Research Article

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# Consumption of Sustainable Renewable Energy by Generation Z from a Utilitarian Perspective

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**Abstract:** Sustainable energy products are pivotal for the well-being of consumers, especially in emerging economies like South Africa. The country has experienced unprecedented load-shedding due to insufficient electricity supply from the national grid. As a result, consumers have resorted to alternative, sustainable, renewable energy sources, particularly solar energy. However, the factors influencing the adoption of solar energy products, especially among young consumers, remain under-researched, with limited empirical studies exploring their motivations for solar energy usage. This study investigated the influence of utilitarian value on Gen Z consumers' household solar energy usage. Using a conceptual model that integrated the Experiential Value Theory (EV) and the Theory of Planned Behaviour (TPB), the study examined the role of customer return on investment and service excellence in shaping green attitudes towards solar product use. The model was tested using survey data from 521 young consumers aged 21 to 27. Partial least squares structural equation modelling (PLS-SEM) was employed to test the proposed hypotheses using SmartPLS Version 4. The findings confirm that the variables under study have significant direct and mediated effects. It was revealed that customer return on investment and service excellence both predict green attitudes, which, along with subjective norms and perceived behavioural control, influence intention. Conversely, the moderation results indicate that gender does not moderate the proposed relationships. The study recommends that campaigns aimed at increasing Gen Z's usage of solar products should emphasise experiential value, particularly service excellence and customer return on investment benefits, to develop positive green attitudes.

**Keywords:** Gender, green attitude, sustainable renewable energy, utilitarian value, young consumers.

## 1. Introduction

Access to a reliable energy supply is critical for enhancing people's quality of life and potentially improving a country's economic development (Fathima et al., 2023). However, escalating energy demands have placed pressure on the energy sector in emerging economies, leading to the current energy crisis. Household energy consumption contributes significantly to global energy demand and accounts for 20% of total energy consumption (Chen et al., 2023). The International Energy Agency (IEA) estimates that the residential energy sector will account for approximately 40% of the increase in global energy demand by 2040 (Thondhlana et al., 2023). This increase, along with the consequential surge in carbon emissions, necessitates energy efficiency and energy conservation measures, which have high potential for delivering significant, long-term reductions in energy consumption (Belaïd & Joumni, 2020). In response to growing environmental concerns and the demand for sustainable electricity systems, there has been a global shift towards renewable energy sources, with solar energy emerging as one of the most in-demand alternatives (Almrafee & Akaileh, 2024).

Consumer concerns over energy prices, coupled with an unstable electricity supply, have resulted in consumers actively engaging in the energy transition by considering the adoption and use of

renewable energy sources like solar energy (Asif et al., 2023). These concerns are particularly pronounced among younger generations, such as Gen Z (Pollack, 2023). Gen Z is an age cohort comprised of individuals born between 1995 and 2012 (Pichler et al., 2021) and accounts for about 26% of the global population (Versace & Abssy, 2022). A study by the Pew Research Centre on climate change activism revealed Gen Z to be the cohort most concerned with climate change, with 69% expressing anxieties about the future in relation to the climate (Tyson et al., 2021). Additionally, the World Economic Forum asserts that this cohort not only shows the most concern for the environment but also inspires others to act more sustainably while influencing first-time sustainability buying decisions (Wood, 2022). While Gen Z is concerned with environmental degradation, the mechanism by which this concern translates into actual consumer behaviour is limited, particularly concerning their adoption of renewable energy products (Belmonte et al., 2023; Pollack, 2023).

### 1.1 Problem statement

Of the available renewable sources, solar energy is the fastest-growing and most accessible renewable energy source on the planet (Nijsse et al., 2023). The International Renewable Energy Agency (IRENA) report (2019) revealed that several African countries showed potential in the uptake of solar as a renewable source, with Nigeria at 19 MW, Egypt at 770 MW, Morocco at 735 MW, and Algeria at 435 MW, out of only 6,093 MW of solar energy installed capacity in Africa. IRENA noted that by 2050, 90% of the world's electricity must come from renewable energy sources (UN, 2024). However, few studies have provided conclusive results on the drivers of solar energy product usage among Gen Z consumers (to the researchers' knowledge). Scholars have argued that Gen Z consumers often face financial barriers to using renewable appliances; therefore, studies on consumers under 30 are limited (Vu et al., 2024). Additionally, studies on Gen Z and their sustainable consumption behaviour have focused on the cognitive and emotional factors influencing their green purchase intentions (Pollack, 2023), the antecedents of their green purchase/consumption intentions (Michel et al., 2023; Sharma et al., 2022), the functional aspects affecting Gen Z's intention towards green products/services (Wu et al., 2023), and the consumption values of this cohort when it comes to green products/services (Rana et al., 2024). However, few studies have focused on the utilitarian aspects of sustainable products and services (Asif et al., 2023) and sustainable renewable energy usage (Vu et al., 2024). Current literature is insufficient in determining a conceptual model that underpins both the value and use of renewable energy in the form of household solar energy among young consumers (Generation Z) (Chen et al., 2023; Steadman et al., 2023). As such, the researchers elucidate the manifestation of value and attitude and their impact on young consumers' use of household renewable solar products. Integrating the EV Theory and TPB to deconstruct and test utilitarian value against Gen Z's green attitude towards household solar energy products is the main contribution of this study. Therefore, it was imperative to frame an empirical conceptual model to enhance the understanding of the antecedents that influence the use of renewable household solar products by Gen Z and the utility of the same products. By answering the following research question, this study contributes to the global discussion on renewable energy consumption and adds to the literature on Gen Z's green consumption behaviour:

- How does utilitarian value influence sustainable, renewable energy consumption among young consumers?

## 2. Literature Review

This section discusses the theoretical framework that guides this study, namely the Experiential Value Theory and the Theory of Planned Behaviour. The integration of the two theories is clearly presented, with justification supported by the novel conceptual model of this study.

