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Wissen, wo das Wissen ist.



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Original research article

The easy way of participating in energy transition — Investigating the purchase intention for plug-in solar devices using an extended theory of consumption values

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ABSTRACT

Renewable energies, such as solar, are essential to combat climate change. Plug-in solar devices (PSD), a form of photovoltaic systems, provide a simple way for consumers to participate in the energy transition, as the devices are smaller and more affordable. However, there is still a need to understand, why consumers purchase those devices. We assume that the Theory of Consumption Values (TCV) might be useful to better understand consumers' purchasing behavior. To test this assumption, we conducted two studies. A qualitative study to test the suitability of the TCV and further determinants for a possible extension, leading to the theory being expanded with two additional values, namely environmental value and autarky value. To empirically test our modified theory, we secondly conducted a survey study ($n = 445$). Using structural equation modeling, we found that 64.4% of the variance of the purchase intention toward PSD can be explained by our modified theory. In particular, our data showed that functional value price, conditional value, epistemic value, as well as social value have a positive influence on the purchase intention. Based on these results, several managerial, policy, and theoretical implications are discussed.

1. Introduction

Increasing global warming leads to climate change and presents the world with major sustainability-related challenges [1]. Human activities like consumption and production patterns are the primary reason for global warming and thus climate change [1,2]. To protect the planet and fight climate change, global climate targets have been set up in the *Paris Agreement* as well as 17 Sustainable Development Goals (SDG) in the *Agenda 2030* targeting several sectors [3,4]. SDG 7 targets the energy sector as it plays a crucial role in climate change being one of the main producers of climate-damaging greenhouse gases [5–7]. Energy resources can be divided into two categories: renewable and non-renewable energy [8]. Non-renewable energy includes fossil fuels such as coal, oil, gas, which have a negative impact on the environment being a main contributor to climate change [6,9]. Currently, over 80% of the globally produced energy is based on fossil fuels producing climate damaging emissions [6,10]. In contrast, renewable energies such as solar, wind, and hydro offer multiple positive effects as they produce much lower emissions, reduce air pollution, and are replenished by nature [6]. Therefore, they are key to fighting climate change [6,9]. Increasing the share of renewable energy is an essential part of goal 7

included in the SDG [5].

Solar photovoltaic (PV) belonging to the renewable energies is recently the most prominent and fast-growing renewable alternative being an integral part of the global energy transformation [11]. Solar PV uses sunlight to produce electrical energy [9]. PV systems allow individuals to become their own energy producers, especially in the case of residential PV systems [12]. Thereby, consumers also take on the role of producers and thus become *prosumers* [13], contributing to the share of renewable energies and sustainability [14]. Against this background, another form of PV systems are plug-in solar devices (PSD), which are small PV systems that can be installed, e.g., in gardens, on balconies, or on garage roofs [15]. Unlike PV systems, they are more affordable (e.g., a standard device costs approximately €200–400) and can be installed independently without great technical effort [16–18]. PSD directly supply the households with the produced energy using a standard household plug [15]. They offer the huge advantage of not being limited to a specific target group, as they can be used by tenants or people living in apartments [19]. Furthermore, they offer a low threshold way to participate in energy transition on a decentralized level [16,19]. Accordingly, PSD address SDG 7.1, which is: “By 2030, ensure universal access to affordable, reliable and modern energy services” [20].

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Therefore, a dissemination of PSD is desired in order to contribute to a higher share of renewable energy in the worldwide energy mix, being part of SDG 7.2 [20]. PSD are already highly recognized in many countries—especially across Europe, being permitted in, for example, Austria, Switzerland, and Spain [17,21–23]. In particular, in Germany, it is a rising trend with around a million installed devices [24,25]. In the US, PSD are also on the rise, with Utah being the first state to allow these devices; however, standards have yet to be developed [17,25].

PV systems, and solar energy in general, have already gained recognition in literature as they have been broadly researched. Early studies focused on factors influencing consumer purchase intention and decision-making, applying various theories such as the theory of planned behavior [12,26,27], social influence theory [28], the technology acceptance model [29,30], and the unified theory of acceptance and use of technology 2 (UTAUT 2) [31]. Other studies have researched possible peer effects [32,33]. However, in contrast to this literature, PSD are less empirically researched. This research gap is astonishing because PSD and PV systems are different in many ways. First, PSD, with their significantly lower costs, could be seen as a “low-budget prosumption technology,” whereas the purchase of PV systems is associated with high investments and seen as a “high involvement decision” [18,30,34]. Second, the devices' easy accessibility (e.g., price, simple installation) implies that it is more likely to be situated in the consumer sector [16–18]. That said, PSD, like PV systems, can both be considered as prosumption technologies; however, PSD are primarily, if not solely, used for personal (household) consumption [15]. In contrast, it can be assumed that consumers take on the role of producers even more in the context of PV systems, as the electricity generated is also fed into the public power grid and thus sold [14,35]. Against this background, it can be assumed that the purchasing process for PSD should differ from that for PV systems, thus calling for specific research.

To close this gap, Molnár and Szép [36] recently applied UTAUT 2 to better understand purchasing decisions regarding PSD. To complement, this study aims to make an additional theoretical contribution by using an alternative theoretical approach—that is, applying the theory of consumption values (TCV) [37], and extending it, based on a qualitative study, with two additional values. Therefore, the goal of this study is to empirically test the ability of TCV to explain prosumers' purchase intention toward PSD. Accordingly, this paper wants to shed a light on the following research question: *What consumption values influence the purchase intention toward PSD?* Based on the empirical findings, the paper also discusses how the dissemination and implementation of PSD can be promoted.

To answer this research question, this paper is structured as follows: In the next section we will provide the theoretical framework—including an explanation of the TCV—and derive some hypotheses, resulting in a research model. Regarding our empirical study, we will next describe our methodology including the qualitative study, measures, the sample, and the data collection. Then we present the results of our quantitative survey study, discuss them, and derive some implications for policymakers, management, and theory. Finally, we will sketch some limitations and end up with a conclusion.

2. Theoretical framework

2.1. Theory of consumption values

The TCV was first introduced by Sheth et al. [37]. It aims to predict, explain, and describe why consumers buy specific brands or products [37]. Biswas and Roy [38] defined a consumption value as “the degree of fulfillment of consumer need by overall assessment of consumers' net utility or satisfaction from a product after comparing the gains with the gives.” However, the TCV only considers benefits and does not take sacrifices into account [39]. Sheth et al. [37] differentiated five consumption values influencing consumers' choice behavior: *functional value*, *social value*, *emotional value*, *conditional value*, and *epistemic value*.

These values are independent and the “consumer choice is a function of multiple consumption values” [37]. A consumer's decision can be influenced by all five or just one value [37]. Sheth et al. [37] also explained that consumption values contribute differently depending on the specific choice context. They illustrate that in the same situation the consumption values have a differentiated influence depending on the person [37].

Sheth et al. [37] applied the TCV to the context of cigarette smoking to explain the buying decision, product decision, and brand decision. However, the theory can be used for different products and product categories (e.g., consumer durables, industrial goods, or even services) [37]. It has already been tested in more than 200 applications [37], including green products in general [40–42], but also specific, e.g., green IT [43] or biofuels [44]. Beyond that, Grębosz-Krawczyk et al. [45] used the theory in the context of PV panel installations. In addition, Mahendar [46] examined the purchase intention toward solar energy systems. However, it has not been applied to the context of the prosumption-enabling technology PSD.

