders** The system allows for different ways of presenting the rec-

ommendations.

**First level explanation** Each recommended option is accompanied by specific information regarding the potential financial benefits it offers, including money saved and the projected annual energy bills.

**Allow for detailed sxplanations** For users who seek more in-depth information, the recommendations page offers the option to access more detailed explanations.

## Simulation

The simulation page (4.7) aims to provide users with more detailed explanations about the recommended options.

**Data visualisation** It utilises data visualization techniques to present information in a visually engaging and easily understandable format.

**Comparison** The simulation page allows users to compare the recommended options with their current configuration using visualised data, making it easier to understand the differences in energy consumption and demand. The comparison enhances users' understanding of the disparities between the recommended options and their current configuration, enabling them to assess the potential benefits.

**Exploration** The simulation page enables users to make adjustments to the recommended options. Users can modify various parameters, such as the system size, or technology configurations, and recalculate the results accordingly. This interactive functionality empowers users to

explore different scenarios and understand how their choices affect the projected outcomes.

## 4.6 Usability testing

For a first round of evaluation, a user testing session was conducted with a total of 5 participants. The primary focus of this testing round was to assess the usability of the service before proceeding with the actual coding and implementation of FLEX models. The goal is to ensure that the service meets the usability requirements and to gather initial feedback on the explainability of the recommendations provided.

### 4.6.1 Participants

The 5 participants selected for the testing session were primarily Human Computer Interaction (HCI) students from Siegen University, chosen through convenient sampling. Because of their background in HCI, they have a solid understanding of usability, which made the evaluation an expert's heuristic evaluation.

### 4.6.2 Testing content

During the testing session, all participants were asked to interact with an interactive Figma prototype to explore and discover recommendations for

“their” home energy systems. Following the prototype interaction, participants were required to complete an online survey created using Typeform [38]. The survey consisted of the following questions:

- What do you think this website is about?
- How clear were the instructions on the website for you to follow?
- Did you find the website visually appealing?
- Was the website easy to use and understand?
- How long do you think it took you to complete the questions?
- What would you change about the website to make it more user-friendly?
- Were the recommendations easy to understand?
- Was there anything about the recommendations that you found confusing or unclear?

#### 4.6.3 Analysis of usability testing

The evaluation of the service involved collecting responses from the participants through a survey (see Appendix C). Overall, the participants demonstrated a good understanding of the website’s purpose, which is focused on energy and cost savings in households. However, it should be noted that one participant (Participant 3) provided somewhat unclear answers, and the responses to text-based questions were overly simplistic. Regarding the usability of the website, the majority of participants (4 out of 5) found the

instructions to be clear and considered the web interface visually appealing. Additionally, they reported that the website was easy to use and understand, indicating a positive user experience. The participants expressed positive feedback regarding the understandability of the recommendations. Three out of five participants gave high scores of 9/10 or full marks when rating the ease of understanding the recommendations. In terms of the time taken to receive the recommendations, most participants indicated that they spent less than 5 minutes, which aligns with the desired design goal. The feedback provided by the participants also highlighted several areas for improvement and enhancement of the service. The following suggestions were made:

- Allow users to go back to previous questions.
- Provide more assistance to help users find the correct options.
- Use “photovoltaic” instead of “PV” for better clarity.
- Provide more explanations about PV and SEMS to enhance understanding of these terms and their role in the energy system.
- Incorporate a wider variety of selection elements, beyond just clicks, to enhance user interaction.
- Improve the usefulness of the step tracer by indicating the exact number of questions.
- Provide suggested minimal or maximal temperatures instead of having users input an ideal temperature range.
- Include more information about the final investment and the time required to recoup the investment.

- Display corresponding results for different PV sizes to assist users in determining the most suitable size.
- Make the survey questions feel more like a friendly inquiry rather than a formal questionnaire.

## 4.7 Iteration

After identifying the areas that required improvement based on the feedback, several redesigns were implemented. Firstly, a "back" button was added to allow users to navigate to previous questions easily. To simplify the options and facilitate decision-making, the number of available choices was reduced, while an indication of the most average option was provided. To enhance understanding, each technology now includes an explanation of its functionality as a helpful hint. Two types of selection elements were introduced: dropdown selection and tab bar selection, providing users with different interaction experiences. Since the exact number of questions to be answered by each participant could not be guaranteed, it was decided to temporarily hide the step tracker. This was done to avoid providing confusing or inaccurate indications. The temperature range question was removed to streamline the survey and make it more user-friendly, as the range is typically common to most people. To facilitate decision-making, annualised costs were presented to help users determine the techno-economic viability of the recommendations. Additionally, calculations were also performed to assist users in identifying the most suitable PV sizes to invest in. Due to time constraints, incorporating more playful elements into the questionnaire was not prioritised. This remains an area for future consideration and further development.

## Current

- ⌚ Rhein-Sieg-Kreis
- 🏠 4-Person Household
- 🏡 Not renovated since 1987
- 🔋 Own electric car

[Back and edit >](#)

### CURRENT

Your current energy bill is estimated to be  
**€ 3839 / year**

[More details >](#)

- ✗ PV system
- ✗ Battery system
- ✗ SEMS system
- ✓ Heat source: Gas
- ✓ Hot water tank: 80 L
- ✓ Space heating tank: 80 L
- ✓ Air conditioner
- ✗ Building renovation: 1989

Why should we turn to renewable  energy? Learn more about the reasons other than cost-savings.

## Recommended configurations

5 energy configurations available for your house that may lower future energy costs and improve energy efficiency.

Sort by [Save the most money](#)

### SAVE THE MOST MONEY

#### Save € 1709 / year

If the following configurations are applied, the annual energy bill is estimated to be €2150.

[More details >](#)

- + Add a PV system
- + Add a battery system
- + Add a SEMS system
- ↑ Change the heat source to electricity
- ↑ Renovate the building

*Investment costs from €1000*

#### Save € 1209 / year

If the following configurations are applied, the annual energy bill is estimated to be €2150.

[More details >](#)

- + Add a PV system
- + Add a battery system
- + Add a SEMS system
- ↑ Change the heat source to electricity

*Investment costs from €800*

### Save € 809 / year

If the following configurations are applied, the annual energy bill is estimated to be €2150.

[More details >](#)

- + Add a PV system
- + Add a battery system
- + Add a SEMS system

*Investment costs from €700*

#### Save € 609 / year

If the following configurations are applied, the annual energy bill is estimated to be €2150.

[More details >](#)

- + Add a PV system
- + Add a battery system

*Investment costs from €600*

### LOWEST INVESTMENT

#### Save € 409 / year

If the following configurations are applied, the annual energy bill is estimated to be €2150.

[More details >](#)

- + Add a PV system

*Investment costs from €500*

Customise my home energy system 



Tell us what you think



Download all options

Figure 4.5: With recommendations <sup>38</sup>

HESR DE

### Current

- ⌚ Rhein-Sieg-Kreis
- 👨 4-Person Household
- 🏡 Not renovated since 1987
- 🚗 Own electric car

[Back and edit >](#)

**CURRENT**

Your current energy bill is ~~€ 1839 / year~~ **€ 1839 / year**

[More details >](#)

- ✓ PV system
- ✓ Battery system
- ✓ SEMS system
- ✓ Heat source: Gas
- ✓ Hot water tank: 80 L
- ✓ Space heating tank: 80 L
- ✓ Air conditioner
- ✓ Building renovation: 2022

Why should we turn to renewable  energy? Learn more about the reasons other than cost-savings.

### Recommended configurations

It seems that your home energy system is already very technically economical and we do not have a recommendation that may lower future energy costs for you at the moment. You can also see how different configurations will affect your house's energy consumption by manually customising your home energy system using our service.



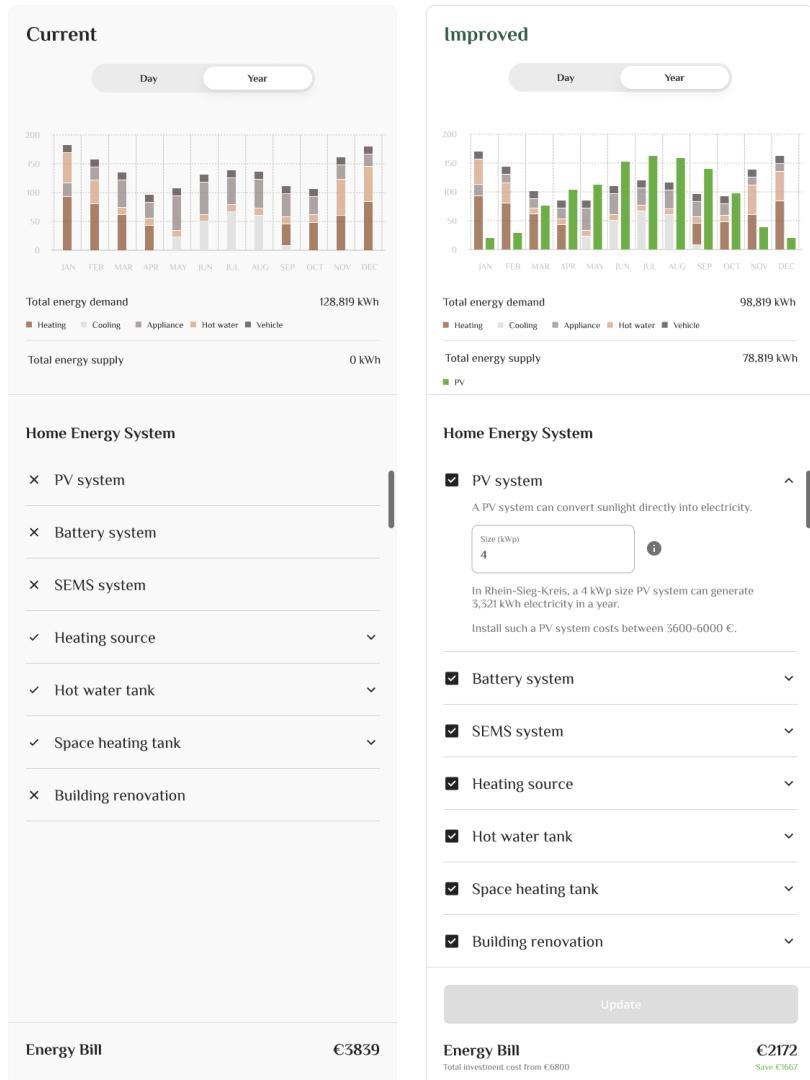
Customise my home energy system >

Tell us what you think

Download all options

Figure 4.6: No recommendation

### Estimates of your household energy use



Why should we turn to renewable energy? Learn more about the reasons other than cost-savings.



 Tell us what you think



Download the estimates

Figure 4.7: Simulation page

# **Chapter 5**

## **Development**

The web application is designed, with the frontend responsible for collecting user data and presenting recommendations and explanations, while the backend handles the processing and analysis of data using the FLEX models.

### **5.1 Frontend**

The frontend of the web application is responsible for creating an engaging and user-friendly interface using HTML, CSS, and JavaScript. These technologies work together to structure the content, define the visual styles, and add interactivity to the application. HTML is used to create the structure of the webpages, CSS is employed to style the visual appearance of the application. JavaScript plays a crucial role in adding interactivity and dynamic functionality to the web application. Additionally, JavaScript is responsible for making asynchronous requests to the server, facilitating communication with the backend. To ensure a responsive design, the web application utilises

the Bootstrap framework. Although the service is not intended for mobile screens, a responsive user interface that adapts to various devices and screen sizes has been taken into account.

### 5.1.1 Questionnaire

To incorporate questionnaires into the web application, we integrated SurveyJS, an open-source JavaScript form builder library. SurveyJS simplifies the process of creating and embedding surveys. It supports logic and branching, allowing for dynamic survey behaviour based on user responses, that fulfils our need of presenting corresponding questions according to the answers, as described in the design section.

### 5.1.2 Charts

For chart building, we initially opted for Google Charts, a charting library provided by Google [17]. However, we encountered difficulties in building multiple columns using Google Charts. As a result, we switched to Highcharts [19], another powerful charting library written in JavaScript.

## 5.2 Backend

The backend of the web application utilises Flask, a Python-based web framework, to serve as the intermediary between the frontend and the FLEX models. This choice was made based on the fact that the FLEX models are implemented in Python. Originally, our intention was to enable direct communi-

cation between the backend and the models using Python. However, during the development process, we realised that the models' calculations, especially when finding recommended configurations, could be time-consuming. Each scenario takes approximately 7 seconds to calculate, and considering the need to identify multiple scenarios that could save energy costs for the household, it would be impractical to make the user wait for the results. To address this issue, we decided to pre-process the data in the FLEX models and store it in a database. This approach significantly reduced the time required to identify energy-saving scenarios, allowing for a more efficient user experience.

### 5.2.1 JSON Schema Documentation

The API design for the service follows a RESTful architecture and adheres to the JSON schema presented in this section. This JSON schema defines the structure and properties of a household's energy system and recommendation.

#### **Household's energy system and recommendation**

##### **Properties**

The documentation consists of three main components: profile, current, and recommendation as displayed in table 5.1.

Name	Type	Description	Required	Default value
profile	object	An object describing the house's location and number of people.	Yes	-
current	object	An object describing the house's current energy system configurations, energy data, and costs.	Yes	-
recommendation	array	A list of recommended configurations that improve the house's energy efficiency.	Yes	-

Table 5.1: Properties

### Properties of profile

As table 5.2 shows, the profile component provides information about the house's location and the number of people residing in it. It includes properties such as location and person.

Name	Type	Description	Required	Default value
location	string	The location of the house.	Yes	-
person	integer	The total number of people residing in the house.	Yes	-

Table 5.2: Properties of profile

### Properties of current

The current component describes the house's current energy system configurations, energy data, and costs. It consists of two properties: config and energy\_data. See table 5.3.

Name	Type	Description	Required	Default value
config	object	An object describing the house's current energy system configurations.	Yes	-
energy_data	object	An object describing the energy demand, PV generation, and energy cost.	Yes	-

Table 5.3: Properties of current

### Properties of config

The config property, as shown in table 5.4, captures the current energy system configurations, including parameters such as pv\_size, battery\_capacity, sems, heating\_system, heating\_system\_type, and building\_renovation.

Name	Type	Description	Required	Default value
pv_size	integer	Determine the size of the PV system.	Yes	-
battery_capacity	integer	Determine the capacity of the battery system.	Yes	-
sems	boolean	Determine the state of a SEMS system.	Yes	-
heating_system	boolean	Determine the state of the heating system used.	Yes	-
boiler_type	string	Determine the type of heating system used.	Yes	-
building_renovation	boolean	Determine the state of the renovation.	Yes	-

Table 5.4: Properties of config

## Properties of energy\_data

The energy\_data property contains data related to energy demand, PV generation, and energy cost. It includes properties like energy\_demand, energy\_generate, heating, cooling, appliance, hotwater, pv, and energy\_bill\_year.

See table 5.5.

Name	Type	Description	Required	Properties in Database
energy_demand	integer	The total energy demand in a year.	Yes	-
energy_generate	integer	The total energy generated by PV in a year.	Yes	-
heating	array	The energy demanded for heating in the house for each month.	Yes	E_Heating + Q_HeatingElement
cooling	array	The energy demanded for cooling in the house for each month.	Yes	E_RoomCooling
appliance	array	The energy demanded by all appliances in the house for each month.	Yes	BaseLoadProfile
hotwater	array	The energy demanded for hot water in the house for each month.	Yes	E_DHW_HP_out
pv	string	The energy generated from PV in the house for each month.	Yes	PhotovoltaicProfile
energy_bill_year	integer	The total yearly energy cost.	Yes	-

Table 5.5: Properties of energy\_data

## Properties of recommendation

The recommendation component represents a list of recommended configurations that can improve the house's energy efficiency. As listed in table 5.6, each recommendation includes properties similar to the config and energy\_data properties in the current component. Additionally, it includes an investment\_cost property indicating the annualised investment cost for the recommended configuration.

Name	Type	Description	Required	Default value
config	object	An object describing the recommended energy system configurations.	Yes	-
energy_data	object	An object describing the energy demand, PV generation, and energy cost.	Yes	-
investment_cost	integer	The annualised investment cost for the recommended configuration.	Yes	-

Table 5.6: Properties of recommendation

## Example JSON data

```
"energy_data": {  
    "energy_demand": 0,  
    "energy_generate": 0,  
    "heating": [0,0,0,0,0,0,0,0,0,0],  
    "cooling": [0,0,0,0,0,0,0,0,0,0],  
    "appliance": [0,0,0,0,0,0,0,0,0,0],
```

```
"hotwater": [0,0,0,0,0,0,0,0,0,0,0],  
"pv": [0,0,0,0,0,0,0,0,0,0,0],  
"energy_bill_year": 0  
},
```

The JSON data example can be found in the appedix [D](#).

### 5.2.2 Endpoints

The API exposes [5 endpoints](#) to retrieve data, they are scenario\_id, recommendations and energy\_data. The endpoints accept HTTP GET requests and returns JSON responses.

# Chapter 6

## Evaluation

In this chapter, we present the evaluation of our IT artefact. The evaluation study focuses on two main aspects. Firstly, we assess the effectiveness of the explanations provided to users in helping them understand why specific configurations were recommended for their home energy systems. Secondly, we evaluate whether the information presented through the explanations has an impact on users' attitudes, such as increased awareness of energy-efficient technologies or a stronger inclination to adopt them.

