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GREEN CONSUMER BEHAVIOR | RESEARCH ARTICLE

Understanding Consumer Value Dimensions in the Usage of Residential Solar Energy Among Generation Z

Belinda Senooane[1], Tatenda Chabata[2*)]

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Author Affiliation:
[1]Department of Marketing and Retail Management, School of Management Sciences, University of South Africa, 1 Preller Street, Pretoria, South Africa

*Corresponding author:
echabatt@unisa.ac.za

Abstract:
Background: Renewable energy transition has become one of the world's top priorities in the global effort to curb energy poverty. Yet scant studies on actual residential energy usage among Generation Z (Gen Z) exist.
Purpose: This study investigated South African Gen Z consumers' renewable energy usage through assessing the prevalence of perceived values (hedonic and utilitarian) in household solar energy products.
Method: Drawing on the Value-Attitude-Behaviour (VAB) framework, a research model was proposed and tested using survey data from a descriptive research design. A convenience sampling method was used to identify suitable respondents, resulting in a sample of 521 young consumers aged 21 to 28. Quantitative data were collected using an online survey. Partial Least Squares Structural Equation Modelling was applied in testing the hypotheses using Smart-PLS version 4.
Findings: The results confirmed that all direct relationships in the conceptual model were supported. Both perceived utilitarian value and hedonic value have a significant positive influence on environmental involvement and green attitude. A green attitude also positively affects solar usage. However, environmental involvement was not found to mediate the relationship between perceived value and green attitude. This study is among the first to explore the relationships among perceived utilitarian and perceived hedonic value, green attitude, and environmental involvement in the context of solar energy use, testing for mediation by environmental involvement.
Conclusions: For practitioners, this study recommends, among other recommendations, enhancing perceived value in marketing strategies for solar energy products and targeted consumer engagement based on their environmental involvement.
Research implication: Marketers, policymakers, and solar energy providers should design value-driven communication strategies that resonate with Gen Z's desire for both functional benefits and emotionally rewarding experiences.

Keywords: environmental involvement, Generation Z, green attitude, hedonic value, sustainable renewable energy, utilitarian value, Value-Attitude-Behaviour

JEL Classification: Q01, Q56, Q40, Q42

Tatenda Chabata

ABOUT THE AUTHORS

Belinda Chiedza Senooane is a Post-Doctoral Fellow at the University of South Africa. She has a PhD in marketing, focusing on consumer culture and the sociology of consumption. Her research interests are child consumer behaviour, retail management, and sustainable consumption. More recently, her research interests have focused on the intersection of consumer culture and pro-environmental behaviour as well as digital marketing and green consumer research. She has published in peer-reviewed journals and presented research at local and international conferences. She is also a contributor to a few marketing textbooks. She can be reached via esenoobc@unisa.ac.za

Tatenda T. Chabata holds a PhD in Business Management, specialising in Digital Marketing Systems, from the University of Free State (South Africa). He is a dedicated Marketing and Communications professional, a practicing Associate Marketer in South Africa (AMSA) and The Marketing Association of South Africa (MASA). Recently bestowed the Platinum Professional Associate lifetime designation by the IMM Graduate School for his contribution to marketing and supply chain. He has published in several peer-reviewed journals and presented research at local and international conferences. Chabata is a Post-Doctoral Fellow at the University of South Africa. He can be reached via echabatt@unisa.ac.za

PUBLIC INTEREST STATEMENT

One of the key priorities in the global effort to combat energy poverty is the transition to renewable energy. This study examined the impact of utilitarian and hedonistic values on the use of household solar energy products by Generation Z (Gen Z) consumers, while accounting for marketers' roles in the contemporary environment. Most studies have focused on the utility of residential energy adoption, yet few have incorporated both hedonic and utility values in the actual use of residential energy products by young consumers who will soon have the strongest purchasing power.

The representativeness of the non-probability sample from Gen Z was one of the primary issues this study faced, as they tend not to engage in survey completion. The study's findings might not accurately represent differences across cultures, regions, and socio-economic backgrounds. Nonetheless, it is undeniable that data collected from a carefully chosen sample of respondents can offer a profound understanding of consumer preferences regarding the use of residential energy products, a novel area of research that incorporates the experiential value aspect.

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1. Introduction

The global transition towards sustainable energy sources is central to achieving climate resilience (Wei et al., 2025) and meeting the United Nations' Sustainable Development Goal 7 (SDG-7), which calls for access to "affordable, reliable, sustainable and modern energy" (United Nations, 2024). International efforts such as COP29 have renewed the emphasis on accelerating renewable energy investments and strengthening commitments from governments, businesses, and consumers alike (Arora, 2025). As nations worldwide commit to ambitious targets for emissions reduction and the transition to renewable energy, consumer behaviour in driving this transition is of paramount importance (Al Maalouf et al., 2024; Kumar & Nayak, 2024). While policy and structural interventions are vital, consumer behaviour is imperative in driving the move to renewable energy by influencing the demand and usage of green energy options, encouraging businesses to invest in sustainable practices, and ultimately shaping market dynamics through consumer purchasing decisions (Batool et al., 2024; Bunea et al., 2020). The global climate crisis and its effects negatively impact consumers, leading them to increasingly commit to protecting the natural environment. For younger consumers, such as Generation Z (Gen Z), this is especially true (Pollack, 2023). In this context, understanding how consumers, particularly younger cohorts, translate their environmental concern into concrete energy-use behaviour has become increasingly important.

Gen Z (born between 1997 and 2012) (Axcell & Ellis, 2023) represents a pivotal group in the energy transition agenda. Estimated to reach over 32% of the global population by 2030 (Fisu et al., 2024), Gen Z is currently the world's largest demographic, representing a significant consumer base (Zamborita et al., 2024). Gen Z is a key demographic to the sustainability agenda because of their distinctive involvement in the environment and impact on upcoming trends (Raman et al., 2024). Gen Z has the most environmental concerns in engaging in green-friendly behaviour and is the most willing to pay for pro-green goods and services (Gomes et al., 2023). However, much of the existing research has focused on their attitudes and intentions toward sustainable products rather than on actual renewable energy use. (Axcell & Ellis, 2023; Fisu et al., 2024; Gomes et al., 2023; Pollack, 2023). The current study contributes to existing research on the green energy transition by examining Gen Z's behaviour regarding solar energy use.

This study applied Homer and Kahle's (1988) Value-Attitude-Behaviour (VAB) framework to examine how hedonic values (e.g., emotional satisfaction, lifestyle enhancement) and utilitarian values (e.g., cost savings, energy independence) influence Gen Z's solar energy use behaviour through green attitudes and environmental involvement. The VAB posits a cognitive hierarchy where values influence attitudes, which then influence behaviour (Govaerts & Ottar Olsen, 2023). Hedonic and utilitarian values represent distinct yet complementary motivations for pro-environmental behaviour: utilitarian values emphasise functional and economic benefits, while hedonic values reflect experiential and identity-related gratifications (Park & Namkung, 2024). Green attitudes reflect a person's predisposition to respond favourably or unfavourably to environmental issues (Van Tonder et al., 2023). In addition, environmental involvement, defined as one's level of cognitive and emotional engagement with environmental issues (Cheng et al., 2020), is further examined as a mediating mechanism linking values to behavioural outcomes. The study argues that while the tangible benefits of solar energy consumption, such as cost savings and independence from national power grids, may hold significant weight, the emotional and experiential aspects may also play a crucial role.

