International Journal of Analysis and Applications

Behavioral Drivers of Solar Energy Adoption: Implications for Business Analysis and Sustainable Management

Do Viet Phuong[1], Tran Anh Tu[2,*]

[1]*Industrial University of Ho Chi Minh City, No. 12 Nguyen Van Bao, Go Vap District, Ho Chi Minh City 71408, Vietnam*

[2]*Faculty of Economics & Management, Van Hien University, Ho Chi Minh City. 613 Au Co, Phu Trung Ward, Tan Phu District, Ho Chi Minh City, 72016, Vietnam*

**Corresponding author:* tuta@vhu.edu.vn

ABSTRACT. The need to switch to renewable energy sources is growing due to environmental issues in developing countries, where green technologies can achieve sustainable development. Thus, this research focuses on the psychological and social antecedents of solar energy adoption through the integration of constructs derived from Value-Belief-Norm (VBN) theory and the Theory of Planned Behavior (TPB). The research focuses on how perceived consequences and ascription of responsibility from the VBN theory affect TPB constructs attitude, subjective norms, and perceived behavioral control which drive behavioral intention. Research results after testing 5000 bootstrap samples from 362 respondents, the findings suggest that perceived behavioral control has the strongest direct effect on intention to solar energy adoption (beta = 0.268, p-value = 0.000), while perceived behavioral control affects attitude to solar energy adoption (beta = 0.239, p-value = 0.000). The findings by the present study reveal that perceived environment partially mediates the association between the attitude with behavioral intention and subjective norms with behavioral intention and holistically mediate the behavioral control with intention to solar energy adoption but the moderating role of perceived environment is insignificant for behavioral control with intention to solar energy adoption. The practical effects include removing self-efficacy barriers and finding working-age workers. Future research should include demographic cluster analysis and longitudinal views to improve core understanding.

1. INTRODUCTION

The accelerating impacts of climate change and growing concerns over environmental degradation have heightened the urgency to transition toward renewable energy sources [1]. Solar energy as one of the renewable, efficient and clean approaches has become one of the

Received Feb. 5, 2025

2020 Mathematics Subject Classification. 62P12, 97M50, 91C05, 62P20.

Key words and phrases. environment; technology; solar energy; behavioral intention; sustainable solutions.

https://doi.org/10.28924/2291-8639-23-2025-103

ISSN: 2291-8639

leading sources of the energy transformation globally [2]. At the same time, several authors noted that the penetration of solar energy remains irregular across different regions and social layers [3]. Knowledge of these behavioural factors that predict intention to engage in solar energy use is thus essential in closing the gap between recognition and action in fighting climate change.

Behavioral theories provide a robust framework for exploring the psychological and social dimensions of pro-environmental actions. From these, the Value-Belief-Norm (VBN) theory of environmentalism and the Theory of Planned Behavior (TPB) are found to be two closely related theories that can be used to explain environmentally relevant behaviors. According to VBN theory, personal values influence the perceptions of environmental impact, which evoke the personal norms towards the environmentally responsible behavior [4]. Awareness of the consequences, one of the two important constructs of the VBN, describes how people view environmental outcomes influenced by their actions, and ascription of responsibility [5], the second VBN construct, states the personal responsibility of the customers regarding the actions necessary to reverse the impacts, negative and otherwise [6]. These constructs are important for analysis of the first level of anchored motivational states that underlie attitudes toward the use of solar energy.

Meanwhile, the TPB extends the analysis by incorporating the roles of attitude toward solar energy adoption, subjective norms, and perceived behavioral control (PBC) as mediators that translate values and beliefs into actionable intentions [7]. Attitude reflects the individual's evaluation of adopting solar energy, subjective norms capture the perceived social pressure to adopt, and PBC assesses the individual's perceived ability to undertake the behavior [8]; [9]. These mediators offer a detailed understanding of the interaction between psychological and social factors in shaping behavioral intentions related to energy conservation [10].

Despite the fact that VBN and TPB are widely used in environmental psychology, few studies have combined them directly to explore solar energy adoption [9]; [11]. The theoretical gap highlighted here calls for an integration of the value-based beliefs in the VBN with the social and the control-based cognition in TPB model. In addition, the mediating function of the Perceived Environment or other contextual factors has not received enough attention [12].

To further emphasize the urgency of this research, Vietnam is one of the countries most vulnerable to climate change, with rising sea levels and increasing frequency of extreme weather events [13]. The country has recorded progressive improvements in the formulation of policies in renewable energy with intentions of growing the solar energy system ratio in the energy system [14]. There is still a number of barriers including; financial restrictions, low level of public awareness, and limitations in technology [15].

To fill these gaps, the present research intends to synthesize and test a structural model that explores the nature of the relationship between environmental responsibility by VBN

constructs interfaces with TPB mediating variables to adopt solar energy intentions. The research is expected to inform policymakers, businesses and educators in a bid to enhance the use of renewable energy in the course of energy transformation globally.

2. LITERATURE REVIEW

The purpose of this research is to explore the psychological, social, and contextual factors that drive individual intentions to adopt solar energy, addressing gaps in understanding pro-environmental behaviors. To achieve this, the study integrates the Value-Belief-Norm (VBN) Theory and the Theory of Planned Behavior (TPB). VBN theory pinpoints values of awareness of consequences (AC) and ascription of responsibility (AR) as the predictors of environmental responsibility and pro-environmental behaviours [4]. Meanwhile, TPB enlarges this approach with mediators such as attitude toward solar energy adoption, subjective norms, and perceived behavioral control that links beliefs to behavioral intentions [7]. This confirms the moderating influence of the perceived environment, introduces the aspect of climate urgency and controls for variations in environmental conditions that affect behavior [16]. Combined with these complementary theories, the present research aims to build a comprehensive theoretical model to describe and predict solar energy adoption behaviors in order to advance academics and practical work related to sustainable energy consumption.

2.1 Perceived consequences (PC)

Perceived consequence means an understanding by an individual of the outcomes of the action on the environment and society, thus strongly influencing his or her stances and actions towards acceptance of sustainable options such as solar energy [8]. Examination of the literature revealed that increased consciousness of the negative effects of conventional sources of energy including fossil energy encourages the acceptance of solar energy due to its environmental returns [4]; [17]. This awareness also strengthens perceived behavioral control, as individuals who understand the urgency of environmental issues are more likely to perceive solar energy adoption as a feasible and impactful solution [7].

Additionally, perceived consequences affect the level of subjective norms by increasing the perceived prescriptive norms toward performing environmentally responsible behaviors. If people observe that energy decisions have impacts on climate change, then they are more sensitive to the social norms that promote appropriate energy consumption [18]. Furthermore, perceived consequences does directly and indirectly affect attitude toward the adoption of solar energy because people who understand there are consequences for the environment will be compelled to embrace renewable energy such as solar energy [8]; [9]. The integration of such findings underscores the importance of perceived consequences in understanding the psychological and social antecedents of behavioral disposition toward solar energy.

These relationships have been further investigated in the recent studies. For example, Ghosh et al. (2024) pointed that environmental knowledge and perceived usefulness of solar energy have a positive relationship with the buying intention, yet environmental concern has no impact [19]. This suggests that the awareness must be made side with the right perceptions of the usefulness of the technology in order to foster its adoption [20]. Similarly, the research used meta-analysis to show that perceived benefits and subjective norms have a positive reciprocal relationship to photovoltaic system residential adoption intention. This suggests that, apart from perceived benefits of adopting the cardinal areas of specialization, social pressure influences the decision as well [21].