As already depicted, the theory has been applied to various contexts and has thus evolved over time [47] with regard to the existing five values, which also resulted in another value, namely *convenience value* [48]. This value focuses on the simplicity of use, accessibility, and availability of a product or service [46]. It has been tested, for example, by Pura [48] in the context of location-based mobile services and by Mahendar [46] in the context of solar systems. Based on the characteristics of PSD described in Section 1, convenience value could also be relevant in this context. Therefore, the following six values are considered: *functional value*, *social value*, *emotional value*, *conditional value*, *epistemic value*, and *convenience value*.

2.2. Hypothesis development

2.2.1. Functional value

According to Sheth et al. [37], functional value is assessed as the primary driver of consumer choice and is based on the economic utility theory. They describe the value as “the perceived utility acquired from an alternative's capacity for functional, utilitarian, or physical performance” [37]. Attributes such as price, reliability, and durability can determine the functional value [37], whereby Sweeney and Soutar [49] described that reliability and durability are seen as a component of quality in other value models. They suggested that price and quality are functional subconstructs contributing separately and should be measured accordingly [49]. In terms of price, Sweeney and Soutar [49] described the variable as “functional value (price/value for money),” wherein the utility of the product arises from “the reduction of its perceived short-term and longer-term costs” [49]. Regarding the quality, the utility results from the perceived quality of the product and also from the expected performance and, according to Sweeney and Soutar [49], it is referred to as “functional value (performance/quality).” Price and quality are important factors in purchase decisions, particularly in the context of green products [38]. In this context, studies have shown that functional value positively influences the intention to adopt green IT products [43] and willingness to pay for biofuels [44]. In the context of biofuels, the consumers' willingness to pay depends on whether the price is reasonable, but also on the quality of the biofuels in terms of engine performance not being impaired [44]. Regarding PV systems, studies have revealed that the attitude toward the systems is positively influenced by financial gains—PV system is profitable and a secure financial investment—and is one of the main predictors [12,26]. Furthermore, studies have shown that if the costs of the PV system are perceived as high, it negatively influences the attitude toward it, indicating that costs are the primary obstacle for switching to solar [12,30]. Grębosz-Krawczyk et al. [45] confirmed the positive impact of functional value on consumers' choice behavior for PV panel installations. Against this background, and in line with the separate measurement according to Sweeney and Soutar [49], we hypothesize the following:

H1. . Functional value price positively influences the purchase intention toward PSD.

H2. . Functional value quality positively influences the purchase intention toward PSD.

2.2.2. Social value

Social value can be defined as “an alternative's association with one or more specific social groups” [37]. This value is closely linked to the construct subjective norm within Azjen's theory of planned behavior, which explains behavioral intention [50]. Subjective norm refers to the behavior of peers and there along the social pressure that triggers a certain behavior [50]. Sheth et al. [37] stated that consumers choose products based on their social image and less for functional reasons, especially products that have a high visibility (e.g., clothing or jewelry) and are shared with others. This also applies to products where the focus is expected to be on the functional value, such as a car [37]. Especially in the context of green products, social value plays an important role as studies have shown that green purchasing behavior is influenced by social value [41,43,51–53]. Green consumption behavior is influenced by how one's own behavior is perceived by others [54]. By purchasing and consuming green products, consumers can achieve a certain social status, being recognized as an environmentally responsible person with moral and ideological values [54]. Suki and Suki [52] highlighted the importance of social value encouraging consumers to express their environmental concern by buying green products. In the context of energy, earlier studies have validated the influence of social contacts on the intention to use green electricity [55]. This can also be confirmed for the adoption of PV systems, where factors such as social influence, social interaction, or peer effects in general have a strong influence [28,56,57]. In particular, the communicative exchange with the social environment as well as the visibility of the device were influential factors, which have already been confirmed in studies on PV systems [8,28,58,59]. However, there are also a few contrary results, which have shown that social values or social interaction do not influence the consumers' choice behavior for green products and also PV system or solar energy [42,45]. Based on these results, the following hypothesis is proposed:

H3. . Social value positively influences the purchase intention toward PSD.

2.2.3. Epistemic value

Epistemic value describes the ability of an alternative to offer novelty, satisfy the desire for knowledge, and arouse curiosity [37]. The value can occur if the consumer is bored with an old product or brand and therefore seeking novelty [37]. Lin and Huang [42] stated that one of the main factors influencing the consumer choice behavior regarding green products are novelty seeking and the desire for knowledge. Similarly, epistemic value has a significant positive effect on the purchase intention for convergence home robots [60], adoption intention for green IT products [43], and the willingness to pay for biofuels [44]. In the context of PV systems, studies have shown that the consumer's innovativeness has a significant positive influence on the purchase intention of those systems [27,61,62]. That is, the more open consumers are to environmentally innovative technologies, the more likely is the usage of PV systems [61]. Furthermore, interest in technological innovations and enjoyment of the technical aspects of energy systems are seen as motivating factors for the adoption of electric solar systems [63]. Therefore, we offer:

H4. . Epistemic value positively influences the purchase intention toward PSD.

2.2.4. Emotional value

Emotional value refers to the perceived benefit of an alternative if it causes certain feelings, emotions, or affective states [37]. Emotional value arises when certain feelings are associated with a product and are

triggered by it [37,49]. Sheth et al. [37] gave the example that certain foods are associated with childhood experiences and therefore release a feeling of comfort. In the context of green consumption, emotional value refers to the utility that arises from the emotions triggered by environmentally friendly consumption [43]. Consequently, emotional value positively impacts the adoption and purchase intention, as well as the consumers' choice behavior, regarding green products [42,43]. Lin and Huang [42] explained that people have a positive feeling of doing something good for society and themselves when they perceive environmentally conscious behavior as a contribution to environmental protection. This was also confirmed by Zailani et al. [44] in the case of willingness to pay for biofuels. Regarding PV systems, previous research has shown that the purchase intention is positively influenced by emotional value [46]. Based on the results of previous studies, we assume that emotional value is also a relevant factor contributing to the purchase intention for PSD. Therefore, we hypothesize:

H5. . Emotional value positively influences the purchase intention toward PSD.

2.2.5. Conditional value

Sheth et al. [37] described conditional value as “the perceived utility acquired by an alternative as the result of the specific situation or set of circumstances facing the choice maker.” Accordingly, the benefit of a product or an alternative depends on the specific situation and circumstances, as some products can be characterized by the fact that they have a seasonal or a ‘once in a lifetime’ value [37]. Therefore, situational factors such as time and place can affect consumers' choice behavior [64]. In the context of green products, studies have confirmed that conditional value significantly affects the consumers' choice behavior regarding green products [42] and the willingness to pay for them [44]. This can also be adapted to the context of solar or PV systems as a study has shown that facilitating conditions affect the consumers' behavioral intention to use solar PV [59]. Similarly, financial incentives from the government, such as subsidies, strongly influence consumers to install or adopt PV systems [27,58,65]. As studies have indicated that situational factors impact the adoption intention and consumer behavior regarding PV systems, we assume that this also applies to PSD. This results in the following hypothesis:

H6. . Conditional value positively influences the purchase intention toward PSD.