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The VAB has been empirically tested across several areas of pro-environmental behaviour research, including organic food consumption, sustainability crowdfunding, food waste management, and green purchase behaviour (Cheung & To, 2019; Govaerts & Ottar Olsen, 2023; Kim & Hall, 2021). However, fewer studies have investigated green energy intention/consumption using variations of the VAB framework (Perlaviciute & Steg, 2015; To & Lam, 2023). The novelty of this study lies in its integration of hedonic and utilitarian values within the Value-Attitude-Behaviour (VAB) framework to explain Gen Z's solar energy consumption behaviour, a perspective that remains underexplored in the renewable energy literature. The findings will contribute to the literature by (1) advancing the theoretical understanding of value-driven renewable energy adoption, (2) providing empirical evidence on Gen Z's role in the green energy transition, and (3) offering practical insights for policymakers, energy providers, and marketers designing interventions to accelerate household solar use.

2. Literature Review

2.1 Energy Poverty in South Africa

South Africa's energy poverty has become a persistent environmental issue that requires further exploration (Batool et al., 2024). The term energy poverty describes instances wherein households are unable to access adequate levels of energy, leaving them unable to satisfy basic energy needs (Simcock, 2020). Energy poverty is particularly prevalent in developing nations like South Africa. For many years, the country has battled with an energy crisis that has led to persistent power outages, with the country's power utility struggling to keep up with increasing demand (Masuku, 2024). Despite an electrification rate of 86%, putting the country at the forefront of sub-Saharan African countries regarding electricity provision, the country still grapples with energy poverty (Lesala et al., 2024).

In order to address the energy crisis, the South African government is implementing pro-environmental technologies, incentives, and legislation aimed at encouraging renewable energy usage (Batool et al., 2024; Bunea et al., 2020; Vu et al., 2024). Governments worldwide are encouraging citizens to use alternative energy sources, with solar energy being touted as a sustainable alternative (Al Maalouf et al., 2024; Aravindan et al., 2022). Household consumers contribute over 60% of greenhouse gas emissions and are estimated to be responsible for 40% of total environmental harm (Fatema, 2025). Considering the current energy crisis and solar energy's huge potential to alleviate energy shortages, understanding the factors influencing solar usage behaviour is paramount for formulating an appropriate strategy to provide adequate energy alternatives. However, despite the growing research on sustainable energy adoption, there have been limited studies that have focused on the psychological mechanisms explaining how individual value orientations translate into actual solar energy use, particularly among younger consumer cohorts, such as Generation Z.

2.2 Value Attitude Behaviour Theory (VAB)

Introduced by Homer and Kahle (1988), the VAB serves as a framework for understanding how consumer values translate into energy conservation behaviour. The framework proposes causal interrelationships among values, attitudes, and behaviour, in which consumer values are said to influence behaviour through the mediating role of attitudes (Govaerts & Ottar Olsen, 2023). Values are considered persistent convictions that a particular course of action or outcome is better for oneself or society (Cheung & To, 2019), while attitudes are an individual's evaluative perspective (i.e., positive or negative/good or bad) (Lupindo et al., 2024; Vu et al., 2024). Behaviour is then described

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as actions within a person's volitional control (Kim & Hall, 2021). Homer and Kahle (1988) proposed a causal relationship among value, attitude, and behaviour, as well as offered evidence-based support for VAB. Since then, VAB has been successfully applied to consumers' pro-environmental behaviours in various contexts. For instance, Cheung and To (2019) found that environmental consciousness is an important value that influences attitudes toward environmental issues, which, in turn, influences green purchase behaviour. Most of these studies have applied the VAB in general, pro-environmental, or consumer behaviour settings. Limited research has been conducted specifically within the contexts of renewable energy or solar adoption. This study seeks to fill the gap.

The VAB framework has been adopted for studies within the context of green energy. For instance, Perlaviciute and Steg (2015) investigated how people's biospheric values and egoistic values influence their evaluation of energy alternatives. The authors found that these values translated into attitudes, which in turn influence their perception of the consequences of alternative energy. Likewise, Ugarte Lucas et al. (2023) adopted the VAB framework and determined that egoistic and altruistic values significantly improved attitudes towards renewable energy, which in turn influenced their intention to vote for the same type of energy. The aforementioned studies highlight the usefulness of the VAB framework in predicting pro-environmental behaviour. However, most of these studies have examined direct, linear relationships within the VAB framework and have rarely tested additional mediating variables that may influence these relationships. Therefore, this study proposes applying an extended VAB model to predict Gen Z consumers' solar energy products usage behaviour by incorporating the decomposed value aspects of utilitarian and hedonic value, with environmental involvement as a mediator.

2.3 Perceived Utilitarian Value

When purchasing products, consumers often choose among the perceived costs and benefits of said purchases (Bai et al., 2024). This assessment is known as customer perceived value. In consumer behaviour literature, perceived value is often demarcated into hedonic and utilitarian value (Caesalpinia & Suryawardani, 2025; Cheng et al., 2020). The concept of utilitarian value is the idea that the practical uses of products/services are the primary motivators for their consumption (Larasatie et al., 2023). Consumers motivated by utilitarian value meticulously evaluate the cost-benefit aspects of their consumption, which enables them to conduct an overall assessment of the product's usefulness (Bai et al., 2024).

2.4 Perceived Hedonic Value

Consumers driven by hedonic values typically seek pleasure, sensory gratification, and satisfaction (Larasatie et al., 2023). Such consumers are motivated by the transient satisfaction they obtain from engaging in consumption. Lee et al. (2021) investigated whether utilitarian and hedonic values enhanced pro-environmental behaviour, finding that these values increased place attachment and support for tourism festivals. Likewise, Nosrati et al. (2023) examined how pro-environmental behaviour is influenced by perceived hedonic values through the three-way moderating effects of individualism and long-term orientation, as well as the mediating role of a positive attitude towards travel, finding that hedonic value significantly influenced pro-environmental behaviour. While these studies are crucial, none of them have investigated hedonic value as a distinct motivation for the adoption of renewable solar energy.

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2.5 Environmental Involvement

Environmental involvement is the degree to which a person finds environmental issues personally significant (Nazir & Wani, 2024). Environmentally conscious consumers are concerned about environmental issues, aware of environmental dangers, and driven to frequently preserve the environment (Lavuri, 2022). Studies have indicated a positive influence of environmental involvement on green consumer behaviour (Nazir & Wani, 2024; Qing et al., 2022). Nevertheless, most existing studies have examined environmental involvement as a direct predictor of behaviour, with far fewer exploring its mediating role between consumer values and attitudinal outcomes within the VAB framework. This creates a conceptual gap that this study aims to address. While some research has shown that utilitarian and hedonic values directly influence pro-environmental behaviour, other studies have emphasised the need to further investigate the potential of intervening and mediating influences among the variables (Bai et al., 2024; Lee et al., 2021).

2.5.1 Perceived Utilitarian Value and Environmental Involvement

Given that environmental involvement denotes the degree of personal relevance and concern an individual attaches to environmental issues (Cheng et al., 2020). It is therefore likely to be influenced by the extent to which sustainable products like solar energy deliver clear utilitarian outcomes. For Gen Z consumers, who are both highly value-driven and environmentally conscious (Raman et al., 2024), perceiving solar energy as a functional and beneficial investment may heighten their involvement with environmental issues and increase their sense of responsibility toward sustainability goals. Cheng et al. (2020) explored the relationship between utilitarian value, customer scepticism, and green consumption, finding that the role of environmental involvement translates values into consumer scepticism towards green advertising. This implies that if the practical benefits (utilitarian) are clearly perceived, the personal relevance (involvement) should increase, making this link theoretically sound. Accordingly, this study posits that perceived utilitarian value positively influences environmental involvement.