As highlighted in Nunes and Jannach's summary [30], there is no universally accepted definition of what constitutes a correct or best explanation, evaluating the quality of explanations relies on capturing the subjective perceptions of users and monitoring the impact of these explanations on user behaviour, and user studies have been the predominant research method for assessing explanations in recommender systems. Aligned with this understanding, our goal of capturing the subjective perceptions of users regarding the explanations provided and assessing any changes in their attitudes, we

have made the decision to conduct real-user studies.

Due to time constraints imposed by the university's requirements for a master's thesis, we conducted qualitative user studies with 6 participants in the [South Germany](#) region. While the sample size was small, qualitative studies provide valuable insights into users' perceptions, attitudes, and experiences.

## 6.1 Semi-structured interviews

The interview will follow the structured format to gather insights from the participants.

1. Express gratitude to the interviewee for their willingness to participate and introduce myself briefly.
2. Provide a brief recap of the project, emphasising its purposes, and clarify the specific objectives of the interview.
3. Inform the interviewee about the expected duration of the interview (approximately 40 minutes) and assure them that the recording will be used solely for transcription purposes, ensuring confidentiality.
4. Explain that the interview will involve participants using the web service to explore and discover recommendations tailored to their home energy systems.
5. Prior to participants using the service, they will be asked a series of questions pertaining to their demographic information and initial perceptions of energy technologies.

6. Allow participants to utilise the service using a laptop.
7. Once the participants have interacted with the service, other questions will be asked.
8. Inquire if the interviewee has any remaining questions or uncertainties.
9. Express appreciation once again for their participation and inform them that they can reach out with any further concerns or inquiries they may have.

## **Target groups**

The target users of this study are individuals residing in Germany who own single-family houses. The participants were recruited using a convenient sampling approach. We employed a snowball technique by reaching out to acquaintances to inquire about their residence in a single-family house or their knowledge of individuals residing in such properties. Additionally, we extended our recruitment efforts to colleagues within Fraunhofer ISI.

The interview invitation is:

Are you a homeowner in Germany with a single-family house? Do you want to make informed investment decisions about energy technologies for your home? If so, we invite you to participate in a 40-minute interview for our web service developed in collaboration with the University of Siegen. Don't miss out on the opportunity to test our web service, which provides personalised techno-economic investment recommendations tailored to your unique home situation. During the interview, you will use our online service and share your experience. Rest assured that all information shared will be kept

confidential and anonymised. The interview will be conducted remotely for your convenience. If you are interested, please choose your preferred time slot by clicking on the following link: <https://calendar.app.google/F8RnWSKmnofz3cHf6>. If you have any questions, feel free to contact us. Thank you for considering this exciting opportunity to collaborate on our project!

Every participant took part in the evaluation signed a consent form (Appendix E) before starting.

ID	Gender	Age	Nationality	Occupation
PA	M	60	Germany	Constructor
PB	M	30	Germany	Researcher
PC	F	28	Taiwan	HCI student

Table 6.1: Participants

## Goals

- Evaluate the effectiveness of explanations in helping users understand the rationale behind recommended configurations for their home energy systems.
- Assess the impact of the provided information on users' attitudes, including increased awareness of energy-efficient technologies and a higher propensity to adopt them.

## Material

- **Laptop:** Participants will be provided with a laptop to access and use the web service before the interview.

- **Recording Device:** A mobile phone for instance, will be used to capture and record the interview session to enable accurate transcription of the interview responses for analysis and reference.
- **Interview Guideline:** A printed copy of the interview guideline.
- **Pen and Papers:** A pen and some papers to jot down any notes or additional information during the session.
- **Translator:** In the event that participants are not comfortable with the English language, a German speaker will be present to assist in facilitating communication and ensuring a clear understanding of the questions and responses.

## Welcome

Thank you for participating in this interview. My name is Yanwei Miao, and I am currently working on my master's thesis project in collaboration with Fraunhofer ISI. We developed a web service to help homeowners like you make informed decisions about investing in energy technologies for your homes. Our aim is to provide personalised recommendations based on your specific circumstances, enabling you to determine the economic feasibility of implementing these technologies. To proceed, we kindly request your cooperation in answering a few questions about your background. This will help us gain a better understanding of your knowledge and perspective on AI and energy. Once is complete, we will guide you through the web service to obtain personalised recommendations for your home energy system. While using the service, we encourage you to think out loud and share your thoughts and observations. Afterward, we will conduct a 30-minute interview to gather

your feedback and insights. If you have any questions at any point, please don't hesitate to ask. Are you ready to begin?

## Questions

The interview questions can be categorised into four main categories: *demography, explainability, attitude change, and additional questions*. Demography questions focus on gathering information about the background of the interviewees, aiming to identify any demographic factors that may influence their interest in more detailed explanations. Explainability questions are designed to assess the clarity and comprehensibility of the provided explanations, aiming to determine if they are clear and understandable to the participants. Attitude change questions are divided into two parts: before using the service and after using the service. These questions aim to capture any changes in participants' attitudes towards energy technologies and their perception of the recommendations after using the service. Lastly, additional questions or thoughts may arise during the interview. They could be an opportunity to explore additional insights or address any specific concerns during the conversation.

Category	Questions
	Before using the web service
Demography	Gender Age Educational background

	<p>Occupation</p> <p>Nationality</p> <p>Knowledge and interest in AI</p> <p>Knowledge and interest in the energy domain</p>
Learnability	<p>Have you heard of energy-efficient appliances or renewable energy technologies for households?</p> <p>Have you ever considered implementing energy-efficient technologies, such as solar panels and smart thermostats in your house?</p> <p>What is your understanding regarding the benefits of energy-efficient technologies?</p> <p>Do you know climate change and why it is important for individuals to save energy and utilise renewable energy sources?</p>
After using the web service	
Trust	<p>How do you feel about the recommendations provided?</p> <p>Do you find the recommendations useful or valuable?</p> <p>Are you considering investing in any of the recommended technologies now? Why or why not?</p> <p>What factors influence your decision to adopt or reject the recommendations?</p>

	<p>Do you know why the recommendations were recommended to you?</p> <p>Do you trust the recommendations? Why or why not?</p> <p>What factors contribute to your trust or lack of trust in the recommendations?</p>
Learnability	<p>Were you familiar with these technologies before using the system?</p> <p>Did the system provide enough information for you to understand the technologies?</p> <p>Has your knowledge of energy efficient technologies improved as a result of using the system?</p> <p>Do you believe adopting these technologies can lead to lower energy costs? Why or why not?</p>
Additionals	<p>Give participants an opportunity to share any additional thoughts, concerns, or suggestions regarding the system and its recommendations.</p> <p>Ask if they have any questions for you or if there's anything else they would like to discuss.</p>

Table 6.2: Interview guideline

## Closure

Thank you so much for taking the time to participate in this interview session. I truly appreciate your willingness to share your thoughts and experiences with us. If you have any further questions, concerns, or additional insights that you would like to share, please don't hesitate to reach out.

## 6.2 Future work: Kano survey

The Kano model [34] is a commonly used framework in quantitative research to understand customer satisfaction and prioritise features or attributes. In our project, we aim to also incorporate the Kano model survey (Table 6.3) as part of our future work. We plan to integrate this survey directly into the web service, allowing individuals who have interacted with the service online to voluntarily complete the survey. Through the integration of the Kano survey into the web service, we have the opportunity to collect insights from users who engage with the service online. This will enable us to assess whether the inclusion of specific features in the service brings delight to our users. This assessment will help us determine the necessity of explanations in the service.

Features	I like it	I expect it	I'm neutral	I can tolerate it	I dislike it

Show corresponding yearly energy bill					
Don't show corresponding yearly energy bill					
Show detailed simulated yearly energy consumption					
Don't show detailed simulated yearly energy consumption					
Show detailed simulated daily energy consumption					
Don't show detailed simulated daily energy consumption					
Show climate change information					
Don't show climate change information					
Allow exploring and adjusting configurations of the recommended technologies					
Don't allow exploring and adjusting configurations of the recommended technologies					

Show comparison with current situation					
Don't show comparison with current situation					
Show explanation of each technology					
Don't show explanation of each technology					
Show total investment costs of each technology					
Don't show total investment costs of each technology					
Show annualised investment costs of each technology					
Don't show annualised investment costs of each technology					

Table 6.3: Kano survey

## 6.3 Analysis

Table 6.4 summarises the participants' overall knowledge and interest in AI and energy, as well as their perspective on the altitude change and trust in the recommendations following their use of the service. In addition, all transcripts can be found in the appendix F.

ID	Interest in AI	Interest in energy	Learned more	Trust
PA	No	Yes	No	Yes
PB	No	Yes	Yes	Yes
PC	No	No	Yes	Not much

Table 6.4: Participants' perceptions about AI and energy

### Participant A

Before using the service, Participant A, who works in the house construction industry, displayed knowledge of EU energy policy and familiarity with energy-efficient appliances and renewable energy technologies. He had implemented solar panels in one of his houses and believed in their ability to reduce energy costs for households. Participant A emphasised the rising energy prices and the importance of addressing climate change, expressing dissatisfaction with Germany's continued use of coal.

During the service usage, Participant A found the service to work smoothly, receiving a comprehensive list of around 50 recommendations to lower energy costs. While he agreed with most configurations, he felt overwhelmed by the extensive list and preferred to focus on specific options such as installing a

heat pump and conducting a house renovation, given his expertise in his own house's needs. Despite not finding recommendations for biomass utilisation, Participant A relied on his professional experience and personal resources in considering biomass as the most cost-effective option. Although he missed the last level of explanation on renewable energy benefits, he clicked to view more details on the specific recommendation he sought.

After using the service, Participant A appreciated the recommendations but felt they were more suited for general houses rather than his unique situation. Financial considerations and environmental impact guided his energy technology decisions. Trusting the recommendations due to his familiarity with them, he acknowledged the service provided an overwhelming amount of information and a surplus of recommendations.

## **Participant B**

Before using the service, Participant B, who works in the renewable energy industry, expressed a strong awareness of climate change and a desire to implement energy-efficient technologies and measures in his house primarily for economic reasons.

During the service usage, Participant B found the service to be simple, clean, and straightforward, which he appreciated. Although the service did not consider his electric car, he believed the estimation of the remaining energy bill to be accurate. He found the information on investment costs to be useful and liked the ability to adjust settings to see changes in energy demand and bill. While he noticed the "why turn to renewable energy" card, he did not click to view it.

After using the service, Participant B found it particularly helpful in determining the appropriate sizes for investment consideration. He believed that implementing these technologies could lead to energy cost savings, but expressed concern about the upfront investment amount, which posed a barrier for him. He suggested that government assistance in the form of support for monthly payments or other financial incentives could make green living more accessible. Participant B also suggested that the service should offer more comprehensive guidance on getting started and allow for more detailed inputs, such as providing options to enter specific details like roof size and receive insulation recommendations. He expressed trust in the recommendations, as the energy bill was accurate when not considering the electric car. The well-programmed and responsive website service contributed to his trust as well, and he appreciated that the interface was not overly complicated.

### **Participant C**

Before using the service, Participant C, a current master's student in human-computer interaction, admitted that she doesn't have much knowledge or interest in artificial intelligence, energy, or energy technologies. She does have a smart thermostat installed on her heater, which was provided by her landlord, and she is familiar with how it operates. Additionally, her colleagues at work have also shared their experiences with smart thermostats, as many of them have one. She holds the belief that the concept of „energy efficiency” does not necessarily mean conserving energy but rather generating energy more efficiently, while ensuring human comfort.

During the service usage, Participant C carefully read all the explanation texts for each technology while providing the current configuration of her

house. She wanted to ensure that she answered correctly. When selecting the battery capacity, she wasn't entirely sure about the size of the battery in her house, but with only two options available, she quickly made her choice, believing that the battery in her house should be a larger one. After receiving the estimates of her current annual energy bill, Participant C calculated the monthly bill herself and was pleasantly surprised to find that it was very precise. She then proceeded to choose a recommendation and closely examined the accompanying energy graphs. Noticing that the energy demand bars for each month showed variations, with less demand in the summer and more in the winter, she found this pattern to be logical and sensible. However, she also encountered a confusing aspect when she noticed an energy bar for cooling, even though she didn't have an air conditioner in her house. This information puzzled her. Participant C also clicked on the climate change education card to quickly scan its content and appreciated the information being presented in that section.

After using the service, Participant C found it to be a potential replacement for the Energieausweis, a nation-wide recognised standard in Germany for displaying a house's energy-efficiency level, which people usually need to pay professionals for. She appreciated that the recommendations were presented in a neutral manner, but suggested that more eye-catching visuals could make her feel the significant impact of potential savings and encourage her to make changes.

Participant C felt that the recommendations might not perfectly align with her own situation, because the questions asked in terms of her energy consumption behaviours, were relatively general. She believed that more detailed and private questions could lead to a more personalised calculation.

Regarding trust, she initially believed in the service, especially after seeing that the estimated energy bill was accurate. However, when she encountered confusion in the graph, her trust in the system wavered. Participant C had concerns that the service might be promoted by business companies with the intention to sell their products. This led her to believe that the algorithm behind the model might be biased and pushing users to spend money. However, after it was clarified that the project was solely a research-driven initiative sponsored by the EU without any commercial influence, she gained more trust in the service. To further validate her trust in the system, she decided to test it by inputting the best energy configuration. The service did not provide any recommendation for this situation, which reinforced her belief that the system was not solely focused on pushing users to spend money. This positive experience increased her trust in the service and the recommendations.

Participant C also mentioned that her investment willingness was influenced by various factors, including how long she planned to stay in her current house and whether she could take the technologies with her when moving. In her background, households were not allowed to privately install PV systems without obtaining a certificate from authorities, and selling excess electricity back to the grid was prohibited. which differs from Europe where governments encourage PV installations. Upon learning about these differences, she became enthusiastic about installing a PV system, recognising its benefits in both cost savings and contributing to environmental preservation.

Despite not having much prior knowledge of energy technologies, Participant C was able to answer all questions about her current house after reading the descriptions provided. She mentioned that the service allowed

her to gain a rough understanding of these technologies but expected to learn more detailed benefits and information through the platform.

## **6.4 Discussion**

# **Chapter 7**

## **Conclusion**

# Appendices

## Appendix A

### Input of the FLEX models

Category	Data
Behaviour profile	id_hour, people_at_home_profile_1, hot_water_demand_profile_1, appliance_electricity_demand_profile_1, vehicle_at_home_profile_1, vehicle_distance_profile_1.
Battery	ID_Battery, capacity, capacity_unit, charge_efficiency, charge_power_max, charge_power_max_unit, discharge_efficiency, discharge_power_max, discharge_power_max_unit.
Continued on next page	

**Table A.1 – continued from previous page**

Category	Data
Behaviour	ID_Behavior, id_people_at_home_profile, target_temperature_at_home_max, target_temperature_at_home_min, target_temperature_not_at_home_max, target_temperature_not_at_home_min, shading_solar_reduction_rate, shading_threshold_temperature, temperature_unit, id_hot_water_demand_profile, hot_water_demand_annual, hot_water_demand_unit, id_appliance_electricity_demand_profile, appliance_electricity_demand_annual, appliance_electricity_demand_unit, id_vehicle_at_home_profile, id_vehicle_distance_profile.
Boiler	ID_Boiler, type, power_max, power_max_unit, carnot_efficiency_factor.
Building	ID_Building, type, construction_period_start, construction_period_end, person_num, Af, Hop, Htr_w, Hve, CM_factor, Am_factor, internal_gains, effective_window_area_west_east, effective_window_area_south, effective_window_area_north, grid_power_max, supply_temperature.
Energy price	ID_EnergyPrice, id_electricity, id_electricity_feed_in, id_gases, price_unit.
Heating element	ID_HeatingElement, power, power_unit, efficiency.
Continued on next page	

**Table A.1 – continued from previous page**

Category	Data
Hot wa- ter tank	ID_HotWaterTank, size, size_unit, surface_area, surface_area_unit, loss, loss_unit, temperature_start, temperature_max, tempera- ture_min, temperature_surrounding, temperature_unit.
PV	ID_PV, size, size_unit.
Region	ID_Region, code, year, norm_outside_temperature.
Space cooling technol- ogy	ID_SpaceCoolingTechnology, efficiency, power, power_unit.
Space heating tank	ID_SpaceHeatingTank, size, size_unit, surface_area, sur- face_area_unit, loss, loss_unit, temperature_start, tempera- ture_max, temperature_min, temperature_surrounding, tempera- ture_unit.
Vehicle	ID_Vehicle, type, capacity, capacity_unit, consump- tion_rate, consumption_rate_unit, charge_efficiency, charge_power_max, charge_power_max_unit, discharge_efficiency, discharge_power_max, discharge_power_max_unit, charge_bidirectional.
Energy price	Region, year, id_hour, electricity_1, electricity_2, electric- ity_feed_in_1, gases_1.
Continued on next page	

**Table A.1 – continued from previous page**

Category	Data
Region weather	region, year, id_hour, pv_generation, pv_generation_unit, temperature, temperature_unit, radiation_south, radiation_east, radiation_west, radiation_north, radiation_unit.