The results presented here illustrate that perceived consequences plays a complex role in influencing solar energy adoption. Although remind that awareness is a basic prerequisite, the combination of past knowledge, perceived benefits, identified social norms, and individual attitudes determines adoption intentions. Therefore, in order to successfully affect behavior, programs that aim to promote solar energy should not just try to improve knowledge, but they need also address these linked issues.

H1.a Based on the analysis, perceived consequences a significant and positive predictor of attitude toward solar energy adoption.

H1.b Subjective norms has been positively influenced by perceived consequences.

H1.c Consequently, perceived consequences have an influence on perceived behavioral control.

2.2 Ascription of responsibility (AR)

Assumption of responsibility implies that part of an anthropological presumption of the self is the acceptance of the individual's responsibility to address an environmental problem, which consequently affects whose perception towards sustainable energy solutions [8]. Assumption of responsibility are predicted by a pro solar energy approach, and people who perceived themselves as bearers of responsibility toward minimizing the negative impacts of our planet feel more positively about the use of renewable energy solutions [22]. However, this study examined the energy-conserving behaviours of employees in organisations; this does not capture the flow of residential aptitude for adopting solar power by individuals and thus restricts generalisation of the results of the study.

This sense of responsibility also likewise improves perceived behavioral control. Employees who feel accountable for delivering results are more likely to report about numerous obstacles regarding the implementation of solar energy [3]. While focusing on the perceived benefits involved in behavior control, this research meta-analysis does not directly examine the social emotional and moral aspects of responsibility which may thus under estimate the range of influence of assuming responsibility.

Moreover, role modeling matches the individual with the social norms that require him or her to change and adopt pro-environmental behaviors. This alignment increases perceived social norms to adapt to renewable energy technologies [18]. Although Cialdini et al. (2021) scrutinized the figures that originate from outside the subjective norms, no distinct examination of moral obligation internalized in responsibility taken comprises the study's focus.

Finally, recent research results on ascription of responsibility affect intention toward the enhanced implementation of solar energy through facilitating the intrinsic motivation geared toward performing the right thing and meeting the expected social responsibility [9]. However, the studies of other kinds rely on a different view by including ascription of responsibility into the overall picture of green consumption, which may overlook its applicability to the solar energy scenarios [8].

H2.a Ascription of responsibility (AR) has a positive effect on attitude toward solar energy adoption.

H2.b Ascription of responsibility (AR) positively influences subjective norms.

H2.c Ascription of responsibility (AR) has a positive effect on perceived behavioral control.

2.3 The mediating role of the theory of planned behavior in solar energy adoption

In the context of promoting renewable energy solutions, such as solar energy adoption, the Theory of Planned Behavior (TPB) provides a comprehensive framework to understand the psychological and social determinants of individual decision-making. Developed by [7], TPB describes how three constructs of attitude, subjective norms and perceived behavioral control collectively determine behavioral intention that is in turn a precursor for the actual behaviour.

Within this framework, attitude toward solar energy adoption captures an individual's evaluation of the behavior, which is often influenced by perceived benefits such as environmental protection, cost savings, and energy independence [23]. While subjective norms concern perceived social pressure or support for changing behaviour to be more environmentally friendly [11]. These norms underscore that environmental context greatly influences pro-environmental behaviours.

Perceived behavioral control represents an individual's confidence in their ability to adopt solar energy, accounting for perceived barriers such as financial constraints, technological complexity, or lack of knowledge [24]. These two constructs together afford a more developed appreciation of both the intrinsic and extrinsic intention towards use of solar energy [19].

H3.a Attitude toward solar energy adoption has a positive effect on intention toward solar energy adoption.

H3.b Attitude toward solar energy adoption has a positive effect on perceived behavioral control

H4.a Subjective norms positively influence intention toward solar energy adoption.

H4.b Subjective norms positively influence perceived behavioral control

H5. Perceived behavioral control has a positive effect on intention toward solar energy adoption.

2.4 The modrating role of the perceived environment.

Perceived environment encompasses people's beliefs about their environmental conditions, climatic change intensity, local pollution, and the need for renewable energy systems [12]. This construct plays a critical moderating role in the relationships between the Theory of Planned Behavior (TPB) constructs and intention toward solar energy adoption [16]. More specifically, the results showed that perceived environment increases or decreases the impact of attitude, subjective norms and perceived behavioral control on the intentions to adopt solar energy.

For instance, those with a favourable attitude towards the use of solar energy will have intention when there is perceived unfavourable environment or existence of urgency in climate change [3]. Similarly, subjective norms recover more authority wherever overload pollutes again because perceived norms tolerate fewer harms to the environment [11]. In addition, the estimate of an environment getting worse may enhance perceived behavioral control to vary as the individuals perceived advantage and self-confidence in using solar energy systems increase [8]; [9].

This moderating role establishes environmental context factors as significantly relevant to the applicability of TPB constructs and contributes towards a better understanding of the behavioral intention related to renewable energy.

H6.a Perceived environment moderates the relationship between attitude toward solar energy adoption and intention toward solar energy adoption.

H6.b Subjective norms are directly influenced and moderated by perceived environment in the study of intention toward solar energy adoption.

H6.c Perceived environment has a moderating effect on the relationship between perceived behavioural control and intention towards adopting solar energy.

2.5 The behavioral intention for adoption towards the use of solar energy

Behavioral intention towards solar energy explains the extent of a person's desire in adopting solar energy solutions as part of their energy consuming behavior. According to the Theory of Planned Behavior (TPB), behavioral intention is influenced by three core components: self-reported perceived control, behavioral beliefs, and perceived normative beliefs [7]. A favorable attitude towards solar energy, aroused by perceived utilities such as the conservation of the environment and reduction in cost, greatly increases the intention [3]. Similarly, perceived norms or pressures from other people, as well as social norms from friends, family and society at large act as antecedents of intention especially in societies that uphold sustainable practices [25].

In addition, regarding the theory of Value-Belief-Norm (VBN), the awareness of consequences influences the intention of an individual through enhancing the attitudes and matching norms of a society to environment friendly behaviors [4]; [26]. Also related to ascription of responsibility, intended mediators are produced to give people a feeling of responsibility, where they are compelled into making changes for adoption of renewable energy [1]. Collectively, these concepts explain the different extent of values, attitude, social factor, and perceived behavioural control in predicting behavioural intention that, in this case, is the key to improving the usage of solar energy [8].

As presented on the Figure 1, the mediating and moderating interactions of the study are affirmed by the Value-Belief-Norm (VBN) theory and the Theory of Planned Behavior (TPB).

