The PV Solution Guide: A Prototype for a Decision Support System for Photovoltaic Systems

Research Paper

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Abstract. Current photovoltaic (PV) consultation guides are often too rigid, failing to accommodate unique home designs or the diverse knowledge levels of homeowners. This creates significant barriers to user trust and adoption. To address these shortcomings, we present the conceptual design of the PV Solution Guide, a user-centric prototype. Our prototype addresses these issues by adapting its guidance to specific house types and varying degrees of user expertise, empowering homeowners to make informed decisions with confidence. An initial evaluation suggests that our prototype can outperform established tools, such as Solarkataster Rheinland-Pfalz, in key adoption factors such as usability and trust.

Keywords: Decision Support Systems, Photovoltaic Systems, Human-Centered Design, Qualitative Research

1 Introduction

Due to climate change (Shukla et al. 2023) and the limited availability of fossil fuels (McGlade & Ekins 2015), a transition to renewable energy is mandatory. A viable alternative to fossil fuels is using photovoltaic (PV) systems to generate electricity (IEA 2024). These systems convert sunlight into electricity, allowing homeowners to generate their own power, reduce electricity bills, and decrease their carbon footprint (Kabir et al. 2018). Nevertheless, designing an optimal PV system, tailored to each specific scenario, poses significant challenges. Consumers often lack the information needed to evaluate offers from various companies (Alipour et al. 2020, Palm & Eriksson 2018). Community forums with varied experiences, and manufacturer websites are common starting points for researching PV (Alipour et al. 2020), but this information is often biased or incomplete (Palm & Eriksson 2018). Other PV information exists online but is scattered across various sources (Palm & Eriksson 2018), and can be inaccurate (Benegal & Scruggs 2024, Palm & Eriksson 2018).

When consumers are unable to readily access trustworthy information, they become frustrated, leading to decision paralysis and ultimately, the abandonment of their plans to adopt renewable energy solutions (Rai et al. 2016, Palm 2018). This information gap creates skepticism towards available sources and makes the decision-making process overwhelming for potential adopters (Rai et al. 2016, Heiskanen & Matschoss

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2017). Trust is another crucial factor when looking for PV options (Rai et al. 2021, Reeves et al. 2017, Rai et al. 2016). As the PV market matures, potential adopters tend to shift their trust towards information sources with greater perceived objectivity and established reputations (Reeves et al. 2017). Government applications like the "Solarkataster Rheinland-Pfalz (RLP)"[1] offer trusted information but were criticized for poor user-friendliness and inability to generate specific offers (Giorio et al. 2025).

The limitations of solar cadasters include underdeveloped data visualization, incomplete integration of critical regulations such as heritage constraints, lack of transparency about data sources, and inability to detect existing installations. As a result, users are often unable to obtain personalized and actionable recommendations that cater to their unique circumstances (Giorio et al. 2025). To address these shortcomings, we propose a shift from static calculators to a dynamic consultation system. The dynamic nature of the tool is reflected in its capacity to adapt in real time, thereby enabling an interactive and personalized user experience. Instead of a fixed questionnaire, it employs a conversational agent to adjust the guidance based on the user's specific house type and level of expertise. The consultation is achieved by actively guiding the user, consolidating scattered information, and using transparent visualizations like 3D models to build confidence and empower homeowners. This approach seeks to transform the user from a passive recipient of data into an active participant in the design of their own PV system. This leads to our research question:

How can a dynamic PV system consultation tool be designed to consolidate scattered information, build trust, and personalize guidance to improve user decision making?

As the first step in this exploratory study, we present the PV Solution Guide: a conceptual prototype designed to investigate this new paradigm. It aims to counter decision paralysis by offering an adaptive, user-centric interface that moves beyond the limitations of existing cadasters. By integrating personalized guidance and transparent visualizations, the prototype serves as a tool to explore how to build confidence and simplify the adoption of a PV system.