Table A.1: Input data of the FLEX-Operation model

# **Appendix B**

## **Privacy Policy**

This Privacy Policy outlines how University of Siegen and The Fraunhofer Institute for Systems and Innovation Research (ISI) collect, use, and protect data for research purposes.

### **Data Collection**

When you use our service, we collect data for research purposes. All data will be anonymous, meaning that we will not collect any personal information that can identify you. The data we collect may include, but is not limited to, information about your usage of the service, your location, and demographic information.

## **Data Use**

We will use the data collected to conduct research and may publish papers based on the findings. The data will be used only for research purposes and will be safely taken care of by and only by all the parties involved in this research, which are University of Siegen and The Fraunhofer Institute for Systems and Innovation Research (ISI).

## **Data Retention**

Please note that once you have used our service, you cannot delete your data. This is because your data will become part of a larger pool of data that will be analysed anonymously. The data will be retained for as long as is necessary for research purposes.

## **Data Security**

We take appropriate measures to protect the data we collect from unauthorized access, use, or disclosure. We use industry-standard security protocols and techniques to safeguard the data from unauthorized access, use, or disclosure. All the parties involved in this research, which are University of Siegen and The Fraunhofer Institute for Systems and Innovation Research (ISI), will have access to the data.

## **Data Sharing**

We do not share the data we collect with third parties, except as required by law or with your explicit consent.

## **Changes to this Policy**

We reserve the right to modify this Privacy Policy at any time, so please review it frequently. If we make any changes to this Privacy Policy, we will post the revised version on our website.

## **Contact Us**

If you have any questions or concerns about this Privacy Policy or our data collection and processing practices, please contact us.

# Appendix C

## Usability testing survey responses

Q1. What do you think this website is about?	
P1	suggesting some better ways to save energy at home and decrease the cost of that
P2	Energy saving
P3	Calculating how much energy is used per/sqr
P4	I think it is about helping individuals to understand strategies to save money while supporting climate change. It seems to be a hybrid between educate visitors and sell "green energy" services/products.
P5	getting energy-related information in my household

Table C.1: Question 1

Q2. How clear were the instructions on the website for you to follow?				
P1	P2	P3	P4	P5
10/10	8/10	8/10	7/10	5/10

Table C.2: Question 2

Q3. Did you find the website visually appealing?				
P1	P2	P3	P4	P5
10/10	10/10	6/10	8/10	4/10

Table C.3: Question 3

Q4. Was the website easy to use and understand?				
P1	P2	P3	P4	P5
10/10	8/10	7/10	5/10	4/10

Table C.4: Question 4

Q5. How long do you think it took you to complete the questions?				
P1	P2	P3	P4	P5
1-5 min	1-5 min	1-5 min	5-10 min	1-5 min

Table C.5: Question 5

Q6. What would you change about the website to make it more user-friendly?	
P1	adding a "back" button, in case of returning to the previous page to edit something

P2	<p>1. I didn't realize if one step moved to the next in the tracker (top left), make you could use a color gradient (i.e. the circles go from light to dark green gradually) to highlight the progress.</p> <p>2. Is a little weird that the Children's age is 0-25 (is that the standard in Germany?).</p> <p>3. It would be great if, in the drop-down menus, there is an "I don't know" option. And then provide some guidance for the users to find that out (I saw you already have some questions to support the user, I think that's very helpful!).</p>
P3	More explanation, cues

P4

"I felt the need for a back button on the interface. For instance, when I clicked on "more details" on the last page, I couldn't go back to check the other options. I ended up clicking on the logo that lead to the start of the questionnaire. I also had to Google the PV meaning. It would be more clear if it was written photovoltaic system. I saw there was a link to explain what PV is, but I think it would be more clear for me if it was written photovoltaic because I know what that means. The steps tracker was not that useful as well. It was not reflecting the number of questions. So I was not sure how many questions would be asked until moved to the next step. I am also concerned about the question of the max and min home temperature for me. I never know that as I don't measure it in my home. I would prefer the questionnaire to provide me with a suggestion based on the "ideal" temperature. I don't know if I would decide on an option only by the website usage. Maybe I would like to see more info about the final investment and how much time it would be required to "get that money back" by saving energy consumption from the power provider. In the PV system, I would like to be able to see how many I would be able to add to my home to understand how much energy it could generate. At first glance, 3.321 kwh seems to be not much. The graphic comparing the current and possible options is not clear. What does it represent? Are the green bars showing how much the PV would generate? Maybe rather than showing many elements (Heating, cooling etc) It would be easier to understand if it don't show that information too granular."

P5	<p>"This is difficult to explain in writing. I would rather speak about this. However, here are few things that can be communicated in a written form. The start pages looks nice! but it can be further improved to make it more appealing and gives better vibes. If this was an interview, I would have showed some examples of what I think would improve it. The questions seemed more like a normal survey. I would rather design it so that it looks more like a friendly inquiry rather than a very serious questionnaire. I would include a more friendly language or even use some slang. Also I would include few emojis or even illustrations where appropriate. The 'please wait' page after the questions, gives the impression that the page is not responsive anymore. A more dynamic/moving illustration is expected to know that something is happening and avoid the feeling that the page is lagging. Am I supposed to know information about the battery and PV systems in my house? I was asked for these informations and I am not sure where can I get this information from, if I don't know it. 'What is a PV system' and 'What is a battery system' is not active. So I couldn't understand what is that."</p>
----	---

Table C.6: Question 6

Q7. Were the recommendations easy to understand?				
P1	P2	P3	P4	P5
10/10	9/10	7/10	5/10	9/10

Table C.7: Question 7

Q8. Was there anything about the recommendations that you found confusing or unclear?	
P1	about PV or SEM systems which I could not see what they are
P2	I love your data visualization! I would make sure all axis have their respective unit of measure. Just to be extra clear
P3	No
P4	Yes, the bar chart. I think it is also important to understand more clearly the cost of each suggestion and the time to implement such a system.
P5	"In the 'recommendation configuration' page, the word 'current' at the top left is not very clear. I stopped for a second and looked at the information below to know what 'current' refers to here. Also, for a first glance, I was expecting a 'results' page, before the recommendation appears. Here, all is presented in one page. For the second page, the axes in the 'energy use' bar chart needs to be named. Also, the annual energy bill is the same for all options. I think it's a typo here.. Other than that, I think the follow in which the information is presented could be improved."

Table C.8: Question 8

## Appendix D

### Example JSON Data

```
{  
  "profile": {  
    "location": "DE",  
    "person": 3  
  },  
  
  "current": {  
    "config": {  
      "pv_size": 0,  
      "battery_capacity": 0,  
      "sems": false,  
      "heating_system": true,  
    }  
  }  
}
```

```
        "heating_system_type": "heating oil boiler",
        "building_renovation": true

    },

    "energy_data": {

        "energy_demand": 0,
        "energy_generate": 0,
        "heating": [0,0,0,0,0,0,0,0,0,0,0,0],
        "cooling": [0,0,0,0,0,0,0,0,0,0,0,0],
        "appliance": [0,0,0,0,0,0,0,0,0,0,0,0],
        "hotwater": [0,0,0,0,0,0,0,0,0,0,0,0],
        "pv": [0,0,0,0,0,0,0,0,0,0,0,0],
        "energy_bill_year": 0

    },

    "recommendation": [{

        "config": {

            "pv_size": 0,
            "battery_capacity": 0,
            "sems": false,


```

```
        "heating_system": true,  
        "heating_system_type": "heating oil boiler",  
        "building_renovation": true  
  
    },  
  
    "energy_data": {  
  
        "energy_demand": 0,  
        "energy_generate": 0,  
        "heating": [0,0,0,0,0,0,0,0,0,0,0,0],  
        "cooling": [0,0,0,0,0,0,0,0,0,0,0,0],  
        "appliance": [0,0,0,0,0,0,0,0,0,0,0,0],  
        "hotwater": [0,0,0,0,0,0,0,0,0,0,0,0],  
        "pv": [0,0,0,0,0,0,0,0,0,0,0,0],  
        "energy_bill_year": 0  
  
    },  
  
    "investment_cost": 0  
  
}]  
}
```

# **Appendix E**

## **Consent form**

Thank you very much for collaborating with us on this exciting project!

**Principal Investigator:** Yanwei Miao

**Affiliation:** Siegen University, The Fraunhofer Institute for Systems and Innovation Research

**Date:**

### **Purpose of the Study**

The study aims to develop a web service that provides personalised recommendations to homeowners, assisting them in making informed decisions regarding energy investments.

## **Procedures**

If you choose to participate, you will be asked to engage with our web service and answer questions regarding your experience and opinions. The interview is estimated to take approximately 40 minutes, and can be conducted both in person and remotely.

## **Confidentiality**

Your privacy and the confidentiality of your information are of utmost importance to us. Any information collected during the study will be anonymised, and your identity will remain confidential.

## **Contact Information**

If you have any questions, concerns, or require further information, please feel free to contact Yanwei Miao ([yanwei.miao@student.uni-siegen.de](mailto:yanwei.miao@student.uni-siegen.de)).

## **Consent**

By proceeding with the study, you acknowledge that you have read and understood the information provided in this consent form. Your participation is entirely voluntary, and you may withdraw at any time without consequences.

**Participant Name:**

**Participant Signature:**

**Date:**

Thank you again for considering participating in our study. Your contribution is greatly appreciated!

# Appendix F

## transcription

### Participant B

Miao, Yanwei 00:00:00.739 – 00:00:15.500  
Okay, I think you have received the information that it's recording right now and for your demographical information, I would like to ask about your gender.

Participant B 00:00:16.100 – 00:00:20.580  
A male.

Miao, Yanwei 00:02:17.700 – 00:02:20.860  
Do you mind letting me know your age?

Participant B 00:02:20.940 – 00:02:22.700  
30.

Miao, Yanwei 00:02:24.420 – 00:02:29.700  
And your educational background.

Miao, Yanwei 00:02:40.100 – 00:02:43.300  
And like, what, what did you study, what is your subject?

Participant B 00:02:43.340 – 00:02:51.100  
So I started geography, which is the main topic and it was about environmental and climate change.

Miao, Yanwei 00:02:55.460 – 00:02:59.020  
And your occupation right now.

Participant B 00:03:00.060 – 00:03:03.740  
So I'm working for the ISI, It's like.

Participant B 00:03:06.740 – 00:03:09.540  
I don't know the English expression actually, so it's wissenschaftliche Mitarbeiter.

Miao, Yanwei 00:03:15.660 – 00:03:23.540  
Okay, that's, that's fine. And May, I know whether you have a bit of knowledge or interesting, AI.

Participant B 00:03:25.100 – 00:03:28.820  
The first part of the thing was, was a little bit.

Miao, Yanwei 00:03:31.420 – 00:03:35.780  
Do you have any knowledge or do you have any interest in AI?

Miao, Yanwei 00:03:37.060 – 00:03:38.340  
Artificial intelligence.

Participant B 00:03:39.220 – 00:03:49.220  
Not really no, not more than like, the, the basic interest in I just tried out the new tools which are available, but not more than that.

Miao, Yanwei 00:03:49.220 – 00:03:55.980  
Okay, and do you have any knowledge or interest in the energy domain?

Participant B 00:03:57.180 – 00:03:58.780  
Since I.

Participant B 00:04:00.180 – 00:04:14.820  
A lot of time into researching for my masters thesis I have a little bit experience in the field of district heating and, and a wind power as I worked as a wind power company before.

Miao, Yanwei 00:04:15.460 – 00:04:16.579  
Okay.

Miao, Yanwei 00:04:19.299 – 00:04:38.500  
Sounds good, thank you. So maybe also I would like to know something about your attitudes towards energy efficient technologies. Have you heard of energy efficient appliances or renewable energy technologies for households.

Participant B 00:04:44.300 – 00:04:56.420  
So you mean like installation measures or new technologies regarding eat production or on water production. Something like that, or what do you mean?

Miao, Yanwei 00:04:56.500 – 00:05:00.900  
Yes, basically like, very general, have you ever heard of any.

Miao, Yanwei 00:05:03.460 – 00:05:13.660  
And have you ever considered implementing energy efficient technologies such as solar panels or smart thermostats.

Participant B 00:05:15.220 – 00:05:34.180  
We're talking about installing smart term as we also have an electric car, we would like to use it to better plan the charging procedure, and then we also are talking about getting our roof insulated better insulation.

Participant B 00:05:34.940 – 00:05:41.220  
It's hardly insulated now, but we want to increase the installation and.

Participant B 00:05:41.980 – 00:05:47.500  
Also thinking about buying a footable tank.

Participant B 00:05:49.740 – 00:05:56.860  
Tags, but the lack of money right now can afforded, but it's, we have plans for it.

Miao, Yanwei 00:05:57.220 – 00:06:06.580  
Sounds good, and what is your understanding regarding the benefits of energy efficient technologies.

Participant B 00:06:10.100 – 00:06:25.940  
Reduction of the needs. So we, we would need less energy consumed and obviously also for, for example, the roof insulation, it's in the summertime or during the winter, it's less.

Participant B 00:06:27.340 – 00:06:32.420  
Strong changes in the room temperature, which is beneficial as well.

Miao, Yanwei 00:06:33.780 – 00:06:39.140  
And do you know climate change And why is it important to individuals?

Miao, Yanwei 00:06:42.660 – 00:06:55.060  
Climate change and why is climate change important for individuals to save energy or utilize renewable energy resources.

Participant B 00:06:55.820 – 00:07:15.940  
You mean why it is important to everybody, and why everybody should, I think everybody should do what, what he or she can do in order to reduce their demand so that in, in total, the demand decreases and the targets, which are set for.

Participant B 00:07:16.140 – 00:07:19.780  
For the entire community can be reached so...

Participant B 00:07:20.660 – 00:07:23.220  
Play its small part. I think.

Miao, Yanwei 00:07:25.700 – 00:07:27.700  
Know a lot about that.

Miao, Yanwei 00:07:29.380 – 00:07:38.180  
Sounds good, so I, I've already finished the pre-questions and now I will send you a link.

Miao, Yanwei 00:07:39.860 – 00:07:44.100  
You should have received a link in our chat now.

Miao, Yanwei 00:07:46.660 – 00:07:50.500  
If you click the link and then you are landing our service.

Miao, Yanwei 00:07:53.060 – 00:08:05.220  
And do you mind to share your screen so that I can see how you operate through the website, but if you don't want to eat, you can also just say no, and just let me know which step you are.

Miao, Yanwei 00:08:59.220 – 00:09:03.540  
As long as it's comfortable for you to see, then it's fine.

Participant B 00:09:04.740 – 00:09:06.580  
Okay, so.

Miao, Yanwei 00:09:09.860 – 00:09:10.500  
You can think out loud.

Miao, Yanwei 00:09:11.900 – 00:09:14.340  
When you are navigating through it.

Participant B 00:09:14.380 – 00:09:22.660  
Okay, so, so what shall I look for shall. I look for like the UI or what, what is the main topic to look at?

Miao, Yanwei 00:09:23.300 – 00:09:25.100  
Everything basically.

Participant B 00:09:25.300 – 00:09:25.860  
Everything.

Miao, Yanwei 00:09:26.500 – 00:09:30.220  
You can just share any thoughts when you are navigating.

Participant B 00:09:30.460 – 00:09:34.780  
Great, so I like the look, it's really clean. That's the first impression.

Participant B 00:09:54.020 – 00:09:56.780  
So I just need to select.

Participant B 00:10:01.700 – 00:10:07.620  
So I think it's pretty straightforward. You, there's not much going on on the screen. I like that.

73 Participant B 00:10:40.660 – 00:10:42.100  
Okay, so.

Participant B 00:10:48.340 – 00:10:52.580  
Okay, so what's, what's the screen about?

Miao, Yanwei 00:11:02.460 – 00:11:07.420  
You can ask me if you think you don't understand which part.

Participant B 00:11:07.540 – 00:11:12.620  
So I, I will just click here to see more details how this calculated.

Participant B 00:11:16.500 – 00:11:17.940  
Maybe I just.

Participant B 00:11:36.980 – 00:11:41.700  
It's this for, for, it's for.

Participant B 00:11:42.780 – 00:11:47.780  
An energy build, so this is for, and electricity.

Miao, Yanwei 00:11:50.420 – 00:11:52.980  
You mean the price, the total price price.

Participant B 00:11:53.020 – 00:11:53.620  
Yes, yes.

Miao, Yanwei 00:11:53.940 – 00:11:59.380  
For all the energy, your whole house could consume.

Participant B 00:12:00.820 – 00:12:01.940  
So.

Participant B 00:12:04.260 – 00:12:06.660  
And electricity might take.

Participant B 00:12:30.900 – 00:12:32.020  
Yes, makes sense.

Participant B 00:12:39.060 – 00:12:41.060  
So it's for.

Participant B 00:12:42.900 – 00:12:54.020  
For electricity and, and leading. So I just just quickly checked, but it's, it's underestimating already price.

Participant B 00:12:58.060 – 00:13:09.140  
Yeah, but I think it's because we have electric car and it doesn't ask if we have an electric car in charge at home. So our electricity Bill is alone is really high. so.