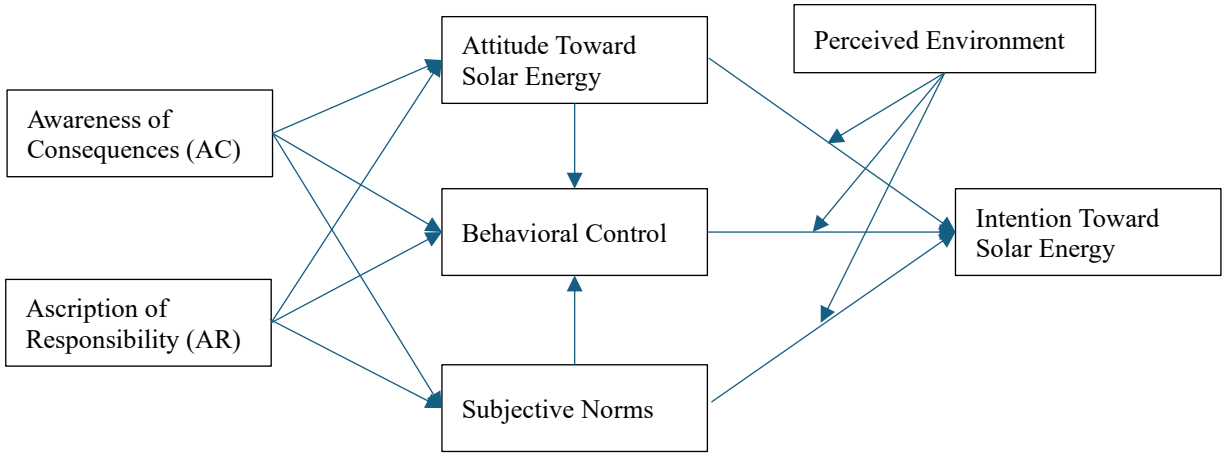

Figure 1. Framework for environmental responsibility and the adoption of solar energy

Source: author's synthesized, 2025

3. METHODOLOGY

3.1 Research design and sample size

This study employs a quantitative research design to investigate the factors influencing solar energy adoption, integrating constructs from the Value-Belief-Norm (VBN) Theory and the Theory of Planned Behavior (TPB) into a comprehensive conceptual framework. A structured survey questionnaire is the most important data collection tool used. The questionnaire items are created from other research questionnaires to achieve content reliability and validity.

For example, the items under the construct awareness of consequences are based on Kabir et al., Farm et al., Wang et al. and Schulte et al. Ascription of responsibility is assessed by items derived from Farm et al. (2024), Wang et al. (2023), Cialdini, and Jacobson (2021), and Pagliuca et al. (2022). The construct attitude toward solar energy adoption measures are developed with items from the previous works: Ghosh et al. (2024); Djurisic et al. (2020); Farm et al. (2024). For

perceived behavioral control constructs, items are derived from Awais et al., 2022; Ghosh et al., 2024; Ru et al., 2018. The perceived behavioral control encompass items attained from Ru et al. (2018), Ghosh et al. (2024), and Djurisic et al. (2020). Perceived environment is assessed by items borrowed from Latif et al. (2024); Gu and Jiang (2024); Farm et al. (2024); and Awais et al. (2022). Last but not the least; behavioral intention includes items from Rehman et al., Farm et al., Sibtain et al., and Hassan et al., (2024).

To measure the respondents' perception and behavioral intent the survey uses a 5 Likert scale with options including strongly disagree, disagree, neutral, agree and strongly agree [27]. In order to validate the measurement scales used in the study, a pilot study was carried out with 60 participants; 30 are faculty members teaching in the Faculty of Commerce and 30 are households using solar energy systems [28]. These different types of pilots guarantee the applicability and understandability of the questionnaire items to both academic and practical settings. On validity, constructs' convergent validity and discriminant validity were analyzed by performing Confirmatory Factor Analysis (CFA). The results demonstrate the following: The reliability analysis was assessed by Cronbach's Alpha and the values of all constructs were higher than 0.70, so cross loadings were satisfactory. To check the convergent validity, AVE of all constructs were above 0.50. Discriminant validity was tested using Fornell and Larcker criteria which validated that each construct is different from others.

To examine the seven variables and have sufficient statistical power for hypothesis testing, the blanket measurement model using partial least squares structural equation modeling (PLS-SEM) was employed using four items per variable. Following the 10 times rule, which requires a sample size at least ten times the number of indicators in the most complex construct, a minimum of 280 responses was targeted. However, the study was designed for a total sample size of 500, with 362 valid responses collected from January to May 2024.

3.2 Approach potential sample

Data gathering is done in two primary areas in order to achieve the sample heterogeneity. First, respondents are contacted personally at trades across commercial centers and exhibitions in products and solutions on light energy. Such places create an opportunity for the researchers to interact with individuals who are interested in implementing solar energy. Second, survey was carried out among inhabitants of agricultural regions and among households who either use or planning to use solar energy systems. This one introduces additional context by leveraging user and potential adopter data. This type of data collection allowed for clarity and accuracy in the methodology of data collection. Face-to-face acquaintance was made, and the objective of the research and the policies regarding anonymity were explained to them [29]. Some guidelines on the use of the questionnaire and definition of the core constructs were given to facilitate understanding.

Last, the questionnaire was administered through Google Forms whereby the participants were provided with a link or a QR code to fill the questionnaires at their own free time [30].

3.3 Analytical techniques

The analytical steps are also carried out in a series of phases to provide credibility and reliability of the results obtained. Frequency distributions provide the characteristics of respondents as well the results of the surveys and that is why they are useful for fulfilling the basic requirements of data analysis [31]. The internal consistency of the measurement scales is determined by using Cronbach 's Alpha while the measurement model and the validity of the constructs in terms of convergent and discriminant validity are measured by using confirmatory factor analysis [32]. Finally, PLS-SEM is applied in order to test the postulated relationships within the presented conceptual model. This method is especially suited to the examination of complex models and is less sensitive to the distribution of data and to sample size [33]. This design captures multiple types of data and uses sophisticated forms of analysis to offer a rich picture of the antecedents of behaviour relevant to solar energy decisions.

4. THE FINDINGS

4.1 Descriptive statistics results

In this study, a total sample of 362 responses to the distributed questionnaire was collected, providing detailed insights into the demographic characteristics within the research context. Gender representation among respondents has 216 (59.67%) female respondents and 146 (40.33%) male respondents. The largest portion of respondents is the age of 30-39 years old with 182 participants, or 50.27 % of the total respondents. Thus, 281 people (77,62% of the total respondent's pool) characterized themselves as an employee, 50 people (13,70%) as a manager, and 51 people (13,92%) as unemployed. Detailed demographic information of the respondents can be found in Table 1.

Table 1. Survey sample information

Demographic	Options	Count	Frequency (%)
Gender	Female	216	59.669
	Male	146	40.331
Age	18 - 29	86	23.757
	30 - 39	182	50.276
	40 - 49	83	22.928
	Up 50	11	3.039
Job	Employees	281	77.624
	Management	23	6.354
	Unemployed	58	16.022

Source: author's analysis from datatest, 2025

These results are significant because they show a wide but relevant sample mix, which matches the study's demographics. The overrepresentation of working-age people, particularly workers, fits the study's focus on behavioral factors impacting solar energy adoption because they make energy consumption decisions [31]. The gender distribution also balances perceptions of solar energy uptake across demographic groupings. These findings allow the study's conclusions and policy suggestions for similar demographics to be used in real-world situations.