2.2.6. Convenience value

Convenience value can be described as the perceived value that arises from the simplicity of use, accessibility, and availability of a product or service [46]. The construct is closely linked to perceived ease of use within the technology acceptance model by Davis [66]. The factor describes the extent to which the use of a certain technology is associated with effort for a person [66] and is therefore easy to understand, operate, and maintain [30]. In the context of PV systems, studies have shown that perceived ease of use positively affects the attitude toward PV adoption [29,30]. Against this background, and due to the fact that PSD in particular are characterized by its ease of installation compared to PV systems [16], the following hypothesis is assumed:

H7. . Convenience value positively influences the purchase intention toward PSD.

From our hypothesis development, the question arises as to whether the previously derived values fully explain the purchase intention for PSD. This is due to the fact that, although PSD are also referred to as small PV systems [15], they differ from them in many respects, as highlighted in Section 1. The question also arises because previous studies regarding PV systems have shown that there is still unexplained variance (e.g., [12,29,46]). Thus, before conducting an empirical quantitative study, a qualitative study was carried out to determine whether the previously derived values are reflected as well as whether

other values could be relevant in the context of PSD and if an extension is necessary.

3. Methodology

3.1. Qualitative study

To test the comprehensiveness and suitability of the conceptual model as well as further possible context-specific determinants influencing the purchase intention, a qualitative study was conducted. This was mainly due to the fact that the theory has not yet been tested in the context of PSD, and the main study aimed to generate the highest possible variance explanation. Thus, the study was conducted as part of qualitative focus groups with PSD owners. The aim of the focus groups was to identify main reasons for buying a PSD. We performed two focus groups with six participants each and a duration of 2 h. The participants were all men aged between 26 and 71. As the focus groups were part of a project (called “MehrWertRevier”) with a project partner, a call for participation was issued to find people who own a PSD. As a result, only men participated in the project and therefore in the focus groups.

The focus groups were conducted as semi-structured interviews and were audio recorded. In this process, the focus groups started with introductory questions on the topic PSD, followed by the core questions regarding the reasons for purchasing the device and also possible obstacles. The focus groups ended with concluding questions and a summary. The analysis of the focus groups consisted of two steps. First, the audio recordings were transcribed, smoothed (to increase readability), and anonymized. Second, the final transcripts were analyzed using the Gioia method, which is an approach to conduct qualitative inductive and grounded theory research [67]. The analysis was carried out in three steps: Starting with the first order analysis, in which first-order categories/codes were formed, closely following the terms used by the informants [67]. In the second step, the number of first-order categories was reduced to a smaller number of second-order categories by identifying similarities and differences [67]. Third, it was examined whether it was possible to further summarize the second-order categories into “2nd-order aggregated dimensions”¹ [67]. The analysis resulted in five “2nd-order aggregated dimensions”: (1) price as a reason and motive to purchase, (2) other reasons and motives for purchase, (3) peer influence, (4) additional sources of information, and (5) barriers to purchase and use.

The first dimension “price as a reason and motive to purchase,” focuses in particular on the price of the device, its profitability, and the potential for saving money. For example, the following comments were made: “It worked well right away and has also paid off relatively quickly”; “You don’t have to spend thousands of euros first, €500 or whatever amount is enough”; and “[...] but also that I have savings in it.” This shows that, according to the TCV, functional value price plays a relevant role in the purchase of PSD. This is also highlighted by the fact that price as a reason and motive to purchase represents an own second-order aggregate dimension. Furthermore, conditional value is also reflected in this dimension as it includes the topic of subsidies and also rising electricity prices, which represent situational contexts. For example, the following was said: “[...] then, by chance, I became aware of one or two support programs offered by our city and also by the local authority, and I said to myself, OK”; and “That was, of course, also due to the rising electricity prices that were coming.”

The second dimension “other reasons and motives for purchase” is particularly noteworthy, as it not only confirms the values of the theory but also contains new elements that are not covered by the TCV. With

¹ Please note that the term “dimension” is based on the application of the Gioia method [67], while the term “value” is a specific term used in the TCV. However, in the context of the TCV “dimension” can result in (new/additional) “values.”

regard to the confirmation of existing values, it can be emphasized that this dimension addresses epistemic value, convenience value, and emotional value. This is because the dimension includes, among others, the second-order category “interest in technology, fun, and simplicity.” Regarding epistemic value, the construct highlights topics such as interest in technology and interest in experimentation. In the focus groups, for example, the following was said: “Then, just out of curiosity and a desire to tinker, I simply said: I’ll give that a try, too [...].” Regarding convenience value, the simplicity of the device was also pointed out in the focus groups: “Then, what ultimately convinced me was the ease of installation. [...], because it was totally easy”; “[...] above all, a simple implementation option”; and “And I think it’s totally awesome that nowadays you can just plug it in.” Furthermore, emotional value is included through the fun and enjoyment of the device as participants stated: “I think that’s really great, and in that respect, it’s simply the joy of doing it”; and “Yes, unless, like me, you just say, I think it’s great to have, whether it makes a profit or not, because I enjoy it.” These statements refer to emotions that are related to the use of PSD, i.e., post-purchase emotions. With regard to the investigation of the purchase intention, pre-purchase emotions were considered in the following quantitative study.

The dimension also included new elements that were not covered by the existing values. In particular, it should be emphasized that the participants addressed the topic of autarky as a reason for purchasing PSD. They mentioned that the possibility of generating own electricity and being independent of the electricity supplier were reasons for their purchase. The following comments, for example, were made: “Not even to save money, but simply because of this idea: I am able to generate electricity myself and use it directly [...]”; “Looking back, however, I would say that even if I hadn’t received the subsidies, it would still have been worth it, simply so that I can say: 1. I am a little more independent from the electricity supplier, [...].” The relevance of self-sufficiency in the context of PV has also been highlighted in previous studies on PV systems, as studies indicate that the strive for autarky is a strong factor predicting the attitude toward PV systems as well as influencing the purchase intention [12,68–70]. Based on the findings of the qualitative study, and in line with literature on PV systems, we extend the TCV and add autarky value to the conceptual model. In addition to the topic of autarky, another new element was addressed—namely, the possibility of making a contribution to the energy transition and climate protection by purchasing the PSD, also with regard to having a clear conscience. In this regard, participants said, for example, the following: “And my personal motivation has always been to contribute to the energy transition and do my bit to combat climate change”; and “I am fundamentally interested in sustainable power generation, and I also did this to make my own small contribution to the energy transition.” This topic is also highlighted in literature regarding PV systems or solar energy, as studies have shown that environmental concern, awareness, and responsibility are relevant factors influencing the attitude toward PV, as well as the purchase intention [26,30,31,58,71]. In contrast, environmental value has also been tested in the context of PV systems showing no effect on the purchase intention [45]. Against this background, we add environmental value to the conceptual model. The addition of these two new values results in the following additional hypotheses:

H8. . Environmental value positively influences the purchase intention toward PSD.