Participant B 00:13:10.420 – 00:13:14.220  
Do not have then fuel costs other than the electricity.

Participant B 00:13:16.180 – 00:13:26.500  
So maybe it could ask for a car if, if someone has a car, then should have a higher demand for electricity.

Participant B 00:13:52.020 – 00:14:00.140  
Already it was not not that much for this. I only have the numbers for last year, so.

Participant B 00:14:06.740 – 00:14:09.300  
It was like, they had electricity Bill of.

Participant B 00:14:14.580 – 00:14:19.500  
Three thousand, six hundred, but that's only electricity.

Participant B 00:14:21.500 – 00:14:22.820  
Also, gas.

Participant B 00:14:25.340 – 00:14:31.300  
Whether he was one thousand eight hundred, so.

Participant B 00:14:55.380 – 00:15:00.060  
Okay, and then on the right side, you see, I can see some suggestions.

Participant B 00:15:03.940 – 00:15:05.940  
Let me check. Let's see.

Participant B 00:15:10.100 – 00:15:20.980  
Annualized cost, okay, and does it also show, like total costs or it like the total investment costs.

Participant B 00:15:33.900 – 00:15:35.700  
Yeah, that's good.

Participant B 00:16:33.940 – 00:16:39.660  
IZED investment costs of two thousand something. Yes, so I would.

Participant B 00:16:41.660 – 00:16:44.820  
In total, I would pay like a hundred more.

Participant B 00:16:45.860 – 00:16:46.100  
Okay.

Participant B 00:17:13.740 – 00:17:24.500  
Or will there be the, or is there going to be the opportunity to enter my own figures, like, if I- if I see, okay, this doesn't fit perfectly...

Participant B 00:17:25.339 – 00:17:30.260  
Can I then alter the estimations to my demand, for example.

Miao, Yanwei 00:17:30.900 – 00:17:38.580  
And you can click the more detail on the recommendation cards if you want to like, see one of these.

Participant B 00:17:38.580 – 00:17:39.220  
Oh, okay.

Participant B 00:17:50.740 – 00:17:53.540  
And you also program this website.

Participant B 00:17:57.780 – 00:18:00.980  
It's really nice. I like, it's really clean.

Miao, Yanwei 00:18:03.580 – 00:18:06.100  
Very happy, it's my first.

Participant B 00:18:06.260 – 00:18:08.980  
No, I can. Yeah, I can.

Participant B 00:18:09.940 – 00:18:12.500  
For example, take this away and then.

Participant B 00:18:13.820 – 00:18:14.940  
Okay.

Participant B 00:18:48.340 – 00:18:50.300  
Okay, that's cool.

Participant B 00:19:10.100 – 00:19:15.860  
Yeah, I, I think this, this website looks as I said, it looks really good.

Participant B 00:19:19.700 – 00:19:26.740  
That you can alter some things and, and see what it makes, what kind of differences it makes.

Participant B 00:19:34.420 – 00:19:42.220  
That's really cool. And so what is, what is your plan going forward with this?

Miao, Yanwei 00:19:42.740 – 00:19:52.980  
This is already actually.

Miao, Yanwei 00:19:53.860 – 00:19:55.100  
The results.

Miao, Yanwei 00:19:58.100 – 00:20:01.940  
Yeah, you've already reached the last phase.

Miao, Yanwei 00:20:03.860 – 00:20:20.500  
Thank you, and there's actually one more page, but it, you, you didn't notice it, but it's fine. It's for like, yes, it's the green bar. It says why should we turn to renewable energy?

Participant B 00:20:21.640 – 00:20:24.440  
Before it was on the first page as well.

Miao, Yanwei 00:20:24.680 – 00:20:27.880  
Yes, but it.

Participant B 00:20:28.760 – 00:20:32.360  
That's like a, like a FAQ for.

Participant B 00:20:33.640 – 00:20:35.080  
Why it's important.

Miao, Yanwei 00:20:35.560 – 00:20:50.200  
Yes, it's for people who may want to the energy technologies, but they, they might mainly focus on the financial aspect.

Miao, Yanwei 00:20:51.120 – 00:21:00.520  
Provide a little bit more information regarding like climate change, so it's just, someone doesn't.

Participant B 00:21:03.720 – 00:21:05.200  
That it's also.

Participant B 00:21:06.400 – 00:21:13.800  
Issue of like the human society in its core and not only about the numbers.

Miao, Yanwei 00:21:17.160 – 00:21:25.520  
But according to my research financial reason, it's still the main reasons for.

Miao, Yanwei 00:21:27.520 – 00:21:29.800  
To choose their energy technologies.

Participant B 00:21:33.200 – 00:21:44.040  
Especially in times where other energies are really expensive, it's, it would, or it could be a huge benefit to produce your own energy as well, and, and do.

Participant B 00:21:46.080 – 00:22:04.640  
Something good with it as well. So I think it will always be, or it should be, maybe should be different than everybody should be doing it because it's better for the environment, but I think the, the main driver will still be the economics at the end.

Miao, Yanwei 00:22:09.720 – 00:22:14.120  
You have seen everything from the website, then.

Participant B 00:22:16.200 – 00:22:17.320  
Fully.

Participant B 00:22:18.640 – 00:22:25.000  
Haven't come fully into it now, but I can, I can do it via the link again and play around with.

Miao, Yanwei 00:22:28.200 – 00:22:39.080  
And now the port is eighty eighty, but maybe later we will remove the eighty eight port. We will make it global so that you don't need to type the eighty eighty in the end.

Miao, Yanwei 00:22:40.400 – 00:22:42.280  
Flex model dot org.

Miao, Yanwei 00:22:44.200 – 00:22:46.680  
And, but before.

Miao, Yanwei 00:22:48.760 – 00:23:08.400  
There are still some more questions after you operate with the system. Okay, I would still like to ask some questions regarding your attitude. So firstly, like, how do you feel about the recommended recommendations provided.

Participant B 00:23:09.800 – 00:23:16.840  
So, as I already said in the beginning, we already thought about applying some of those recommend.

Participant B 00:23:20.320 – 00:23:27.080  
In a sense, like at the moment, they're just too expensive to, to afford to implement, but.

Participant B 00:23:29.120 – 00:23:47.040  
Fact that you get to play around with them and maybe you can, you can then check which size and you should go for or you get an idea at least, and then you can take that idea and go and look for solutions like technical solutions, for example, for Bettery size and the, the perfect.

Participant B 00:23:48.840 – 00:24:06.120  
Recommendation for someone who can really put it in your home and then get some offers about that thing, and then you have a number in mind, what, what we expect, I think that's a really good overview, if you are just starting, it's like the first step is go there.

Participant B 00:24:08.080 – 00:24:13.800  
What can I do and how much will it be? Roughly, that's really good like that.

Miao, Yanwei 00:24:14.520 – 00:24:30.440  
And, and you said you were worrying because you were worrying about the financial aspect, but after you seeing some of the recommendations where it says actually you will pay less every year.

Miao, Yanwei 00:24:31.120 – 00:24:32.360  
Comparing to the.

Participant B 00:24:32.480 – 00:24:38.760  
Well, the electric car you pay, you have to pay a little upfront and then you save.

Participant B 00:24:40.080 – 00:24:53.000  
I think still the, the thing is to invest the money in the first place, you, you need to have some money to do the to do, So, so I think that's still.

Participant B 00:24:54.160 – 00:25:00.520  
A little prevents many people from doing it. I think so, maybe they're.

Participant B 00:25:01.360 – 00:25:04.880  
Be more easier accessible.

Participant B 00:25:07.560 – 00:25:09.480  
How to say bottom.

Miao, Yanwei 00:25:09.480 – 00:25:10.120  
Well, the big.

Participant B 00:25:10.400 – 00:25:12.040  
Support from the government for.

Participant B 00:25:13.320 – 00:25:13.960  
Yeah, yeah.

Participant B 00:25:13.960 – 00:25:21.000  
So that, that people can do it more easily or even can pay for it on a monthly basis or something like...

Participant B 00:25:21.640 – 00:25:27.840  
And that way it would be easier for, for many people to do it.

Miao, Yanwei 00:25:28.680 – 00:25:37.000  
Yes, you are right? And do you find the recommendations useful or valuable?

Participant B 00:25:39.120 – 00:25:49.160  
And I also, yeah, as I said, I like how it's presented it also. I think it plays a huge role, how you get the information back if it's like.

Participant B 00:25:50.640 – 00:26:04.160  
If it's not like providing a good overview and it's like, you have to search for the results, then it will be, it will not be used. So I really like it that it's really clean and lightweight so to say.

Miao, Yanwei 00:26:04.520 – 00:26:07.640  
Thank you, so.

Miao, Yanwei 00:26:09.760 – 00:26:17.320  
What factors influence your decision to adopt or reject the recommendations. I think you just answered that.

Miao, Yanwei 00:26:19.240 – 00:26:23.720  
And, you know, why the recommendations were recommended to you.

Participant B 00:26:25.080 – 00:26:41.640  
Yeah, it depends on the, on the situation of the home. What would be interesting for me, for example, be like, but that's, I think that's too too deep for for a website, which ones just to make some recommendations to.

Participant B 00:26:42.360 – 00:26:59.560  
Give you information to start with. Would then be like you need to know. Okay, is my building really, is it an option would be able to put a system on it because of the shape of the roof and stuff like that, but.

Miao, Yanwei 00:27:06.000 – 00:27:07.880  
More detailed information about.

Participant B 00:27:08.280 – 00:27:24.520  
But I don't know how to apply to that website because then you would need to do them calculations on how your roof is suitable for a, for a photo TIG system and how much energy you could expect from it. For example.

Participant B 00:27:25.800 – 00:27:32.960  
How large is the roof and what's the insulation and stuff? I think that's maybe out of scope.

Miao, Yanwei 00:27:33.480 – 00:27:47.560  
No, actually the model it provides everything, but during our first version we didn't put so much numbers in it so much data that you cannot change or you can adjust.

Participant B 00:27:48.240 – 00:27:48.840  
Yeah.

Miao, Yanwei 00:27:48.840 – 00:27:50.760  
But that's possible.

Miao, Yanwei 00:27:51.560 – 00:27:53.960  
Could be future work. Yes.

Participant B 00:27:53.960 – 00:27:55.080  
So.

Miao, Yanwei 00:27:55.920 – 00:27:56.520  
Consider.

Participant B 00:27:56.560 – 00:28:08.160  
It's really interesting, like, if it develops into a one stop opportunity to do all your calculations there. I really think that's a great thing.

Participant B 00:28:09.560 – 00:28:16.360  
I work with a software for district heat planning and they also tried.

Participant B 00:28:19.600 – 00:28:26.680  
Also really accelerates how people approach that. So I think that's a good thing to develop stuff like that.

Miao, Yanwei 00:28:27.880 – 00:28:34.360  
I also believe so, and so you, do you trust the recommendations.

Participant B 00:28:35.880 – 00:28:56.040  
Since for, for example, the first thing I rec, I noticed is that the only based on your, some of your questions and then the estimations were quite accurate now leaving behind that didn't ask for the car and that's why the recommendations don't fit perfectly, but I think.

Participant B 00:28:56.160 – 00:29:12.680  
They are quite good other than that, so that makes very good impression. must be a good model behind it. So I think it's, it's good. I couldn't click on the details page on that for that, but I would like to see.

Participant B 00:29:14.720 – 00:29:26.200  
Behind it, so not not for an end user, I think not the real detailed calculations, but like, split into the numbers, but probably you have that as well. So.

Miao, Yanwei 00:29:26.760 – 00:29:34.440  
You, you could also when you click the recommendation detail, you could also see the current data on the left side.

Participant B 00:29:34.720 – 00:29:37.000  
Oh, okay, that was the current. yeah.

Miao, Yanwei 00:29:37.000 – 00:29:37.640  
Yes, yes.

Miao, Yanwei 00:29:41.480 – 00:29:46.600  
Yeah, there, there's sort of like a comparison with your current situation. Yeah.

Miao, Yanwei 00:29:47.400 – 00:29:58.800  
It was my fault that I've, I've only put all the links on the right side. I forgot it. I mean, thank you for, for noticing that, and I, I need to adapt my usability.

Miao, Yanwei 00:30:02.840 – 00:30:08.680  
I was considered also to be shown there of the current detail as well.

Miao, Yanwei 00:30:12.200 – 00:30:14.240  
Yes, and.

Miao, Yanwei 00:30:15.520 – 00:30:20.680  
What factors contribute to your trust or a lack of trust in the recommendations.

Participant B 00:30:24.060 – 00:30:30.460  
So, yeah, as I said, in the first place, the numbers so that the estimations work, right? Quite correct. I think.

Participant B 00:30:32.460 – 00:30:42.620  
That's the, the main reason why you can trusted if you, so, I mean, if you put in your personal data and then the calculation is quite accurate, then.

Participant B 00:30:43.540 – 00:30:52.860  
Then you can rely on it in a sense that it will give you a recommendation that is not completely out of scope, like, then.

Miao, Yanwei 00:30:52.900 – 00:30:53.500  
Then you can.

Participant B 00:30:53.780 – 00:31:13.980  
A little more and as well, what contribute, what contributes I think is the, the periods of the website is really well programmed and it works quickly smoothly. So I think that's also a part that plays an important role if you are a consumer that looks at the page and if it's.

Participant B 00:31:14.060 – 00:31:31.900  
Responsive if it's not like too many options, but you can go through it very quickly. So then you will do it more likely than going through a website which takes you like two hours to complete and you will, you will never do that. So, but.

Participant B 00:31:32.700 – 00:31:42.780  
Fast and responsive and looks looks good and is experiment explanations that are understandable for everyone. I think that's.

Participant B 00:31:43.420 – 00:31:46.700  
A good contribution as well to trust it.

Miao, Yanwei 00:31:47.380 – 00:31:51.020  
Thank you is understandable all those information provided.

Participant B 00:31:52.380 – 00:32:12.220  
Yeah, at least for me, it was, but I, I'm also a little bit into the topic so I think for, for someone who owns the house and thought about it a while and has some, some of the vocabulary down, I think then it's no issue. I don't know how it.

Participant B 00:32:12.860 – 00:32:17.340  
For someone who has never been in touch with a topic. I don't know, but.

Participant B 00:32:18.260 – 00:32:22.020  
Doesn't seem too over complicated to me.

Miao, Yanwei 00:32:23.100 – 00:32:30.140  
Great and, and did the system provide enough information for you to understand the technologies. You think.

Participant B 00:32:30.780 – 00:32:50.620  
There's more descriptive text. I, I really like that as well there. I think it's better to have a small or short descriptive text that mentions the main things and not too much detail because then it also could make people not read it at all. if it's too long.

Participant B 00:32:50.620 – 00:32:51.900  
So I think.

Participant B 00:32:53.180 – 00:33:02.140  
It's a good balance between a short text information and keeping people on track and to do it.

Miao, Yanwei 00:33:03.540 – 00:33:07.140  
Do you mean having some short.

Miao, Yanwei 00:33:08.620 – 00:33:12.700  
Generalized information as well for the current technologies.

Participant B 00:33:15.660 – 00:33:18.460  
Sorry, I didn't get the first part.

Participant B 00:33:41.220 – 00:33:53.980  
My case is not because I already looked into it, but yeah, as I said, for someone who didn't have any contact with the topic before it might be the case, I don't know.

Miao, Yanwei 00:33:57.180 – 00:34:14.460  
And maybe do you have anything you would like to share this is the last question, like, besides what I have asked you any extra thoughts about the system or anything can be IMPRO.

Participant B 00:34:17.659 – 00:34:26.620  
Yeah, as I said, only the thing that you might want to enter your own figures like your own.

Participant B 00:34:27.540 – 00:34:40.700  
Or the, the last, if you have a utilities, Bill and, you know, your demand you could enter it so that would make the calculations even better. I assume. so I think that would be an option for someone who.

Participant B 00:34:41.460 – 00:34:45.940  
Wants to deprint it, and maybe you can also.

Participant B 00:34:47.740 – 00:35:07.580  
Some values for, for offers you got from, from a company, for example, who wants to, to build your photobal tax system or something like that. Maybe you can put it into that into your system as well. Maybe that is also a good thing, but I think that's more for the advanced US.

Participant B 00:35:07.780 – 00:35:10.780  
Some sort of thing like you really want.

Participant B 00:35:14.220 – 00:35:18.980  
Assimulation to the, to the most accurate point, maybe.

Miao, Yanwei 00:35:21.020 – 00:35:24.860  
Maybe I'm trying to find out.

Miao, Yanwei 00:35:27.420 – 00:35:38.260  
Thank you so much. These are all the info, all the questions and I, I think we are actually, I'm, I'm three minutes exceeding my.

Miao, Yanwei 00:35:39.620 – 00:35:44.340  
But no, I'm sorry that I, I spent.

Miao, Yanwei 00:35:48.740 – 00:35:55.740  
It's really very informative information that I get from you and I, I would really like to show my appreciations.

Participant B 00:35:56.260 – 00:35:56.860  
Thank you very.

Miao, Yanwei 00:35:57.180 – 00:35:58.140

Thank you.

## Participant C

Miao, Yanwei 00:15:05.080 – 00:15:11.280  
Before we begin, I would like to know some of your demographical information.