### 2.1 Experiential value theory (EVT)

The EVT posits that consumers evaluate products and services not only based on functional utility but also on the experiential value created through emotional, cognitive, and relational interactions

(Wei et al., 2025). The perception of value derived by customers from the "experiences" they obtain from goods and services is conceptualised as "experiential value" by Mathwick et al. (2001). Consumers are "value-driven" because of the experiences they gain from using products (Brakus et al., 2022; Schmitt et al., 2015). Holbrook (1999) postulates that value resides not only in a product but also in the overall experience derived from the products used by consumers. Mathwick et al. (2001) further conceptualised "experiential value" as the value gained from experiences through interactions involving either direct usage or distanced appreciation (indirect observation) of goods or services. Similarly, Yuan and Wu (2008) affirm that the "value" customers derive from an experience is consequently termed "experiential value".

Based on the seminal work of Mathwick et al. (2001) and Pine and Gilmore (1999), contextual experiences have been considered across various domains, such as luxury brand experience (Atwal & Williams, 2009), customer experience (Gentile et al., 2007), general brand experience (Brakus et al., 2022), and hotel experience (Wu & Liang, 2009). However, this framework has found scant usage in the sustainability domain, which is imperative for inclusion in this novel study. To gain a competitive advantage, experiential value is integral in today's experience economy. Given the fragmentation in the academic literature on experiential value (Chabata et al., 2024; Verhoef et al., 2009; Wu & Liang, 2009), more empirical studies are required to validate its applicability in different contexts, particularly in this study.

## 2.2 Theory of planned behaviour (TPB)

This study drew insights from the Theory of Planned Behaviour (TPB) to identify the factors associated with the use of household solar energy products. The TPB has become one of the most prominent models for predicting and explaining human behaviour in specific contexts (Dilotsotlhe & Chabata, 2024; Harorli & Erciş, 2023; Xu et al., 2024). The TPB suggests that there are three antecedents of the intention to engage in a certain behaviour, and these antecedents mediate their relationship with specific behaviours (Almrafee & Akaileh, 2024). The TPB posits that attitude, subjective norms, and perceived behavioural control affect an individual's intention towards a behaviour (Ajzen, 1991). Essential to the TPB is an individual's intention (Ajzen, 1991), described as the readiness and likelihood to adopt a specific behaviour (Xu et al., 2024). The TPB has been applied in pro-environmental behaviour, including sustainable consumption, green tourism, renewable energy usage, and other environmentally conscious behaviours (Agrawal & Pradhan, 2023; Belmonte et al., 2023; Juma-Michilena et al., 2024; Van Tonder et al., 2023; Xiao et al., 2023).

Researchers have integrated the TPB with complementary theories to enhance the understanding of the factors influencing consumers' pro-environmental behaviour (Kim, 2023; Wang et al., 2018; Wu et al., 2024). While the TPB emphasises rational and intentional drivers of behaviour, it does not explicitly account for the emotional, sensory, and relational experiences that often shape consumer behaviour, which the Experiential Value Theory (EVT) can address. Combining the EVT and TPB provides a more comprehensive framework for explaining consumer behaviour by integrating experiential and cognitive determinants. Thus, this study empirically examined how extending the TPB by integrating the utilitarian value constructs from the EVT can yield deeper insights into Generation Z's use of household solar energy products.

## 2.3 Conceptual model and hypothesis development

Based on the existing literature review, a self-constructed conceptual framework outlining the possible antecedents, mediators, moderators, and outcomes of household solar energy use is presented in Figure 1.