H1: Perceived utilitarian value has a significant positive influence on environmental involvement

2.5.2 Perceived Hedonic Value and Environmental Involvement

Prior studies have shown that hedonic motivations can play a powerful role in shaping pro-environmental engagement, as consumers often seek not only functional benefits but also emotional gratification from sustainable consumption (Govaerts & Ottar Olsen, 2023; Kim & Hall, 2021). Sun et al. (2022) investigated the moderating effect of environmental involvement in the relationship between virtual co-creation and the purchase intention of green products, finding this relationship to be significant. For Gen Z, who place high importance on hedonic values, the experiential rewards of solar energy adoption may further deepen their involvement with environmental issues. This suggests that hedonic value perceptions can serve as a catalyst for strengthening Gen Z's connection to, and engagement with, sustainability initiatives. The emotional appeal of 'feeling good' about an environmental choice (hedonic) is expected to enhance the consumer's personal significance of that issue (involvement). Accordingly, this study posits that perceived hedonic value positively influences environmental involvement.

H2: Perceived hedonic value has a significant positive influence on environmental involvement

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2.6 Green Attitude

The VAB framework emphasises the importance of attitude in the relationship between values and behaviour (Govaerts & Ottar Olsen, 2023; To & Lam, 2023). Attitude is described as "an individual's overall evaluation of an activity and is the degree to which behaviour is evaluated as positive or negative" (Harorli & Erciş, 2023), while green attitude reflects an individual's assessment of the importance of preserving the environment (Kaur et al., 2024). Research has shown that people with a pro-environmental attitude are concerned about ecosystem health and seek to engage in behaviours that do not harm ecosystems (Van Tonder et al., 2023). Scholars have also argued that environmental attitudes direct individuals' attitudes towards the environment (Mahliza et al., 2025). Despite extensive research confirming the predictive power of green attitude in sustainable behaviours, limited studies have examined how such attitudes are shaped by different value perceptions, particularly among younger, sustainability-oriented cohorts. Addressing this limitation helps strengthen the explanatory power of the VAB framework in renewable energy research.

2.6.1 Perceived Utilitarian Value and Green Attitude

Prior studies indicate that when consumers recognise strong utilitarian outcomes, they are more likely to form favourable attitudes toward green products, as the perceived usefulness reinforces the desirability and practicality of engaging in sustainable behaviours (Perlaviciute & Steg, 2015; To & Lam, 2023). For instance, Adams et al. (2024) used green attitude as a mediating variable to examine the relationship between perceived value and homeowners' greening intention. Thus, utilitarian value not only satisfies personal needs but also shapes consumers' positive evaluations of eco-friendly practices. In this regard, solar energy adoption framed through its utilitarian benefits is likely to foster a stronger green attitude among Gen Z consumers. Studies have shown a positive and significant relationship between perceived value and green attitude. For instance, Woo and Kim (2019) investigated the relationship between green perceived value, attitude towards green products, and the intention to purchase green products. The results revealed a positive and significant relationship. This study, therefore, isolates utilitarian value as a distinct determinant of green attitude. In light of the preceding discussion, the following hypotheses were formulated:

H3: Perceived utilitarian value has a significant positive impact on green attitude

2.6.2 Perceived Hedonic Value and Green Attitude

Research has shown that hedonic motivations are important drivers of pro-environmental behaviour, as individuals often pursue not only functional outcomes but also the affective rewards linked to sustainable consumption (Govaerts & Ottar Olsen, 2023; Kim & Hall, 2021). For Generation Z, who are known for prioritising authenticity, social identity, and values-based consumption, these positive emotional and experiential associations can enhance their evaluations of solar energy use. As such, hedonic value is expected to foster stronger green attitudes by making solar energy adoption not only practical but also enjoyable and personally meaningful. While the hedonic dimension of environmental behaviour has gained some attention in tourism and retail contexts, its influence on attitudes toward renewable energy products remains underexplored. This study contributes by extending the concept to solar adoption among Generation Z. Consequently, we propose the following hypothesis.

H4: Perceived hedonic value has a significant positive impact on green attitude

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2.7 Environmental Involvement and Green Attitude

Environmentally conscious consumers perceive that human intervention is crucial for protecting the environment (Cheng et al., 2020). People involved in environmental issues are likely to have a positive attitude towards conservation. Faza et al. (2024) and Hakim and Aprianingsih (2024) highlighted the importance of environmental involvement and a green attitude. Similarly, Lavuri (2022) investigated the moderating roles of environmental protection emotion and price sensitivity in organic green purchasing, finding that environmental involvement directly affects green attitude. In the current study, we argue that environmentally engaged young consumers will have a positive attitude towards green solar energy products. Few studies have contextualised this relationship in the renewable energy domain or examined whether environmental involvement acts as a key psychological link between perceived value and pro-environmental attitude. Exploring this relationship may help fill an important theoretical gap. Consequently, the study proposes the following hypothesis:

H5: Environmental involvement has a significant positive impact on green attitude

2.8 Green Attitude and Solar Usage Behaviour

Consumers' positive attitude towards a certain behaviour may likely result in them engaging in said behaviour (Fawehinmi et al., 2024). Green attitude has evolved into a central concept in pro-environmental behaviour research. Several studies highlight the role of pro-environmental/green attitude in predicting behaviour (Lavuri, 2022; Nazir & Wani, 2024; Pegan et al., 2023). For instance, attitude was used as a mediator between internal values and green customer citizenship behaviours, and was found to be statistically significant (Van Tonder et al., 2023). However, studies investigating the role of green attitude in energy conservation behaviour are still limited; more studies are recommended. For instance, Stieglitz et al. (2023) investigated the role of digital nudging in bridging the gap between environmental attitude and smart home usage behaviour. Although attitude–behaviour relationships are well established, limited empirical evidence exists linking green attitude, particularly to solar energy usage behaviour among emerging market consumers. For this reason, this study proposes the following hypothesis:

H6: Green attitude has a significant positive impact on solar usage behaviour.

2.9 The Mediating Role of Environmental Involvement on Perceived Hedonic Value and Green Attitude

The previous discussions described the direct relationships between the various variables of interest. Environmental involvement as a potential mechanism that translates the influence of hedonic value on green attitudes is a key contribution of this study. Hence, environmental involvement is adopted as a mediating variable. Consumers with higher environmental involvement are more likely to engage in green consumption (Cheng et al., 2020). Other studies have also adopted environmental involvement as a mediating variable. For instance, Qing et al. (2022) demonstrated the mediating effects of environmental involvement in the relationship between created shared values and enterprise image, whereas Nazir and Wani (2024) applied environmental involvement as a mediating variable within a social media usage context. Thus, the study proposes the following hypotheses:

H7: Environmental involvement mediates the relationship between perceived hedonic value and green attitude

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2.10 The Mediating Role of Environmental Involvement On Perceived Utilitarian Value and Green Attitude

This study probes the less-explored mediating role of environmental involvement in greater detail to better understand its impact on the relationship between utilitarian value and green attitude. To the best of the researcher's knowledge, this study pioneered empirical evidence of the mediating role of the environment in the current context. While extant studies postulated the mediating role of environmental involvement towards several green initiatives, there is consensus that more empirical testing of its role as a mediator is yet to be explored (Krstić et al., 2021; Tee et al., 2022). For this reason, we heed this call and formulated the following hypothesis:

H8: Environmental involvement mediates the relationship between perceived utilitarian value and green attitude

3. Conceptual Framework

The study applies the VAB framework to examine how hedonic, utilitarian value, environmental involvement, and green attitude influence solar usage behaviour in Gen Z consumers. Environmental involvement is positioned as the key mediating variable between values and green attitude because it captures the extent to which individuals translate perceived values into pro-environmental attitudes and behaviours. A conceptual framework delineating possible antecedents, a mediator, and household solar energy as an outcome has been proposed in Figure 1.