Miao, Yanwei 00:15:12.040 – 00:15:24.080  
Don't mind, but if you mind, you could also just like, say that you don't want to provide such information. All right, so what is your gender?

Participant C 00:15:24.240 – 00:15:25.360  
Female.

Miao, Yanwei 00:15:25.680 – 00:15:27.400  
And your age.

Participant C 00:15:27.400 – 00:15:29.120  
Twenty-eight.

Miao, Yanwei 00:15:29.320 – 00:15:33.080  
And what is your major and your education?

Participant C 00:15:33.800 – 00:15:35.600  
Major is.

Participant C 00:15:37.040 – 00:15:43.400  
Human computer interactions in my masters, but industrial design is my bachelor.

Miao, Yanwei 00:15:43.400 – 00:15:51.720  
Okay, the same with me and your occupation right now it's a master student, right?

Miao, Yanwei 00:15:53.000 – 00:16:00.000  
And do you have any knowledge or do you have any interest in artificial intelligence?

Participant C 00:16:00.040 – 00:16:02.680  
Not really not much.

Miao, Yanwei 00:16:03.880 – 00:16:08.480  
And do you have knowledge or interest in energy domain?

Participant C 00:16:10.320 – 00:16:16.920  
No, I would rate myself very low because I don't really know that much based on my background.

Miao, Yanwei 00:16:19.400 – 00:16:28.840  
And I would like to know, have you heard of any energy efficient appliances or renewable energy technologies for households?

Participant C 00:16:30.200 – 00:16:49.320  
As far as I know from my landlord and as Linda, where I left, they have artificial intelligent appliance on my, on our heater systems. So when the detector or the sensor. So called sensors, they sense that the degrees of seventeen degrees is more than in a row.

Participant C 00:16:49.480 – 00:16:55.080  
For five days, they will switch completely off the heater for month.

Miao, Yanwei 00:16:55.280 – 00:16:56.360  
Seventeen degrees.

Participant C 00:16:56.360 – 00:16:57.640  
Yeah, for seventeen degrees.

Participant C 00:16:58.960 – 00:17:18.520  
And I don't have seventeen or, or nine nineteen, but it's not over twenty. So when it's seventeen in a row and then they switch off the heating systems and then they will switch it on again in September. So this heating systems is totally controlled by the.

Participant C 00:17:19.400 – 00:17:21.959  
Is not someone who set it off and.

Participant C 00:17:23.959 – 00:17:27.959  
This year and Spring, we have the heating.

Miao, Yanwei 00:17:29.680 – 00:17:30.280  
Which means.

Participant C 00:17:30.520 – 00:17:36.680  
We don't have it even though the weather become like, eight degrees at night, the other day.

Participant C 00:17:37.400 – 00:17:47.560  
We have the seventeen degrees in a row for a week and then the AI think. Oh, now it's very warm, but it's kind of a false detections. I would say.

Miao, Yanwei 00:17:52.040 – 00:18:03.560  
Okay, and have you ever considered implementing energy efficient technologies such as solar panels and smarts and your home?

Participant C 00:18:03.560 – 00:18:14.440  
Yes, I've heard one and, and Bosch, so it's very common that I think my colleagues they all buy this stuff, You can put it on your heat heater, turning stuff, you know, you can.

Participant C 00:18:15.200 – 00:18:24.680  
And then you don't have to turn it. You just say I want the room always add twenty-one. Yeah, Celsius.

Participant C 00:18:25.480 – 00:18:28.400  
They would help you to make it stable.

Miao, Yanwei 00:18:32.480 – 00:18:34.920  
You also want to like, buy that thing.

Miao, Yanwei 00:18:35.080 – 00:18:36.200  
For your home, if you.

Miao, Yanwei 00:18:38.160 – 00:18:43.600  
And what is your understanding regarding the benefits of energy efficient technologies.

Participant C 00:18:47.080 – 00:19:03.280  
I think it is in the compensation of human comfort and energy saving because if we always talk about saving savings, then we just don't use it, but I think Energy Savings should always in the balance of.

Participant C 00:19:05.720 – 00:19:08.840  
Human comforts, like, you know what I mean? Yeah.

Participant C 00:19:11.400 – 00:19:14.600  
But do you want me to say a definition of it? Or what, what's?

Participant C 00:19:15.320 – 00:19:17.160  
Do you want me to answer from your question?

Miao, Yanwei 00:19:19.720 – 00:19:26.720  
Overall, your understanding regarding the benefits of like, using such technologies.

Participant C 00:19:27.440 – 00:19:30.600  
Then I would say it's more like...

Participant C 00:19:32.520 – 00:19:33.720  
You, you.

Participant C 00:19:33.960 – 00:19:42.760  
It's independent, it's not so not independent. It's dependent on the location. The weather condition, the wind.

Participant C 00:19:42.760 – 00:19:51.720  
Or the Sun where the sun hits like the, the angle I mean, so it depends on this, and then you can make use of the.

Participant C 00:19:52.400 – 00:20:12.840  
Nature resources in order to gain the last energy cost from your location, I would define like this, and I think it's very clever because I've heard that in Taiwan my country, a lot of people are promoting us to use the, the wave, the, the way.

Participant C 00:20:16.980 – 00:20:19.540  
The water goes high and low. What's that called?

Participant C 00:20:22.740 – 00:20:23.860  
Tide.

Participant C 00:20:24.860 – 00:20:26.580  
Will go one, one month, like.

Participant C 00:20:28.100 – 00:20:31.060  
And then the tide will go up to low, right?

Participant C 00:20:32.340 – 00:20:35.460  
We make this into energy.

Participant C 00:20:37.460 – 00:20:57.300  
Very efficient and it's also very clean, so we don't have to burn the coal and I think every country or location have to think about what is the best way for them to produce energy, which is clean and efficient at the same time. So that's why I think it's good that.

Participant C 00:20:58.620 – 00:20:59.860  
This, this stuff, so.

Participant C 00:21:00.500 – 00:21:05.620  
Every single apartment or every single location has its.

Participant C 00:21:06.460 – 00:21:08.820  
Encies like it's different.

Miao, Yanwei 00:21:13.300 – 00:21:15.500  
So you, you think.

Miao, Yanwei 00:21:16.540 – 00:21:20.820  
Those energy efficient technologies, they, they help.

Miao, Yanwei 00:21:22.260 – 00:21:25.820  
They help like reduce energy use.

Participant C 00:21:26.740 – 00:21:47.220  
No, I would say produced energy in a way that time the environment less. I wouldn't say that use less because if we want to reach a comfortable temperature or comfortable feeling, we need to use anyway at March of energy, right?

Participant C 00:21:48.740 – 00:22:08.980  
Energy efficiency doesn't mean that we said, okay, now we don't switch on the heater anymore. It's that, we still have the comforts in winter times, but how do we make the energy in the most efficient way, how do we use it in the most efficient way or how do we produce it in a more, in most efficient way? So it's more like.

Participant C 00:22:10.900 – 00:22:19.860  
Not compensate for our comforts, but we think about better solutions to reaching the goal of human comfort. I would say.

Miao, Yanwei 00:22:20.860 – 00:22:24.980  
For environmental protection, like the ultimate goal.

Participant C 00:22:25.620 – 00:22:35.220  
Yeah, that's part of the goal, but in my perspective, the main goal is still we have, we, we don't compensate for our living quality.

Miao, Yanwei 00:22:35.900 – 00:22:36.500  
Yes.

Participant C 00:22:36.500 – 00:22:39.060  
But we care about the environment of course.

Miao, Yanwei 00:22:40.980 – 00:22:57.460  
Make sense, okay, the last one before we start to use the service do you know, climate change and why is it important for individuals to save energy and utilize renewable energy sources?

Participant C 00:22:57.620 – 00:23:04.020  
I heard about this topic of climate change when I was like, nine years old.

Participant C 00:23:05.460 – 00:23:22.580  
A topic, I think a lot of movies and papers and people are talking about this that humans we imagine, we emissions a lot of co two on the globe, which is very bad and the global and the global become very warm.

Participant C 00:23:24.100 – 00:23:26.420  
In the polar areas, the ice would meld.

Participant C 00:23:27.540 – 00:23:38.580  
The land being less and less because the water would go higher and since we live on the island, it's possible that we would no longer be there anymore. So.

Participant C 00:23:39.380 – 00:23:46.260  
When I was around nine or ten, I start to have this sense of global climate change stuff.

Participant C 00:23:47.540 – 00:23:51.380  
Then may I know your question again.

Miao, Yanwei 00:23:53.500 – 00:23:58.420  
It's do you know, climate change and why is it important for individuals?

Participant C 00:23:58.540 – 00:24:00.340  
And I think I answered that two questions.

Miao, Yanwei 00:24:00.700 – 00:24:06.500  
Yes, you did. Okay, so now I will send you a link.

Miao, Yanwei 00:24:09.940 – 00:24:13.740  
And I will send it by chat.

Miao, Yanwei 00:24:16.340 – 00:24:34.380  
Please open it with your browser and try to find those recommendations for your house. You can refer to the house that you, you currently are living in.

Participant C 00:24:35.540 – 00:24:37.460  
Should I share my screen?

Miao, Yanwei 00:24:37.540 – 00:24:46.780  
That would be good. Thank you and you can like, meanwhile, when you are operating it, you can think out loud.

Participant C 00:24:52.220 – 00:25:09.460  
This is a homepage of your home energy could be cheaper and greener. We help you decide what to invest in your home. Okay, so now I, I guess this is something that I can check of how energy efficient my house is...

Participant C 00:25:09.500 – 00:25:29.940  
And then maybe I click on this to check if there's something. No, so I click on answer some questions in a few minutes, help us understand your current. Okay, this is like a survey to understand what might own houses and this is received personalized improvement.

Participant C 00:25:29.980 – 00:25:34.060  
So this kind of some suggestions from the professional.

Participant C 00:25:35.060 – 00:25:38.780  
Starting you agree to share you. Okay, yeah, start.

Participant C 00:25:42.740 – 00:25:43.860  
Country.

Participant C 00:26:00.300 – 00:26:01.900  
Right in German.

Participant C 00:26:07.700 – 00:26:22.900  
Yes, when was the house built know the year of the house? Build can provide insight into its constructions. material such as compositions of the walls. Okay, I, as far as I know, our houses before.

Participant C 00:26:25.780 – 00:26:32.140  
Has the house been renovated? Yes, renovation can include up, yes, exactly.

Participant C 00:26:34.580 – 00:26:35.700  
Yes.

Participant C 00:26:37.140 – 00:26:43.540  
How many people live in a house, So it's including my neighbors upstairs or only me, and my roommate?

Miao, Yanwei 00:26:44.220 – 00:26:46.660  
It's everyone in the house.

Participant C 00:26:58.260 – 00:27:02.020  
What type of heating system is used in a house?

Participant C 00:27:04.660 – 00:27:13.620  
Biomass boiler district heating heat pump all the boiler. This one gas boiler.

Participant C 00:27:14.900 – 00:27:28.340  
It's still a hot water tank in the house, a hot water tank or a space heating tank is a device that is used to store hot water for the domestic user to particular my boyfriend also used this one.

Miao, Yanwei 00:27:28.380 – 00:27:28.980  
Oh, okay.

Participant C 00:27:29.020 – 00:27:29.620  
Yeah.

Participant C 00:27:31.540 – 00:27:42.500  
It's a different one. Next, is there a PV system in a house, a PV system is a system that uses solar panels to convert online. No.

Participant C 00:27:44.340 – 00:27:49.380  
Next a battery system, so energy is produced by Solavanos.

Participant C 00:27:50.100 – 00:28:00.980  
Other sources to be used later when needed, we have a battery system for the House of heating up the water to the shower that is also c- included.

Miao, Yanwei 00:28:01.740 – 00:28:04.180  
Yes, you can consider that.

Participant C 00:28:04.820 – 00:28:12.620  
What is the capacity of this? I'm not so sure, but I guess it's the high, it's around this.

Participant C 00:28:15.700 – 00:28:23.300  
Let me choose this one and see what would happen. Is there a smart energy management systems and a house?

Participant C 00:28:24.020 – 00:28:25.940  
Otherwise consumption.

Participant C 00:28:27.220 – 00:28:34.260  
I think definitely, yes, but it does not belong to me. It will also landlord because I think they definitely have one in the basement.

Participant C 00:28:35.220 – 00:28:52.180  
Yes, okay, recommend. Oh, it's on the recommendation coming out your curr currently energy bills estimate to be wow three's for almost four thousand a year. So let me calculate four thousand.

Participant C 00:28:53.180 – 00:28:59.220  
By twelve, which let me see. Let me calculate. that's a real.

Participant C 00:29:00.540 – 00:29:05.620  
That is my payment so that I know how real this.

Participant C 00:29:10.180 – 00:29:17.140  
Invited by twelve months and also depends on the summer and winter because wintertime always consume more energy.

Participant C 00:29:18.540 – 00:29:22.900  
So each month re- okay, it's very, it's, it's very true.

Participant C 00:29:25.500 – 00:29:45.300  
Systems battery system. Very good. It has a thing that shows me what I click on like an overview to check if I did something wrong, so I can change it five people household Germany. Okay, so if I lowest and investment in the flowing configurations are applied.

Participant C 00:29:45.460 – 00:30:05.780  
The annual energy Bill is estimated B- two thousand. Let me see if there's more detail current. Yeah, it's cool that you also talk about the, month differences because of energy consumption during summer. It's any way lower.

Participant C 00:30:06.420 – 00:30:12.180  
And that's why it went at times. I always like to Defin a house which have to post on me to.

Participant C 00:30:12.820 – 00:30:26.260  
So you just only have to pay a certain range, but this heating cooling, ah, it also include cooling, but I don't have a cooling system. Why is it included?

Miao, Yanwei 00:30:28.740 – 00:30:38.900  
To be honest, I'm not so sure, but this is how the model has calculated, but I noted it down, your confusion I will ask the expert.

Participant C 00:30:39.620 – 00:30:48.580  
That's cool. Okay, so the hot water. Okay, so I think one thing it's very special for me, is that the hot water.

Participant C 00:30:49.860 – 00:30:53.980  
Why is the hot water doesn't have any hot water.

Participant C 00:30:55.660 – 00:30:57.220  
Winter times.

Participant C 00:31:06.500 – 00:31:14.700  
And so weird home because in winter times you, you always shower hot, but in summer times you show a cold, sometimes I mean, sometimes.

Participant C 00:31:30.820 – 00:31:35.300  
But I think in our house, the heating systems are heating systems.

Participant C 00:31:36.060 – 00:31:44.260  
Water boilers with a water boiler. It's different energies and resources, and because the water border uses electricity.

Participant C 00:31:46.380 – 00:31:48.100  
Systems use gas. So.

Participant C 00:31:48.740 – 00:31:50.020  
Two different.

Participant C 00:31:51.940 – 00:31:57.700  
But anyway, anyway, I, I just got confused by this graphic because.

Participant C 00:31:58.980 – 00:32:18.820  
Of course, according to the system, doesn't exist in Germany or at least in my house and also the hot water should be more in December and January, February, March, April, May. Summertimes should be almost equal because we, as a female, we still shower, but not that warm.

Participant C 00:32:19.460 – 00:32:20.740  
Still use it...

Participant C 00:32:21.380 – 00:32:36.740  
According to this one, it's appliances. Okay, I think appliances, for example, like fridge is something that always takes up a lot of energy in our house.

Participant C 00:32:37.380 – 00:32:57.860  
Open it through the year, but I, I learned from my dream roommate is that then Summertimes, we always switch the fridged into a cooler temperature. So we use less energy. I think that also makes a change because as far as I know the fridge is one of the best.

Participant C 00:32:59.420 – 00:33:01.060  
A lot of energy resources.

Participant C 00:33:02.060 – 00:33:22.180  
So I agree with this graphic and I want to see what it recommends me to do. Okay, this is just our estimation of my energy resources. I guess. So what can I do? This is my current one. I want to see what's gre PV means again, I think you, you have.

Participant C 00:33:22.300 – 00:33:23.460  
Explain me in.

Miao, Yanwei 00:33:24.420 – 00:33:27.940  
Yes, it's solar panels.

Participant C 00:33:29.020 – 00:33:30.500  
So if I use solar panels.

Participant C 00:33:31.980 – 00:33:35.620  
Get more energy and.

Participant C 00:33:37.540 – 00:33:46.220  
Okay, I want to understand what's the difference between this growing stuff and the, the stuff next to it.

Participant C 00:33:47.780 – 00:33:51.620 Because now I think, okay, if I use solar panels.

Participant C 00:33:53.540 – 00:33:55.540 I can reduce the.

Participant C 00:33:56.740 – 00:34:17.220 I can spend less money annually, but I need to also calculate how much money I need to invest to install those panels and how many years I need. I can get the money back. So I start to get this benefit the cost and benefits start going to be the same.

Participant C 00:34:17.860 – 00:34:36.419 Now, as far as I see also you can see there are not many differences. So, solar panels could reach the energy. I need. I think it's like, this is the same, just telling me that the green is what the PV can produce as an energy.

Participant C 00:34:41.540 – 00:34:43.940 I, I didn't really fully understand.

Participant C 00:34:45.379 – 00:34:51.580 Or pv system can convert sunlight directly into electricity. Yes, that's, I know it.