4.2 Reliability of measurement instruments

Table 2. Evaluating consistencyof measurement reliability

Items	Questionnaire contents	Cronbach's alpha	Outter loading	VIF
PC	**Perceived Consequences**	**0.878**		
PC1	User acknowledges the negative environmental impacts of conventional energy sources, such as fossil fuels (Kabir et al., 2018).		0.860	2.330
PC2	User recognizes the societal benefits of adopting solar energy as a renewable energy solution (Farm et al., 2024).		0.886	2.555
PC3	User perceives solar energy adoption as an effective action to address climate change and environmental issues (Wang et al., 2023).		0.886	2.524
PC4	User feels motivated to transition to solar energy due to its positive contributions to environmental sustainability (Schulte et al., 2022; Ghosh et al. (2024).		0.784	1.803
AR	**Ascription of Responsibility**	**0.887**		
AR1	User feels personally responsible for addressing environmental issues through sustainable energy choices (Farm et al., 2024).		0.870	2.369
AR2	User believes that they can enjoy the issue that is switching to solar energy is moral (Wang et al., 2023).		0.864	2.343
AR3	Users understand that they have to use renewable power because of society’s demand (Cialdini & Jacobson, 2021).		0.862	2.273
AR4	User perceives adopting solar energy as a way to fulfill their responsibility to mitigate environmental harm (Pagliuca et al., 2022).		0.863	2.325
AT	**Attitude toward solar energy adoption**	**0.869**		
AT1	User evaluates solar energy adoption positively due to its environmental benefits Ghosh et al. (2024).		0.851	2.154
AT2	User is awareness of solar energy adoption means fulfilling energy requirement at a cheaper rate (Djurisic et al., 2020).		0.832	2.008
AT3	User thinks that using solar energy improves the energy sovereignty and efficiency (Djurisic et al., 2020).		0.838	2.016
AT4	User considers adoption of solar energy as a form of endeavoring to support a solution to the environmental issues (Farm et al., 2024).		0.866	2.193
SN	**Subjective norms**	**0.889**		

SN1	User gets a sense that the family will support him or her to embrace the use of solar energy (Awais et al., 2022).		0.872	2.517
SN2	User is prompted by friends to switch into a solar energy system (Awais et al., 2022).		0.862	2.181
SN3	User supposes that solar power is supported by their community (Ghosh et al., 2024).		0.869	2.433
SN4	User feels the pressure from shoulders of society to shift to green energy (Ru et al., 2018).		0.860	2.276
BC	**Perceived behavioral control**	**0.888**		
BC1	User feels confident in their ability to afford solar energy technology (Ru et al., 2018).		0.849	2.202
BC2	User believes enough knowledge is understood to appreciate possibility of using solar energy Ghosh et al. (2024).		0.885	2.764
BC3	Users experience while implementing solar energy technology (Ru et al., 2018).		0.877	2.648
BC4	User trusts who can handle solar energy adoption difficulties (Djurisic et al., 2020).		0.847	2.111
PE	**The role moderates perceived environment**	**0.904**		
PE1	User is motivated to use solar energy by climate change (Latif et al., 2024).		0.887	2.609
PE2	User acknowledges the criticality of local pollution as the key reason for the need to embrace renewable energy systems (Gu & Jiang, 2024).		0.861	2.603
PE3	User has opinion that pollution of environment makes reliance on solar power necessary (Farm et al., 2024).		0.902	2.651
PE4	Users will perceive that worst environmental conditions increase the relevance of observing the appropriate social norms for being environmentally friendly (Rehman et al., 2024; Awais et al., 2022).		0.870	2.751
IE	**Behavioral Intention**	**0.899**		
IE1	User intends to adopt solar energy solutions in the near future (Rehman et al., 2024).		0.879	2.516
IE2	User perceived changes in society to use the solar energy in the future (Farm et al., 2024).		0.878	2.576
IE3	User is ready and agrees to take solar energy as one of the alternatives to consume energy (Sibtain et al., 2024).		0.860	2.247
IE4	User feels that it is about doing this change for, solar energy as part of helping in making the state of the environment better (Hassan et al., 2024).		0.885	2.738

Source: author's analysis from datatest, 2025

In respect to the internal consistency and the external truthfulness of the measuring items, the reliabilities and validities of all of the constructs which are mentioned in Table 2 seem to be sufficiently fit. All construct values on Cronbach's Alpha test are above the acceptable criterion of 0.70 [34], confirming internal consistency. For example, the construct perceived consequences

gains Cronbach's Alpha of 0.878, while intention to adopt solar energy gains 0.899. Similarly, the value of outer loadings of all items are above 0.70 which is the acceptable limit [33], and the minimum value observed is 0.784 for PC4 which proves the validity of individual items in assessing their respective construct.s.trating the validity of individual items in measuring their constructs.

Additionally, Moreover, the mean VIF for all the items also does not exceed the limit of 3.0, which avoids a problem such as multicollinearity [33]. For example, numbers of VIF for items in subjective norms fall in the range of 2.181- 2.517. These results validate the reliability of the measurement model, and the subsequent analysis using partial least squares structural equation modeling.

4.3 Validation of measurement models

Table 3. Construct validity - Fornell and Larcker

	CR	AVE	AR	AT	BC	IE	PC	PE	SN
AR	0.922	0.747	0.865						
AT	0.910	0.718	0.314	0.847					
BC	0.922	0.748	0.379	0.409	0.865				
IE	0.929	0.767	0.353	0.456	0.488	0.876			
PC	0.916	0.732	0.421	0.329	0.362	0.372	0.855		
PE	0.932	0.775	-0.208	-0.199	-0.195	-0.229	-0.173	0.880	
SN	0.923	0.750	0.243	0.265	0.302	0.398	0.217	-0.110	0.866

Source: author's analysis from datatest, 2025

Note: Composite reliability (rho_c), average variance extracted (AVE), perceived consequences (PC), ascription of responsibility (AR), attitude (AT), subjective norms (SN), perceived behavioral control (BC), perceived environment (PE), intention to adopt solar energy (IE)

Table 3 shows that the measurement model is construct validity using the Fornell-Larcker criterion. Most importantly, all the constructs' composite reliability estimate in excess of 0.70 evidencing satisfactory internal consistency. For example, the dependability of ascription of responsibility in this study has a composite reliability of 0.922 while that of perceived environment (PE) was 0.932 [35].

Moreover, all constructed have an average variance extracted (AVE) greater than 0.50 that confirm the convergent validity (Fornell & Larcker, 1981). Perceived behavioral control (BC) and intention to adopt solar energy (IE) have AVEs of 0.748 and 0.767, respectively, showing that the constructs reflect their indicators.

Discriminant validity is confirmed by each construct's square root of AVE being bigger than its correlations with others. The square root of AVE for ascription of responsibility (0.865) exceeds its associations with attitude (0.314) and perceived behavioral control (0.379). These results demonstrate the measurement model's resilience, making it suitable for hypothesis testing and structural equation modeling.