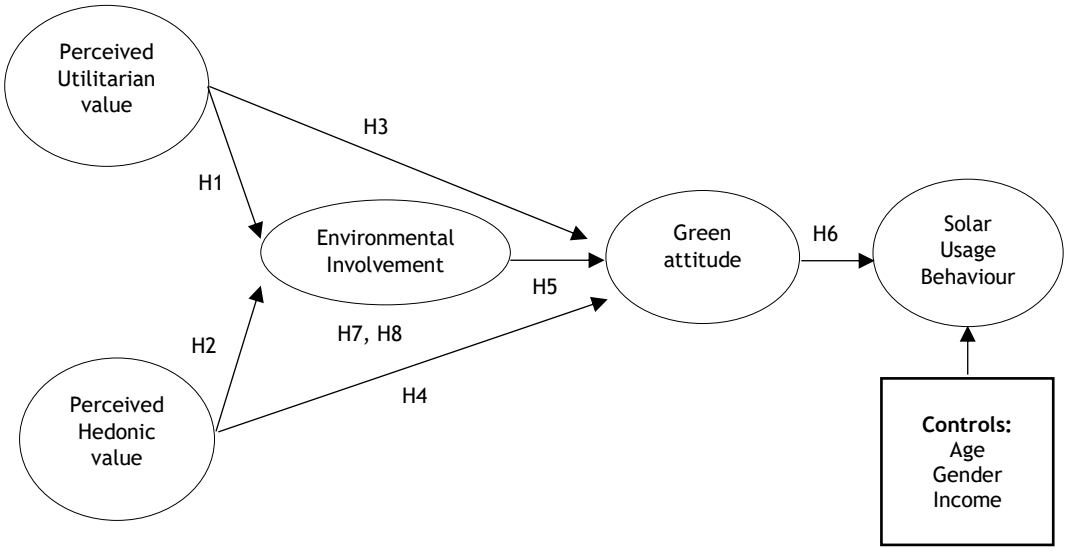

Figure 1. Conceptual framework: depicting perceived utilitarian and hedonic values, environmental involvement, as well as green attitude in driving solar usage behaviour.

Based on Figure 1, the hypotheses in this study are formulated as follows:

H1: Perceived utilitarian value has a significant positive influence on environmental involvement.
H2: Perceived hedonic value has a significant positive influence on environmental involvement.
H3: Perceived utilitarian value has a significant positive impact on green attitude
H4: Perceived hedonic value has a significant positive impact on green attitude
H5: Environmental involvement has a significant positive impact on green attitude

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H6: Green attitude has a significant positive impact on solar usage behaviour
H7: Environmental involvement mediates the relationship between perceived hedonic value and green attitude.
H8: Environmental involvement mediates the relationship between perceived utilitarian value and green attitude

4. Methods

4.1 Research Design

A descriptive research design was adopted to collect data from Gen Z consumers in South Africa, the justification for its adoption over other research designs was that this study was not trying to answer the "Why?" or "How?" of the research, but the "What" was happening with the relationships empirically tested in the proposed conceptual model. The data were collected at a single point in time, denoting the cross-sectional nature of the data. Using an online survey, the main technique for gathering data was the use of a seven-point Likert Scale questionnaire to further enable the testing of the relationships between the different constructs of interest (Hair et al., 2018). The study was thus conducted in South Africa, targeting Gen Z consumers of household solar energy products.

4.2 Sampling

The study used individuals as the units of analysis and focused on Gen Z consumers who identify as green consumers. Gen Z consumers in South Africa are people born between 1997 and 2012 (Nhedzi & Azionya, 2025). Gen Z makes up roughly 42% of the population, translating to 26.88 million consumers. Moreover, the target respondents were aged 21 to 28 and were environmentally involved in using household solar products in the last six months, since six months is regarded as a crucial timeframe for memorabilia in behavioural studies. The respondents had to recall the household solar energy product they last used to enable them to address the online question with that product in mind. The researchers obtained ethical clearance before data could be collected, and the anonymity of respondents was upheld by not requesting personal information among the Gen Z sample of interest. Gen Z is a key demographic to the sustainability agenda due to their unique environmental engagement and influence on future trends (Raman et al., 2024). Due to the absence of a sampling frame, the study applied a non-probability, convenience sampling technique. The minimum sample size was determined by multiplying the number of latent variables by 10 (23x10=230). After sending 750 online questionnaires to the sample of interest, only 521 were returned and fully completed without missing values. Therefore, the response rate was 69% (521/750 x 100), which allowed the researchers to proceed with the rest of the data analysis process.

4.3 Measurement

All measurement scale items were adapted or adopted from well-established extant literature, and expert validation was performed to ensure cultural appropriateness for South Africa by the researchers. The scale items assessing perceived utilitarian value were adopted from Lee et al. (2021) while those for perceived hedonic value were adapted from Nosrati et al. (2023). The environmental involvement scale items were obtained from Cheng et al. (2020) and those for a green attitude were adapted from Van Tonder et al. (2023) as well as Baburajan et al. (2024) The scale items for the primary dependent variable in this study, being solar usage behaviour, were adapted from Patharia et al. (2022) (Table 1).

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Table 1. Operational definition and indicators of measurement variables

Variables	Operational Definition	Indicators
Perceived Utilitarian Value (PUV)	The functional and practical benefits consumers derive from products or services, including efficiency, reliability, and economic savings (Babin et al., 1994).	1) I think that using solar energy products is more economical than electricity. 2) I think that using solar energy products is a better value for money than electricity. 3) I think that the quality of solar energy products exceeds their expense. 4) I think that solar energy products offer more benefits than electricity.
Perceived Hedonic Value (PHV)	Captures the emotional, experiential, and pleasure-driven benefits connected with using a product and deriving pride, delight, and enthusiasm (Babin et al., 1994)	1) I think that using solar energy products is a joyous occasion. 2) Making use of solar energy products is a pleasant experience. 3) Using solar energy products is a fascinating encounter. 4) Using solar energy products is an enjoyable experience.
Environmental Involvement (EI)	Environmental involvement describes a person's level of commitment to the environment and the level of personal commitment to environmental issues (Cheung & To, 2019)	1) I think the environment is impacted by my actions 2) Making sacrifices to protect the environment is a noble action 3) The quality of my life is determined by the condition of the environment 4) The environment worries me
Green Attitude (GA)	Green attitudes refer to individuals' overall positive or negative evaluations of engaging in environmentally friendly behaviours (Ogiemwonyi et al., 2023).	1) There is value in purchasing household solar products. 2) I feel rewarded by purchasing household solar products. 3) I think it makes sense to use solar products at home. 4) Using household solar products is a good idea 5) Using household solar products is a wise idea 6) Using household solar products is pleasant
Solar Usage Behaviour (SUB)	Conceptualised to define how individuals adjust their energy consumption patterns when they have access to solar power	1) I have bought household solar products in previous years. 2) I buy household solar products with high review ratings. 3) I have switched over to products that make use of fewer electricity consumption. 4) Purchasing household solar products in the midst of them being more costly is always my option. 5) I avoid buying energy products with potential harm to the environment.