Participant C 00:34:53.780 – 00:34:57.540 The annual cost of five kilowatt peak is approximate.

Participant C 00:35:02.700 – 00:35:07.100 This is caught. This is mean that this is the money I.

Participant C 00:35:14.460 – 00:35:18.020 PV means so how many PV do I need.

Participant C 00:35:32.580 – 00:35:34.660 Okay, so I need five.

Participant C 00:35:38.700 – 00:35:40.420 I need five, not ten.

Participant C 00:35:49.620 – 00:36:00.900 Can store it sees energy rarely by your solar panels. Ah, okay, so it saves it in a, in a battery like a tank like an energy tank, and then when I needed, they will give it to me. I also note this because.

Participant C 00:36:01.660 – 00:36:16.900 I think my boyfriend's garden, we have this Sonar solar light and then they save it very small like this big, and then I save it, and at night, I can use it a whole night. So I know this battery system around twenty, what hours.

Participant C 00:36:29.780 – 00:36:38.020 Systems, ah, okay, so it's like a smart detector or a smart AI that I can optimize managing usage.

Participant C 00:36:38.660 – 00:36:43.140 Adjusting the heating ads is something like I just said in the very beginning of Bosch.

Participant C 00:36:43.780 – 00:36:47.340 This is kind of artificial intelligence, which.

Participant C 00:36:48.260 – 00:36:54.020 The systems, the technology that's used to generate heat in order to warm a space or provide hot water.

Participant C 00:36:57.860 – 00:36:59.140 Yeah, that's what.

Participant C 00:37:00.420 – 00:37:01.700 What is a heat pump.

Miao, Yanwei 00:37:08.740 – 00:37:18.380 Like using electricity to boil the water or boil the, so it makes the space hot.

Miao, Yanwei 00:37:19.700 – 00:37:26.820 Like natural gas, it's using gas to heat water or to keep the room hot.

Participant C 00:37:36.900 – 00:37:50.020 This is very important. I really like the last one because a building renovations really can have a better sealing, like they, they still the house better. So the energy will not go out.

Participant C 00:37:52.260 – 00:37:57.980 And you get, you, you can save a lot of money based on that, like.

Participant C 00:37:59.300 – 00:38:02.740 And, and insulations of the windows, the doors.

Participant C 00:38:04.100 – 00:38:18.500 Very old house. If like, I live in a very old house, the door and the window are very bad isolated. so no matter how, how much heating system you turn on the heat, anyway goes out. So.

Participant C 00:38:19.420 – 00:38:23.620 You waste a lot of energy, but now the windows, if you buy it this new window.

Participant C 00:38:24.580 – 00:38:25.540 More seal.

Participant C 00:38:27.180 – 00:38:31.300 Week out, which is really important, but two thousand.

Participant C 00:38:32.300 – 00:38:37.700 Not a, if I'm not an owner, I would definitely not do the dis decision on my.

Participant C 00:38:40.900 – 00:38:46.020 Yeah, this is something cool. So what would I happen if I click on update, can I click?

Miao, Yanwei 00:38:46.260 – 00:38:48.620 Sure you can do whatever.

Participant C 00:38:49.220 – 00:38:55.620 So update means that, ah, okay, if I change something here and then I click on update and then they will change. I guess.

Participant C 00:38:56.900 – 00:38:58.780 So let me change something.

Participant C 00:39:02.660 – 00:39:03.940 Oh, cool, so.

Participant C 00:39:05.220 – 00:39:10.260 Change it, and then this would change. So the heating would become.

Participant C 00:39:18.060 – 00:39:19.940 What does this mean? Okay.

Miao, Yanwei 00:39:20.020 – 00:39:21.860 Try to understand.

Participant C 00:39:21.860 – 00:39:26.340 The technology user heat in order to, so.

Participant C 00:39:27.860 – 00:39:48.100 I don't understand if I use this again, and then I spend this energy build is my money, and this is, this is the heating I, I need to use per energy in each month, but if I use this.

Participant C 00:39:48.740 – 00:40:03.540 Which they suggest to me down here. I need to pay more and I use more heating systems. Why, why does adjust me a bad recommendation?

Miao, Yanwei 00:40:04.100 – 00:40:07.300 It didn't suggest you, you change it yourself.

Participant C 00:40:07.660 – 00:40:13.340 Oh, they suggest me, they suggest that I should use this.

Miao, Yanwei 00:40:14.980 – 00:40:25.220 This might be a bug of mine. I shouldn't put that maybe if it didn't suggest you to change your heat pump, but yeah.

Participant C 00:40:25.500 – 00:40:32.260 This is not a suggestion. This is just telling you that if you use this, the money would cost like this.

Participant C 00:40:35.540 – 00:40:38.100 Which I already insert. I used this one.

Participant C 00:40:39.500 – 00:40:44.500 It would cost, it didn't tell me the, the cost is, but anyway, it's lower.

Participant C 00:40:52.180 – 00:40:55.380 Which means that I don't need to change it because it's kind of.

Participant C 00:40:57.340 – 00:41:01.140 Efficient in my perspective compared to heat pomp.

Miao, Yanwei 00:41:01.140 – 00:41:08.180 Right, it's not energy efficient, but it saves more money than changing to heat pump.

Participant C 00:41:08.180 – 00:41:08.820 But.

Participant C 00:41:10.180 – 00:41:15.300 But in a lot in the long term a heat pump, a better choice for me.

Miao, Yanwei 00:41:19.740 – 00:41:30.740 Actually, from the model, it's calculated for you since it didn't recommend you. That means it's not a proper idea for you to change it.

Participant C 00:42:12.900 – 00:42:16.660 That was done. Okay, now I fully understand.

Participant C 00:42:17.940 – 00:42:28.820 This is the energy I need, and this is energy that after recommendation, they would give to me, so they produce more energy than that need.

Participant C 00:42:30.300 – 00:42:42.260 With a lower cost. So that's why you said it's a cheaper and more efficient way in the end, and this is all the recommendation already. They choose it for me.

Participant C 00:42:42.260 – 00:42:44.660 So I don't need to do any changes.

Participant C 00:42:46.340 – 00:42:49.940 It becomes bad because that's the way they choose for me already.

Participant C 00:42:50.620 – 00:42:54.420 But if anyway, I can, I can change it and then see what happens.

Participant C 00:42:55.580 – 00:42:58.900 Not the best way because they are way changing for me.

Participant C 00:42:59.620 – 00:43:06.580 Just leave it like this and produce a PF and take a look by the way, I was.

Participant C 00:43:07.260 – 00:43:07.860 A few minutes a.

Participant C 00:43:09.780 – 00:43:12.980 I was checking some energy stuff as well.

Miao, Yanwei 00:43:13.620 – 00:43:14.260 Okay.

Participant C 00:43:14.420 – 00:43:15.540 Because my thesis.

Participant C 00:43:17.500 – 00:43:20.020 If you want to sell a house or you want to rent a house.

Participant C 00:43:20.860 – 00:43:24.500 Energieausweis to provide you this energy else voice.

Miao, Yanwei 00:43:24.540 – 00:43:26.420 Oh, really...

Participant C 00:43:26.660 – 00:43:46.900 Yeah, and this Energieausweis is also like a report of how energy efficiency this houses and this, this done by a human, which is a professional, they go into your house and use the measurement to look at your windows everything in combinations and do a final report.

Participant C 00:43:48.180 – 00:43:53.940 How energy efficiency or houses, and this is also done by the thermal camera, which I'm working on. So.

Miao, Yanwei 00:43:54.900 – 00:43:55.220 Okay.

Participant C 00:43:55.380 – 00:44:05.460 I think based on your work, it's also cheap because people don't have to act this professionally to come to your house and do this for you. Of course, it's more Preci.

Participant C 00:44:06.820 – 00:44:13.140 I can also do it with your model and, and complete it by myself.

Participant C 00:44:13.780 – 00:44:22.100 And then I can make a decision on my own or then I can refer to an expert that this is my first step, which I really like.

Participant C 00:44:24.660 – 00:44:30.420 I can share with you what I just this one.

Miao, Yanwei 00:44:30.420 – 00:44:31.540 Yes.

Participant C 00:44:31.700 – 00:44:35.540 So this is the energy also in Germany.

Participant C 00:44:36.220 – 00:44:38.100 This is a real one. This is not a fake one.

Participant C 00:44:38.900 – 00:44:45.780 This is a house in a guisvi near Siegan and it's for sale and I'm checking for it because I think it's cool.

Participant C 00:44:46.700 – 00:44:50.900 Big apartment you live alone. Have your own garden.

Participant C 00:44:51.540 – 00:44:52.820 This is the.

Participant C 00:44:54.780 – 00:44:56.660 Means like.

Participant C 00:44:58.660 – 00:44:59.860 Get demand exactly.

Participant C 00:45:00.500 – 00:45:01.780 And it's.

Participant C 00:45:02.420 – 00:45:03.700 This, this range.

Participant C 00:45:04.340 – 00:45:09.460 Yeah, the level. and also here are all the parameters they calculate.

Participant C 00:45:12.380 – 00:45:16.500 It's in Germ, and this is very standard.

Participant C 00:45:18.700 – 00:45:19.700 Where all the German.

Participant C 00:45:21.620 – 00:45:22.260 They.

Participant C 00:45:23.100 – 00:45:24.180 Will have this one.

Miao, Yanwei 00:45:24.500 – 00:45:26.740 Can you send this picture to me?

Participant C 00:45:26.740 – 00:45:27.380 Sure, sure.

Miao, Yanwei 00:45:27.580 – 00:45:28.900 Thank you.

Miao, Yanwei 00:45:32.300 – 00:45:39.380 This is, yeah, maybe it's a good inspiration for my.

Participant C 00:46:48.020 – 00:46:53.140 And I think now I fully understand what it is, and I think it's very nice to have it because now.

Participant C 00:46:55.060 – 00:46:57.620 Have to turn to these professional people.

Participant C 00:46:57.620 – 00:47:02.740 I think they have a drop tribe. It's called Energy Consulting.

Participant C 00:47:03.660 – 00:47:08.500 The consultant and I also talked to them as my interview is in my projects...

Participant C 00:47:09.780 – 00:47:15.540 They do this for people, and then what they have to do is just do the calculations and generate this report.

Participant C 00:47:16.380 – 00:47:21.940 Which have a national-wide standard, like, all the parameters have to be checked.

Participant C 00:47:22.580 – 00:47:43.060 So let me see if there's anything else, why should we turn to renewable energy learn more about the reasons other than cost savings. Okay, so I think this is a topic that would share with me. I only not, I not only saving cost, but I only save some polar bears or.

Participant C 00:47:43.780 – 00:47:50.100 Animals and also my future Simplings not simply is my notebooks. My children.

Participant C 00:47:57.260 – 00:48:04.820 What damages have caused by okay, interesting. So this is not something I can click on, but these are some information I can look through.

Participant C 00:48:07.020 – 00:48:10.420 I would like if there is some nice.

Participant C 00:48:11.940 – 00:48:18.260 Nice pictures or link to, I can watch some horrible disasters about.

Participant C 00:48:18.900 – 00:48:22.740 Didn't change it. No, I think it's good. like this, you.

Participant C 00:48:22.740 – 00:48:27.340 And when I click on this, I go back again, I can start the, the.

Miao, Yanwei 00:48:28.620 – 00:48:29.740 Everything.

Participant C 00:48:30.700 – 00:48:33.620 Over again, and I really like this.

Participant C 00:48:34.260 – 00:48:35.540 I really like this model.

Participant C 00:48:37.100 – 00:48:38.700 What is this?

Participant C 00:48:40.100 – 00:48:41.300 It's on the icon.

Miao, Yanwei 00:48:42.580 – 00:48:48.340 When you come to the other, the project website.

Participant C 00:48:48.340 – 00:48:49.980 Ah, okay.

Participant C 00:48:51.540 – 00:48:52.820 Great, nice work.

Miao, Yanwei 00:48:52.820 – 00:48:58.580 Thank you, all right, thank you. So you've tested the product.

Miao, Yanwei 00:49:00.100 – 00:49:09.020 I would still like to ask you a bit more questions if you don't mind because it's already been a while.

Miao, Yanwei 00:49:11.380 – 00:49:25.660 Okay, so I will continue asking a bit of questions like, sorry, give me a second. How do you feel about the recommendations provided to you?

Participant C 00:49:26.740 – 00:49:46.580 At first, I was, I really like the concept, but for the interface I was a bit confused because I see the selections, right? I, I see the COMPU, the, the black box they selected for me, but I would have this intuition to think. Oh, should I select it, but then I understand that they already.

Participant C 00:49:46.980 – 00:50:05.780 For me, so I don't have to think about which I should select just to see what they select from me and see the result, but the selection, the selecting functions confuse me that the computer is selected for me. I think I have do it on my own because it's kind of confusing feeling.

Miao, Yanwei 00:50:05.820 – 00:50:06.420 Okay.

Participant C 00:50:06.620 – 00:50:12.620 But I realize that when you explain to me that now they already give it to you. You just have to accept it.

Miao, Yanwei 00:50:13.460 – 00:50:20.500 So do you forget that? you actually chose one of the recommendations when you came to this page.

Participant C 00:50:20.500 – 00:50:21.780 I think I forgot... yeah.

Participant C 00:50:22.620 – 00:50:34.580 I forgot, and also I think it's a bit confusing when you wrote something beneath it with the greater little text that said heat prompt is cost nine hundred euros.

Participant C 00:50:35.400 – 00:50:50.120 I would think nine hundred years I don't know how much the gas thing I, I spent, so I would think maybe it's a recommendation for, for me. I should change it to that one. I think that the low text has this feeling for me. It's a good thing.

Participant C 00:50:50.840 – 00:50:52.680 Stick to, but it's not.

Miao, Yanwei 00:50:53.320 – 00:50:53.960 So.

Miao, Yanwei 00:50:55.480 – 00:51:02.920 It was more like a usability thing. I shouldn't put it there if I- if the recommendation didn't ask you to change the heat pump.

Participant C 00:51:17.000 – 00:51:18.880 And also I think.

Participant C 00:51:20.200 – 00:51:24.040 I'm a user, I like to have this kind of responsive set.

Participant C 00:51:24.680 – 00:51:34.920 Agreeing check that now it's everything you save better, but the interface gave me a feeling that it's everything, it's very neutral.

Participant C 00:51:34.960 – 00:51:36.200 You know, everything.

Participant C 00:51:37.240 – 00:51:40.040 I didn't feel the feeling of success.

Participant C 00:51:41.400 – 00:51:42.600 Better person.

Participant C 00:51:42.600 – 00:51:50.920 So, for example, you give me the selections which is not selecting saying recommendation.

Participant C 00:51:52.840 – 00:51:54.760 See something more strong to say.

Participant C 00:51:55.440 – 00:52:00.520 And help you save something, and then there's a big check.

Participant C 00:52:01.840 – 00:52:08.200 Check it soft. The problem could be better like this, This improvement feeling is not visualized. So.

Participant C 00:52:08.920 – 00:52:13.960 I know that this is something that can improve myself, but I understand it in a logical way.

Participant C 00:52:14.600 – 00:52:17.640 It's emotional, I didn't really.

Participant C 00:52:19.080 – 00:52:21.360 So the happen is, and improvement.

Participant C 00:52:22.480 – 00:52:34.440 Kind of happiness that I achieved a better energy efficiency from an interface. I didn't mean that it's bad. I think it's good to be a neutral interface, but.

Participant C 00:52:35.080 – 00:52:40.440 If there is something that needs to be a successful feeling.

Participant C 00:52:41.720 – 00:52:44.680 It comparison because when I look at the two two charts...

Participant C 00:52:45.320 – 00:52:48.520 The, left one is me, and the right one is the recommendation.

Participant C 00:52:49.800 – 00:52:50.440 The two.

Participant C 00:52:51.720 – 00:52:54.920 The two UI is very similar.

Miao, Yanwei 00:52:55.800 – 00:52:56.200 I would.

Participant C 00:52:58.160 – 00:53:00.680 Of course, I assume that the right one's better.

Participant C 00:53:02.040 – 00:53:04.520 I didn't really feel.

Participant C 00:53:07.120 – 00:53:09.640 The strong contrast I would say.

Miao, Yanwei 00:53:10.280 – 00:53:10.920 Okay.

Participant C 00:53:10.920 – 00:53:15.400 So I'm confused about, of course, I talk about the parameters of the.

Participant C 00:53:16.040 – 00:53:18.960 Systems and the heating systems. I think.

Participant C 00:53:19.880 – 00:53:23.720 You already choose Germany and I already said I don't use any cooling systems.

Miao, Yanwei 00:53:24.120 – 00:53:24.360 Yes.

Participant C 00:53:24.360 – 00:53:35.240 Then in the, in the last phases, they shouldn't talk about the cooling any more because no insert the parameters inside in the beginning.

Miao, Yanwei 00:53:35.480 – 00:53:37.800 Could be like a model problem. I think.

Participant C 00:53:37.800 – 00:53:47.400 And also about the, the water hot water. I think it should be also one of the questions to ask me.

Participant C 00:53:48.040 – 00:53:55.160 The temperature I shower and the frequency I shower and also.