2 Related Work

In Baginski & Weber (2017), the decision-making process involved in renovating a house to improve its energy efficiency, which also includes installing PV systems, is examined. The different stages of the decision process are illustrated. In the second stage, "information search & processing", the availability and quality of information are central points. During that phase, the consumer remains skeptical and is actively seeking information to validate their decisions to ensure they do everything right. But, more importantly, users want to confirm whether their efforts are yielding useful and reasonable results, which highlights the need for a reliable source of information.

A study by Sommerfeldt et al. (2022) revealed the gap between the demand and supply of information for household PV investments. The information demand was induced through interviews, whereas the supply was assessed by analyzing Swedish PV calculators (which are similar to the German ones like "Solarkataster RLP"). Since

[1] https://www.energieatlas.rlp.de/earp/daten/solarkataster/solarkataster-photovoltaik

homeowners, contrary to investors, often cannot afford a consultant, they rely on online calculators or, for a personalized analysis, on calculations from private companies. But online calculators often produce inconsistent results due to differences in their underlying assumptions for the calculation, such as different slopes of the roofs. This inconsistency leads to varied results for the same house when using multiple PV calculators, which erodes trust in these tools. This issue reveals the need for a neutral, authoritative information source, including results that are personal to the customer. With that, the information gap could be further closed, and simultaneously, increase the users' trust in the calculation.

Those results are also supported by Giorio et al. (2025), which focused on analyzing multiple solar cadasters provided by governments of different states. The solar cadasters are analyzed, among others, on the factors "geometric model and solar data visualization" or "the users' interaction in the solar cadaster platforms". As they show, a personalized calculation is only possible to a limited extent. Factors like inter-building reflections or elements that limit the size available on the roof for PV panels are not included. Nevertheless, these factors can substantially impact the return on investment efficiency, making it crucial to consider them in the decision-making process to ensure optimal financial outcomes. Further, the need for a user-centered design, simplifying the navigation as well as the data interpretation, is mentioned.

As shown in Gupta et al. (2022), the trust in a decision support system (DSS) can be increased by using a conversational user interface (CUI) instead of a traditional graphical user interface (GUI). They implemented a DSS for online house recommendations by using a CUI. The study revealed that users generally exhibit greater trust in CUIs compared to traditional GUIs. Moreover, the accuracy of the generated results was found to have a significant impact on user satisfaction when interacting with CUIs, highlighting the importance of providing highly accurate information to maintain user trust and satisfaction. This aligns with findings from Araujo et al. (2020). The findings of this survey, exploring the perceptions of automated decision-making across multiple domains including media, healthcare, and justice, resonate with the economic agent model's emphasis on trust as a crucial factor in harnessing the potential of AI consultants. By examining stakeholder attitudes towards automated decision-making, the survey sheds light on the importance of establishing confidence in these systems, which is essential for users to fully benefit from their advanced information processing capabilities.

A first step in creating a DSS for PV systems with the focus on personalization was done by Lopes et al. (2020). They present a new DSS for PV systems, which simulates the usage of the PV system, resulting in an estimate of the return on investment. This tool provides personalized information by using data like location or the monthly expenses for electricity for the calculation. They establish, as shown by other studies, that usability, security, and reliability are key requirements for a PV DDS, which were considered during the design of the tool. However, the user needs to possess prior knowledge of specific details like the contracted power, which often can only be supplied once they have decided on a PV system and a supplier.

We aim to bridge the gap between the supply and demand of information by designing a prototype for a DDS for PV systems that provides personalized results. This innovative approach aims to tackle key challenges such as incorrect calculations and distrust in displayed information. In contrast to the approach taken in Lopes et al. (2020), our work focuses on supporting users throughout the entire decision-making process, from the initial stages of information gathering up to the final decision.