4.4 Data Collection

The researchers appointed a qualified research consulting firm to assist with data collection. The firm conducted weekly response monitoring to detect non-response bias, including early and late respondents. Convenience sampling was used to identify respondents, as no sample frame was available for probability sampling. The research instrument adopted was developed as a multi-item scale, measured on a seven-point Likert scale (1 denoting 'strongly disagree' and 7 denoting 'strongly agree'). Pilot testing of the questionnaire was conducted among 20 respondents selected from the sample of interest. The pilot test results revealed that all respondents understood the instructions

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and questions posed in the online questionnaire. Cronbach's alpha was computed to ensure that the constructs under study met the minimum reliability threshold. All constructs ranged from 0.700 to 0.850, thus confirming that the research instrument was reliable enough to proceed with further data collection.

4.5 Data Analysis

The measurement and structural models were assessed using Partial Least Squares (PLS-SEM), a variance-based technique widely recommended for predictive modelling in social sciences (Hair et al., 2019). PLS-SEM was chosen because of its suitability for complex models with multiple constructs. When adopting PLS-SEM to conduct statistical analysis, Hair et al. (2020) propose that a researcher commences with the outer (measurement) model as the first port of call. Moreover, per the established views by Hair et al. (2018), a two-phase method of assessing SEM models is recommended, with the outer model analysis coming first and the inner model testing coming last.

5. Findings

5.1 Respondent Characteristics

Descriptive statistics were obtained using SPSS version 28. The sample characteristics are depicted in Table 2. The sample comprised 521 respondents, with gender results indicating that 60.8% are female, 38.8% male, and 0.4% preferred not to disclose their gender orientation. Regarding academic qualifications, most respondents held a bachelor's degree (33%), with a smaller portion having attended school but not completing their matriculation (3.1%). The income distribution was varied, 26.5% earned below R10 000.00, followed by those earning R15,001–20,000 (13.6%), those earning R10,000-15,000 (13.4%), then those who preferred not to disclose their income (11.9%). Regarding the respondents' employment status, those who were part-time employed by an organisation were 39.3%, followed by 16.9% full-time employed by an organisation, and only 0.6% were unemployed. Regarding the marital status of the respondents, 41.5% were single or living alone, 28.7% were married or living with a partner, 21.3% were living with parents, while those who were remarried were 7.7%. Only 0.8% were divorced or separated.

Table 2. Demographic profile (n=521)

Variables	n	%
Gender		
Male	202	38.8
Female	317	60.8
Preferred not to say	2	0.4
Qualification		
Attended school, but did not complete matric	16	3.1
Matric/Grade 12 completed	149	28.6
Post high school certificate/diploma	99	19.0
Bachelor's degree	172	33.0
Postgraduate	52	10.0
Preferred not to answer	33	6.3

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Table 2. Demographic profile (n=521) (Continue)

Variables	n	%
Income		
No disposable income	49	9.4
Below R10 000	138	26.5
R10,000–15,000	70	13.4
R15,001–20,000	71	13.6
R20,001–30,000	57	10.9
R30,001–40000	35	6.7
R40,001–50000	16	3.1
R50,001 and more	23	4.4
Preferred not to answer	62	11.9
Employment status		
Self-employed	28	5.4
Full-time employed by an organisation	88	16.9
Part-time employed by an organisation	205	39.3
Full-time student	41	7.9
Part-time student	45	8.6
Housewife or househusband	26	5.0
Retired	3	0.6
Unemployed	3	0.6
Other	82	15.7
Marital status		
Single (living alone)	216	41.5
Married or living with a partner	150	28.7
Living with parents	111	21.3
Divorced or separated	4	0.8
Remarried	40	7.7

Aligning the demographic results with the context of this study, it is clear that more female respondents used household solar products, which could be attributed to more female-oriented roles within the household, especially in an emerging economy such as South Africa. The majority of the respondents were educated, with most having a degree, meaning they are knowledgeable about the household solar products they make use of. However, most respondents seem to be earning a low income of below R10 000, but this corresponds to the audience of interest (Gen Z), since most would be in entry-level jobs, which do not pay high salaries. There is also evidence that a very small number of the respondents were unemployed (0.6%), which could mean that the majority of them can afford to purchase and then use household solar energy products since they have jobs to gain an income. Most of the respondents were single, which could hypothetically mean they were living alone; thus, they could have less demand for household solar products than those who are married and potentially have children, who could then require more household solar products.

5.2 Evaluation of the Measurement Model (Outer Model)

The proposed model was tested using Smart-PLS software (version 4.0). Ringle et al. (2020) support the use of Smart-PLS in empirical studies as it produces lower biases in estimating latent variable models and works best on small and large sample sizes. Using 5000 subsamples at a 5% significance level based on two-tailed sampling, the bootstrapping technique was used to evaluate the model's significance. In the initial estimation of the measurement model, some items displayed poor loading (< 0.5); therefore, they were removed, and a new model estimation was performed. Cronbach's Alpha (CA) and Composite Reliability (CR) were used to evaluate internal consistency.

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According to Table 3, all Cronbach Alpha values fall within the recommended threshold of 0.600 and 0.900 (Sarstedt et al., 2024). Cronbach's alpha values of 0.60, 0.70, and 0.90 are considered acceptable, good, and outstanding, respectively (Hair et al., 2020).

Table 3. Reliability and validity results

Variables	Factor Loadings	Cronbach's Alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Extracted
Perceived Hedonic Value		0.761	0.766	0.847	0.581
PHV1	0.750				
PHV3	0.752				
PHV4	0.743				
Perceived Utilitarian Value		0.711	0.731	0.793	0.563
PUV1	0.668				
PUV2	0.830				
PUV4	0.744				
Environmental Involvement		0.715	0.728	0.824	0.541
EI1	0.651				
EI2	0.818				
EI3	0.713				
EI4	0.751				
Green Attitude		0.839	0.848	0.882	0.555
GA1	0.738				
GA2	0.781				
GA3	0.601				
GA4	0.751				
GA5	0.733				
GA6	0.656				
Green Usage Behaviour		0.711	0.722	0.793	0.561
GU2	0.780				
GU3	0.778				
GU4	0.685				

The results indicate that CR values ranged from 0.711 to 0.839, surpassing the recommended threshold. Convergent validity was evaluated using standardised factor loadings and Average Variance Extracted (AVE). Item loadings assess how well the indicators explain the construct, while AVE measures the variation in the construct as explained by the indicators (Kaur & Kaur, 2023). Values for both must be at least 0.5, with 0.7 being ideal for factor loadings (Cheung et al., 2024). Factor loadings ranged between 0.656 and 0.830, while AVE values ranged from 0.541 to 0.581, confirming acceptable convergent validity. Although the AVE values are somewhat near the lower limit, there is an indication that the measurement items still have the capacity to adequately explain the latent constructs, even though they could be strengthened; however, this would not prevent further analysis from being considered (Fornell & Larcker, 1981). Additionally, composite dependability values are 0.793 and higher, which is above the expected minimum level of 0.70 (Chabata et al., 2024). No items were removed, as there were no issues with low factor loadings. Finally, all the results in Table 3 indicate that the construct measures exhibit an acceptable level of internal consistency.