Participant C 00:53:58.280 – 00:54:07.240 The seasonal changings, like if I do do your shower code in winter times, I think the question can be also a little bit more in detail because.

Participant C 00:54:08.040 – 00:54:09.160 Behaviors.

Participant C 00:54:11.120 – 00:54:12.360 Different season.

Participant C 00:54:13.680 – 00:54:14.920 For example.

Participant C 00:54:15.680 – 00:54:20.040 I think in the summertime in Germany or in the whole European countries.

Participant C 00:54:20.920 – 00:54:23.880 More and we don't use that much light anymore.

Participant C 00:54:24.640 – 00:54:29.640 I still turn it on. I know, but I mean, at some point we stop to use it for.

Participant C 00:54:30.320 – 00:54:31.560 Longer time.

Participant C 00:54:34.120 – 00:54:37.320 This also has to be into consideration that.

Participant C 00:54:38.320 – 00:54:39.880 We use less energy.

Participant C 00:54:40.560 – 00:54:44.360 I think you, you did, I saw that in summer times, the energy is last.

Miao, Yanwei 00:54:46.920 – 00:54:53.960 Can I interpret this way? You actually don't trust the model so much, you think.

Miao, Yanwei 00:54:55.240 – 00:55:11.120 Because you think different people's behaviors are different. So the big data they actually use for the model might not be so accurate, linked to your own. Yeah, like your personal behavior.

Participant C 00:55:12.520 – 00:55:18.920 I would say so, but in the very beginning, when I start to use this model, my attitude is very.

Participant C 00:55:19.000 – 00:55:22.120 Neutral and trust.

Participant C 00:55:23.000 – 00:55:27.240 When I start to insert the questions, I also found it very good.

Participant C 00:55:27.440 – 00:55:36.840 Then when I see the graphic, the confusion pushed me into. I don't trust it anymore. I, I, because there, there's too many flaws.

Participant C 00:55:37.480 – 00:55:50.920 That it's very different from my own experiences and I already see the problem, I know that if there's a big miscalculation, then the whole money that I need to spend is definitely wrong then.

Participant C 00:55:52.000 – 00:55:56.040 But if the big thing is I was very excited.

Participant C 00:55:56.680 – 00:55:58.600 That it would be very precise.

Participant C 00:55:59.880 – 00:56:04.960 And during the, when I really read each sections.

Participant C 00:56:06.320 – 00:56:08.840 See that there must be some miscalculations.

Miao, Yanwei 00:56:10.760 – 00:56:13.960 Okay, that makes very much sense.

Miao, Yanwei 00:56:15.440 – 00:56:21.440 So would you still trust the recommendation that was recommended to you?

Participant C 00:56:22.600 – 00:56:25.480 I think the main target.

Participant C 00:56:26.760 – 00:56:31.880 For them to ask me to use this is asking me to buy their products, right?

Miao, Yanwei 00:56:32.520 – 00:56:33.800 Buy those technologies?

Participant C 00:56:34.000 – 00:56:42.120 Buy those technologies and I was thinking in this way, so it's not about trust this model or not. The.

Participant C 00:56:45.320 – 00:56:49.800 Reason is not trusting the dee reason is they urge me to want to spend money.

Participant C 00:56:50.880 – 00:56:51.720 Stuff.

Participant C 00:56:53.640 – 00:57:01.960 Why do I think so. Because if I buy energy technology energy, efficiency technologies that help me to SA.

Participant C 00:57:04.560 – 00:57:06.440 Promoted with this.

Participant C 00:57:08.360 – 00:57:12.200 Website to tell me that. okay, if you buy.

Participant C 00:57:12.840 – 00:57:17.960 If you use my product and you save a lot of energy, do you want to, but.

Participant C 00:57:18.680 – 00:57:21.160 Customer already know their strategy.

Participant C 00:57:22.600 – 00:57:39.080 For me, I would quickly check. Yeah, okay, and I, I would just want to check how good the products is efficient, and of course, I want to know how efficient this product fits to my own household of course, it's important.

Participant C 00:57:39.720 – 00:57:40.360 So, so.

Miao, Yanwei 00:57:40.400 – 00:57:48.680 So, so you think the website was created by some business people or like by some business brands?

Participant C 00:57:48.800 – 00:57:51.240 I would say the website, it's more.

Participant C 00:57:53.880 – 00:57:55.200 The product.

Miao, Yanwei 00:57:57.120 – 00:58:06.600 This way, but actually if you, I saw you actually click on the, the new trans project.

Participant C 00:58:07.240 – 00:58:08.520 Yeah, I did. That's why.

Miao, Yanwei 00:58:08.720 – 00:58:14.800 And, and do you know the whole service was provided by Fraunhofer.

Miao, Yanwei 00:58:16.200 – 00:58:21.320 And, you know, they are all research institutes, so there's no.

Participant C 00:58:21.360 – 00:58:21.960 Money.

Miao, Yanwei 00:58:23.240 – 00:58:26.400 Yes, like there are no companies that are involved.

Miao, Yanwei 00:58:27.760 – 00:58:30.280 The Research Institute. So.

Miao, Yanwei 00:58:31.560 – 00:58:39.240 Actually, no brands or no business. It's related to this project.

Participant C 00:58:39.600 – 00:58:39.880 So.

Participant C 00:58:42.080 – 00:58:46.800 It's more like the, the country is promoting.

Participant C 00:58:47.560 – 00:58:50.760 Into a more greener place.

Participant C 00:58:51.520 – 00:58:57.160 People to use gas or burn their calls anymore. Yeah, okay, so basically it's a good idea.

Participant C 00:59:01.680 – 00:59:04.160 I think it's something.

Miao, Yanwei 00:59:06.120 – 00:59:26.120 But, but that's in, that's very valuable. You're, you're inside there. So you think if it's, if it's by some business, then you think it's not just worthy, but if I tell you now they are research institutes and they are by the national German government and the EU.

Miao, Yanwei 00:59:26.600 – 00:59:35.560 Do you still think it's, it's, it's not for promoting the products because they didn't even recommend you which brand to buy or which.

Miao, Yanwei 00:59:36.840 – 00:59:45.000 Exactly which one to buy. They just say if you get a PV, you can back get the PV from any brands, anything anywhere.

Participant C 00:59:45.160 – 00:59:46.280 Okay.

Miao, Yanwei 00:59:47.160 – 00:59:47.720 Trust voice.

Participant C 00:59:48.480 – 01:00:01.160 Yeah, I would say my attitude would change a little bit from super skeptical to a little bit skeptical, then would test then I would test was my friend's house, which is super patty, an energy efficient.

Participant C 01:00:01.960 – 01:00:05.000 And test it if they already did the passwork.

Participant C 01:00:05.640 – 01:00:08.200 In, in this model still very bad, you know what I mean?

Participant C 01:00:08.840 – 01:00:16.520 I want to know if this model in the end anyway, they will tell you that it's bad because if I already exert a very good parameters.

Participant C 01:00:17.200 – 01:00:19.080 Like, highly energy efficient.

Participant C 01:00:21.360 – 01:00:30.240 Tell me that you did a good job everything's, perfect, you don't need to buy the Sonar panels. I want to know this. I would test it in the model to see.

Participant C 01:00:31.240 – 01:00:33.800 If I'm a super energy efficient.

Participant C 01:00:34.480 – 01:00:42.120 They would say, Oh, now it's everything's good. You don't need any, any improvement if this is something like this in a model, I would trust it really a lot.

Miao, Yanwei 01:00:43.980 – 01:00:49.100 You might just do, do the whole thing again.

Miao, Yanwei 01:00:49.860 – 01:00:52.300 Beginning, and then you choose all the best option.

Participant C 01:00:56.900 – 01:01:04.460 I want to see what, what would happen if I choose the best stop and then they still say, you have still have to buy a sort of panels.

Miao, Yanwei 01:01:06.380 – 01:01:08.300 You can try it. Yes.

Participant C 01:01:08.340 – 01:01:12.780 Okay, that's right. Another country I want to see if there's some difference.

Miao, Yanwei 01:01:13.060 – 01:01:18.700 No, I, I only have touch land now. Sorry, but.

Miao, Yanwei 01:01:24.300 – 01:01:29.300 I wonder like, why is your screen, Not showing those selections?

Participant C 01:01:30.060 – 01:01:35.820 I don't know why it's okay when was the house built that me choose the most newest after.

Participant C 01:01:37.740 – 01:01:44.500 Yes, how many people which one is the best.

Participant C 01:01:48.620 – 01:01:54.380 So that you, oh, no, yeah, of course more is better because you share by more people or.

Miao, Yanwei 01:01:55.020 – 01:01:56.940 Maybe I am not. So sure.

Participant C 01:01:57.020 – 01:01:59.540 You have last week or you use last energy.

Miao, Yanwei 01:02:00.980 – 01:02:02.060 Could be.

Participant C 01:02:02.060 – 01:02:02.700 But the energ...

Participant C 01:02:03.980 – 01:02:06.540 It's talking about how many people per.

Miao, Yanwei 01:02:06.540 – 01:02:11.260 And it's for energy, I guess maybe more makes more sense. Yeah.

Miao, Yanwei 01:02:14.620 – 01:02:16.780 Maybe he pump it's the best.

Participant C 01:02:16.780 – 01:02:18.060 Okay, let's just keep.

Miao, Yanwei 01:02:18.380 – 01:02:18.700 Yeah.

Participant C 01:02:18.820 – 01:02:19.980 Is it a hot water?

Miao, Yanwei 01:02:20.180 – 01:02:22.460 Be having power tank.

Miao, Yanwei 01:02:23.820 – 01:02:33.540 Of course, a PV system, yes, no, you just said, yes, yes, and then choose the biggest one. The tank, you know what? yeah.

Miao, Yanwei 01:02:34.700 – 01:02:40.460 And yes, a better system and a twenty kilow.

Miao, Yanwei 01:02:43.260 – 01:02:44.380 Yes.

Miao, Yanwei 01:02:45.580 – 01:02:47.620 And now you see.

Miao, Yanwei 01:02:53.260 – 01:02:57.740 Now you can still see your current energy bell, right?

Miao, Yanwei 01:02:58.380 – 01:03:18.860 And then you will see the recommended configurations, which is it seems that your home energy system is already very technically economical and we do not have a recommendation that may lower energy future energy costs for you at the moment, but you can also see how different configurations.

Miao, Yanwei 01:03:18.900 – 01:03:26.500 Will affect your house energy consumption by manually customizing your home energy system using our service.

Participant C 01:03:29.100 – 01:03:31.020 So anyway they would tell me.

Miao, Yanwei 01:03:32.460 – 01:03:34.340 Just give you whatever.

Participant C 01:03:38.700 – 01:03:39.820 What.

Participant C 01:03:41.900 – 01:03:44.460 Why is the energy bell, higher.

Miao, Yanwei 01:03:46.380 – 01:03:48.940 Your current is the left one. You remember.

Participant C 01:03:50.260 – 01:03:52.140 Why is the recommendation price higher?

Miao, Yanwei 01:03:52.780 – 01:03:54.700 On the right one.

Miao, Yanwei 01:03:55.140 – 01:03:59.460 Simulation if you go through, if you could scroll up.

Miao, Yanwei 01:04:01.100 – 01:04:08.180 It's simulate, so you can just basically change everything the simulate to see what happened.

Participant C 01:04:12.820 – 01:04:15.060 Can I change this simulate?

Miao, Yanwei 01:04:15.220 – 01:04:20.300 You can change like, like here the simulation just give you a random thing.

Participant C 01:04:21.180 – 01:04:22.540 I see.

Participant C 01:04:26.700 – 01:04:31.140 Yeah, but I can change it. It's not from me.

Miao, Yanwei 01:04:31.460 – 01:04:38.860 You remember the previous page already told you, like you can just go into check on whatever you want to see.

Miao, Yanwei 01:04:39.740 – 01:04:42.020 No recommendation for you.

Participant C 01:04:42.700 – 01:04:45.780 I see now I understand.

Miao, Yanwei 01:04:46.540 – 01:04:47.660 Yes.

Participant C 01:04:48.460 – 01:04:49.740 And it's just saying that's correct.

Miao, Yanwei 01:04:50.660 – 01:04:51.780 Yes.

Participant C 01:04:52.740 – 01:04:54.220 Nice, nice work.

Miao, Yanwei 01:04:55.500 – 01:04:58.060 Now do you feel like you trusted a bit more.

Participant C 01:04:58.060 – 01:04:58.700 Yeah, yeah.

Participant C 01:05:03.180 – 01:05:04.460 At customer.

Miao, Yanwei 01:05:05.100 – 01:05:24.940 No, you are good. You provide a lot of insights and, and okay, then I continue asking my questions. All right, are you considering investing in any of those recommended technologies? Like previously we have recommended some technolog.

Miao, Yanwei 01:05:25.220 – 01:05:30.060 To you, would you consider investing them.

Participant C 01:05:30.060 – 01:05:31.980 I have one questions regarding to your question.

Miao, Yanwei 01:05:32.100 – 01:05:33.260 So, yes.

Participant C 01:05:33.900 – 01:05:40.860 Investment means the money only to buy the technologies or including the installations.

Miao, Yanwei 01:05:42.860 – 01:05:45.420 Investment means total.

Participant C 01:05:45.420 – 01:05:46.700 Yeah, I understand.

Miao, Yanwei 01:05:49.900 – 01:05:50.540 Would, would you like.

Miao, Yanwei 01:05:51.580 – 01:05:59.500 Those technologies, if you see that they can actually have an impact on your energy Bill.

Participant C 01:06:00.140 – 01:06:10.380 The government would pay would help me in certain present, if I try to save the, the whole world, buy my own money.

Participant C 01:06:11.220 – 01:06:21.900 And I would think about it, but like, you know what I mean? If I buy a solar panel and then I can the government will pay at fifty percent for me. Not that much of me thirty percent.

Participant C 01:06:22.540 – 01:06:25.100 I would really think about it.

Miao, Yanwei 01:06:25.100 – 01:06:25.740 Okay.

Miao, Yanwei 01:06:28.940 – 01:06:30.860 All your, on your own.

Participant C 01:06:31.740 – 01:06:37.900 Then I would still think about it, but not that like, really want to do it, like, still.

Participant C 01:06:39.180 – 01:06:44.940 Because it really depends on how long I plan to live in this house.

Participant C 01:06:46.420 – 01:06:50.700 If I am just a buyer of the house, for example, I buy this house.

Participant C 01:06:51.460 – 01:06:51.980 Owner, but.

Participant C 01:06:55.180 – 01:06:55.820 In two months.

Miao, Yanwei 01:06:55.860 – 01:06:56.980 Okay.

Participant C 01:06:57.380 – 01:07:01.580 Why do I have to do this investment? I didn't even get my money back and.

Miao, Yanwei 01:07:01.700 – 01:07:11.420 Because you can sell it for more expensive price if you provide that your house, it's in the efficiency of level a.

Participant C 01:07:13.780 – 01:07:16.940 Depends you have to calculate for me that.

Participant C 01:07:17.580 – 01:07:20.780 Much much efficiency. I can really get the money.

Participant C 01:07:22.700 – 01:07:23.820 But.

Miao, Yanwei 01:07:24.300 – 01:07:28.060 Want to sell your house if you already bought this one.

Participant C 01:07:28.660 – 01:07:37.420 I mean, if I change my working location, if I, I mean there's always something that I can switch my houses.

Participant C 01:07:38.260 – 01:07:44.460 I sell it in this case, I would think about the investment, which is not fixed invest.

Participant C 01:07:46.260 – 01:07:51.500 Means it's in a house, which, when I move off, it's, it belongs to the house.

Participant C 01:07:52.340 – 01:08:03.020 All the recommendations from this MO model, it's fixed or fixed recommendations. It's not something like I do know in Taiwan when we.

Participant C 01:08:03.860 – 01:08:05.580 On the AC, the air conditioner.

Participant C 01:08:06.940 – 01:08:16.460 We can bring a lot of energy efficiency when you bring when you bought a certain kind of circulation fan a ventilatour.

Participant C 01:08:17.100 – 01:08:18.380 And demonside.

Participant C 01:08:19.660 – 01:08:29.900 Because if you buy this fan, it only costs two euros, Taiwanese dollars and it circulates the wind and cools the whole house down.

Participant C 01:08:30.700 – 01:08:32.460 Using the same energy.

Participant C 01:08:33.740 – 01:08:38.220 So if it's like this and I bought a fan and I move out, I can take it.

Participant C 01:08:38.220 – 01:08:47.819 I would definitely do it like all the Tony's household. They do it, but the recommendation. now I got found this model is to really insert with such a high price.

Participant C 01:08:48.660 – 01:08:49.740 I move out.

Participant C 01:08:50.380 – 01:08:51.660 I don't even know. I can.

Participant C 01:08:51.940 – 01:08:53.580 Solar panels with me.

Miao, Yanwei 01:08:53.700 – 01:08:54.859 No, usually the.

Miao, Yanwei 01:08:55.580 – 01:08:57.420 System they stay with the home. So.

Miao, Yanwei 01:08:59.339 – 01:09:02.540 But yes, solar panels, You can actually bring with you.

Miao, Yanwei 01:09:03.180 – 01:09:05.740 But it's just a lot of work.