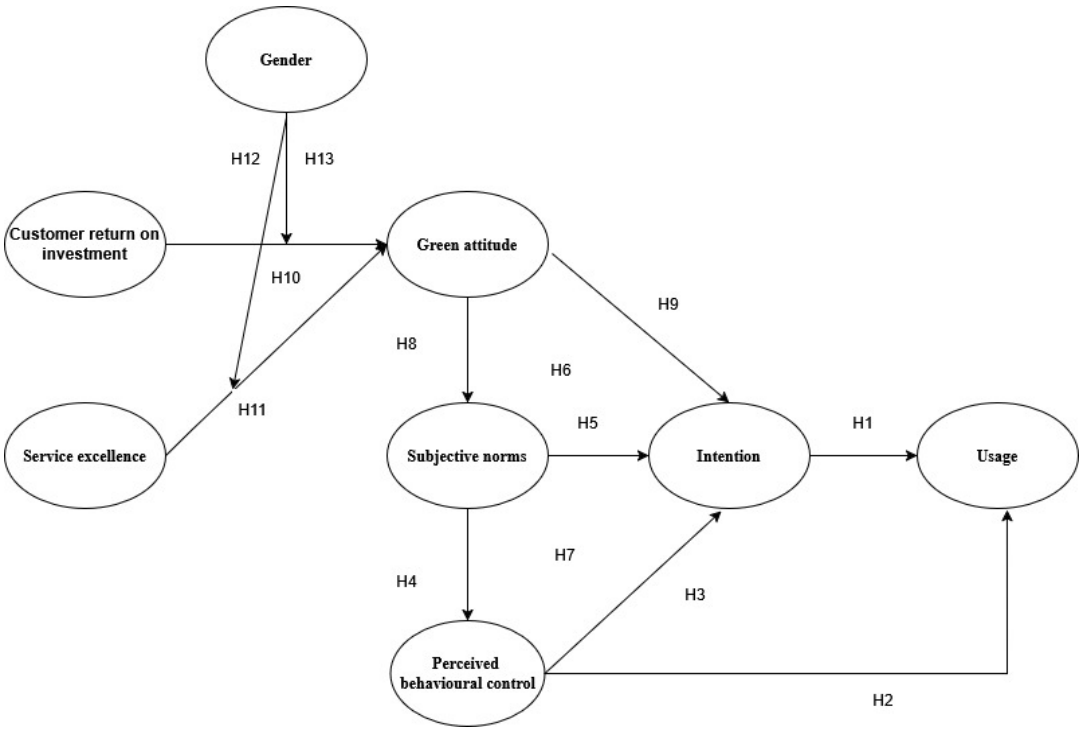


***Figure 1:*** *Conceptualised experiential value-behaviour model*

### *2.3.1 Intention and green use*

Studies on renewable energy adoption have considered various factors that may contribute to energy conservation behaviour, such as individual characteristics (Masrahi et al., 2021), technology-specific factors (Lan et al., 2020), socio-demographic factors (Jacksohn et al., 2019), barriers to adoption (Qureshi et al., 2017), and socio-psychological factors (Li et al., 2022). Research investigating personal characteristics that lead to renewable energy adoption has extensively built upon the Theory of Planned Behaviour. For instance, Liu et al. (2021) explored the effects of the Big Five personality traits on energy-saving behaviour and found that TPB attributes connect personality traits and household energy-saving behaviours as key intentions that drive usage. Given that prior studies have confirmed that core factors within the TPB can predict household energy-saving behaviour, the current study proposes the following hypothesis:

- H1: Intention has a significant and positive influence on the green use of household solar energy products.

### *2.3.2 Perceived behavioural control and green use*

Perceived behavioural control (PBC) describes an individual's perception of the ease or difficulty of engaging in or performing a specific behaviour (Agag & Colmekcioglu, 2020). To overcome the limitations of the Theory of Reasoned Action (TRA) and expand on Bandura's (1977) concept of perceived self-efficacy, Ajzen (1991) introduced PBC to account for a person's perception of their ability to engage in a certain behaviour. Ajzen (1991) argued that a person's self-efficacy beliefs would impact their selection of activities, readiness for an activity, level of effort invested during performance, cognitive patterns, and emotional responses. A positive, significant relationship has been established between PBC and energy conservation (Masrahi et al., 2021; Waris et al., 2023; Yee et al., 2022). Likewise, Belmonte et al. (2023) established a positive, significant relationship between PBC and the acceptance of alternative energy. Considering these past findings, the study proposes the following hypothesis:

- H2: Perceived behavioural control has a significant and positive influence on the green use of household solar energy products.

### *2.3.3 Mediating role of intention on perceived behavioural control and green use*

Buying intention has become a key mediating factor in understanding how personality attributes affect the actual purchase behaviour of sustainable products (Salleh et al., 2024). Existing studies have supported the mediating role of consumer intention in various contexts. For instance, Liu et al. (2021) found that purchase intention partially mediates the relationship between PBC and actual purchase behaviour in the health sector. Similarly, Kautish et al. (2019) and Zaremohzzabieh et al. (2021) demonstrated that purchase intention mediates the effect of PBC on actual behaviour in sustainable product markets. Moreover, Sharma and Foropon (2019) posited that purchase intention plays a crucial mediating role when consumers manage their purchasing habits, thereby strengthening their buying intention for sustainable products and further leading to actual purchase behaviour. In line with the insights from the existing literature, this study proposes that:

- H3: Intention mediates the relationship between perceived behavioural control and green use of household solar energy products.

### *2.3.4 Subjective norms and perceived behavioural control*

Subjective norms pertain to an individual's perceived social pressure to engage in, or refrain from, certain behaviours (Belmonte et al., 2023). The social pressures and influences from reference groups, such as family, friends, and colleagues, can affect whether an individual performs a behaviour or not (Harorli & Erciş, 2023). Xu et al. (2024) point out that people can infer social expectations regarding energy conservation from friends and family members, which can, in turn, influence their own intention to conserve energy. The current study presents a novel conceptualisation of subjective norms and perceived behavioural control (PBC). It posits that subjective norms will influence a consumer's perceived ability to engage in solar usage behaviour. Therefore, we propose that:

- H4: Subjective norm has a significant and positive influence on perceived behavioural control.

### *2.3.5 Subjective norms and intention*

Subjective norms are a significant predictor of the intention to engage in a behaviour. Similarly, subjective norms have been shown to influence a consumer's intention to engage in energy conservation behaviour. For instance, Belmonte et al. (2023) found that subjective norms significantly impact the intention to adopt nuclear energy. Likewise, Almrafee and Akaileh (2024) assert that consumers' intention to use solar panel systems in Jordan is influenced by subjective norms in the form of social influence. Zulu et al. (2021) determined that subjective norms affect the intention to use solar energy. In light of these findings, the current study proposes the following hypothesis:

- H5: Subjective norms have a significant and positive influence on the intention to use household solar energy products

### *2.3.6 Mediating role of subjective norms on green attitude and intention*

Even though people are influenced by external factors that encourage them to be more planned and structured, they may feel more in control when purchasing sustainable products (Eastman et al., 2021). Consumers' attitudes towards sustainable products could influence their intention to buy these products (Tarka et al., 2022), mediated by subjective norms. Moreover, existing studies have validated the mediating role of subjective norms (Kautish et al., 2019; Shen et al., 2022). Thus, subjective norms affect green attitudes, which in turn intensify purchase intentions. Therefore, in line with previous studies, this research proposes the following hypothesis:

- H6: Subjective norms mediate the relationship between green attitude and intention to use household solar energy products

### *2.3.7 Mediating role of perceived behavioural control on subjective norms and intention*

PBC stems from Ajzen's Theory of Planned Behaviour (TPB), which reflects an individual's perception of the ease or difficulty of performing a particular behaviour, influenced by past experiences and anticipated obstacles (Ajzen, 1991). Studies show that PBC significantly influences purchase behaviour, as individuals with strong subjective norms regarding their actions are more likely to translate intentions into actual purchases (Hagger et al., 2022). Ajzen (1991) established the positive and significant influence of subjective norms, which aligns with the findings of Dilotsotlhe and Duh (2021). Similarly, Van Tonder et al. (2023) maintain that subjective norms influence intention, although they suggest that future studies should test the mediating factors of this relationship. In response to this, the researchers propose the following hypothesis regarding the mediating role of PBC:

- H7: Perceived behavioural control mediates the relationship between subjective norms and intention to use household solar energy products

### *2.3.8 Green attitude and subjective norms*

Attitude relates to an individual's positive or negative perception of a behaviour (Patel & Parkins, 2023). It is the result of an individual's psychological and emotional evaluation of engaging in a specific behaviour (Agag & Colmekcioglu, 2020). According to the Theory of Planned Behaviour (TPB), consumers are more inclined to engage in a behaviour when they have a favourable attitude towards it, which leads to their intention and willingness to act upon that behaviour (Harorli & Erciş, 2023). Green attitudes are environmentally specific and are likely to result in environmentally friendly actions (Van Tonder et al., 2023). The current study proposes a novel conceptualisation of the relationship between green attitudes and subjective norms. It posits that a positive green attitude towards household solar products will positively influence the development of favourable subjective norms. Therefore, the following hypothesis is proposed:

- H8: Green attitude has a significant and positive influence on subjective norms

### *2.3.9 Green attitude and intention*

Positive attitudes towards energy conservation in the renewable energy consumption sector are likely to lead to increased engagement in energy-saving practices, such as using domestic solar energy products. For instance, Juma-Michilena et al. (2024) found that Gen Z's pro-environmental behaviours are motivated by attitudes generated by intrinsic motivations and environmental participation. Research has shown that having a favourable outlook on renewable energy leads to an increased inclination and readiness to utilise renewable products (Almrafee & Akaileh, 2024; Patel & Parkins, 2023). For instance, when studying residents' intentions and behaviours towards the purchase of photovoltaic power, Xu et al. (2024) found that attitudes had a positive effect on intention. Wijaya and Kokchang (2023) found that attitudes towards energy transition positively influence the intention towards energy transition. Considering the preceding discussion, the following hypothesis is proposed:

- H9: Green attitudes have a significant and positive influence on the intention to use household solar energy products

### *2.3.10 Intention and green use*

Customer return on investment (CROI) refers to all the gains that a consumer accrues from investing financial resources in the shopping process. It further describes the value consumers expect from investing economic and time resources in the consumption process (Wu & Hussein, 2024). Studies have found CROI to be one of the pivotal dimensions of experiential value (Deng & Tang, 2020; Stavrianea & Kamenidou, 2022), influencing consumer attitudes. The current study posits that the value consumers attain from using household solar energy products will influence their green attitudes. This conceptualisation aligns with Razali et al. (2021), who investigated the effect of value

on attitudes toward sustainable transportation, finding this relationship to be significant. Similarly, Stavrianea and Kamenidou (2022) found that CROI positively influences attitude. Based on previous findings, we propose the following hypothesis:

- H10: Customer return on investment has a significant and positive influence on green attitude

#### *2.3.11 Service excellence and green attitude*

Service excellence refers to the degree to which a firm providing a service performs optimally, serving as a basis for consumers to make quality judgments (Shobeiri et al., 2013). Essentially, service excellence relates to customer satisfaction with the product or service (Wu & Hussein, 2024). Various authors have identified service excellence as an important dimension of experiential value (Deng & Tang, 2020; Stavrianea & Kamenidou, 2022; Taylor et al., 2018). The current study proposes a novel conceptualisation of the relationship between service excellence and green attitude. It suggests that a consumer's satisfaction with the solar service will positively influence their decision to use the household solar energy product. A positive experience with a green product is likely to enhance the consumer's attitude, leading us to propose the following hypothesis.

- H11: Service excellence has a significant and positive influence on green attitude

#### *2.3.12 Moderating role of gender*

Gender Schema Theory, Evolutionary Psychology, Socialisation Theory, and Self-Construal Theory have supported previous research that further integrates the role of gender as a moderator (Hanks & Mattila, 2014; Sharma et al., 2012; Schiffman et al., 2010). Greater perceived value is sometimes associated with greater sacrifice (time, money, or effort) in purchasing goods, and vice versa. For men, utilitarian value is a stronger predictor of consumer attitude and pleasure, while for women, it is the opposite (Mishra, 2014). This may be because males are less likely than females to put in the same effort when using a product; consequently, they may experience a lower utilitarian value for the same amount of sacrifice. Given how value affects consumer intentions differently (Hyun et al., 2011; Neuhofer, 2012), gender is expected to moderate attitudes and value types. As a result, the following hypotheses were developed:

- H12: The relationship between customer return on investment and attitude is moderated by gender
- H13: The relationship between service excellence and attitude is moderated by gender

## 3. Methodology

A quantitative research approach was used to support a descriptive study design. Since the researchers lacked a sample frame, they employed a non-probability convenience sampling technique. The sample size of 521 Gen Z users of solar products in an emerging economy was consistent with prior studies in the same domain, specifically 304 (Peterson et al., 2020), 332 (Kamboj et al., 2022), and 351 (Fathima et al., 2023). Items measuring the constructs of the questionnaire were derived from reputable previous research. Customer return on investment was measured using a three-item scale adapted from Shobeiri et al. (2013). Service excellence was measured using a six-item scale adopted from Mathwick et al. (2001). Green attitude was measured on a six-item scale (Baburajan et al., 2024; Van Tonder et al., 2023), while subjective norm was measured using a five-item scale (Masrahiv et al., 2021; Paul et al., 2016). Perceived behavioural control was measured using a six-item scale from the research of Wong et al. (2022), and lastly, green use was measured on a six-item scale from the work of Patharia et al. (2021). The conceptual model of this study was generated and tested using SmartPLS software (version 4.0). This was accomplished by running the Partial Least Squares Structural Equation Modelling (PLS-SEM) algorithm, which is flexible and, according to Sarstedt et al. (2023), produces lower biases in estimating latent variable models. The selection of PLS-SEM over covariance-based SEM was due to the former's suitability for handling non-normal

data distributions and moderate sample sizes, as is the case in our study (n = 521) (Ringle et al., 2020). However, PLS-SEM does have its limitations, such as bias in small samples and limitations in model fit indicators (Sarstedt et al., 2023).