After convergent validity was established, the researchers were able to conduct discriminant validity tests using the Heterotrait-Monotrait Ratio (HTMT) proposed by Henseler et al. (2015), which is an improvement over cross-loadings and the Fornell-

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Larcker criterion. Henseler et al. (2015) established that strong evidence of discriminant validity (conservative threshold) is indicated by an HTMT < 0.85, whereas for semantically related constructs, an HTMT < 0.90 indicates acceptable discriminant validity (liberal threshold). The inference of HTMT 0.85 or HTMT 0.90 at a 95% confidence interval should not contain 1. If so, then the discriminant validity conditions are violated. The HTMT values indicated in Table 4 are all below 0.90. As a result, discriminant validity is present. To this point, all results indicate acceptable levels of validity and reliability, enabling the researchers to further evaluate the structural (inner) model, which is discussed in the next section.

Table 4. Heterotrait-Monotrait Ratio (HTMT) values

Variable	EN	GENDER	GA	INCOME	PHV	PUV
Environmental involvement						
Gender	0.166					
Green attitude	0.579	0.153				
Income	0.037	0.089	0.111			
Perceived hedonic value	0.657	0.131	0.734	0.069		
Perceived utilitarian value	0.803	0.071	0.786	0.048	0.838	
Solar usage behaviour	0.645	0.080	0.624	0.145	0.651	0.757

5.3 Structural Model (Inner Model) Evaluation

The first step in assessing the robustness of the structural model was to check for multicollinearity issues. As recommended by (Hair Jr. et al., 2021), the Variance Inflation Factors (VIFs) were considered. The impact of multi-collinearity on the model falls within the suggested criteria ($1 \leq VIF \leq 3$) (Sarstedt et al., 2024). VIF values greater than three indicate collinearity between sets of predictor constructs (Ringle et al., 2020). Collinearity is not a critical issue in this study, as evidenced by the lowest VIF of 1.016 and the highest of 1.715, both well below the more conservative threshold of 3.

After examining the constructs for possible collinearity problems, the next step considered the importance and relevance of the structural model linkages (i.e., the path coefficients) and the model's explanatory and predictive capacity. The first step involved inspecting the f-squared values. The f^2 values of 0.02, 0.15, and 0.35 represent small or negligible, medium, and large effects, respectively (Cohen, 1988). The f^2 effect sizes with the highest being green attitude ➔ solar usage behaviour (0.290), representing a significant effect, followed by perceived hedonic value ➔ green attitude (0.150) indicating a medium effect, while the other relationships below 0.02, environmental involvement ➔ green attitude (0.017), gender ➔ solar usage behaviour (0.001) and income ➔ solar usage behaviour (0.006) indicate small effect sizes. Figure 2 presents the empirical structural results of this study.

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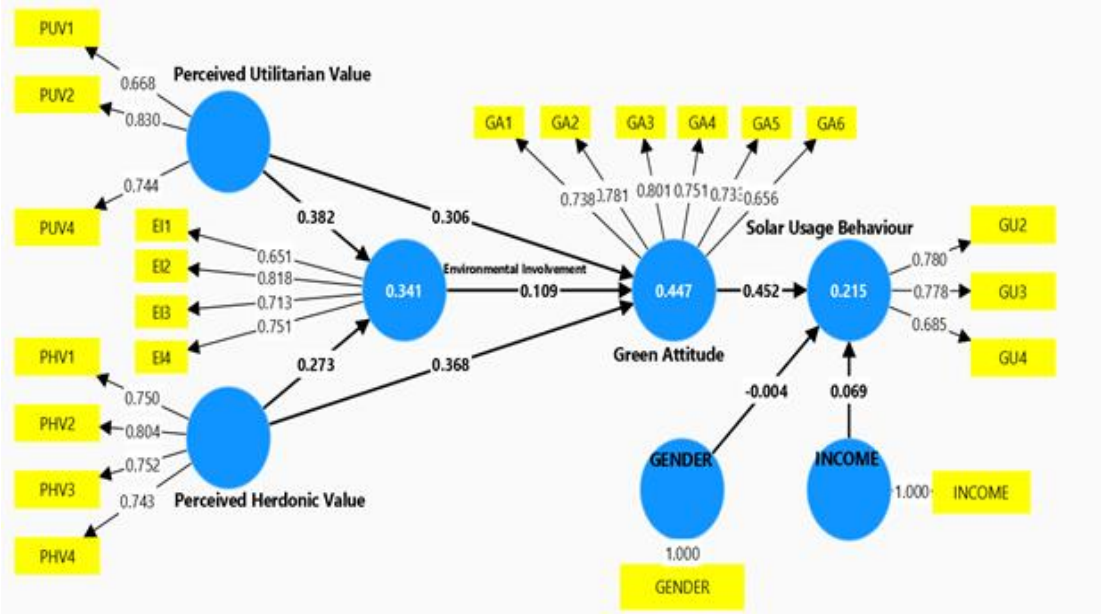

Figure 2. Structural model empirical results

After the paths were examined, the researchers analysed the coefficient of determination. Rigdon (2012) points out that a range from 0 to 1 quantifies the variance explained by the endogenous construct. Higher R^2 values indicate more explanatory power, while values of 0.75, 0.50, and 0.25 are generally considered significant, moderate, and weak (Hair et al., 2011; Henseler et al., 2009). Accordingly, the green attitude had the most significant impact on solar usage behaviour (0.447); consequently, 22% of the impact of the exogenous constructs (antecedents) on the endogenous construct (solar usage behaviour) is explained, which represents weak explanatory power.

5.4 Hypothesis Testing

Hypothesis testing examined the proposed relationships among perceived utilitarian value, perceived hedonic value, environmental involvement, green attitudes, and solar energy usage behaviour. In line with the study's conceptual framework, each hypothesis was tested within the PLS-SEM framework to determine the strength and significance of the causal paths. Hypothesis testing in PLS-SEM involves estimating path coefficients and evaluating their statistical significance through bootstrapping procedures, which provide confidence intervals and p-values for each hypothesized relationship (Hair et al., 2019).

The results presented in Table 5 indicated significant positive effects for perceived utilitarian value on environmental involvement (β = 0.364, t = 4.522, p = 0.000), perceived hedonic value on environmental involvement (β = 0.286, t = 3.984, p = 0.000), perceived hedonic value on green attitude (β = 0404, t = 5.383, p = 0.000), perceived utilitarian value on green attitude (β = 0.344, t = 5.446, p = 0.000), environmental involvement on green attitude (β = 0.118, t = 1.811, p = 0.000) and green attitude on solar usage behaviour (β = 0.493, t = 8.457, p = 0.000). As a result, H1-H6 were significant and accepted.