3 Methods

3.1 User Requirements Elicitation

To gain a deeper understanding of the user requirements (UR), we employed semi-structured interviews (SSI) (in person and online) as our primary data collection method. This approach allowed us to strike a balance between using a predefined set of questions and exploring unexpected topics that arose during the conversations, thereby gaining rich insights into users' perspectives. The predefined questions are used to guide the interview and not meant as a questionnaire, which needs to be strictly followed (DiCicco-Bloom & Crabtree 2006, Hannes et al. 2022, Zowghi & Coulin 2005, Adams 2015).

The objective of the interviews was to gain a deeper understanding of individuals' information-seeking behaviors, decision-making processes, and expectations regarding PV consulting tools. We conducted information about their primary information sources, sources that were perceived as trustworthy, factors influencing the decision-making, and preferences when using a consulting tool for PV systems. Our study involves a total of seven interview partners (IPs), with ages ranging from 36 to 60 years old (mean age: 53.29 years, standard deviation: 8.92 years). Each IP had to be either a current owner of a PV system or a prospective buyer, making them a potential user of the tool without being a PV expert. Each interview lasted 30 to 60 minutes. The interview notes, with detailed information on the IP can be found in OSF - PV Solution Guide. The interviews were recorded and analyzed to find overlapping topics. To analyze the interview data, we applied a thematic analysis using open, axial, and selective coding. Two interviewers first independently performed open coding on the transcripts to break down the data into initial concepts. Through axial coding, these concepts were then grouped into broader categories, with any discrepancies in the process resolved through discussion until a consensus was reached. Finally, selective coding was used to refine and consolidate these categories into our six core URs (Corbin & Strauss 1990). Despite the small sample size, we did observe a stabilization of these core ideas across the final interviews, suggesting the primary requirements were captured.

3.2 Prototype Development & Evaluation

Based on the learnings from the first interviews, we created a Figma prototype for the PV consulting tool. The design elements were chosen to address the previously elicited URs. We evaluated the aspects of usability and trust through a multi-method approach, consisting of an interview with practical tasks, multiple surveys, and a final SSI segment. As for the UR elicitation, the IPs were potential users, but not experts in the field of PV, and the evaluation was online or in person. We interviewed twelve IPs aged 28 to 58 (mean age = 44.58, standard deviation age = 13.85) to evaluate the prototype. Each interview, including a practical test, SSI, and surveys, lasted 30 to 60 minutes. We assessed the usability of our prototype in two parts. First each IP had to complete a set of three tasks that simulated common scenarios, allowing us to evaluate how easily and effectively they could interact with the prototype:

- Setting up a PV solution that includes a battery storage system
- Comparing prices with another company's offer
- Changing a setup by removing an electric car charging station to see how it affects the cost

For each task, we gave the interview partners a background scenario and asked them to complete the task using the prototype without further assistance. We observed the IPs' interactions with the prototype, noting difficulties and instances where they needed hints to progress. Based on the feedback, we could pinpoint specific areas of the UI that required refinement, while also identifying elements that were intuitive and easy to use.

Secondly, we used the system usability scale (SUS) (Brooke 1995) to measure the usability of our prototype. The SUS is a standardized 10-item questionnaire that asks users to rate various aspects of usability on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). By aggregating the scores of each aspect, an overall score for the usability can be calculated (Brooke 1995).

To evaluate the perceived trust, we used TrustedUX (Gulati et al. 2017, TrustedUX 2020). Similar to SUS, it is a 9-item questionnaire, where users must rate different aspects of trust on a 5-point Likert scale. Next to a total trust score, a score for the following three trust dimensions (Gulati et al. 2017) can be derived from the questionnaire:

- Perceived risk: Is the use of the system perceived as risky from the user's perspective? (Question 1-3)
- Perceived benevolence: Does the system provide the necessary help for the user? (Question 4-6)
- Perceived competence: Does the system have all the necessary functionalities the user needs? (Question 7-9)

To compare the results to the current state-of-the-art, the IPs evaluated our prototype as well as an existing PV consulting tool ("Solarkataster RLP") using the two surveys SUS and TrustedUX. This allowed us to directly compare our prototype to an established solar cadaster, revealing areas where our prototype excelled or fell short. Following the questionnaire, the IPs provided feedback on both usability and trust, discussing factors that influenced their trust or distrust, and sharing their positive and negative perceptions of our prototype. The interview notes, with detailed information on the IPs, task tests, interview, and the survey results can be found in OSF - PV Solution Guide.