H9. . Autarky value positively influences the purchase intention toward PSD.

The third dimension “peer influence” includes, for example, the communicative exchange with the social environment as an impulse for the purchase or the initial contact with PSD. Participants, e.g., said the following: “Yes, my buddy said it’s good, so I’ll do it too”; and “Many colleagues have already been pioneers in this area, saying that they have equipped themselves with a photovoltaic system or a geothermal pump, or whatever. That was the turning point for me.” This dimension reflects that

the social environment plays a relevant role in the purchase of PSD, which in turn confirms the relevance of social value in this context.

In addition to the motives outlined above, the focus groups also revealed two further dimensions: (4) additional sources of information and (5) barriers to purchase and use. In view of the subsequent empirical quantitative study, these dimensions will not be examined further, as the aim was to determine whether the existing values can also be confirmed in the context of PSD and whether new additional values could also be of relevance.

Regarding functional value quality, it can be noted that this value was also partially reflected in the focus groups, but cannot be assigned to any of the dimensions mentioned above. In this regard, the following statements were made: “*And if I had known that it works, I would have bought it earlier*”; “*And I trust it blindly, and that generates something, [...]*.”

Based on the hypotheses development and the results of the qualitative study, we include the following values: *functional value price*, *functional value quality*, *social value*, *epistemic value*, *emotional value*, *conditional value*, *convenience value*, *environmental value*, and *autarky value*. Fig. 1 illustrates the final conceptual model:

3.2. Measures

Building on the results of the qualitative study, we run a second study to test the hypotheses empirically by using an online survey. The questionnaire started with two introductory questions regarding the knowledge about PSD and energy transition: “Are you familiar with ‘plug-in solar devices?’” and “Are you familiar with the term ‘energy transition?’ Have you ever heard of it?” To ensure the same level of knowledge, all participants were then shown a brief mandatory definition of PSD, regardless from their previous answer. This was followed—among other descriptive questions—by a filter question as to whether the participants own or owned such a device in order to exclude owners from the survey, as the study focusses on the purchase intention. Afterwards, participants received an explanation of a commercially

available PSD, including facts about price, performance (approximate wattage depending on sunlight), and components (number, size, and weight) as well as the information that the connection is made directly via a standard power outlet and the feed-in takes place directly into the house network. Subsequently, we assessed the scales regarding the conceptual model using slightly modified multi-item scales from prior research measuring them on a 7-point-Likert-type scale (1 = strongly disagree, 7 = strongly agree): Purchase intention was measured with three items from Angowski et al. [61] and two additional self-created items; e.g., “I could imagine purchasing the named device in the near future.” Functional value price was tested with four items from Sweeney and Soutar [49] such as “The named device would offer value for money” and one self-created item. Four items were used to test functional value quality [46]; e.g., “The named device would be reliable enough to safely provide electricity.” Social value was measured with three items from Sweeney and Soutar [49], e.g., “Purchasing the named device would make a good impression on other people” and one self-created item. Three items from Pura [48] and two self-created items were applied to measure epistemic value with, for example, the item “I would purchase the named device to test new technologies.” Regarding the measurement of emotional value, we focused on emotions that are associated with the intention to purchase a PSD. Emotional value was tested with three items from Grębosz-Krawczyk et al. [45] and two items from Pura [48]; e.g., “Purchasing the named device would make me feel good.” Four items from Sangroya and Nayak [72] and two self-created were used to test conditional value; e.g., “I would purchase the named device if it was financially supported.” To measure convenience value, three items from Mahendar [46] were applied and four self-created items to create a better fit with the PSD context. In this regard, for example, the item “I would purchase the named device if it was easy to install” was used. Finally, four items were used to measure environmental value—two from Grębosz-Krawczyk et al. [45] such as “I would purchase the named device for ecological reasons” and two self-created items. Six items were applied to test autarky value—five items from

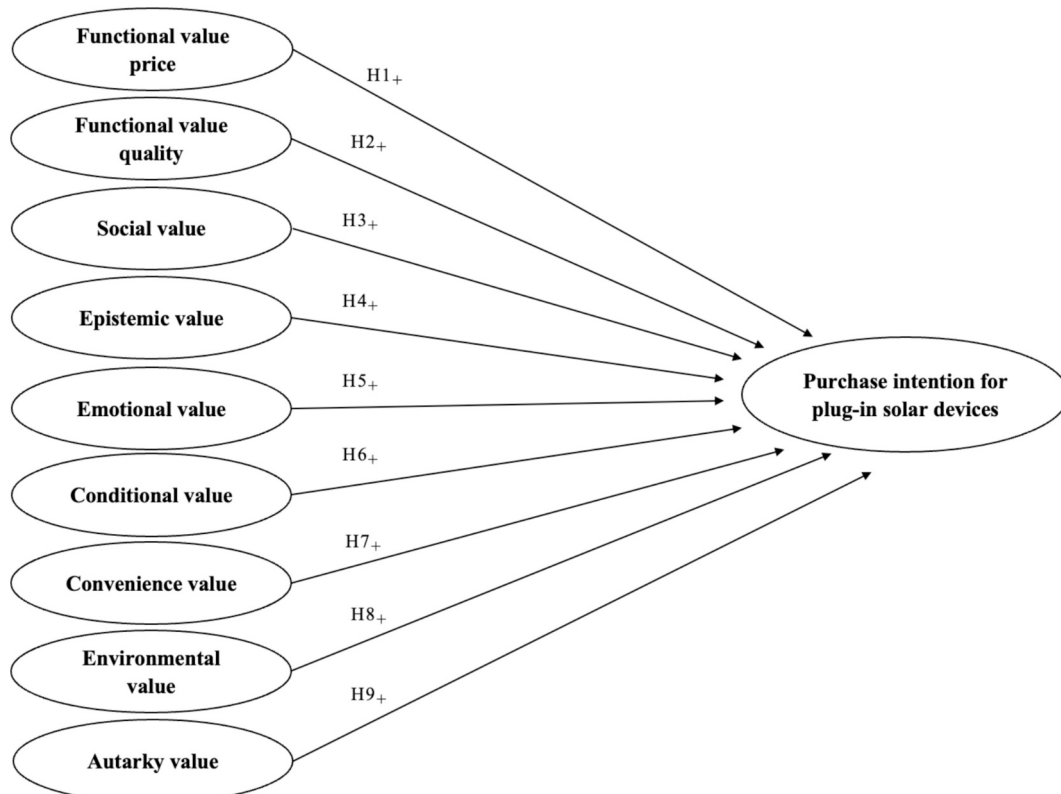


Fig. 1. Conceptual model.

Engelken et al. [26] and one self-created; e.g., “This named device would give me more control over my energy provision.” The self-created items were integrated due to the special features of PSD and their differences from PV systems, which have already been depicted. Since data collection took place in Germany, all scales were adopted to the context of PSD and translated into German. In order to test for socially desirable responses and thus a bias, a social desirability scale was included consisting of six items—three to test the exaggeration of positive qualities and three for the understatement of negative qualities (5-point Likert-type; [73]). Subsequently, a blue marker variable [74] was integrated to test for common method bias. The questionnaire concluded with a set of demographical questions on gender, age, income, place of residence (e.g., rural or urban), and type of residence (e.g., own house, rented house, rented apartment, etc.).