4.4 Assessment of hypothetical propositions

Table 4. Path coefficient analysis of the conceptual framework

Hypothesis	Patch	Coefficient beta	Standard deviation	T statistics	P values
H1.a	PC -> AT	0.239	0.057	4.207	0.000
H1.b	PC -> BC	0.165	0.053	3.098	0.002
H1.c	PC -> SN	0.139	0.059	2.369	0.018
H2.a	AR -> AT	0.213	0.058	3.653	0.000
H2.b	AR -> BC	0.193	0.055	3.527	0.000
H2.c	AR -> SN	0.184	0.058	3.166	0.002
H3.a	AT -> BC	0.254	0.052	4.868	0.000
H3.b	AT -> IE	0.236	0.055	4.251	0.000
H4.a	SN -> BC	0.153	0.052	2.915	0.004
H4.b	SN -> IE	0.193	0.056	3.450	0.001
H5	BC -> IE	0.268	0.056	4.799	0.000
H6.a	PE x AT -> IE	0.119	0.047	2.531	0.011
H6.b	PE x BC -> IE	0.065	0.045	1.453	0.146
H6.c	PE x SN -> IE	0.122	0.052	2.341	0.019

Source: author's analysis from datatest, 2025

Note: Note: Perceived consequences (PC), ascription of responsibility (AR), attitude (AT), subjective norms (SN), perceived behavioral control (BC), perceived environment (PE), intention to adopt solar energy (IE)

The results presented in Table 4 demonstrate the strength and significance of the direct relationships in the conceptual framework. All tested hypotheses for direct relationships (H1.a, H1.b, H1.c; H2.a, H2.b, H2.c; H3.a, H3.b; H4.a, H4.b; H5) are statistically significant, with p-values < 0.05, confirming their acceptance. For instance, H1.a (PC -> AT) shows a positive and significant effect with a coefficient of 0.239 (p = 0.000). Similarly, the interpretation of the test results for H5 (BC -> IE) was significant at a positive directional relationship (coefficient = 0.268, p = 0.000) hence stating that perceived behavioral control is systematic to the actual adoption intention of solar energy [36]. Such findings therefore require future research that covers a wide spectrum of the predictor constructs regarding attitude, subjective norms, and perceived behavioural control, towards the use of solar energy [8].

Conversely, the results obtained in the moderating relationships section are rather inconclusive. H6.a (PE x AT -> IE) and H6.c (PE x SN -> IE) are both significant; coefficients are 0.119 (t = 2.53, p = 0.011) and 0.122 (t = 2.34, p = 0.019). This proves that perceived environment, it does serve to amplify attitude (AT) and subjective norms (SN) in affecting intention to adopt solar energy [21]. The test of the moderation hypothesis (H6.b: PE x BC → IE) found no significant relationship between perceived behavioral control (BC) and intention to use solar energy (coefficient = 0.065, t = 1.453, p = 0.146). Additionally, perceived environment (PE) does not moderate the effect of BC on the intention to adopt solar energy [37].

There is still some need to explain why H6.b did not achieve significance, even when the direct relationship expressed in H5 appeared to be highly significant. They are suggesting that the role of perceived behavioral control may be more primary than the influence of perceived environment in encompassing the behavioral intention (coefficient = 0.268, p = 0.000). This can be argued by the fact that the perceived behavioral control has a trait characteristic of people's outlook and their capabilities to act effectively, irrespective of the prevailing environmental conditions [38]. On the other hand, attitude and subjective norms are generally influenced by the context factors to a greater extent such as the severity of the environmental cues [39]. These findings offer useful information about the complexity of behavioural aspects in solar energy utilisation.

The total effects of variables within the measurement structure are outlined in the following results, presumptions therefore being valid and presented in Table 5. The findings herein present the direct and indirect impacts simultaneously, providing a realistic depiction of the roles of the individual constructs in the framework's functioning.

Table 5. Indirect effects in the measurement structure

Indirect effects pathways	Estimation coefficient	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
AR -> AT	0.213	0.058	3.653	0.000
AR -> BC	0.275	0.054	5.123	0.000
AR -> IE	0.159	0.031	5.142	0.000
AR -> SN	0.184	0.058	3.166	0.002
AT -> BC	0.254	0.052	4.868	0.000
AT -> IE	0.304	0.053	5.736	0.000
BC -> IE	0.268	0.056	4.799	0.000
PC -> AT	0.239	0.057	4.207	0.000
PC -> BC	0.247	0.054	4.554	0.000
PC -> IE	0.149	0.033	4.581	0.000
PC -> SN	0.139	0.059	2.369	0.018
SN -> BC	0.153	0.052	2.915	0.004
SN -> IE	0.233	0.056	4.187	0.000
PE x AT -> IE	0.119	0.047	2.531	0.011
PE x BC -> IE	0.065	0.045	1.453	0.146
PE x SN -> IE	0.122	0.052	2.341	0.019

Source: author's analysis from datatest, 2025

Note: Note: Perceived consequences (PC), ascription of responsibility (AR), attitude (AT), subjective norms (SN), perceived behavioral control (BC), perceived environment (PE), intention to adopt solar energy (IE)

The results in Table 5 demonstrate the cumulative effect of the factors on the intention to adopt solar energy. Figure 2 illustrates the interrelated pathways by which the primary drivers

influence solar energy adoption. This method enhances the model's interpretation, facilitating a more profound comprehension of the behavioral aspects included in this investigation.

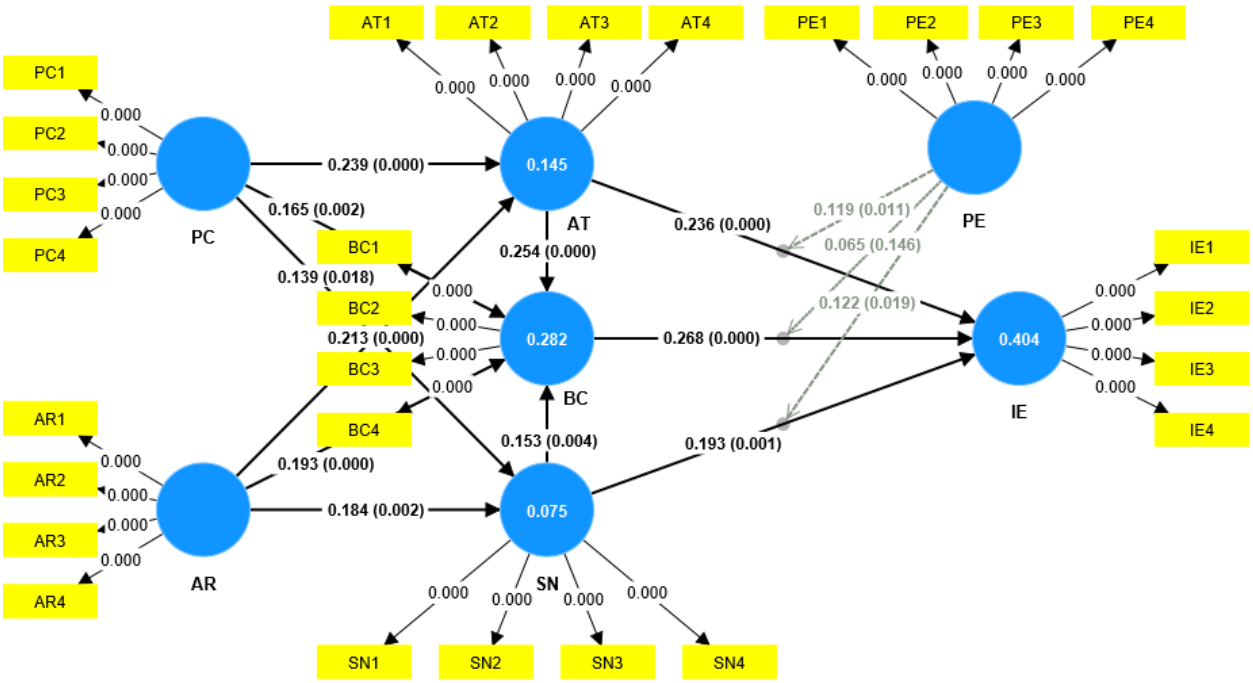

Figure 2. Visualization of perceived consequences and responsibility attribution in the value-belief-norm framework and theory of planned behavior for solar energy adoption.