4 Results

4.1 User Requirements

URs outline the specific conditions or features that users expect from a tool. The 6 URs we derived from the interviews are outlined in the following and accompanied by the IPs who expressed the corresponding need during the interviews.

UR 1 - Adaptation to customer needs in terms of knowledge and house type: There is a need for a comprehensive tool that provides all relevant information in one place. Furthermore, it is essential to consider the unique circumstances of each customer's individual case. As highlighted by IP 3, current providers often fail to provide complete information, such as accounting for low light levels during winter months. (IP 1-3, IP 7)

UR 2 - Neutral information & availability of information: The information should be presented in a neutral and informative way, free from commercial intent. To facilitate informed decision-making, it is essential that all pertinent information, such as cost calculations and technical specifications, is readily available and easily accessible to users. Furthermore, the tool itself should project trustworthiness by maintaining a professional appearance and high standard of information quality. (IP 1-4, IP 6-7)

UR 3 - Access to peer experience & customer support: As a way to validate information the access to external forums is required to consult with other customers. Notably, several IPs expressed concerns that relying solely on a chatbot could lead to distrust. Furthermore, they emphasized the importance of after-sales service, as this is often a critical period when issues may arise. (IP 1-2, IP 4, IP 6-7)

UR 4 - Transparency & quality of information: Users should have access to a comprehensive and unbiased overview of all relevant information, including the necessity and implications of each data point, presented in a way that is free from commercial or market-driven influences. Additionally, the tool should enable users to compare the pros and cons of different technical solutions, facilitating informed decision-making. (IP 1-7)

UR 5 - Personalized calculation: The calculation should be tailored to each individual's specific situation, utilizing the collected information. If the tool is integrated with an energy provider's website that offers PV systems, customer data can be leveraged for calculations, provided that the customer has given their consent. This ensures the resulting PV system configuration and its financial analysis are highly customized to the user's specific circumstances. (IP 1-2, IP 3-4, IP 7)

UR 6 - Interaction & communication with the online consultant: A clear communication between users and the tool should be guaranteed. It should provide the option to switch to personal consulting if desired by the user. A trustworthy chatbot is acceptable, yet without the appearance of being a chatbot. Last but not least, it is imperative to have robust data security measures for personal data. (IP 1-2)

4.2 The PV Solution Guide Prototype

The PV Solution Guide features a dynamic questionnaire driven by a conversational agent (CA) powered by a large language model (LLM), which is able to take the unique characteristics of the users' house into account and adjust its guidance to match the users' level of knowledge. CAs are software-based systems that are able to interact with a user in natural language (Feine et al. 2019). An LLM is a type of artificial intelligence that is trained on a vast amount of data, such that it is able to understand and generate human language in the form of text (Zhao et al. 2023), which is why they are commonly used to implement CAs. The idea to use a CA for the PV solution guide is founded on the "Computers Are Social Actors" (CASA) paradigm, saying that humans acknowledge computers as social actors (Nass et al. 1994). That means humans elicit a wide range of social behavior when interacting with computers, whereas the machine does not possess feelings. Especially CAs often have various social cues leading to an increase in perceived trust. (Cassell & Bickmore 2000) shows that if technology follows interaction rituals, like greetings, the human perceives the technology as more trustworthy. Therefore, with the use of a CA that features different social cues, we aimed to increase the perceived trust. Further, our goal was to enhance the user experience by improving usability, which we achieved by eliminating unnecessary complexity and designing an intuitive system that fosters user confidence and facilitates effortless interaction.