### 3.1 Ethical consideration

The online questionnaire included an informed consent form for respondents to either accept or decline participation in the study. Respondents could click 'accept' or 'decline' on the online informed consent form, and only those who accepted became the sample of interest. Confidentiality and anonymity were upheld as outlined in the consent form. This study received ethical approval from the UNISA College of Economic and Management Sciences, ERC Marketing and Retail Management, with ethics approval number 307.

## 4. Presentation of Results

The demographic profile of the respondents included 202 males and 319 females, with only two preferring not to disclose their gender orientation. All respondents were aged between 21 and 27, categorising them as young consumers.

### 4.1 Outer model or measurement model results

Hair et al. (2018) suggest a two-step approach to evaluating SEM models, beginning with outer model tests followed by testing the structural model. Significance testing on the model was conducted using the bootstrapping technique with 5,000 sub-samples, operating at a 5% significance level based on two-tailed sampling.

### 4.2 Reliability and validity tests

The table below presents the reliability and validity assessment results for each construct, indicating that all values met or exceeded the recommended thresholds for internal consistency and convergent validity.

***Table 1**: Reliability and validity results*

| | **Cronbach's alpha** | **Composite reliability (rho_a)** | **Composite reliability (rho_c)** | **Average variance extracted (AVE)** |
|---|---|---|---|---|
| Thresholds | 0.60-0.90 | >0.70 | >0.70 | >0.50 |
| Consumer behaviour | 0.715 | 0.748 | 0.823 | 0.541 |
| Customer return on investment | 0.735 | 0.816 | 0.844 | 0.645 |
| Green attitude | 0.839 | 0.845 | 0.882 | 0.554 |
| Intention | 0.611 | 0.719 | 0.793 | 0.562 |
| Perceived behavioural control | 0.725 | 0726 | 0.819 | 0.576 |
| Service excellence | 0.726 | 0.731 | 0.820 | 0.578 |
| Subjective norms | 0.706 | 0.705 | 0.751 | 0.503 |

Cronbach alpha values ranged from 0.611 to 0.839, indicating that all construct items are reliable and acceptable. Furthermore, all AVE values are above 0.50, supporting the acceptable measure of CV (Henseler, 2021). The composite reliability (CR ρc) values are 0.751 or higher, exceeding the expected

minimum level of 0.70. Finally, the results presented in Table 1 suggest that the construct measures exhibit acceptable levels of internal consistency reliability. Items with loadings between 0.60 and 0.70 were retained based on their theoretical relevance, contribution to content validity, and acceptable composite reliability and AVE at the construct level, as confirmed by Hair et al. (2018) and Hair et al. (2014).

### 4.3 Discriminant validity

The table below presents the Heterotrait-Monotrait Ratio (HTMT) values for the various constructs, indicating the level of discriminant validity among the variables.

***Table 2:*** *HTMT values*

| Variables | Heterotrait-monotrait ratio (HTMT) |
|---|---|
| Customer return on investment ➔ use | 0.541 |
| Gender ➔ use | 0.166 |
| Gender ➔ customer return on investment | 0.105 |
| Green attitude ➔ use | 0.579 |
| Green attitude ➔ customer return on investment | 0.674 |
| Green attitude ➔ gender | 0.153 |
| Intention ➔ use | 0.645 |
| Intention ➔ customer return on investment | 0.586 |
| Intention ➔ gender | 0.080 |
| Intention ➔ green attitude | 0.624 |
| Perceived behavioural control ➔ use | 0.710 |
| Perceived behavioural control ➔ customer return on investment | 0.628 |
| Perceived behavioural control ➔ gender | 0.123 |
| Perceived behavioural control ➔ green attitude | 0.703 |
| Perceived behavioural control ➔ intention | 0.800 |
| Service excellence ➔ use | 0.595 |
| Service excellence ➔ customer return on investment | 0.864 |
| Service excellence ➔ gender | 0.082 |
| Service excellence ➔ green attitude | 0.887 |
| Service excellence ➔ intention | 0.646 |
| Service excellence ➔ perceived behavioural control | 0.793 |
| Subjective norms ➔ use | 0.366 |
| Subjective norms ➔ customer return on investment | 0.708 |
| Subjective norms ➔ gender | 0.244 |
| Subjective norms ➔ green attitude | 0.421 |
| Subjective norms ➔ intention | 0.732 |
| Subjective norms ➔ perceived behavioural control | 0.669 |
| Subjective norms ➔ service excellence | 0.630 |

Henseler et al. (2015) maintain that the HTMT enables a researcher to better explain the extent to which a construct empirically exhibits its distinctiveness from the other constructs. A too-high HTMT above 0.90 would indicate discriminant validity problems, but one below and around 0.90 is acceptable (Henseler et al., 2015). Based on the assertion by Henseler et al. (2015), the HTMT values of this study were all below 0.90; hence, we conclude that discriminant validity is present.

## 4.4 Inner model or structural model results

After examining the constructs for possible collinearity problems, the researchers had to ascertain the structural model linkages and the model's explanatory and predictive capacity after examining the constructs for possible collinearity issues.

***Table 3:*** *Variance inflation factor (VIF) values*

| Variables of interest | VIF |
|---|---|
| Customer return on investment ➔ green attitude | 1.717 |
| Gender ➔ green attitude | 1.005 |
| Green attitude ➔ intention | 1.443 |
| Green attitude ➔ subjective norms | 1.000 |
| Intention ➔ use | 1.402 |
| Perceived behavioural control ➔ use | 1.402 |
| Perceived behavioural control ➔ intention | 1.600 |
| Service excellence ➔ green attitude | 1.736 |
| Subjective norms ➔ intention | 1.205 |
| Subjective norms ➔ perceived behavioural control | 1.000 |
| Gender × service excellence ➔ green attitude | 1.751 |
| Gender × customer return on investment ➔ green attitude | 1.733 |

According to the results in Table 3, the effects of multicollinearity on the model are within the recommended thresholds (1←VIF←3), with threshold values of five (Hair et al., 2014) and three (Diamantopoulos & Siguaw, 2006). Collinearity between sets of predictor constructs is indicated by VIF values greater than three (Ringle et al., 2020). However, collinearity can also occur at lower VIF values, as demonstrated in the context of the measurement model under study. The highest VIF value (1.751) is below the more conservative threshold of 3, confirming that collinearity is not critical.