Source: author's analysis from datatest, 2025

Note: Perceived consequences (PC), ascription of responsibility (AR), attitude (AT), subjective norms (SN), perceived behavioral control (BC), perceived environment (PE), intention to adopt solar energy (IE)

5. DISCUSSION

The purpose of this study was to establish the relationship between variables derived from the Value-Belief-Norm theory (VBN), Theory of Planned Behavior (TPB) and the individual's intention to adopt solar energy (IE). The research specifically examined the impact of perceived consequences (PC) and ascription of responsibility (AR) on TPB constructs attitude, subjective norms, and perceived behavioral control while also analyzing the moderating role of perceived environment in these relationships.

According to respondents, 77.62% are employees, and most of them, 50.27%, are within the working-age group of 30–39 years. This concentration shows the group that is in charge of energy decisions and it falls under the study thus making them relevant [40]. For the relationships between perceived control and TPB constructs, PC and AR have coefficients ranging from 1.48 to 2.13, and all are statistically significant at a level of $p < 0.05$. More importantly, the direct impact is most significant in BC (0.268, $p = 0.000$) with AT second at 0.236, ($p = 0.000$). Indeed, we find a significant and positive

moderation of PE on AT -> IE (b = 0.119, p = 0.011) and SN -> IE (b = 0.122, p = 0.019), but not for PE × BC -> IE (b = 0.065, p = 0.146).

The demographic findings also suggest that workers using solar energy are within the working-age population, possibly due to enhanced sensitivity to the sustainability of the environment and their financial potential [41]. The findings of the study depicting significant and positive correlations between the concerned PC, AR, and TPB hypotheses support environmental values and personal responsibility in carrying positive attitudes, strong perceived social pressures and perceived behavioural control. These results are evident in [3] who pointed relevance to psychological frameworks of renewable power. The dominance of the BC as a predictor of IE is furthermore in supporting the significance of self-efficacy in overcoming the perceived barriers including the financial or technological kind as corroborated by the results obtained in the present study and in agreement with other prior works by [9]; [42]. However, the fact that PE did not significantly moderate in the relationship BC -> IE provides evidence that self-confidence regarding the ability to action is relatively not easy to external environmental conditions.

These findings provide increased evidence for prior research of the VBN theory which asserts that values, including those defined by PC and AR by [4], dictate environmental behaviour. Likewise, the large part played by TPB constructs corresponds directly to [7] findings that attitudes, norms, and control beliefs intervene between environmental beliefs and intention. This mediational role of PE is in support of the argument by [12] that while contextual environmental urgency intensifies the influence of attitudes and norms, however, where PE only achieved a minimum of moderation which is BC -> IE, this differs from the finding of [8] wherein self-efficacy can be argued to have a primary and direct control over intention irrespective of environmental influence.

The majority of samples are the participants employed at the company within the age range from 30 to 39 years old which may add sentiments and inclinations of this age group affecting the results and cannot be applicable for younger or retired generations. Furthermore, using self-collected data, there is always an opportunity to experience response bias as people give answers that they think others want to hear instead of stating what is true [43]. Subsequent studies should administer the research to more various subjects and use more longitudinal research designs to assess subjects' behavior transformation.

The roles of various constructs embedded in the VBN and TPB frameworks are well explained in the study under the context of solar energy adoption. Primarily, the tremendous impact of the interaction between BC with IE, as well as the mediating role of PE in some relations, proves the complexity of the intention to adopt solar energy [44]. These insights are in line with and build on prior research and stress the importance of psychosocial contextual, and

environmental solutions that promote sustainable human behaviour for fast, efficient advancement of renewable energy.

6. CONCLUSION

In this study, the psychological, social and environmental factors promoting use of solar energy among people was examined, thus filling the gap in understanding environmental responsibility particularly in the process of energy transition globally.

The demographic analysis sets up a general framework for the analysis of the study. Hence, the study involved 362 respondents; females comprised 59.67%, and the respondents' age range was 30–39 years for 50.27%. Moreover, 77.62% of respondents reported that they are an employee. These demographics support the applicability of the results on working-age populations, which are directly involved in decision-making regarding energy use, and give a solid starting point to analyse behavioural aspects affecting the acceptance of solar energy.

The study shows that perceived consequences (PC) and ascription of responsibility (AR) from the VBN theory have a significant effect on attitude (AT), subjective norms (SN), and perceived behavioural control (BC) with path coefficients of 0.139–0.213, ($p < 0.05$). This explains the place of environmental values and personal responsibility for the psychological constructs in TPB that define intention to adopt solar energy IE. More specifically, PC was most predictive of AT (coefficient = 0.239, $p = 0.000$) which underlines the role of this construct for the formation of positive attitudes towards solar energy.

The measures of TPB (AT, SN, BC) exerts a highly mediating influence with intention to adopt solar energy (IE). BC has the largest and positive (coefficient = 0.268, $p = 0.000$) and AT (coefficient = 0.236, $p = 0.000$). Based on this, it has accentuated perceived behavioural control as a leading factor mainly owing to self-effort to counter barriers in the advancement of solar energy undertakings. The results given above also confirm that all the TPB constructs play a role in influencing the intention but the BC is the most influential.

The study also validates the hypothesis that perceived environment (PE) partially mediates the TPB constructs and intention to adopt solar energy. More precisely, their PE significantly enhances the influence of AT (coefficient = 0.119, $p = 0.011$) and SN (coefficient = 0.122, $p = 0.019$) on IE. Nevertheless, the influence of this factor on the correlation between BC and IE is not significant (coefficient = 0.065, $p = 0.146$). This indicates that even though external environmental conditions enhance the moderating impact of attitude and social norms, independence of BC on IE reduces the intervening moderation of PE.

Thus, further research on the role of values, beliefs, and contextual environmental conditions should be included in the approaches targeting the enhancement of effective strategies for implementing common agendas for growing solar energy acceptance among the global

community's participants [45]. Moreover, the revealed findings are valuable for policymakers and researchers with further developing effective strategies for integrated distributions of effective value-related beliefs in the contextual environmental conditions, focused on the increase of solar energy acceptance.

7. IMPLICATIONS (PRACTICAL, SOCIAL, RESEARCH)

This study on environmental responsibility and solar energy adoption provides valuable implications. Practically, demographic findings reveal that targeting working-age employees, particularly females aged 30–39, through marketing campaigns and policies can effectively promote solar energy adoption. The strong influence of perceived consequences and ascription of responsibility on attitude and subjective norms underscores the need for campaigns emphasizing the environmental benefits of solar energy and fostering personal accountability. Additionally, this immunising effect of perceived repercussions on attitude (coefficient = 0.239, p = 0.000) implies that the future promotion of solar energy should focus on the environmental consequences [46]. Because of the central role of perceived behaviour control, efforts utilising theory should focus on increasing perceived control while reducing cost and technical requirements.