3.3. Sample and data collection

The participants for the main study were recruited with the help of the professional market research institute “infas quo” in December 2023 in Germany obtaining a total number of 1147 respondents. The number of respondents includes respondents from a preliminary conducted pretest in which the measurement scales were tested for scale reliability and validity. Since there were no abnormalities, these respondents were also included in the main study and thus in the total number of respondents. The total number of respondents, before data cleaning, constituted a representative sample.

To ensure data quality, at first the filter question was analyzed and all owners ($n = 117$) were removed from the data set. Second, the data was checked for straightlining, which refers to respondents “giving non-differentiated (identical) ratings to a series of statements” [75]. Based on this, participants with a consistent response behavior choosing the same answer over all values were eliminated ($n = 126$). Third, the social desirability scale was analyzed by calculating the mean value of the items for the exaggeration of positive qualities and for the understatement of negative qualities [73]. In line with Gier-Reinartz et al. [76], respondents with the most extreme scores (0 for the understatement of negative qualities; 4 for the exaggeration of positive qualities) in one or both aspects were excluded. As a consequence, 182 participants were removed from the data set. Last, the data were tested for missing values (participants choosing the “don't know” option), leading to the elimination of $n = 277$ data sets. The final sample consisted of 445 people. The average age of respondents in the final sample was 47.43 ($SD = 15.98$) and 45.0% were female. With regard to the questions at the beginning of the questionnaire, results showed that only 29.0% of the participants were familiar with PSD and also knew what they are, while 34.6% had never heard of them. In contrast, 72.4% were familiar with the topic of energy transition and knew what it means. An overview of the socio-demographic results can be found in Table 1.

4. Results

4.1. Measurement model

The measurement model was tested for validity and reliability using SPSS and AMOS 29. First, the reliability of the scales was tested by calculating the Cronbach's alpha for all constructs. Results show that all scales exceeded the threshold of 0.7 implying good reliability [77]. Second, a confirmatory factor analysis (CFA) was performed. In this process, the standardized factor loadings and average variance extracted (AVE) were calculated to test the convergent validity. Standardized factor loadings should be greater than 0.7 [78]. All items showed adequate factor loadings except for two items: Item 02 of the conditional value scale (0.663) and Item 05 (0.680) of the employed autarky value scale had to be dropped due to their loadings not exceeding the threshold. With regard to the AVE, all constructs were able to exceed the minimum threshold of 0.5, showing AVEs between 0.711 and 0.857

Table 1
Socio-demographic results.

| | | N | % |
|------------------------------|----------------------------------|-----|------|
| Gender | Male | 242 | 54.4 |
| | Female | 202 | 45.4 |
| | Diverse | 1 | 0.2 |
| Age (years) | 18–29 | 78 | 17.5 |
| | 30–39 | 86 | 19.3 |
| | 40–49 | 74 | 16.6 |
| | 50–59 | 90 | 20.2 |
| | 60–69 | 73 | 16.4 |
| | 70–79 | 44 | 9.9 |
| | Under 1500 | 46 | 10.3 |
| Monthly household income (€) | 1500–1999 | 46 | 10.3 |
| | 2000–2499 | 60 | 13.5 |
| | 2500–2999 | 58 | 13.0 |
| | 3000–3999 | 76 | 17.1 |
| | 4000–4999 | 75 | 16.9 |
| | 5000–5999 | 32 | 7.2 |
| | Above 6000€ | 25 | 5.6 |
| Place of residence | In the city, close to the centre | 92 | 20.7 |
| | On the outskirts | 114 | 25.6 |
| | Suburb | 81 | 18.2 |
| Type of residence | Rural area | 158 | 35.5 |
| | Rented apartment | 178 | 40.0 |
| | Rented house | 41 | 9.2 |
| Type of residence | Own apartment | 41 | 9.2 |
| | Own house | 185 | 41.6 |

[79]. The results of the measurement model are summarized in Table 2.

In order to test discriminant validity, we applied the Fornell and Larcker criterion, which applies the correlations between the constructs and the square root of each AVE [79]. According to the criterion, discriminant validity exists if the square root of each AVE is greater than the correlation of the respective constructs [79]. The results (see Table 3) show discriminant validity for all constructs except for conditional value and convenience value. Due to the lack of discriminant validity, the convenience value construct was eliminated. Conditional value was retained, as this construct belongs to the core values based on Sheth et al. [37]. Consequently, convenience value was no longer taken into account in the following calculations.

Furthermore, the model fit was checked as part of the CFA showing an acceptable model fit of the measurement model ($\chi^2/df = 2.256$; Tucker–Lewis index (TLI) = 0.949; comparative fit index (CFI) = 0.954; root mean square error of approximation (RMSEA) = 0.053; standardized root mean square residual (SRMR) = 0.048).

The data were also tested for common method bias by using the marker variable technique. The questionnaire included the marker variable “attitude toward blue” [74]. Based on the approach by Lindell and Whitney [80]—using the strongest correlation between the marker variable and the constructs though—all correlations remained significant and therefore results showed no indications for a common method bias [81].

4.2. Structural model

Structural equation modeling with maximum likelihood estimation was used to test our conceptual model and the hypotheses using AMOS 29. The structural model demonstrated an acceptable model fit ($\chi^2/df = 2.256$; TLI = 0.949; CFI = 0.954; RMSEA = 0.053; SRMR = 0.048). Results of the structural equation modeling show that 64.4% of the variance in purchase intention for PSD can be explained by the conceptual model, with four significant effects at a significance level of 5%. This implies that four out of the nine hypotheses are supported. The results reveal that H1 can be confirmed, which implies that functional value price ($\beta = 0.213$, $p < 0.001$) has a significant influence on the purchase intention for PSD. Social value ($\beta = 0.091$, $p = 0.054$) shows a slightly significant effect, confirming H3. Supporting H4, epistemic value ($\beta = 0.171$, $p < 0.001$) positively affects the purchase intention. In

Table 2
Measurement model results.