***Table 4:*** *F-squared values*

| Variables of interest | f-square |
|---|---|
| Customer return on investment ➔ green attitude | 0.049 |
| Gender ➔ green attitude | 0.017 |
| Green attitude ➔ intention | 0.051 |
| Green attitude ➔ subjective norms | 0.082 |
| Intention ➔ use | 0.054 |
| Perceived behavioural control ➔ use | 0.163 |
| Perceived behavioural control ➔ intention | 0.106 |
| Service excellence ➔ GA | 0.395 |
| Subjective norms ➔ intention | 0.059 |
| Subjective norms ➔ perceived behavioural control | 0.200 |
| Gender × service excellence ➔ GA | 0.004 |
| Gender × customer return on investment ➔ Green attitude | 0.000 |

According to Cohen (1988), $f^2$ values of 0.02, 0.15, and 0.35 represent small, medium, and large effects. Moreover, $f^2$ values of less than 0.02 indicate that there is no effect (Cohen, 1988). $f^2$ effect sizes with the highest being service excellence ➔ green attitude (0.395), representing a large effect, followed by subjective norms ➔ perceived behavioural control (0.200). The other relationships indicate a negligible effect size since they are below 0.02, namely gender ➔ green attitude (0.017), gender × service excellence ➔ green attitude (0.004), gender × customer return on investment ➔ green attitude (0.000) – meaning no effect on the dependent variable.

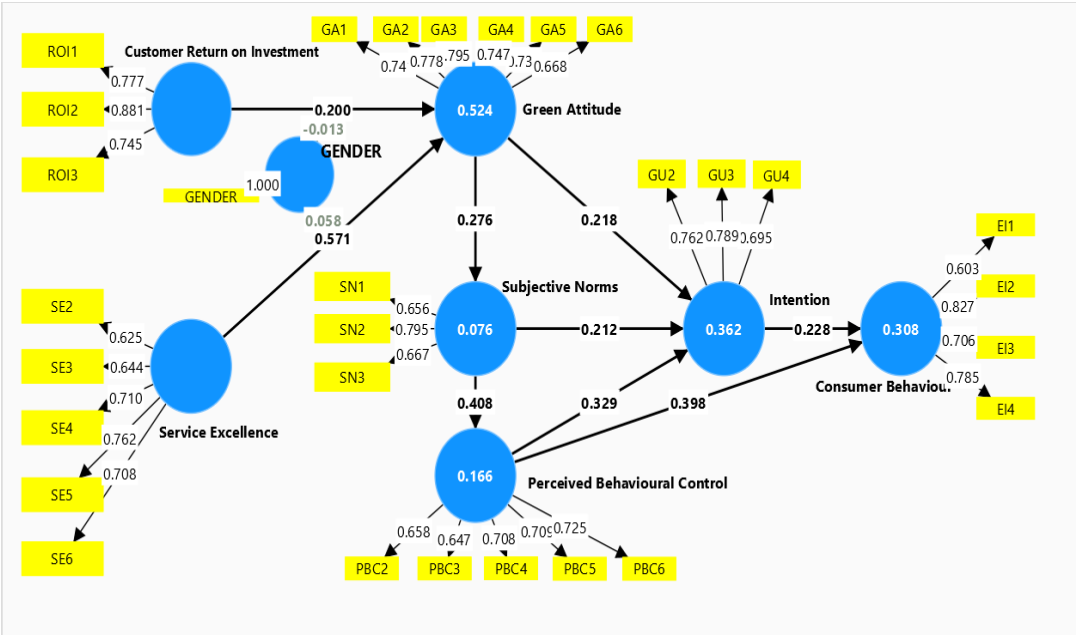


***Figure 2:*** *Structural model empirical results*

## 4.5 Coefficient of determination ($R^2$)

When forecasting stock returns, an $R^2$ value as low as 0.10 is deemed adequate and in certain fields (Raithel et al., 2012). In other instances, scientists normally predict greater $R^2$ values exceeding 0.65. Based on the $R^2$ values, intention had the greatest impact on usage (0.362), followed by PBC (0.166), resulting in 31% variance.

## 4.6 Model measurements

Table 5 displays the measurement model results, showing the standardised outer loadings and corresponding p-values for each indicator; all loadings are statistically significant ($p < 0.05$), demonstrating that the observed variables reliably represent their respective latent constructs.

***Table 5:*** *Measurement model results*

| Variable | Standardised outer loading | P-value (two-tailed) |
|---|---|---|
| EI1 | 0,603 | 0,000 |
| EI2 | 0,827 | 0,000 |
| EI3 | 0,706 | 0,000 |
| EI4 | 0,785 | 0,000 |
| GA1 | 0,741 | 0,000 |
| GA2 | 0,778 | 0,000 |
| GA3 | 0,795 | 0,000 |
| GA4 | 0,747 | 0,000 |
| GA5 | 0,732 | 0,000 |
| GA6 | 0,668 | 0,000 |
| GU2 | 0,762 | 0,000 |
| GU3 | 0,789 | 0,000 |
| GU4 | 0,695 | 0,000 |
| PBC2 | 0,658 | 0,000 |
| PBC3 | 0,647 | 0,000 |
| PBC4 | 0,708 | 0,000 |
| PBC5 | 0,709 | 0,000 |
| PBC6 | 0,725 | 0,000 |

| | | |
|---|---|---|
| ROI1 | 0,777 | 0,000 |
| ROI2 | 0,881 | 0,000 |
| ROI3 | 0,745 | 0,000 |
| SE2 | 0,625 | 0,000 |
| SE3 | 0,644 | 0,000 |
| SE4 | 0,710 | 0,000 |
| SE5 | 0,762 | 0,000 |
| SE6 | 0,708 | 0,000 |
| SN1 | 0,656 | 0,000 |
| SN2 | 0,795 | 0,000 |
| SN3 | 0,667 | 0,000 |

## 4.7 Structural model analysis

The table below presents the results of the structural model analysis, indicating that all proposed direct hypotheses are statistically supported, with significant path coefficients ($p < 0.05$), thus confirming the strength and direction of relationships among the study constructs.