Socially, the awareness raising and collective responsibility are necessary and sufficient factors fostering the pro-environmental attitudes and strengthened social norms thereby the community initiatives and educational programmes serve as the cornerstone in that respect [3]. In that sense, by bringing environmental concern, such programmes may positively establish societal norms of sustainable energy-use change [47]. The significant influence of subjective norms on behavioral intention to adopt solar energy (coefficient = 0.122, p = 0.019) highlights the importance of leveraging social networks and peer influence to encourage adoption.

For future research, this study's reliance on working-age employees limits its generalizability. Broadening the research base to younger, retired, rural citizens may provide a better measure of behavioural trends [41]. Furthermore, the insignificant moderating role of perceived environment on perceived behavioural control with behavioural intention to adopt solar energy relationship has an implication that further research and constructions of contextual or cultural may be useful [48]. Future research should also actively explore how perceived environment might moderate the relationship between attitude and subjective norms, because this was found to be a significant moderator in these pathways. Longitudinal studies can again be helpful in affording greater understanding of how behavioural intentions change with changes in the environments and societies [36].

Acknowledgment: Authors express our gratitude to our agency for the work that has arranged an appropriate time to focus on improving the research capacity of lecturers. Industry University of Ho Chi Minh City. Address No. 12 Nguyen Van Bao Street, Ward 4, Go Vap District, Ho Chi

Minh City, Vietnam. And, Van Hien University, Ho Chi Minh City. 613 Au Co, Phu Trung Ward, Tan Phu District, Ho Chi Minh City, 72016, Vietnam.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

[1] Q. Hassan, P. Viktor, T. J. Al-Musawi, et al. The Renewable Energy Role in the Global Energy Transformations, Renew. Energy Focus 48 (2024), 100545. https://doi.org/10.1016/j.ref.2024.100545.

[2] M.M. Vanegas Cantarero, Of Renewable Energy, Energy Democracy, and Sustainable Development: A Roadmap to Accelerate the Energy Transition in Developing Countries, Energy Res. Soc. Sci. 70 (2020), 101716. https://doi.org/10.1016/j.erss.2020.101716.

[3] A.U. Rehman, S. Iqbal, A. Shafiq, et al. Multifaceted Impacts of Widespread Renewable Energy Integration on Socio-Economic, Ecological, and Regional Development, Sustain. Futures 8 (2024), 100241. https://doi.org/10.1016/j.sftr.2024.100241.

[4] P.C. Stern, T. Dietz, T. Abel, et al. A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism, Hum. Ecol. Rev. 6 (1999), 81–97.

[5] T.M. Sang, N.T. Hung, Exploring the Relationship between ESG Practices and Financial Performance of Vietnamese Companies, Int. J. Anal. Appl. 22 (2024), 214. https://doi.org/10.28924/2291-8639-22-2024-214.

[6] R. Gifford, A. Nilsson, Personal and Social Factors That Influence Pro-Environmental Concern and Behaviour: A Review: Personal and Social Factors that Influence Pro-Environmental Behaviour, Int. J. Psychol. 49 (2014), 141–157. https://doi.org/10.1002/ijop.12034.

[7] I. Ajzen, The Theory of Planned Behavior, Organ. Behav. Hum. Decis. Process. 50 (1991), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

[8] M.Y. Farm, A. Vafaei-Zadeh, H. Hanifah, D. Nikbin, The Role of Value, Belief and Norm in Shaping Intentions to Use Residential Rooftop Solar for Environment Sustainability, Energy Policy 194 (2024), 114334. https://doi.org/10.1016/j.enpol.2024.114334.

[9] Y. Wang, Z. Wang, F. Huang, et al. Modeling Behavioral Factors Influencing Farmers' Willingness to Adopt Rooftop Solar Photovoltaic: Empirical Evidence from Rural China, J. Clean. Prod. 424 (2023), 138874. https://doi.org/10.1016/j.jclepro.2023.138874.

[10] T. Nguyen-Anh, H. Nguyen-Thu, L. Nguyen-Thi-Thuy, C. Tran-Phuong, N. To-The, Determinants of Energy-Saving Behavior among the Youth: Does Migration Play a Moderating Role?, Energy Environ. (2023), 0958305X231192364. https://doi.org/10.1177/0958305X231192364.

[11] M. Awais, T. Fatima, T.M. Awan, Assessing Behavioral Intentions of Solar Energy Usage through Value-Belief-Norm Theory, Management of Environmental Quality: An International Journal 33 (2022), 1329–1343. https://doi.org/10.1108/MEQ-09-2021-0227.

[12] B. Latif, J. Gaskin, N. Gunarathne, et al. Climate Change Risk Perception and Pro-Environmental Behavior: The Moderating Role of Environmental Values and Psychological Contract Breach, Soc.

Responsib. J. 20 (2024), 538–567. https://doi.org/10.1108/SRJ-02-2023-0084.

[13] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2023. https://doi.org/10.1017/9781009325844.

[14] A.N.T. Mai, V.N. Xuan, H.L. Mai, et al. Population, Carbon Dioxide Emissions and Renewable Energy Consumption Nexus: New Insights from Vietnam, Energy Explor. Exploit. 42 (2024), 1763–1798. https://doi.org/10.1177/01445987241252453.

[15] H. Jafarizadeh, E. Yamini, S.M. Zolfaghari, et al. Navigating Challenges in Large-Scale Renewable Energy Storage: Barriers, Solutions, and Innovations, Energy Rep. 12 (2024), 2179–2192. https://doi.org/10.1016/j.egyr.2024.08.019.

[16] D. Gu, J. Jiang, Navigating an Unpredictable Environment: The Moderating Role of Perceived Environmental Unpredictability in the Effectiveness of Ecological Resource Scarcity Information on pro-Environmental Behavior, BMC Psychol. 12 (2024), 261. https://doi.org/10.1186/s40359-024-01762-1.

[17] E. Kabir, P. Kumar, S. Kumar, et al. Solar Energy: Potential and Future Prospects, Renew. Sustain. Energy Rev. 82 (2018), 894–900. https://doi.org/10.1016/j.rser.2017.09.094.

[18] R.B. Cialdini, R.P. Jacobson, Influences of Social Norms on Climate Change-Related Behaviors, Curr. Opin. Behav. Sci. 42 (2021), 1–8. https://doi.org/10.1016/j.cobeha.2021.01.005.

[19] A. Ghosh, V.K. Satya Prasad, Evaluating the Influence of Environmental Factors on Household Solar PV Pro-Environmental Behavioral Intentions: A Meta-Analysis Review, Renew. Sustain. Energy Rev. 190 (2024), 114047. https://doi.org/10.1016/j.rser.2023.114047.

[20] N. Jayaraj, A. Klarin, S. Ananthram, The Transition towards Solar Energy Storage: A Multi-Level Perspective, Energy Policy 192 (2024), 114209. https://doi.org/10.1016/j.enpol.2024.114209.

[21] E. Schulte, F. Scheller, D. Sloot, T. Bruckner, A Meta-Analysis of Residential PV Adoption: The Important Role of Perceived Benefits, Intentions and Antecedents in Solar Energy Acceptance, Energy Res. Soc. Sci. 84 (2022) 102339. https://doi.org/10.1016/j.erss.2021.102339.

[22] M.M. Pagliuca, D. Panarello, G. Punzo, Values, Concern, Beliefs, and Preference for Solar Energy: A Comparative Analysis of Three European Countries, Environmental Impact Assessment Review 93 (2022), 106722. https://doi.org/10.1016/j.eiar.2021.106722.