| Construct / Items | | Factor loadings | AVE | Cronbach's Alpha |
|---------------------------------------|--|-----------------|-------|------------------|
| <i>Functional value price (FVP)</i> | | | 0.772 | 0.943 |
| FVP01 | The named device would be reasonably priced | 0.824 | | |
| FVP02 | The named device would offer value for money | 0.907 | | |
| FVP03 | The named device would be a good product for the price | 0.916 | | |
| FVP04 | The named device would be economical | 0.886 | | |
| FVP05 | The named device would allow me to save money | 0.858 | | |
| <i>Functional value quality (FVQ)</i> | | | 0.807 | 0.943 |
| FVQ01 | The named device would be reliable enough to safely provide electricity | 0.875 | | |
| FVQ02 | The named device would be robust enough to meet the energy needs | 0.917 | | |
| FVQ03 | The named device would be efficient enough to meet the energy needs | 0.910 | | |
| FVQ04 | The level of performance of the device would be satisfactory | 0.891 | | |
| <i>Social value (SV)</i> | | | 0.857 | 0.959 |
| SV01 | Purchasing the named device would help me to be perceived positively by others | 0.885 | | |
| SV02 | Purchasing the named device would improve the way I am perceived | 0.942 | | |
| SV03 | Purchasing the named device would make a good impression on other people | 0.946 | | |
| SV04 | Purchasing the named device would give me social approval | 0.928 | | |
| <i>Epistemic value (EPV)</i> | | | 0.815 | 0.956 |
| EPV01 | I would purchase the named device to experiment with a new technology | 0.889 | | |
| EPV02 | I would purchase the named device to test new technologies | 0.927 | | |
| EPV03 | I would purchase the named device out of curiosity | 0.866 | | |
| EPV04 | I would purchase the named device to learn something new | 0.906 | | |
| EPV05 | I would purchase the named device to try something new | 0.924 | | |
| <i>Emotional value (EMV)</i> | | | 0.734 | 0.930 |
| EMV01 | Purchasing the named device would feel like making a personal contribution to good for society | 0.892 | | |
| EMV02 | Purchasing the named device would feel morally right | 0.869 | | |
| EMV03 | Purchasing the named device would make me feel like a better person | 0.809 | | |
| EMV04 | Purchasing the named device would give me pleasure | 0.817 | | |
| EMV05 | Purchasing the named device would make me feel good | 0.894 | | |
| <i>Conditional value (CDV)</i> | | | 0.711 | 0.926 |
| CDV01 | I would purchase the named device if offered at a discount | 0.809 | | |

Table 2 (continued)

| Construct / Items | | Factor loadings | AVE | Cronbach's Alpha |
|----------------------------------|---|-----------------|-------|------------------|
| CDV03 | I would purchase the named device if it was financially supported | 0.775 | | |
| CDV04 | I would purchase the named device when it is easily available | 0.889 | | |
| CDV05 | I would purchase the named device if electricity prices continued to rise | 0.867 | | |
| CDV06 | I would purchase the named device if the energy crisis gets worse | 0.871 | | |
| <i>Convenience value (CVV)</i> | | | 0.827 | 0.951 |
| CVV01 | I would purchase the named device if it was easy to install | 0.902 | | |
| CVV02 | I would purchase the named device if it was easy to operate | 0.926 | | |
| CVV03 | I would purchase the named device if it was easy to master the operating of the system | 0.921 | | |
| CVV04 | I would purchase the named device if it was easy to maintain | 0.940 | | |
| CVV05 | I would purchase the named device if it was easy to repair | 0.855 | | |
| CVV06 | I would purchase the named device if it was easy to dispose | 0.716 | | |
| CVV07 | I would purchase the named device if it was easy to recycle | 0.736 | | |
| <i>Environmental value (ENV)</i> | | | 0.822 | 0.948 |
| ENV01 | I would purchase the named device for ecological reasons | 0.908 | | |
| ENV02 | The named device would help reduce environment pollution | 0.851 | | |
| ENV03 | I would purchase the named device to help protect the climate | 0.941 | | |
| ENV04 | I would purchase the named device to participate in the energy transition | 0.924 | | |
| <i>Autarky value (AV)</i> | | | 0.782 | 0.941 |
| AV01 | I would be able to compensate for rising energy prices with the named device | 0.881 | | |
| AV02 | I would be able to secure part of my energy provision with the named device | 0.877 | | |
| AV03 | This named device would give me more control over my energy provision | 0.895 | | |
| AV04 | The named device would enable me to become more independent of my energy provider | 0.885 | | |
| AV06 | The named device would give me more autonomy | 0.824 | | |
| <i>Purchase intention (PI)</i> | | | 0.742 | 0.918 |
| PI01 | I could imagine purchasing the named device in the near future | 0.865 | | |
| PI02 | There is a high probability that I will purchase the named device | 0.934 | | |
| PI03 | Most likely, I will be purchasing the named device | 0.918 | | |
| PI04 | I could imagine purchasing the named device even if the price of such a device will rise | 0.710 | | |
| PI05 | I could imagine purchasing the named device even if I had to wait a certain amount of time for it | 0.752 | | |

Table 3
Fornell and Larcker criterion results.

| | AVE | FVP | FVQ | SV | EPV | EMV | CDV | CVV | EVV | AV | PI |
|-----|-------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| FVP | 0.772 | 0.879 | | | | | | | | | |
| FVQ | 0.807 | 0.808 | 0.898 | | | | | | | | |
| SV | 0.857 | 0.536 | 0.550 | 0.926 | | | | | | | |
| EPV | 0.815 | 0.528 | 0.560 | 0.728 | 0.903 | | | | | | |
| EMV | 0.734 | 0.704 | 0.730 | 0.777 | 0.723 | 0.857 | | | | | |
| CDV | 0.711 | 0.710 | 0.757 | 0.480 | 0.544 | 0.699 | 0.843 | | | | |
| CVV | 0.827 | 0.656 | 0.711 | 0.406 | 0.500 | 0.638 | 0.854 | 0.909 | | | |
| EVV | 0.822 | 0.656 | 0.647 | 0.657 | 0.588 | 0.853 | 0.681 | 0.631 | 0.907 | | |
| AV | 0.782 | 0.773 | 0.836 | 0.521 | 0.541 | 0.741 | 0.789 | 0.741 | 0.691 | 0.885 | |
| PI | 0.742 | 0.682 | 0.677 | 0.597 | 0.643 | 0.684 | 0.708 | 0.634 | 0.642 | 0.637 | 0.861 |

Note. AVE: average variance extracted, FVP: functional value price, FVQ: functional value quality, SV: social value, EPV: epistemic value, EMV: emotional value, CDV: conditional value, CVV: convenience value, EVV: environmental value, AV: autarky value, PI: purchase intention. The numbers on the diagonal show the square root of the AVEs.

a similar vein, conditional value ($\beta = 0.339, p < 0.001$) has a significant positive effect on the purchase intention, being the strongest influencing value and confirming H6. On the contrary, functional value quality ($\beta = 0.109, p = 0.131$) and emotional value ($\beta = -0.044, p = 0.586$) do not significantly affect the purchase intention, leading to the rejection of H2 and H5. Regarding the extended values, results show that environmental value ($\beta = 0.078, p = 0.152$) and autarky value ($\beta = -0.112, p = 0.114$) do not have a significant influence on PSD purchase intention, leading to the rejection of H8 and H9. Table 4 shows the results of the structural equation modeling and hypothesis testing.

5. Discussion

This study employed an extended version of the TCV by supplementing it with autarky value and environmental value. The study revealed that functional value price, conditional value, social value, and epistemic value have a significant positive influence on the purchase intention for PSD.