***Table 6:*** *Direct hypotheses testing*

| Hypothesis | Proposed path | Standardised coefficients | *T*-value | *P*-value (two-tailed) | Hypothesis decision |
|---|---|---|---|---|---|
| H1 | Intention → use | 0,228 | 3,423 | 0,001 | Supported |
| H2 | Perceived behavioural control → use | 0,398 | 6,112 | 0,000 | Supported |
| H4 | Subjective norms → perceived behavioural control | 0,408 | 6,734 | 0,000 | Supported |
| H5 | Subjective norms → intention | 0,212 | 3,583 | 0,000 | Supported |
| H8 | Green attitude → subjective norms | 0,276 | 3,531 | 0,000 | Supported |
| H9 | Green attitude → intention | 0,218 | 3,104 | 0,002 | Supported |
| H10 | Customer return on investment → green attitude | 0,200 | 3,064 | 0,002 | Supported |
| H11 | Service excellence → green attitude | 0,571 | 9,190 | 0,000 | Supported |

Table 6 indicates significant positive effects for behavioural intention on solar use (β = 0.228, $t$ = 3.423, $p$ = 0.001), PBC on use (β = 0.398, $t$ = 6.112, $p$ = 0.000), CROI on green attitude (β = 0.220, $t$ = 3.064, $p$ = 0.002) and service excellence on green attitude (β = 0.571, $t$ = 9.190, $p$ = 0.000). These results, therefore, confirm that hypotheses H1, H2, H4, and H5 were supported. Similarly, the results indicate a significant and positive effect of subjective norms on PBC(β = 0.408, $t$ = 6.734, $p$ = 0.000), subjective norms on intention (β = 0.212, $t$ = 3.583, $p$ = 0.000), green attitude on subjective norms (β = 0.276, $t$ = 3.531, $p$ = 0.000), and green attitude on intention (β = 0.218, $t$ = 3.104, $p$ = 0.002). Confirming that H8, H9, H10 and H11 were also supported.

***Table 7:*** *Mediation results*

| Hypothesis | Proposed path | Effect | Standard deviation (STDEV) | *T*-value | *P*- value (two-tailed) | Hypothesis decision |
|---|---|---|---|---|---|---|
| H3 | Intention → perceived behavioural control → use | 0,065 | 0,024 | 2,841 | 0,004 | Supported |
| H6 | Subjective norms → green attitude → intention | 0,059 | 0,022 | 2,616 | 0,009 | Supported |

| | | | | | | |
|---|---|---|---|---|---|---|
| H7 | Perceived behavioural control → subjective norms → intention | 0,074 | 0,025 | 2,979 | 0,003 | Supported |

Zhao et al. (2010) pointed out that a significant indirect effect at play is necessary for significant mediation. Table 7 indicates a significant indirect effect of intention on PBC and use. Since both the direct and total effects were also significant, the observed type of mediation was considered complementary (Zhao et al., 2010). Similarly, the indirect effect was significant in terms of subjective norms, confirming that subjective norms mediated the relationship between green attitude and intention – PBC mediated subjective norms and intention since the indirect effect was significant. Holistically, the mediation results in Table 7 indicate that there is partial mediation given that the indirect relationships I→PBC→U (P=0.004, t=2.841), and SN→GA→I (P=0.009, t=2.616) and PBC→SN→U (P=0.003, t=2.979), as well as direct relationships PBC→U (P=0.000, t=6.112), SN→I (P=0.000, t=3.583) and GA→I (P=0.002, t=3.104), are all statistically significant. Therefore, H3, H6 and H7 were supported.

***Table 8:*** *Moderation results*

| Hypothesis | Hypothesis path | Original sample (O) | Effect | Standard deviation (STDEV) | *T*-value | *P*-value (two-tailed) | Hypothesis decision |
|---|---|---|---|---|---|---|---|
| H12 | GENDER × customer return on investment → green attitude | -0,013 | -0,016 | 0,075 | 0,169 | 0,866 | Not supported |
| H13 | GENDER × service excellence → green attitude | 0,058 | 0,055 | 0,062 | 0,923 | 0,356 | Not supported |

The results in Table 8 indicate that the p-values (H13: p=0.356 and H12: p=0.866) are greater than 0.05, implying that the moderation effect of gender on the relationship between service excellence and green attitude and the relationship between CROI and green attitude is statistically insignificant. Gender does not alter the direct effect of value on green attitude. Hence, hypotheses H12 and H13 were not supported.

## 5. Discussion of Findings

Extending the Theory of Planned Behaviour (TPB) by incorporating the utilitarian value elements (CROI and service excellence), while applying the moderation of gender and mediation on the proposed relationships, adds to the existing literature. Theoretically, this study posits that subjective norms mediate the relationship between green attitude and intention, while perceived behavioural control (PBC) mediates the relationship between subjective norms and intention. Similarly, intention mediates the relationship between PBC and household solar renewable energy product usage. These results enhance the predictive power of the TPB and contribute to the literature on the mediating role of the three underpinning constructs. However, gender did not moderate the relationships between decomposed utilitarian value and green attitude, indicating there are no gender differences in Gen Z's views on their utility or their attitudes towards using solar products. Consequently, solar energy suppliers should not base their marketing efforts on gender differences, as this would not influence attitudes towards their offerings.