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Table 5. Direct hypothesis testing

Hypo-thesis	Proposed path	Standardised coefficients	t-value	P-value	Hypothesis decision
H1	Perceived utilitarian value ➔ environmental involvement	0.364	4.522	0.000	Supported
H2	Perceived hedonic value ➔ environmental involvement	0.286	3.984	0.000	Supported
H3	Perceived hedonic value ➔ green attitude	0.404	5.383	0.000	Supported
H4	Perceived utilitarian value ➔ green attitude	0.344	5.446	0.000	Supported
H5	Environmental involvement ➔ green attitude	0.118	1.811	0.000	Supported
H6	Green attitude ➔ solar usage behaviour	0.493	8.457	0.000	Supported

5.5 Mediation Analysis

According to the results in Table 6, environmental involvement did not mediate the link between perceived hedonic value and green attitude (p= 0.113, t = 1.586) and between perceived utilitarian value and green attitude (p= 0.106, t = 1.616). Therefore, H7 and H8 are not supported. Gender, age, and income were controls; the results indicated minimal influence of control variables on solar usage behaviour, except for income, which significantly impacted solar usage behaviour (< 0.05). This finding suggests that the use behaviour of solar household products, a behavioural decision, may depend on Gen Z disposable income. In contrast, the usage of solar household products is less affected by age and gender. This is because they showed no significant effects, underscoring their irrelevance to the primary dependent variable in this study's context.

Table 6. Mediation results

Hypo-thesis	Proposed path	Effect	t-value	p-value	Lower limit 2.5%	Upper limit 97.5%	Hypothesis decision
H7	Perceived hedonic value ➔ environmental involvement ➔ green attitude	0.034	1.586	0.113	-0.002	0.083	Not supported
H8	Perceived utilitarian value ➔ environmental involvement ➔ green attitude	0.043	1.616	0.106	-0.001	0.107	Not supported

6. Discussion

6.1 Utilitarian Value and Environmental Involvement

The empirical results in Table 5 confirm that H1 is supported, indicating that perceived utilitarian value significantly influences young consumers' environmental involvement. These findings affirm that the practical benefits of solar energy, such as cost savings, energy reliability, and reduced grid dependency, heighten Gen Z's engagement with environmental issues. Perceived utilitarian value and attitudes have been widely

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acknowledged as antecedents of pro-environmental behaviour (Bai et al., 2024; Larasatie et al., 2023; Nosrati et al., 2023; Van Tonder et al., 2023). While prior research has examined utilitarian value largely in shopping or consumption settings (e.g., Bai et al., 2024; Larasatie et al., 2023), this study extends the construct to the context of renewable energy adoption. The stronger influence of utilitarian value, consistent with Cheng et al. (2020), suggests that the practical uses of solar energy products are more important than aesthetic aspects in predicting environmental involvement, an important finding for the solar usage context of this study. This insight contributes to the literature by demonstrating that in resource-constrained or energy-unstable contexts such as South Africa, practical utility may serve as a gateway to environmental involvement, highlighting the functional roots of pro-environmental engagement.

6.2 Hedonic Value and Environmental Involvement

This study confirmed the relationship between hedonic value and environmental involvement, providing support for H2. This finding partly aligns with Cheng et al. (2020) who found a positive relationship between hedonic value and environmental involvement. The finding also aligns with studies from the hospitality industry, such as Han et al. (2018) who focused on green hotel guests and found that hedonic value substantially impacted guests' green involvement. This suggests that values such as enjoyment, satisfaction, and emotional gratification derived from adopting solar energy appear to strengthen young consumers' environmental involvement. This offers novel insights by showing that, even for functional technologies, symbolic and experiential gratifications matter in fostering sustained environmental engagement among Gen Z.

6.3 Utilitarian Value and Green Attitudes

The positive and significant findings for H3 support the role of perceived utilitarian value in enhancing green attitudes. These findings are consistent with other studies that have demonstrated the role of value in fostering positive attitudes towards pro-environmental behaviour in different contexts, including that of urban greening (Adams et al., 2024), green food products (Woo & Kim, 2019) and agritourism (Phung et al., 2024). Correspondingly, young customers expect to derive value for money from household solar energy products, thereby demonstrating a positive green attitude towards them. The findings reinforce that Gen Z consumers develop favourable environmental attitudes when they perceive strong performance and cost-efficiency benefits from renewable products. Woo and Kim (2019) emphasise that consumers with green attitudes are influenced by the utility they derive from the environmentally friendly products. The finding strengthens the cognitive component of the VAB framework, showing that rational evaluations of utility anchor pro-environmental attitudes even among values-driven consumers.

6.4 Hedonic Value and Green Attitudes

The results for H4 confirm that hedonic value significantly predicts green attitudes, illustrating that emotional and experiential enjoyment derived from solar energy usage fosters stronger environmental orientations. Although previous research has linked hedonic motivations to environmental attitudes (Kim & Hall, 2021; Steg et al., 2011), this study is among the first to establish this relationship in the household solar usage context. The findings support the notion that the affective benefits of household solar energy products amplify young consumers' attitudes toward continued environmental consciousness.

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6.5 Environmental Involvement and Green Attitudes

The results in Table 5 also supported H5, highlighting the role of environmental involvement in fostering a green attitude among young consumers. Similar to past studies, the results reiterate the centrality of cognitive and emotional engagement in shaping environmental orientation (Cheng et al., 2020; Lavuri, 2022; Nazir & Wani, 2024). Mataracı and Kurtuluş (2020) maintain that involvement in environmental issues positively influences consumers' perceptions of businesses that engage in eco-friendly practices. For Gen Z, the results suggest that the more environmentally conscious the consumer is, the more involved they will be. This reinforces the hierarchical structure of the VAB model, in which involvement serves as a motivational bridge between values and attitudes.

6.6 Geen Attitude and Solar Usage Behaviour

The empirical results in Table 5 support H6, indicating that green attitude influences solar usage behaviour. This finding is supported by research on the role of green attitude in influencing green consumer behaviour (Stieglitz et al., 2023; Van Tonder et al., 2023). The current study is important because it confirmed this relationship in the context of solar energy usage behaviour, which had been underexplored. Theoretically, this confirms that attitude remains a proximal predictor of pro-environmental behaviour, even when values and contextual constraints vary. These empirical results indicate that younger consumers exhibit positive green-oriented attitudes and are more inclined to use solar energy as their preferred source of electricity, further enabling emerging countries like South Africa to preserve their electricity supplies and reduce the crisis of load shedding and energy poverty.

6.7 Mediating Role of Environmental Involvement

The study also sought to determine the potential mediating effects of environmental involvement on the relationship between perceived values and green attitudes, given the dearth of extant literature on this novel relationship. Contrary to expectations, environmental involvement did not mediate the relationship between perceived values (hedonic and utilitarian) and green attitudes. This is contrary to findings of studies in other contexts (Cheng et al., 2020; Qing et al., 2022). The findings imply that in contexts of energy poverty and limited affordability, direct value–attitude pathways may be more significant than mediated ones. In other words, when the utilitarian and hedonic benefits of solar energy are salient and immediate, consumers form positive attitudes without requiring heightened environmental involvement. Therefore, firms initiating household solar energy services should amplify perceived value (hedonic and utilitarian), as both significantly influence green attitudes independent of environmental involvement. The mediation results suggest that some context-specific modifications to the VAB framework may be necessary where mediation effects may weaken in high-need or low-resource settings due to stronger direct associations. The lack of significance in the mediation results may have played a pivotal role in the low explanatory power of the overall research model.