We designed an interactive prototype with the help of Figma[2], the PV Solution Guide[3]. We used interactive elements like buttons or drag-and-drop-like features to visualize the desired functionality. No LLM or 3D modeling functionality is included in the prototype, only mock-ups to demonstrate the usage are included. The chat conversation with the CA is only represented through a fixed example conversation. In the following paragraphs, the prototype, with its different design elements, is explained more closely.

Before starting the conversation with the CA, the knowledge state of the user must be established. There are three levels the user can choose from: "just started to inform myself" (little knowledge), "already gathered some information" (moderate knowledge), and "strong knowledge. I want to compare offers" (extensive knowledge).

For users with little or moderate knowledge, the next step is a short form to collect all necessary information for the following chat. Users can input specific details about their house, e.g., its location. Additionally, users have the option to upload photos of their house, particularly of the roof, such that a 3D model of the house can be created. This 3D model is then subsequently displayed in the following steps.

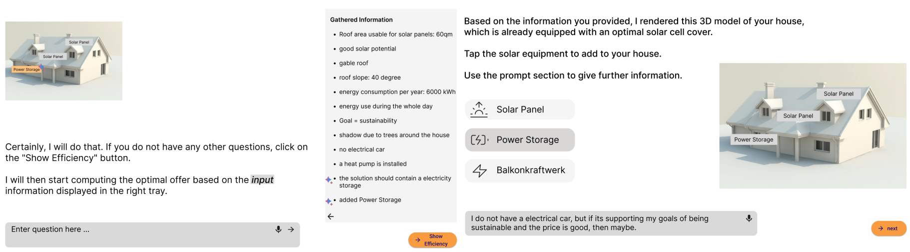

Figure 1. Left: Example screen for the chat with the CA
Right: Screen where the 3D model can be altered by the user

After that, the chat with the CA is started (see Figure 1 on the left side). During the entire chat process, the 3D model of the house is constantly shown and adjusted,

[2] https://www.figma.com
[3] https://figmashort.link/Ctf7Hd

depending on which tools the customer considers to include. For example, if a user indicates that they require a wallbox due to owning an electric vehicle, the system automatically adds this component to the 3D model. This visualization is one way to ensure transparency and understandability. Another is the gray box on the right-hand side of the screen, named "gathered information". This feature provides a comprehensive summary of all the information gathered throughout the conversation and the initial data collection. This approach enables users to track which information is relevant and has been collected, while also allowing them to easily identify any misunderstandings. These can then easily be corrected by simply notifying the CA.

Customers with moderate knowledge also have the opportunity to first adapt the 3D Model of their house according to their desires (see Figure 1 on the right side) with the help of drag-and-drop elements, before starting the conversation with the CA. Additional information, like the preference for using a wallbox, can be entered into the text field at the bottom of the screen. Following this, users are directed to the conversation with the CA, where any additional necessary information can be collected. This intermediate step speeds up the questioning process but also provides the users an easy way to communicate their desires and conceptions.

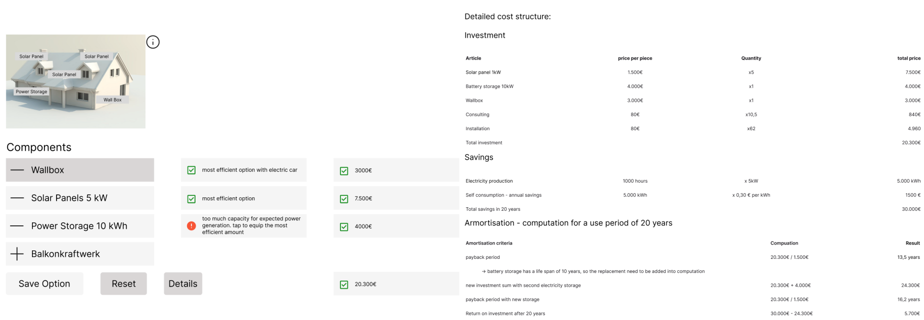

Figure 2. Left: Offer Overview given by the PV Solution Guide prototye
Right: Detailed cost structure for the chosen offer