[23] V. Djurisic, J.C. Smolovic, N. Misnic, S. Rogic, Analysis of Public Attitudes and Perceptions towards Renewable Energy Sources in Montenegro, Energy Rep. 6 (2020), 395–403. https://doi.org/10.1016/j.egyr.2020.08.059.

[24] X. Ru, S. Wang, S. Yan, Exploring the Effects of Normative Factors and Perceived Behavioral Control on Individual's Energy-Saving Intention: An Empirical Study in Eastern China, Resour. Conserv. Recycl. 134 (2018), 91–99. https://doi.org/10.1016/j.resconrec.2018.03.001.

[25] M.M. Sibtain, M. Hashim, F.P.G. Márquez, et al. Role of Social Influence in Adoption of Energy-Efficient Household Systems among Pakistani Consumers: A Quantitative Study, Int. J. Hous. Mark. Anal. (2024). https://doi.org/10.1108/IJHMA-04-2024-0054.

[26] T. Handriana, M. Kurniawati, S.S. Sangadji, et al. Antecedents and Consequences of Green Trust in

Environmentally Friendly Cosmetic Products, Int. J. Environ. Impacts, 7 (2024), 713-721. https://doi.org/10.18280/ijei.070412.

[27] R. Likert, The Method of Constructing an Attitude Scale, in: M.M. Gary (Ed.), Scaling, Routledge, 2017: pp. 233–242. https://doi.org/10.4324/9781315128948-23.

[28] G.A. Johanson, G.P. Brooks, Initial Scale Development: Sample Size for Pilot Studies, Educ. Psychol. Measure. 70 (2010), 394–400. https://doi.org/10.1177/0013164409355692.

[29] D.E. White, N.D. Oelke, S. Friesen, Management of a Large Qualitative Data Set: Establishing Trustworthiness of the Data, Int. J. Qual. Methods 11 (2012), 244–258. https://doi.org/10.1177/160940691201100305.

[30] K.L. Manfreda, V. Vehovar, Internet Surveys, in: International Handbook of Survey Methodology, Routledge, 2015. https://doi.org/10.4324/9780203843123.ch14.

[31] M. Osman, M.M. Saad, M. Ouf, U. Eicker, From Buildings to Cities: How Household Demographics Shape Demand Response and Energy Consumption, Appl. Energy 356 (2024), 122359. https://doi.org/10.1016/j.apenergy.2023.122359.

[32] G. Dash, J. Paul, CB-SEM vs PLS-SEM Methods for Research in Social Sciences and Technology Forecasting, Technol. Forecast. Soc. Change 173 (2021), 121092. https://doi.org/10.1016/j.techfore.2021.121092.

[33] J.F.H. Jr., L.M. Matthews, R.L. Matthews, M. Sarstedt, PLS-SEM or CB-SEM: Updated Guidelines on Which Method to Use, Int. J. Multivar. Data Anal. 1 (2017), 107. https://doi.org/10.1504/IJMDA.2017.087624.

[34] J.C. Nunnally, An Overview of Psychological Measurement, in: B.B. Wolman (Ed.), Clinical Diagnosis of Mental Disorders, Springer, Boston, MA, 1978: pp. 97–146. https://doi.org/10.1007/978-1-4684-2490-4_4.

[35] C. Fornell, D.F. Larcker, Evaluating Structural Equation Models with Unobservable Variables and Measurement Error, J. Mark. Res. 18 (1981), 39–50. https://doi.org/10.1177/002224378101800104.

[36] A. Maqsoom, M. Hammad, M. Umer, et al. From Intentions to Actions: Unveiling the Socio-Psychological Drivers of Solar Home System Adoption in Developing Nations, Archit. Eng. Des. Manag. 20 (2024), 1019–1036. https://doi.org/10.1080/17452007.2024.2316658.

[37] T. Le-Anh, M.D. Nguyen, T.T. Nguyen, K.T. Duong, Energy Saving Intention and Behavior under Behavioral Reasoning Perspectives, Energy Effic. 16 (2023), 8. https://doi.org/10.1007/s12053-023-10092-x.

[38] C.S. Tan, H.Y. Ooi, Y.N. Goh, A Moral Extension of the Theory of Planned Behavior to Predict Consumers' Purchase Intention for Energy-Efficient Household Appliances in Malaysia, Energy Policy 107 (2017), 459–471. https://doi.org/10.1016/j.enpol.2017.05.027.

[39] A. Anjum, M. Subhan, Examining Public Intentions and Attitudes toward Solar Rooftop Panel Adoption in Indian Residences: An Integration of TPB, DOI and UTAUT, Kybernetes (2024). https://doi.org/10.1108/K-01-2024-0080.

[40] C. Briggs, A. Atherton, J. Gill, et al. Building a 'Fair and Fast' Energy Transition? Renewable Energy Employment, Skill Shortages and Social Licence in Regional Areas, Renew. Sustain. Energy Transit. 2 (2022), 100039. https://doi.org/10.1016/j.rset.2022.100039.

[41] S.B. Badole, S. Bird, M.D. Heintzelman, L. Legault, Willingness to Pay for Solar Adoption: Economic, Ideological, Motivational, and Demographic Factors, Energy Econ. 136 (2024), 107703. https://doi.org/10.1016/j.eneco.2024.107703.

[42] N.V. Nguyen, T.L.P. Dang, N.T. Phuong, Behavioral Intentions in Cashless: The Role of Green Finance Perception in the Vietnamese Market, Int. J. Anal. Appl. 23 (2025), 3. https://doi.org/10.28924/2291-8639-23-2025-3.

[43] C. Kormos, R. Gifford, The Validity of Self-Report Measures of Proenvironmental Behavior: A Meta-Analytic Review, J. Environ. Psychol. 40 (2014), 359–371. https://doi.org/10.1016/j.jenvp.2014.09.003.

[44] N. Adnan, Powering up Minds: Exploring Consumer Responses to Home Energy Efficiency, Energy Rep. 11 (2024), 2316–2332. https://doi.org/10.1016/j.egyr.2024.01.048.

[45] S. Sharma, K. Raj, S.K. Sharma, et al. Applications of Strongly Deferred Weighted Convergence in the Environment of Uncertainty, Int. J. Anal. Appl. 22 (2024), 181. https://doi.org/10.28924/2291-8639-22-2024-181.

[46] L.M.V. Tolentino, A.K.S. Ong, J.D. German, Analysis of Values-Beliefs-Norms of Decommissioned Nuclear Power Plant Reestablishment Acceptance in Developing Countries: A Perspective from the Philippines, Nuclear Eng. Technol. 56 (2024), 3224–3235. https://doi.org/10.1016/j.net.2024.03.023.

[47] B. Amiri, A. Jafarian, Z. Abdi, Nudging towards Sustainability: A Comprehensive Review of Behavioral Approaches to Eco-Friendly Choice, Discov. Sustain. 5 (2024), 444. https://doi.org/10.1007/s43621-024-00618-3.

[48] F.Z. Kherazi, D. Sun, J.M. Sohu, et al. The Role of Environmental Knowledge, Policies and Regulations toward Water Resource Management: A Mediated-moderation of Attitudes, Perception, and Sustainable Consumption Patterns, Sustain. Dev. 32 (2024), 5719–5741. https://doi.org/10.1002/sd.2991.