6.8 Effects of Demographic Variables

Given that the study was based on Gen Z, their age, gender, and income were deemed necessary. Including them as the three control variables ensured the conceptual model was more robust, helping the researchers avoid spurious conclusions. Among the control variables, income was the only significant predictor, highlighting its role in shaping solar energy usage behaviour. This finding was consistent with other studies highlighting the

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influence of income on Gen Z pro-environmental behaviour (Ivković & Mandić, 2024), confirming income as a critical enabler of Gen Z behaviour. Therefore, income attributes of young consumers should be considered in marketing materials, such as diversifying solar energy offerings to cater to diverse income levels (low, middle, and high) and offering seasonal discounts to encourage usage.

6.9 Managerial Implications

This study highlights various implications for practice. Firstly, given that both hedonic and utilitarian values positively influence environmental involvement as well as green attitudes, solar energy firms should design marketing campaigns that emphasise not only the functional benefits (e.g., cost savings, energy efficiency) but also the emotional and experiential aspects (e.g., social prestige, personal satisfaction) of solar energy adoption. If solar energy firms offer hedonic and utilitarian value to young consumers, they will be more involved in the environmental issues of their offerings, which will further enhance their positive green attitude behaviour (Han et al., 2019; Jin, 2018). Firms can enhance their valuable offerings through eco-friendly management activities that increase their environmental involvement (Mukonza & Swarts, 2020), which will amplify their green attitudes towards household solar products.

Given the findings on the central role of green attitudes in predicting solar usage, practitioners should employ various effective strategies to evoke positive green attitudes. Since both perceived utilitarian and hedonic values directly and positively influence green attitudes, implementing emotional and utility-based marketing strategies can help to evoke favourable green attitudes. Marketing communications for solar energy products can effectively convey the practical benefits and enjoyable aspects of solar energy. Additionally, given the strong relationship between environmental involvement and a green attitude, managers should invest in initiatives that encourage young consumers to engage with environmental issues. While the effect size was weak, Kumar et al. (2017) and Ahmad et al. (2020) also found that environmental involvement directly affects environmental management and attitudes toward products; therefore, it can be fostered through educational campaigns and community initiatives that engage young consumers in the energy conservation agenda.

Lastly, the study proposes that firms should focus directly on value propositions in their green marketing. Given that environmental involvement did not mediate the relationship between perceived values and green attitudes, it is crucial for solar energy companies to prioritise direct messaging around the perceived values (both utilitarian and hedonic) of their products. Even if young consumers are not initially highly environmentally involved, highlighting the practical and enjoyable aspects of solar energy usage can still cultivate positive green attitudes and encourage solar energy usage. Highlighting the benefits of having a backup power source and reduced reliance on the national grid can encourage energy independence, a necessary condition for reducing power outages.

6.10 Theoretical Contribution

This study offers insights into the personal factors influencing Gen Z consumers' energy conservation behaviour by investigating how perceived values, environmental involvement, and green attitude influence household solar use. Theoretically, the study extends pro-environmental behaviour research by integrating hedonic and utilitarian values within the Value–Attitude–Behaviour (VAB) framework. While prior research has demonstrated the role of perceived values and attitudes in various eco-friendly contexts (Cheng et al., 2020; Phung et al., 2024; Woo & Kim, 2019), to our knowledge, this study is the first to examine these relationships empirically within the household solar usage

domain in an emerging market. This finding advances the Value–Attitude–Behaviour (VAB) framework by demonstrating that, in the context of solar energy adoption, values can exert a direct influence on attitudes without mediation. The failure of environmental involvement as a mediator may point to context-specific factors, such as affordability concerns, that outweigh environmental consciousness in South Africa. This represents an important theoretical extension, positioning the VAB model as adaptable to contexts where immediate practical needs and personal value fulfilment dominate over intermediary psychological constructs.

Secondly, the more substantial impact of utilitarian value on environmental involvement suggests that practical and functional considerations may outweigh aesthetic or experiential factors in the context of household solar energy products. This aligns with past studies in different sustainability domains (Adams et al., 2024; Lavuri, 2022) but contrasts with research in shopping behaviour, where hedonic value played a more substantial role (Cheng et al., 2020). These findings reinforce the contextual sensitivity of value-based theories, showing that motivations for green behaviour differ between essential and lifestyle-oriented domains.

Lastly, the study enhances our understanding of environmental involvement as a psychological construct in sustainability research. While previous studies have recognised environmental involvement as an important predictor of green (Mataracı & Kurtuluş, 2020; Nazir & Wani, 2024b), its role as a mediator between perceived value and green attitudes in renewable energy use remains underexplored. The absence of a mediating role for environmental involvement refines theoretical understanding by revealing a boundary condition for the VAB model. The finding that environmental involvement does not mediate these relationships suggests that perceived value alone is a strong enough driver of green attitudes, contributing to a nuanced understanding of consumer motivation in the energy sector.

6.11 Limitations

Firstly, the study explored limited hedonic and utilitarian values. Exploring values other than those depicted in Figure 2 as antecedents of green attitude can potentially enhance solar usage behaviour. The model's modest explanatory power suggests that additional values and other potential psychological and contextual variables may further explain solar energy use among Gen Z. Furthermore, the exclusive focus on Gen Z, while theoretically justified, limits the generalisability of the findings to other generational cohorts whose environmental motivations may differ. Additionally, the study adopted a quantitative research approach by using convenience sampling and only collected data among 521 respondents, which limits the generalisability of the study from a sample size perspective.

Since there was no mediating role of environmental involvement in the proposed relationships, future studies can empirically test other mediating variables crucial in enhancing the literature on sustainable solar energy consumption. Future research should employ larger and more diverse samples to enhance the robustness and external validity of the results. The study can also undertake a longitudinal time horizon to assess Gen Z behavioural changes over time.

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7. Conclusions

This study set out to investigate the role of perceived value in shaping solar usage behaviour among Gen Z. In line with the first objective, the findings confirmed that both utilitarian and hedonic values significantly shape Gen Z's environmental involvement and green attitudes. Green attitudes, in turn, influence solar usage behaviour. Moreover, green attitude emerged as the strongest predictor of solar energy usage, reinforcing its central role in driving pro-environmental behaviour. The study also examined the mediating role of environmental involvement in the relationship between perceived value and green attitude. However, the absence of a mediating effect of environmental involvement suggests that perceived values exert a direct influence on green attitudes. Collectively, these results confirm the applicability of the VAB framework in understanding Gen Z consumers' sustainable energy choices while also indicating that, in this context, value-driven motivations may operate more directly than traditionally theorised. In doing so, the study contributes to global sustainability efforts, particularly the aims of Sustainable Development Goal 7 (Affordable and Clean Energy), by highlighting how value-based drivers can accelerate the renewable energy transition among young consumers.

8. Recommendation

Firstly, future studies should consider incorporating a broader range of hedonic and utilitarian values beyond those tested in this study. The modest explanatory power of the model suggests that additional psychological and contextual factors, such as perceived behavioural control, social norms, environmental concern, or energy literacy, should be incorporated to strengthen the understanding of solar usage behaviour. By expanding the scope of environmental values, researchers may be able to capture additional motivational drivers of green value. Secondly, the study's focus on Gen Z, to the exclusion of other cohorts, may limit the generalisability of the findings to other generational cohorts. Future research could extend the VAB model to other age cohorts to examine potential generational differences in the influence of values on solar adoption. Moreover, investing in strategies that promote utilitarian benefits, such as loyalty rewards and coupons, could increase solar adoption among young consumers. To amplify environmental involvement, practitioners should invest in creating interactive green educational campaigns, focus on meaningful and purposeful community building initiatives that will enhance attitudes towards the use of household solar products.

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