Once all necessary information has been collected, users can proceed to the results page, where their personalized offer is displayed, as illustrated in Figure 2. This page has two objectives: displaying a transparent offer and providing the option to compare different component constellations. To provide a transparent offer, we present not only all components and associated costs (Figure 2 left side), but also a detailed breakdown of the calculations and amortization (Figure 2 right side). Users can easily compare the effects of various components on the overall calculation by adding or removing individual components via the plus and minus symbols located adjacent to each component's name. One could, e.g., assess the impact of a wallbox on the costs and amortization by clicking on the minus sign of the wallbox button, triggering a new calculation. After deleting the wallbox, not only is the offer recalculated, but also the 3D model is adapted accordingly. Each offer variant can be saved and revisited later to compare them. In Figure 2 on the right side, the detailed amortization computation is shown, which can be reached by scrolling down on the overview website or clicking on the button "Details".

The user with the desire to compare his offers is directed to this results page without the conversation with the CA in between. The user must first upload at least one competing offer. The PV Solutions Guide then generates a new proposal based on the uploaded offer, allowing the user to toggle between the guide's result and the original competitor's offer for comparison. The differences between the offers are highlighted in green and red, providing a clear visual indication of the strengths and weaknesses of each offer.

Table 1. Evaluation of prototype features against user requirements

UR	*Feature in the prototype*
UR 1	Adaptation to knowledge: knowledge level questionnaire
	Adaptation to type of house: chat with CA & 3D model of the house
UR 2	Neutral information: CA as an unbiased advisor
	Availability of information: CA as a universal information provider
UR 3	Not included
UR 4	Transparency: "gathered information" box next to the chat, 3D model of the house, which is adapted & detailed cost structure on the result page
	Quality of information: can only be ensured by training the LLM properly
UR 5	Individualization: personalized questionnaire through the conversation with the CA, 3D model of the house, highly customized summary of amortization and costs & ability to compare different offers
UR 6	Clear communication: "gathered information" box next to the chat
	Switch to human consultant: not included

Our prototype was designed with the goal of addressing as many URs as possible. Table 1 highlights which UR is met through which design element. As shown, most requirements were met through various components of the solution. The UR 1 was handled with the initial questionnaire and 3D modeling capabilities. The CA approach, powered by LLMs, enabled the provision of neutral information and ensured the availability of relevant data, thereby fulfilling UR 2. Transparency and information quality (UR 4) were covered through explicit information tracking during the chat (the "gathered information" box), but also through displaying detailed cost and amortization structures. One of the main characteristics of our prototype is the high level of individualization (UR 5). This is achieved by utilizing a 3D model to visualize the house and leveraging a CA, enabling consultations to be based on any type of house. UR 6 is implemented through the information tracking functionality ("gathered information" box), allowing the user to track the data used to calculate the offer. UR 3, which called for external forum links and after-sales service capabilities, was not implemented in the current prototype version. Also, the switch to a human consultant, which is part of UR 6, is not included. However, this functionality can be incorporated into the design of the LLM-powered CA during the implementation phase.

4.3 Evaluation of the Prototype

As shown in Rai et al. (2021), Reeves et al. (2017), and Rai et al. (2016), trust is a critical factor for adaption. Further, Giorio et al. (2025) showed that poor usability causes poor adoption. Accordingly, we assessed the usability and trustworthiness of the prototype presented in section 4.2, as these factors are crucial for user adoption. The evaluation was conducted as presented in section 3.2, so with the help of surveys, practical tasks and an SSI part.