Results indicate that *functional value price* positively influences PSD purchase intention. Consequently, it can be concluded that if consumers perceive PSD as cost-effective, efficient, and an economical solution, this positively influences their intention to purchase those devices. These results are consistent with a study regarding PV systems [45]. Similarly, studies have shown that high costs for PV systems have a negative influence on attitudes toward those systems [12,26,30]. At the same time, it is positively influenced if the systems are perceived as a financial advantage [12,26]. The influence of functional value price has also been proven in the context of green products [41,43,44]. Therefore, functional value price indicates that the price of the device plays a decisive role in the intention to purchase. On the contrary, no significant effect was found for *functional value quality*. Accordingly, the level of performance, robustness, and efficiency of the appliance in terms of covering part of the energy requirements is not relevant for the consumer. This could be explained due to the fact that the performance of the appliance is not high enough to cover a large part of the requirements. Therefore, the quality of the device could be considered less relevant. This result is in line with the study by Lin and Huang [42], showing no significant

Table 4
Structural equation modeling results.

| | Relationship | β | S.E. | p-Value | Result |
|----|--------------|---------|-------|---------|-----------|
| H1 | FVP → PI | 0.213 | 0.061 | <0.001 | Confirmed |
| H2 | FVQ → PI | 0.109 | 0.072 | 0.131 | Rejected |
| H3 | SV → PI | 0.091 | 0.047 | 0.054 | Confirmed |
| H4 | EPV → PI | 0.171 | 0.040 | <0.001 | Confirmed |
| H5 | EMV → PI | -0.044 | 0.081 | 0.586 | Rejected |
| H6 | CDV → PI | 0.339 | 0.066 | <0.001 | Confirmed |
| H8 | EVV → PI | 0.078 | 0.055 | 0.152 | Rejected |
| H9 | AV → PI | -0.112 | 0.071 | 0.114 | Rejected |

Note. β = unstandardized path coefficient; SE = standard error.

effect in the context of green products.

Social value has a slightly significant positive effect. This implies that purchase intention increases when consumers perceive that the purchase of the device will be positively recognized by their social environment or peer group (e.g., friends, family), thus receiving social recognition. Social value is closely linked to the construct subjective norm [50]. Studies have shown that subjective norm [12,26,82] and social influence [8,28,58,59] positively influence the intention to purchase or adopt PV systems. Accordingly, the influence of friends, relatives, and close colleagues plays an important role [8] and is seen as an important way of distributing the technology [58]. This influence is also referred to as the “peer effect” [32]. Palm [32] demonstrated that, in relation to PV adoption, peer effects are primarily present in existing and close social relationships, and less with rather unknown neighbors. On the contrary, Grębosz-Krawczyk et al. [45] did not find any significant influence of social value on the intention to buy PV panel installations.

Furthermore, the results of the study show a significant positive influence of *epistemic value*. Therefore, there is an increased purchase intention for PSD if the consumer has the impression or the feeling that the device offers something new, arouses curiosity, or fulfills the desire for new knowledge. Epistemic value is closely linked to novelty seeking. These results are in line with previous studies confirming the influence of epistemic value on the purchase intention for green products [42–44]. Furthermore, Angowski et al. [61] found that consumer innovativeness is the strongest influencing factor on the purchase intention for PV systems. Likewise, studies have confirmed that consumer innovativeness impacts the attitude toward the installation of rooftop PV [27,62].

Emotional value does not significantly affect the purchase intention for PSD; this is in line with a study by Grębosz-Krawczyk et al. [45] regarding PV panel installations. The perceived emotional value does not affect the purchase intention, which does not mean that emotions are without relevance for the purchase intention. More specifically, the purchase of the device would not be associated with the perception of pleasure, a feeling of moral rightness, or the feeling of contributing to the good of society. This could potentially be explained by the size and the number of components of PSD (which participants received as an information in the questionnaire), as they are significantly smaller than PV systems [18]. Consumers might assume that such small devices do not have a major impact, and therefore would not trigger the feelings mentioned above. Therefore, it can be assumed that the purchase of PSD is more characterized by a cognitive purchasing process, which could be explained by the significant influence of functional value price. Consequently, it could presumably be an extensive purchasing decision. In this regard, it should be highlighted that the results show that only the (abovementioned) perceived emotions which are associated with the purchase of PSD are negligible. However, emotions could be of relevance in the use of PSD or the interaction process with it as well as during the purchasing decision. For example, emotions could be of importance during the use of the PSD as, e.g., users might feel joy when

they save money through the use of the device.

Conditional value plays a decisive role regarding PSD purchase intention. Accordingly, situational conditions, such as the worsening energy crisis and prices, subsidies, or discounts, as well as attractive advertising and easy availability of the product, have a positive influence on the purchase intention. These results are in line with studies on green products in general [41,42], as well as those on biofuels [44] and green IT products [43]. In particular, the part of the conditional value that deals with subsidies and discounts has been proven in other studies, as Kesari et al. [58] and Sun et al. [27] demonstrated the important role of government initiatives on the intention to adopt or install PV solar lighting systems or rooftop PV.

Surprisingly, *autarky value* shows no significant effect. This result is contrary to previous studies on PV systems, in which perceived autarky benefit influences the intention to adopt PV systems [12,26]. It has also been shown that affinity for autarky has a significant influence on the intention to purchase PV systems [70], and that autarky motives are one of the strongest influencing factors in energy-relevant investment decisions [69]. The non-significant influence in our study could be explained by the fact that, compared to PV systems, a consumer is not completely self-sufficient and independent of the energy supplier. This could be due to the fact that PSD have a relatively low output (e.g., in Germany: feed-in power of 800 W) compared to PV systems and only work when plugged in to power sockets [15,18,83]. Accordingly, it can be assumed that PSD offer the consumer just a limited and a kind of “apparent autarky”. Similarly, consumers might assume that PSD offer limited autarky due to their size and number of components compared to PV systems.

Finally, *environmental value* also showed no significant influence on the purchase intention for PSD. It can be assumed that the performance of the device is perceived as low compared to PV systems. Furthermore, PSD also differ from PV systems in size [18], and (depending on how they are installed) may have lower visibility. Therefore, participants may assume that, compared to PV systems, PSD do not considerably contribute to the environment, climate protection, or pollution reduction as well as the energy transition. These results are contrary to previous research on PV systems: Studies have shown that when consumers are aware that the use of the system positively influences the environment [29,30] and perceive the ecological advantages of PV systems, this has a positive effect on their attitude toward the use of solar energy or PV systems [12]. Indeed, Grębosz-Krawczyk et al. [45] found a positive influence of environmental value on choice behavior toward PV.

6. Implications, limitations, and further research

6.1. Managerial implications

As renewable energies are an important part of combating climate change, this study aims to determine the influencing factors on the purchase intention toward PSD and respectively also “low-budget prosumption technologies.” Based on these results, the aim is to understand the motivations of consumers to purchase the device and make managerial, policy, and theoretical recommendations in order to promote the dissemination of the devices with regard to SDG 7.

Accordingly, a number of managerial implications can be derived applying to both manufacturers and retailers. With regard to retailers and also manufacturers addressing the end customers, communication and the promotion of PSD are particularly important. First, price plays an important role, which is highlighted by the effect of functional value price and also conditional value. PSD are characterized in particular by the fact that they are less expensive and more affordable compared to PV systems and are therefore accessible to a wide range of people [17–19]. Accordingly, it is recommended that the price should be the center of communication. Especially, due to the fact that it can be assumed that PV is often associated with high investments by the consumers. In addition to the price, the easy availability of the device is also relevant.