The study's findings support hypotheses H1 and H2, indicating that Gen Z consumers' intention to engage in solar product usage and their PBC have a significant, positive effect on their usage of solar products. These findings align with other studies investigating energy conservation behaviour (Anjum & Subhan, 2024; Okur et al., 2024). Our findings demonstrate that CROI and service excellence influence Gen Z's green attitude. Prior studies have acknowledged the central role of green attitude in precipitating pro-environmental behaviours (Lavuri et al., 2023; Shi et al., 2023; Van Tonder et al., 2023). Support for hypotheses H10 and H11 provides a novel perspective on this topic,

being the first, to the researcher's knowledge, to confirm the effects of CROI and service excellence, as components of utilitarian value, on green attitude in this context. Other studies have also confirmed positive relationships between perceived utilitarian value and attitude, albeit in different contexts. For instance, Woo and Kim (2019) found that functional value has a positive effect on customers' attitudes towards purchasing green products. Similarly, Nosrati et al. (2023) investigated the role of hedonic and utilitarian values on pro-environmental behaviour and found that a supportive attitude towards tourism mediated the relationship between utilitarian value and pro-environmental behaviour.

H5 and H9 were supported and significantly aligned with previous studies (Waris et al., 2023; Zulu et al., 2022). For instance, Almrafee and Akaileh (2023) investigated purchase intentions concerning solar panels and found that attitude, PBC, and subjective norms significantly affect the intention to adopt solar energy. Similarly, Dai and Chen (2023) examined household energy-saving intentions using energy-efficient light bulbs and identified the three variables as predictors of behavioural intention. Vu et al. (2024) found that the three TPB variables promoted the intention to purchase solar appliances. Likewise, Wijaya and Kokchang (2023) discovered that attitude and PBC positively influence Gen Z's intention to support the transition to renewable energy. Conversely, unlike the current study, these authors found that subjective norms had no influence.

Derived from the mediation results, which supported H3, H6, and H7, it can be deduced that Gen Z individuals who feel more in control of household solar products are more likely to turn their intentions into actual behaviour. This finding aligns with Rehman et al. (2019) and Peña-García et al. (2020), who found that the mediation function of purchasing intention is crucial, maintaining that consumers with greater PBC have better buying intentions because they are more confident in their ability to navigate the usage process. Specifically, this study revealed that green attitude indirectly influences intention through subjective norms. Previous studies (Kautish et al., 2019; Shen et al., 2022) have explored the mediation of subjective norms, but not in this study's context. Furthermore, we offer a novel contribution to the literature on the mediating role of subjective norms between green attitude and intention.

Conversely, our findings revealed that gender did not moderate the value types on green attitudes. Hence, there are no differences among gender requirements regarding the values that influence Gen Z's green attitude. In contrast, Dedeoğlu et al. (2016) proposed that tourism service providers should utilise distinct marketing methods for different gender-oriented visitors, offering a range of different values to increase the destination's appeal. For managerial professionals, our findings suggest that variables other than gender could shape the relationship between values and green attitudes.

## 5.1 Implications for practice

The study makes several recommendations for practice. Firstly, campaigns to encourage household solar energy product adoption among Gen Z must highlight experiential value, particularly customer return on investment and service excellence. Managers should propose multidimensional value offers rather than simply one-dimensional value offers. For instance, solar companies can emphasise long-term cost savings and efficiency in their messaging while also highlighting the after-sales services that come with solar energy products. Additionally, firms can use personalised consultations, user-friendly installations, and responsive after-sales support to improve customer service experiences. Secondly, solar companies can leverage green attitudes to drive solar product adoption intention. This could be achieved through environmental education, storytelling, and immersive eco experiences that make solar adoption feel both rational and emotionally rewarding, enhancing Gen Z's green attitudes. Lastly, solar companies could engage in efforts to strengthen the link between intention and behaviour. While the study found that intention significantly predicts use, the effect was moderate, suggesting that intention may not always translate to usage or behaviour. Given the findings on experiential value, incentive programmes, gamified experiences

for energy conservation, and behavioural nudges could be used to encourage solar adoption behaviours.

## 6. Conclusions and Future Research

This study explored the role of customer return on investment and service excellence in influencing green attitudes towards solar product use. The findings confirm that the variables under study have significant direct and mediated effects. It was revealed that customer return on investment and service excellence both predict green attitudes, which, together with subjective norms and perceived behavioural control, influence intention. The results provide empirical evidence to answer the research question regarding how utilitarian value influences sustainable renewable energy consumption among young consumers. The study's findings indicate that both experimental and cognitive determinants have significant positive effects, supporting the combination of the Experiential Value Theory (EVT) with the Theory of Planned Behaviour (TPB). By merging the experiential motivations of Gen Z with cognitive and behavioural variables, the study highlights the importance of utilitarian value in driving household solar energy product usage.

This study was subject to certain limitations that should be acknowledged when interpreting the findings. Firstly, the research was conducted in a single emerging economy, which may limit the generalisability of the results to other cultural or economic contexts. Additionally, the study relied solely on a quantitative research design, which, while useful for testing hypotheses, may not fully capture the depth of consumers' experiential and cognitive motivations. Future research could benefit from adopting a mixed-methods or qualitative approach to gain more nuanced insights. Moreover, the use of non-probability sampling in the form of convenience sampling may have introduced sampling bias, limiting the representativeness of the sample. Replicating the study in other emerging markets using different methodologies could enhance the robustness and validity of the conceptual model.

## 7. Declarations

**Author contributions:** Conceptualisation (T.T.C. & B.C.S.); literature review (T.T.C. & B.C.S.); methodology (T.T.C.); software (N/A); validation (T.T.C.); formal analysis (T.T.C. & B.C.S.); investigation (T.T.C. & B.C.S.); data curation (T.T.C. & B.C.S.); drafting and preparation (T.T.C. & B.C.S.); review and editing (T.T.C. & B.C.S.); supervision (N/A); project administration (T.T.C.); funding acquisition (N/A). All authors have read and approved the published version of the article.

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