We used the SUS (Brooke 1995) to evaluate the general usability. As shown in Figure 3, our prototype achieved a SUS score of 80.21 points, significantly outperforming "Solarkataster RLP" with only 56.04 points. The IPs appreciated our prototypes' clear single-task-per-screen approach, interactive style, and accessibility for those with limited PV knowledge. The results page with cost calculations received positive feedback, though some suggested to improve the visualization by using more diagrams similar to "Solarkataster RLP". Areas for improvement include button placement consistency and clear visual indications to add or remove components from the offer.

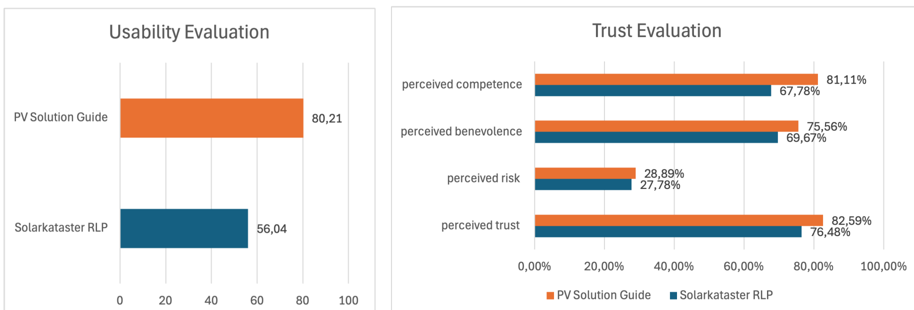

Figure 3. Results of the usability evaluation with SUS and the trust evaluation with TrustedUX

Our prototype achieved a higher perceived trust score (82.59%) compared to "Solarkataster RLP" (76.48%), as shown in Figure 3. Breaking this down by category: the perceived risk, when using the tool, was slightly better for "Solarkataster RLP" (27.78% vs. 28.89%), but our prototype excelled in perceived benevolence (75.56% vs. 69.67%) and especially in perceived competence (81.11% vs. 67.78%). Key trust factors in our prototype included transparency (cost structure and information collection), individualization (adaption to the user's knowledge state and housing condition), and the 3D house model effectively combining both concepts. Some users expressed provider-related trust concerns, suggesting clearer data security explanations would be beneficial.

Table 2. Advantages of our prototype over "Solarkataster RLP" mentioned by the IPs

Advantage	*IP*
Faster and easier to use	1, 2, 3, 10, 12
Detailed offer computation & comparison of offers	1, 6, 8, 10, 12
Visual component, the 3D model	1, 4, 5
Little prior knowledge needed due to better guidance by conversational agent	3, 5, 11
More friendly and human-like	1, 8

Ten of twelve IPs identified advantages of our prototype over "Solarkataster RLP". They mentioned more comprehensive calculations, easier handling for PV beginners, visual components and a more human-like interaction experience as shown in Table 2.

5 Discussion

5.1 Contributions and Implications

A significant advantage of the proposed PV Solution Guide is its potential to democratize access to PV system consulting, reducing customers' reliance on private companies and mitigating the risk of biased advice. By providing personalized information tailored to the user's level of knowledge, our prototype empowers homeowners to make informed decisions about their PV systems. Additionally, the room for error can be minimized and reliability can be maximized for private companies when they use the tool to advise potential customers and generate offers for them.

Conventional online calculators, such as "Solarkataster RLP", are often restricted to standard house types (Sommerfeldt et al. 2022), limiting their usefulness for homeowners with non-standard situations. In contrast, our prototype is designed to be adaptable and inclusive, allowing for any type of house. This feature, but also the ability to adjust to the users' varying levels of knowledge, closes the gap between information demand and supply. As a result, accessibility is increased, which has significant implications for the widespread adoption of PV energy, as it can help overcome existing barriers to entry and promote more informed decision-making among potential PV system owners.

The combination of detailed user information and the usage of a CA powered by an LLM allows for the integration of crucial factors like inter-building reflections or the size of the area where PV panels can be installed (Giorio et al. 2025). This approach enables the calculation of results with the highest possible degree of accuracy. This, but also transparency features like the detailed cost structure or the "gathered information" box, cause our prototype to have a higher trust-level than common cadasters, while maintaining good usability.