Participant C 01:09:05.740 – 01:09:25.580 I mean, oh, so in Germany that the installations causes very high. I think it's almost the same price as I bought. I don't know how much it cost, but in my imagination, it cost a lot. I bought this solo panels and also the installations of all the professional things...

Miao, Yanwei 01:09:26.299 – 01:09:34.380 Makes sense, but what, if you don't want to move away, would you still invest in those technologies for your house?

Participant C 01:09:34.540 – 01:09:39.660 Okay, it depends on my age. So if I'm going to, I'm like eighty years old. I'm going to die.

Participant C 01:09:40.980 – 01:09:44.779 Why do I have to do this? Like, why, why?

Participant C 01:09:45.660 – 01:09:47.339 My money in this, I'm already going to.

Miao, Yanwei 01:09:48.220 – 01:09:58.500 Because for climate change, because for the environment, and because it actually can help you save energy bell, like, can help you save.

Miao, Yanwei 01:10:02.100 – 01:10:02.700 Estimation.

Participant C 01:10:02.900 – 01:10:09.740 Yeah, if I am forty years old, I will definitely be willing like, have enough money because I'm forty years old I have.

Participant C 01:10:10.460 – 01:10:16.780 The investment I have my own host. Yeah, I would definitely do it, but if I'm like an old person, then it's.

Participant C 01:10:17.460 – 01:10:33.420 It's still part of some, I wouldn't do it at all. So I think the focus group, the group that you focus, which would maybe very, very motivated is definitely not a students because they rent a house and they're definitely not a fresh man that just entered a society as working.

Participant C 01:10:35.340 – 01:10:39.820 Someone who is in the middle of forty- two fifty and just retired got some money.

Participant C 01:10:40.460 – 01:10:46.300 And if they are too old, they want, and also if you're just retired, you're thinking about.

Participant C 01:10:48.140 – 01:10:51.340 And why are you making your house energy efficient?

Participant C 01:10:52.700 – 01:10:54.540 Why like, why is the motive?

Miao, Yanwei 01:10:59.660 – 01:11:16.940 You, you provide really good like perspective from this, from this like, angle, it's, it's really good. I really like it, and another question do you know why those recommendations were recommended to you?

Participant C 01:11:18.860 – 01:11:30.980 Okay, because if there are five different ways of generating energy, there must be a best one which is more highly energy efficient.

Miao, Yanwei 01:11:32.340 – 01:11:33.580 For your own situation?

Participant C 01:11:33.700 – 01:11:37.900 Yeah, and the whole situation is based on the parameters, which I just insert.

Miao, Yanwei 01:11:38.060 – 01:11:39.980 Okay, nice.

Participant C 01:11:39.980 – 01:11:41.260 I have a question.

Participant C 01:11:42.060 – 01:11:54.060 They didn't ask about my location more precisely regarding the landscape regarding the weather conditions regarding how big my whole apartment is.

Participant C 01:11:54.860 – 01:12:03.020 Layer it is, because if I live on a third floor, like right now it's warmer and I need more cooling system for, if I have one.

Miao, Yanwei 01:12:03.780 – 01:12:14.540 To answer the first question, your location question, we actually can provide very detailed, like, very just spot location.

Participant C 01:12:14.620 – 01:12:15.740 Yeah.

Miao, Yanwei 01:12:16.540 – 01:12:22.220 According to our model and the whole of Germany, it doesn't make a too big difference.

Participant C 01:12:22.220 – 01:12:22.860 Oh, cool.

Participant C 01:12:23.500 – 01:12:24.140 It's sup.

Miao, Yanwei 01:12:26.100 – 01:12:31.180 But, you know, like, I know like many people want to know very precise detail.

Miao, Yanwei 01:12:32.620 – 01:12:52.300 I could like, we could think of some ways, like some people might just want to do a quick scan so they can enter like some part of the, just they just need to enter Germany, but if you are very interested, knowing very, very detailed things we could even ask you like.

Miao, Yanwei 01:12:53.020 – 01:13:11.500 Exactly and see again, you live and how many people there working habit is, are they working from home or are they working in the office and like those habits, how, what is your most comfortable temperature range?

Participant C 01:13:11.540 – 01:13:13.420 Exactly, oh, I think.

Participant C 01:13:14.700 – 01:13:17.900 The reason why it makes me a little bit untrust.

Participant C 01:13:19.260 – 01:13:22.380 Also, because the, the question is something.

Participant C 01:13:23.660 – 01:13:24.940 Close to my lifestyle.

Participant C 01:13:25.820 – 01:13:29.420 Asking something about technologies equipment in my house.

Participant C 01:13:30.260 – 01:13:47.980 Very far away from my life because I'm not an engineer, I'm a normal person. So this thing is more like you ask me what brand of fridge I bought which I don't care, but I care about if you're asking me my daily life habits, how often I show what temperatures make me feel comfortable.

Participant C 01:13:48.620 – 01:13:57.580 I would feel like this is really personalized. So personalized feelings is like, this is more about me, but not only about the hardware and a house.

Participant C 01:13:58.500 – 01:14:02.700 Person is also affecting how much energy consumption it is, right?

Miao, Yanwei 01:14:03.980 – 01:14:11.020 But you think the, the final calculation was correct according to your current bill.

Participant C 01:14:11.020 – 01:14:12.940 Yeah, that's surprisingly true.

Participant C 01:14:13.580 – 01:14:18.700 I wasn't, I mean, I'm very critical and I want to see if it's true or not, and it's true.

Miao, Yanwei 01:14:19.980 – 01:14:21.260 That's nice.

Miao, Yanwei 01:14:21.900 – 01:14:25.740 I actually contribute to the, to your, to your trust a little bit.

Participant C 01:14:25.900 – 01:14:27.020 Yeah, of course.

Miao, Yanwei 01:14:28.980 – 01:14:36.620 So let me see. were you familiar with all those technologies before you use those systems?

Participant C 01:14:37.260 – 01:14:45.580 No, because when I were doing a survey from this model, you have a lot of the descriptions and I think you, sa, you saw me.

Participant C 01:14:46.540 – 01:14:52.620 Through everything a careful way, it doesn't mean that I, I want to do in a careful ways because I don't understand.

Miao, Yanwei 01:14:53.380 – 01:15:00.940 So do you think after using the service you are more aware of what those technologies are actually for.

Participant C 01:15:01.100 – 01:15:05.420 Yeah, I mean for awareness, of course, I, I aware it now.

Miao, Yanwei 01:15:05.420 – 01:15:07.340 But more understanding.

Participant C 01:15:08.100 – 01:15:09.900 Again, some understanding, yes, but.

Participant C 01:15:10.540 – 01:15:12.460 If you test me right now. okay, what.

Participant C 01:15:13.740 – 01:15:17.580 Something it means. I don't think I remember.

Miao, Yanwei 01:15:17.780 – 01:15:24.620 Okay, but you can, if you don't remember what it means, you can always find the definition there.

Participant C 01:15:26.540 – 01:15:33.580 So it's not something that I can immediately learn as knowledge, but it's something that I have something in my mind so.

Participant C 01:15:33.700 – 01:15:34.220 I have.

Miao, Yanwei 01:15:35.060 – 01:15:44.220 So do you, do you think like, overall you would say that you, your knowledge of those technologies improved a little bit after using it.

Participant C 01:15:44.700 – 01:15:52.780 On a scale of one to ten of improvement, I would say is like one, two, four, like, not like one to ten, like.

Participant C 01:15:53.420 – 01:15:54.700 For a lot.

Participant C 01:15:55.420 – 01:16:09.420 Give me some time to look through like a Google myself, what technology it is. I really, I think this is like a base that motivates me to learn more about those energy efficiency tech.

Miao, Yanwei 01:16:09.420 – 01:16:10.700 Technologies, yes.

Participant C 01:16:11.340 – 01:16:19.020 But I really like that they didn't really explain me so much that make me feel annoyed, but it's like a intro.

Participant C 01:16:20.300 – 01:16:22.860 Yeah, I brought understanding.

Miao, Yanwei 01:16:22.860 – 01:16:26.500 So you think it's a good way doing this way.

Participant C 01:16:32.020 – 01:16:35.020 Always want them to provide me some.

Participant C 01:16:36.940 – 01:16:47.180 About reliable ones, because if I could go by myself, how do I know the information I, I check is, is correct and if you are based on an institute that do the research.

Participant C 01:16:47.220 – 01:16:49.100 Exactly on this area.

Participant C 01:16:51.060 – 01:16:59.340 Give me a, some links and videos which easier for me to learn more information if I really want to know what exactly this technology is about and.

Participant C 01:17:00.340 – 01:17:08.940 Think about wow okay, This is really a nice cool technology and why don't I buy it and use it? It's good that you just only give me one.

Participant C 01:17:09.820 – 01:17:12.780 General understanding of what that means, but.

Participant C 01:17:12.980 – 01:17:14.700 Only helps me to do the survey.

Miao, Yanwei 01:17:14.820 – 01:17:15.980 But it doesn't.

Participant C 01:17:15.980 – 01:17:25.060 Help me to have a deeper understanding of the technology and also give me the motivation to really.

Participant C 01:17:26.380 – 01:17:28.140 Fascinating and want to buy it.

Participant C 01:17:28.780 – 01:17:39.020 The motions and I would say if you are doing a customer journey doing this process when I go through the prototype, then motions is very.

Participant C 01:17:40.380 – 01:17:44.780 There's not really like a wow. Okay, so cool, like there.

Participant C 01:17:45.540 – 01:17:46.700 Up and downs.

Participant C 01:17:47.340 – 01:17:53.740 Annoyed or angry. No, but it's very flat and, and neutral if that's, what you want.

Miao, Yanwei 01:17:54.380 – 01:18:01.420 Yes, actually, actually, that's partly like, because that's our, not our main focus.

Miao, Yanwei 01:18:02.740 – 01:18:05.900 Do you remember when you first saw the PV.

Miao, Yanwei 01:18:06.740 – 01:18:21.900 Green Bar and they actually exceed your demand remember, so isn't you feel surprised like, wow, actually the PV generated electricity. It's more than what I need.

Participant C 01:18:21.940 – 01:18:22.540 I.

Participant C 01:18:23.340 – 01:18:41.740 At that time I wasn't happy about it. I was just thinking about if it's like, I need money for eating and you give me more money than I need, and I would think why like, I don't need that much, so it's like you give me more energy, but I don't need that much. I, I, this is my life. This is my lifestyle.

Participant C 01:18:42.500 – 01:18:44.940 This, isn't comfort for me. You give me more.

Participant C 01:18:45.580 – 01:18:48.780 For, for what I.

Participant C 01:18:50.060 – 01:18:55.820 I won't feel like, wow, it's so nice. I have more, I mean, it's energy, it's not money, It's, it's like...

Miao, Yanwei 01:18:56.580 – 01:19:09.900 Maybe one thing I, I didn't, maybe if you don't know, it's, if you have a PV and if you generate more energy than you actually need.

Miao, Yanwei 01:19:11.220 – 01:19:15.020 Yes, the electricity goes back to the grid.

Participant C 01:19:16.340 – 01:19:17.460 Minus.

Miao, Yanwei 01:19:17.980 – 01:19:19.500 You got minus user.

Participant C 01:19:19.700 – 01:19:22.060 So in Taiwan, it's forbidden.

Participant C 01:19:23.340 – 01:19:26.540 It's forbidden because you can pay less.

Miao, Yanwei 01:19:26.540 – 01:19:36.780 Yes, that's, that's in Germany, it's the case that's why you pay less because these months you probably spend minus two hundred Euro for yours.

Participant C 01:19:37.460 – 01:19:43.820 Exactly, I know this, I know this because in Taiwan, a lot of people put solar panels.

Participant C 01:19:44.660 – 01:19:47.020 They got minus bills from the government.

Miao, Yanwei 01:19:47.660 – 01:19:48.300 Yes.

Participant C 01:19:48.300 – 01:19:49.580 Government's very angry.

Miao, Yanwei 01:19:50.220 – 01:19:52.140 Really that's weird.

Participant C 01:19:52.140 – 01:19:53.420 We're right, because.

Participant C 01:19:53.620 – 01:20:03.660 Legal to put to insert and install. There are other panels on your own. You have to ask the government for permission and stuff. It's anyway, it's about.

Miao, Yanwei 01:20:03.660 – 01:20:05.580 That's a different culture.

Miao, Yanwei 01:20:06.220 – 01:20:19.020 Yes, but now do you feel more comfortable that, actually if you, they provide more, like, if PV generates more electricity and it actually gets your money, they use.

Participant C 01:20:20.940 – 01:20:22.580 I'm happy.

Miao, Yanwei 01:20:22.860 – 01:20:23.500 Okay...

Participant C 01:20:23.780 – 01:20:31.180 I would like to know the extent like you, you said you said I can get some money back if it's like one or two cents.

Participant C 01:20:31.820 – 01:20:36.940 And I really didn't see the difference if it's one, one or two hundred euros a month, then I see the difference.

Miao, Yanwei 01:20:37.620 – 01:20:53.580 If you look at that table right now, you can see, like, for example, June or yeah, April, it's fine and the, the PV generates more than double of what your demand.

Miao, Yanwei 01:20:55.220 – 01:21:04.180 So in the whole month, you, let's say if in June, you need to pay two hundred for your energy bill.

Miao, Yanwei 01:21:04.860 – 01:21:14.100 That means you actually get minus four hundred Euro back. You get four hundred euro back.

Miao, Yanwei 01:21:16.340 – 01:21:17.460 So.

Miao, Yanwei 01:21:19.660 – 01:21:28.060 You definitely earn. That's why your energy bill like in the end was so low, it's only nine hundred for the whole year.

Miao, Yanwei 01:21:29.140 – 01:21:30.420 Yes, yes, that's.

Participant C 01:21:30.540 – 01:21:39.380 Satisfied, then I'm happy to, maybe I think after your explanations make me more motivated to install this technology.

Participant C 01:21:42.580 – 01:21:47.700 I, I think I can save some money and also save the world and why not.

Miao, Yanwei 01:21:47.900 – 01:21:59.860 Yes, yes, like the, the whole service was for making people realizing that actually you save a lot of money and you save the planet.

Miao, Yanwei 01:22:01.220 – 01:22:17.140 But, but maybe we should provide more information to make you realize that it's, it's really hoping. Yeah, and I think it's also because like, for example, you, you're your background, it's a bit different, like in Taiwan, they, they can't just simply.

Miao, Yanwei 01:22:19.300 – 01:22:24.820 So you probably have a different mindset of thinking of those extra energies.

Miao, Yanwei 01:22:25.780 – 01:22:35.700 The Germans that I interviewed, they would quickly realize. Well, I can actually get that money back, so there's also some cultural background.

Miao, Yanwei 01:22:36.620 – 01:22:38.260 Was doing something there.

Miao, Yanwei 01:22:38.900 – 01:22:47.860 Yes, yes, but, but it's really really nice, to get those insights. So now do you believe in adopting those Techn.

Miao, Yanwei 01:22:49.780 – 01:22:51.060 Energy cost.

Miao, Yanwei 01:22:54.260 – 01:23:03.100 Yes, and those are all my questions for you. I'm so thankful that you spend so much time with me. One more hour.

Participant C 01:23:03.260 – 01:23:03.860 Congratulation.

Miao, Yanwei 01:23:04.580 – 01:23:14.700 Thank you so much. and it's really a lot of insights. I'm so grateful. All right, so happy that you admit it to, to come.

Miao, Yanwei 01:23:15.380 – 01:23:17.860 Do you have any extra?

Miao, Yanwei 01:23:19.220 – 01:23:28.060 Questions or thoughts or concerns regarding the whole interview or the system.

Participant C 01:23:30.460 – 01:23:40.980 Because I think it's very interesting that you also consider that the Germans cares about data security and all the thing I insert is nothing critical.

Miao, Yanwei 01:23:42.940 – 01:23:44.860 Yes, we did.

Participant C 01:23:46.380 – 01:23:49.940 So something which I don't care about, but I think Germans care, so it's good.

Miao, Yanwei 01:23:53.780 – 01:24:03.380 Okay, then I, I believe it's, it's done this interview that really got lots of information from you.

Miao, Yanwei 01:24:07.220 – 01:24:27.060 That definitely helps. Okay, then I, I don't interrupt you too much time. You should focus on your, the, and if you want to, if you feel some, some, if you want to consult me about the, your privacy or anything regarding this.

Miao, Yanwei 01:24:27.060 – 01:24:30.260 Interview you can contact me at any time.

Participant C 01:24:31.540 – 01:24:32.820 Yeah, sure.

Miao, Yanwei 01:24:32.900 – 01:24:53.300 We can also play around with the model, the, website page, the web sending it's always there just sometimes you, like, maybe later is going to change the link, the port from eighty eighty to the general to.

Miao, Yanwei 01:24:53.380 – 01:25:02.260 The universal gate so that you only need to type flex model dot org, then it's this website.

Miao, Yanwei 01:25:03.540 – 01:25:11.220 And there will be more countries later and there might be more improvements-made laser as well, but.

Miao, Yanwei 01:25:12.020 – 01:25:13.780 Might take some time.

Participant C 01:25:13.780 – 01:25:15.060 I see.

Miao, Yanwei 01:25:16.980 – 01:25:19.500 Okay, then I stopped recording...

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