Retailers should therefore position themselves broadly in terms of multichannel distribution, so that the device is available to consumers in several ways. Second, the current energy situation—with rising energy prices and the worsening energy crisis—should be highlighted more strongly in communications. More specifically, due to the fact that conditional value is a situational factor, communication should also be geared toward situational conditions. Consequently, communicative measures and promotions should be adapted to respective situations, i. e. if energy prices and the crisis in particular continue to worsen. Therefore, it is relevant that manufacturers ensure that PSD are available at all times, taking into account the adaptation of the communication strategy to situational events being able to react to a possible growing demand. Third, as results show that the degree of novelty of PSD is relevant for the consumers' purchase intention, this could be emphasized and communicated. Consumers who have a desire for new knowledge and novelty in general represent an important target group.

6.2. Policy implications

The results of the study also provide a number of policy implications. First, with regard to the results from the introductory questions of this study, it becomes clear that there is still too little awareness and knowledge about PSD. Accordingly, general information campaigns about the device by policymakers would be advisable. Differentiated communication and information channels could also be used to address broader and younger target groups. Furthermore, Germany, for example, passed a new solar package in 2024 that includes reduced barriers to consumers with regard to registering the device and increasing the feed-in power from 600 to 800 W [18,83]. As a result, the number of PSD owners increased significantly in 2024 [84]. The increase could be explained by the new package implying that barriers to the use of PSD should generally be kept as low-threshold as possible. Second, in relation to functional value price and conditional value, the results show that price is a decisive factor in the purchase intention for PSD. Due to the fact that the results of the study regarding conditional value demonstrate that subsidies are of great importance for PSD purchase intention, it would be advisable for the state to offer subsidies. For instance, Germany offers, on a regional level, subsidies with different rates and conditions [18]. Austria provided a VAT exemption for PV systems (with a maximum output of 35 kW peak), including PSD, in order to promote the expansion of solar power [85]. For this reason and based on the results, it is recommended that states should offer a standardized subsidy for PSD regardless of the region in order to increase the attractiveness of purchasing such devices and therefore promote their dissemination resulting in a double advantage for consumers and politicians: First, subsidies offer a price advantage for the consumer and second, as Kesari et al. [58] stated, it shows the consumers that the state is committed to the distribution and support of green products as well as the promotion of the energy transition. Third, in terms of social value, targeted communication measures on the part of policymakers could give consumers the feeling that they are gaining social recognition by being part of the energy transition and combating climate change.

6.3. Theoretical and methodological implications

The aim of this study was also to make a theoretical contribution by applying a theory not been previously used in the context of PSD in order to better understand and explain the purchase intention of this device — a “low-budget prosumption technology”. Our study shows that the application of a modified version of the theory in the context of PSD works well with a satisfactory variance explanation. In this context, the theory UTAUT 2 has already been applied, with a high variance explanation [36]. The study differs primarily in that the conditional value is not taken into account. As this value is of great importance—showing the strongest effect—it is highly relevant in understanding the consumers' purchase intention for PSD and thus “low-budget prosumption

technology". With the aim of a higher variance explanation, a fusion of theories would therefore be conceivable, taking into account a necessary validation. Furthermore, prosumer technologies are primarily characterized by the fact that people take on the role of consumers as well as producers [13]. It can therefore be assumed that this also changes the value structure of a product or object. Consequently, it can be suggested that a further development toward a "theory of presumption values" would be advantageous also with regard to the use of the theory in other contexts, as prosumer technologies do not only play a role in the energy context [14,86].

6.4. Limitations and further research

This study also has some limitations and based on these recommendations for further research. First, only men who own a PSD participated in the qualitative study. This could lead to the results being biased by a one-sided, male perspective. Bergner et al. [16] stated that among PSD owners or people interested in PSD, the majority are men. Nevertheless, regarding further research, the perspective of women should also be included in order to achieve a higher variance explanation. Second, the study has many data sets with missing values, which had to be eliminated in the process, resulting in a loss of information. This could be due to the fact that PSD were not well known at the time the study was conducted and that the information the participants received was not sufficient for the assessment of the questionnaire, e.g., if the device makes a contribution to climate protection. Third, as previous studies on PV systems as well as the results of the qualitative study have shown autarky value to be a strong influencing factor, further research could focus on this value and investigate whether it has a possible role as a predictor of other values, a mediator, or a moderator for and of consumer behavior regarding PSD. Furthermore, the non-significant effect could also have methodological causes with regard to the conceptualization of autarky value, especially due to the negative path coefficient as the measurement scale was based on the PV literature. Accordingly, further methodological work is necessary to better conceptualize and validate the measurement of consumers' perceived autarky value. Fourth, with regard to emotional value, this study focused on emotions associated with the intention to purchase PSD. Emotions could also be relevant in the usage and interaction process. Based on this, further research could focus on possible usage-related emotions in order to promote the purchase and dissemination of PSD. Finally, in the context of sustainability, the attitude-behavior gap is a relevant construct. That is, attitude toward sustainability is quite high, whereas the actual implementation of the behavior is difficult [87]. Accordingly, future studies could focus on actual consumer behavior by conducting a two-stage survey questioning the real behavior in the second step or by conducting randomized field studies.

7. Conclusion

This study aimed to better explain the purchase intention toward PSD, and thereby provide policy and managerial implications to promote and support the dissemination of PSD with regard to SDG 7. Accordingly, the following research question was formulated: What consumption values influence the purchase intention toward PSD? To answer this research question, the TCV, based on Sheth et al. [37], was applied with the following initial values: functional value, social value, epistemic value, emotional value, and conditional value. Based on the literature and the evolution of the theory [47], convenience value was also included, as it fits the context of PSD. To test the suitability of the TCV and whether there are any other possible explanatory determinants, a qualitative study was conducted, resulting in an extension with two values: environmental value and autarky value. Accordingly, a conceptual model was developed consisting of nine hypotheses. To test the hypotheses, a quantitative study was conducted in Germany with the help of a market research institute. The data were analyzed using

structural equation modeling, revealing four significant effects and thus confirming the following hypotheses: functional value price, social value, epistemic value, and conditional value. The results show that the price, cost efficiency, and profitability of PSD play a decisive role. With regard to this, conditional value depicts that subsidies are also decisive, as are situational conditions such as the energy crisis and prices, as well as the availability of the devices. Furthermore, purchase intention is influenced by novelty seeking and social recognition by others. Based on these results, policy and managerial as well as theoretical implications can be drawn. From a policy perspective, communicative measures are of great importance in order to create more awareness for the devices. Moreover, offering subsidies for PSD from the state regardless of the place of residence are crucial in order to make PSD more attractive in terms of price. With respect to managerial implications, communicative measures emphasizing the price, cost-effectiveness, and the concept of novelty of the PSD are particularly important. From a theoretical point of view, this study successfully applied the TCV in the context of PSD, thereby contributing to the lack of research on PSD (even though the TCV could not be successfully extended with autarky and environmental value due to a lack of significant effects). This provides a basis for further research, such as a closer examination of the role of autarky in the context of PSD, as well as fusion of theories to further explain the consumer behavior for PSD.

CRediT authorship contribution statement

Katharina Rzepucha-Hlubek: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author used DeepL Write and ChatGPT solely to improve language clarity and readability. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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Declaration of competing interest

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Data availability

Data will be made available on request.

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