5.2 Limitations & Future Research

Our approach has methodological limitations, primarily related to the interview and survey methods used to gather URs and evaluate the prototype. On the one hand, a purposeful sampling involving homogeneous interview partners with shared characteristics (DiCicco-Bloom & Crabtree 2006) is important. As the IPs were mainly acquaintances, this requirement is not met. On the other hand, data collection and qualitative data analysis are performed concurrently and iteratively until a saturation point is reached (DiCicco-Bloom & Crabtree 2006). As we had a small sample size, a bias may have been introduced, and the saturation point may not be met. Therefore, additional interviews for the prototype evaluation as well as the UR elicitation need to be conducted, especially including underrepresented user groups.

Furthermore, the evaluation of our prototype is inherently limited, as it is a Figma prototype, not a fully implemented tool. This means that users can only provide heuristic estimates of the interaction experience based on the conceptual interactions presented in the prototype, rather than actual hands-on use. For example, we only provided a sample conversation, rather than enabling users to interact with an actual CA. Therefore, the (dis)advantages of communicating with a CA in contrast to a fixed questionnaire, as used in other cadasters, cannot be assessed or measured. Hence, the current evaluation results are biased. To be able to evaluate the functionality of the tool properly, the prototype should be implemented for future evaluations. This gives the opportunity to measure the impact of using an LLM, but also helps to identify weaknesses in the current UI. Yet, implementing this tool also presents several challenges. The application of LLMs in this context poses two significant hurdles. First, the phenomena of hallucinations, where LLMs make up untrue facts (Shuster et al. 2021), need to be reduced. Secondly, the issue of "goldfish memory" (Xu et al. 2021) poses a challenge, as LLMs tend to suffer from weak long-term memory, leading to the forgetting of previous conversation context in prolonged interactions. One approach to mitigating these limitations is Retrieval-Augmented Generation (RAG), which enables the LLM to supplement its pretrained knowledge by retrieving relevant information from external knowledge bases, thereby enhancing the accuracy and contextuality of its generated outputs.

As we conducted exploratory research, our design choices are currently not linked to established constructs like trust models. An introduction and linkage of such constructs to our design elements, like the 3D model, the LLM chat, or the cost transparency, would help to further prove the effects on trust. Further, with those constructs we would have the possibility to test hypotheses, giving the opportunity to evaluate the design choices and their effect on trust and usability more closely.

Lastly, UR 3, which pertains to the desire for customer support and forums, is currently not incorporated into the prototype. As several IPs emphasized the importance of forums in their decision-making process, it is recommended that this feature should be integrated into future developments.

6 Conclusions

The development of the PV Solution Guide prototype represents another step in helping consumers orient themselves through the often confusing world of PV solutions. We aimed to create a prototype for a single information source and a user-friendly tool that can be adjusted to each user's knowledge level as well as specific housing conditions. Key URs were identified through interviews with potential users. These requirements formed the foundation for the prototype's design, and efforts were made to incorporate as many of them as possible into the design, with only one requirement not being covered by any features. The prototype's ability to address various types of houses and the users' expertise, along with its focus on ease of use and trustworthiness, differentiates it from existing tools like the "Solarkataster RLP". Through an evaluation, with the focus on usability and trust of the prototype, we showed that we increased the level of trust and usability compared to existing tools like "Solarkataster RLP". However, there were some limitations regarding the project. Especially the small sample size, the low variety of IPs, and the usage of a prototype limited the validity of the evaluation.

Therefore, further development and testing are needed to realize its potential and investigate further possible problem factors. Important is to address the LLM-related challenges, like data privacy, hallucination, and the goldfish memory, when implementing the prototype. Although the development of the PV Solution Guide presented several challenges, the overwhelmingly positive feedback from users suggests that it has the potential to address a significant need in the market.

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